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Oana Toader

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LABORATOIRE D'ÉCONOMIE D'ORLÉANS (LEO-UMR 7322)

THÈSE présentée par :

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Discipline/Spécialité : **Sciences Économiques**

Recherches sur les coûts et les bénéfices de la nouvelle régulation bancaire

Applications au cas européen

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"If there is no struggle, there is no progress"

Frederick Douglass (1857)

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Introduction Générale

Les crises bancaires ont un impact très fort sur le fonctionnement de l'économie puisqu'elles affectent à la fois le système de paiement et celui de financement. Des normes réglementaires sont imposées aux banques pour contrôler leur choix en termes de structure financière et de prise de risque afin de stabiliser l'activité bancaire. Néanmoins, établir un bon équilibre entre l'objectif de stabilité des systèmes bancaires et leur efficience (capacité à financer l'économie dans de bonnes conditions de crédit) a toujours été un exercice délicat. Or, l'arbitrage que le régulateur a été amené à faire, a souvent donné lieu à des incitations adverses et à la prise de risque. Les incitations ont d'ailleurs été à l'origine de nombreuses crises que les systèmes bancaires ont connues au long de l'histoire, malgré une réglementation généralement bien plus contraignante que celle imposée aux autres secteurs de l'économie.

Bien avant la création du cadre prudentiel de Bâle, les législateurs nationaux ont soumis leurs banques à un certain nombre de règles dont les plus importantes concernent le capital. Aux États-Unis par exemple, depuis 1829, l'activité bancaire a été encadrée et des normes de capital, basées sur les montants des dépôts, ont été imposées afin d'éviter les déséquilibres dans les structures de financement[1]. La définition des normes n'a pas suivi le développement de l'activité économique et les risques non-encadrés ont contribué au déclenchement de plusieurs défaillances entre la fin du 19ème siècle et le début des années 1930. Les banques centrales, pourtant censées accompagner l'activité économique et maintenir la stabilité des systèmes financiers, n'ont pas toujours fait le nécessaire pour arrêter les paniques bancaires. L'exemple le plus concret est celui de la Réserve Fédérale qui, dans les années 30, n'a pas joué le rôle de prêteur en dernier ressort[2], pour injecter

[1] Après une série de faillites dans le secteur bancaire au début des années 1800, dont la première a été celle de Farmers Bank of Gloucester en Rhode Island, les autorités publiques ont commencé à prendre conscience de la possibilité que les banques puissent faire faillite. En conséquence, en 1829, l'Etat de New York a adopté un régime de protection des déposants, représentant la première tentative de création des systèmes d'assurance des dépôts (New York New York State, 1829; Golembe and Warburton, 1958). Pour encadrer le phénomène d'aléa moral il a ensuite imposé des normes de capital basé sur les dépôts. Un autre pratique mise en place au cours du 19ème siècle a été la double responsabilité des actionnaires (*double liability*), qui a contribué de manière considérable à la prise de risques des banques (Alessandri and Haldane, 2009)

[2] La théorie du prêteur en dernier ressort est souvent associée à Bagehot (1873) alors que Thornton (1802) apportait déjà un examen détaillé du système monétaire britannique et suggérait que seule une banque centrale pourrait accomplir la tâche de prêteur en dernier ressort étant donné qu'elle détient le monopole dans la création monétaire.

suffisamment de liquidité dans le système financier. C'est ainsi que le système bancaire a connu la crise la plus sévère du 20ème siècle.

L'expérience de la Grande Dépression a changé la perception à l'égard de la régulation des systèmes bancaires. En 1933, il a été décidé de mettre en place le Glass-Steagall Act pour réformer fondamentalement le fonctionnement de l'activité bancaire. Il a essentiellement imposé la séparation des activités de crédit et de marché mais a aussi créé un système plus complexe d'assurance des dépôts (la Federal Deposit Insurance Corporation, FDIC). De plus, des normes supplémentaires ont été adoptées pour mieux encadrer les activités de marché[3]. Avec ce système très restrictif, la fréquence des faillites bancaires a été faible pendant plusieurs décennies.

C'est alors qu'à la fin des années 70 - début des années 80, où l'on a connu une période de croissance plus faible, qu'on a procédé à une dérèglementation financière majeure pour redynamiser les échanges économiques en pleine globalisation. Dans ce contexte, l'inflation élevée et l'abandon des parités fixes ont conduit à de nombreuses faillites des caisses d'épargne américaines (*saving and loans associations*), ce qui a remis en cause le système réglementaire existant. En parallèle, les banques européennes, qui avaient bénéficié d'une période de déréglementation les rendant plus compétitives au niveau international, ont, elles aussi, commencé à connaître des déséquilibres en raison de leur prise de risque excessive.

Confrontées à ces dysfonctionnements, les autorités nationales se sont rapprochées pour mettre en place des normes harmonisées et mieux adaptées à la nouvelle structure du système financier mondialisé[4].

Les Accords de Bâle - une nouvelle régulation internationale

Le premier accord international en matière de régulation bancaire a été conçu par le Comité de Bâle en 1988[5] pour homogénéiser les règles prudentielles, dans le but d'éviter les distorsions de concurrence. Communément appelé l'accord de Bâle I, ces normes cherchaient à limiter l'effet de levier excessif, et faire en sorte que les banques assument les risques qu'elles prennent sans les mettre à la charge de la collectivité. Celui-ci se focalisait sur le risque de crédit et imposait un ratio de capital minimum de 8% des actifs

[3] Securities Act a créé la Securities and Exchange Commission (SEC) en 1933 et plus tard, en 1936, le Commodity Exchange Act a abouti à la création de la Commodity Futures Trading Commission (CFTC).

[4] Les structures réglementaires nationales ne suivaient plus le développement des activités bancaires. Exceptées les disparités entre les Etats-Unis et l'Europe, au sein de l'Europe même, l'architecture de la réglementation bancaire était très différente d'un pays à l'autre. La France bénéficiait d'une réglementation très stricte où l'Etat dirigeait la politique bancaire en fixant les objectifs, administrant les investissements, le crédit et le réseau de distribution des prêts. En Allemagne, la BaFin était l'autorité en charge de la supervision des établissements et des marchés, alors qu'au Royaume-Uni, la réglementation était conduite par des principes plutôt que par des règles.

[5] Connu sous l'appellation de l'*Accord de Convergence Internationale de la Mesure et des Normes de Fonds Propres*

pondérés des risques. Ainsi, Bâle I introduisait une mesure qui visait à lier la structure de l'actif à celle du passif (le ratio Cooke).

Mais au cours du temps, l'évaluation des expositions au risque, retenue par le ratio, s'est avérée trop simple et inappropriée[6] et donc, facile à contourner. Exploiter les différences, entre le niveau réel de risque et le risque tel qu'il était évalué par les normes règlementaires, a conduit à une prise de risque excessive sans pour autant contrevenir à la régulation ("cherry-picking").

De plus, depuis l'initiation de ce cadre règlementaire, l'enjeu était de s'adapter aux innovations financières et aux transformations des structures bancaires, ce qui aurait dû conduire à une différenciation des règles selon le type d'institution bancaire. Or, en pratique, le cadre réglementaire de Bâle s'est avéré plutôt uniforme pour l'ensemble des établissements financiers. Pour cette raison, ce dernier a été incapable de s'adapter aux évolutions des modèles bancaires et notamment à la montée des banques universelles.

Quelques années après sa mise en place, les anomalies de Bâle I sont devenues évidentes en raison du développement des activités de marché qui ne rentraient pas dans le champ d'application de cette réglementation. Ainsi, une première réforme des Accords de Bâle fut mise en place au milieu des années 1990 et proposa la révision des pondérations associées aux actifs financiers et l'élargissement des risques couverts (risque lié aux opérations de marché[7], risque opérationnel) pour améliorer la mesure de solvabilité. Sous la direction de W. Mc Donough, le Comité de Bâle a travaillé à l'élaboration d'une réforme du cadre Bâle I à partir de 1998 pour aboutir en 2004 à l'adoption d'une nouvelle régulation, communément appelée Bâle II.

Elle a introduit une nouveauté en proposant différentes modalités de calcul des expositions au risque. Les pondérations associées aux actifs financiers pourraient être évaluées par deux approches:

- l'approche standardisée prenant en compte les notations financières qui permettent un regroupement par catégorie de risque, plutôt que par catégorie d'actifs comme c'était le cas sous Bâle I, et

- l'approche par les notations internes (IRB) à partir des modèles développés par les banques, qui permettait une plus fine évaluation des risques à travers l'utilisation des méthodologies de type Value at Risk (VaR). Alors que ces outils étaient initialement destinés à mesurer le risque de marché, leur utilisation a été ensuite élargie au risque de crédit.

[6] 4 classes de pondération 0%, 20%, 50% et 100% selon les caractéristiques légales des contreparties

[7] Le risque de marché fait référence au risque de taux de change, au risque de taux d'intérêt et au risque lié à la détention des actions.

Conscient que la permission donnée aux banques d'utiliser leurs propres modèles d'évaluation des risques peut générer des incitations adverses, le régulateur ajoute deux autres piliers au cadre réglementaire: la supervision bancaire (pilier 2), destinée à contrôler le respect des règles d'évaluation du ratio de solvabilité, et la discipline de marché (pilier 3) qui oblige à une meilleure communication financière, susceptible de renforcer le contrôle des investisseurs.

Dès lors, Bâle II apporte une philosophie différente, en confiant l'évaluation des risques aux institutions bancaires, considérées alors comme mieux à même de déterminer leur exposition aux risques. Cependant, cette liberté accordée aux banques les a incitées à contourner la régulation en développant des techniques de gestion des risques leur permettant de faire des économies en termes de capital réglementaire. Deux principaux effets pervers ont émergé de son utilisation. D'une part, elle représente une source considérable d'incertitude quant à l'estimation des expositions au risque du fait de son manque de transparence. Et d'autre part, elle favorise les grandes banques, capables de développer des modèles internes plus complexes que les plus petites, conduisant ainsi à des distorsions de compétitivité. C'est la raison pour laquelle les Etats-Unis n'ont pas mis en place ce nouveau cadre[8].

Or, Bâle II traite seulement du risque d'insolvabilité sans aborder le risque d'illiquidité. Il a été considéré que le ratio de fonds propres, pondéré des risques, pourrait indirectement encadrer le risque de panique bancaire, susceptible d'émerger de la fonction de création de liquidité à travers l'activité de transformation des maturités (Goodhart, 2011).

Même si Bâle II a représenté une avancée, avec le temps, lui aussi, a montré d'inertie et des carences puisqu'il n'a pas accompagné l'évolution de l'activité financière. L'accumulation et la transformation des risques se sont développées grâce à l'innovation financière et aux changements de l'architecture des systèmes financiers (dérégulation, désintermédiation). Dans ce contexte, celui-ci n'a pas été en mesure d'assurer la stabilité du système financier lors du choc financier intervenu à partir de 2007.

Les questions soulevées par la crise

Trois principaux facteurs ont conduit à la défaillance du cadre prudentiel de Bâle II. Tout d'abord, l'insuffisante capacité d'absorption des pertes a provoqué la méfiance des investisseurs. Les erreurs d'appréciation des expositions au risque (Blum, 2008) et la définition inappropriée des fonds propres de base ont été principalement en cause. De plus, il ne s'agissait pas seulement d'une insuffisance de solvabilité. Les dérives en

[8] Le cadre Bâle II a été uniquement envisagé pour les grandes banques, car elles seules peuvent disposer de moyens pour développer des modèles internes complexes. D'ailleurs, même pour celles-ci, ces mesures n'ont été adoptées qu'à la fin de l'année 2007. Pour les petites banques, considérées comme non-compétitives au niveau international, il n'a pas été question d'application.

termes de gestion de la liquidité, qu'elles soient le fait des banques de détail à travers la transformation des maturités, ou des banques dites de financement et d'investissement (BFI), ont amené à développer des structures fortement dépendantes du financement de court-terme de marché et très imbriquées. Au-delà des modes de financement très vulnérables, les mauvaises incitations générées par l'existence du prêteur en dernier ressort ont également contribué à d'excessives prises de risque. Enfin, celles-ci, évaluées de façon inappropriée, se sont avérées dépendantes du cycle économique (amélioration du profil de risque pendant les périodes d'expansion et détérioration en période de récession). Ce dernier s'est donc vu amplifié par le fait que les risques perçus évoluaient de façon pro-cyclique. En outre, le cadre prudentiel, par son incapacité à gérer simultanément le risque individuel des institutions et le risque systémique, a constitué un des facteurs clés de la crise des subprimes.

Ainsi, les faiblesses du cadre de supervision ont été également citées comme une des défaillances de Bâle II face aux chocs de 2007-2008[9]. Le manque de coordination des superviseurs nationaux, concernant à la fois le contenu et la mise en place des normes réglementaires, a permis de nombreux arbitrages.

En outre, ce qui a surpris dans le déclenchement de cette crise a notamment été le degré d'interconnexion des institutions financières, constaté par la manifestation et l'ampleur du phénomène de contagion. La crise de liquidité a connu une forme différente de celle illustrée par le cadre Diamond and Dybvig (1983): la panique a été ressentie sur les marchés interbancaires, où la perte de confiance a alimenté la contagion entre les institutions. Elle s'est surtout manifestée par la spirale de dévaluation des prix des actifs (Allen et al., 2012) et non par les canaux traditionnels de propagation des pertes d'une banque vers une autre, suite à une faillite.

Il faut rappeler que l'amplitude de cette dernière crise, la plus désastreuse depuis 1929, a été renforcée par une architecture du système bancaire dans laquelle les banques universelles ont joué un rôle important. Mélangeant l'activité traditionnelle de crédit et les activités de marché, elles ont été affectées de façon semblable et simultanée par les chocs. Mais, au-delà de ces difficultés individuelles, la plupart des grandes banques ont été considérées comme trop grandes pour faire faillite. Ainsi, le phénomène "too-big-to-fail" (TBTF) est apparu comme une menace réelle pour le fonctionnement global des systèmes financiers, mais aussi pour les finances publiques.

En effet, les conséquences des faiblesses des banques ne se sont pas arrêtées au déclenchement de la crise de liquidité de 2008. Les liens croisés entre les banques et les souverains, à travers, d'une part, la détention des titres souverains par les banques, et

[9] Les premiers signaux sur l'accumulation inquiétante des risques ont été apportés par Raghuram Rajan en 2005 (Rajan, 2005). Ses remarques ont suscité une forte réticence de la part des autorités publiques américaines. A ce moment-là, aux Etats-Unis Bâle II n'était pas encore implémenté, alors qu'en Europe, où le cadre réglementaire de Bâle II était déjà en place, cette accumulation des risques n'a pas été remarquée.

d'autre part, les garanties étatiques, n'avaient jamais représenté une inquiétude. La crise a fait ressortir ces interdépendances qui ont fragilisé les dispositifs réglementaires et ont conduit en 2011 au déclenchement d'une crise de la dette publique sans précédent.

Mesures proposées par Bâle III

Dans ce contexte, le nouvel accord de réforme de la régulation a été publié en 2009[10] (Bâle III). Il a apporté des améliorations considérables et son objectif va au-delà du cadre micro-prudentiel et acquiert une dimension macro-prudentielle.

Pour améliorer la capacité à absorber les pertes des institutions, le cadre prudentiel de fonds propres a été revu et impose une révision importante, d'une part, de la définition du capital réglementaire et, d'autre part, des pondérations des actifs risqués. En relevant le seuil du ratio de solvabilité et en rajoutant une exigence en capital, indépendante du risque, pour limiter le levier d'endettement, l'objectif d'assurer une meilleure couverture des risques pourrait être atteint en évitant une prise de risques excessive[11].

Parallèlement, des principes de saine gestion et de surveillance de la liquidité ont été adoptés et apportent un traitement plus approprié du risque de liquidité, traité désormais de façon explicite. Ainsi, Bâle III finalise, sous la pression de la crise, la mise en place d'une mesure qui a été envisagée dès les premiers temps du Comité de Bâle, mais qui a été repoussée à chaque fois, sans doute en raison de la difficulté de la tâche. Dorénavant, la gestion structurelle de la liquidité et celle en cas de scénario de stress sont traitées séparément, à travers, respectivement, le ratio à long-terme (le Net Stable Funding Ratio, NSFR) et le ratio à court-terme (le Liquidity Coverage Ratio, LCR).

L'objectif de Bâle III va au-delà du renforcement de la stabilité des établissements bancaires pris séparément. Une série de mesures macro-prudentielles (coussins contra-cycliques, surcharges en fonds propres pour les banques systémiques) fait l'objet d'un dispositif macroéconomique qui viennent compléter les outils micro-prudentiels. Ainsi, le cadre réglementaire post-Lehman vise également l'encadrement des institutions TBTF, véritable source de vulnérabilités des systèmes financiers. En plus des coussins de fonds propres proposés par Bâle III, le Financial Stability Board (FSB) impose des mesures supplémentaires pour les banques systémiques (TLAC) afin de permettre le renflouement

[10] Le texte réglementaire proposé en 2009 a déjà connu deux adjonctions, en 2010 et 2011.

[11] Blum (1999) montre que le niveau de risque de la banque s'accroît avec les exigences en fonds propres. Confrontée à une hausse future du capital réglementaire, la banque rencontrera des restrictions sur la configuration du portefeuille des actifs. Ainsi, elle sera incitée à prendre plus des risques dans le but d'atteindre son objectif. Néanmoins, les objectifs complémentaires des deux ratios proposés par Bâle III devront permettre de limiter les effets adverses d'une hausse des exigences en capital.

par les créanciers (bail-in)[12]. Par conséquent, un autre point important que la régulation aurait dû considérer depuis sa création - sa différenciation en accord avec la taille, l'importance et l'activité des institutions - est traité par Bâle III et permet de mieux distinguer les banques dont la situation a une incidence toute particulière sur la stabilité du système.

Pour s'assurer d'une mise en place effective des normes imposées, absolument nécessaires mais sans doute complexes (BCBS, 2013d; Dombret, 2014; Haldane, 2015), il apparait essentiel de renforcer la supervision bancaire. De plus, en Europe, là où le besoin d'une meilleure coordination des autorités a été souligné par la crise, de nouvelles structures institutionnelles ont été créées afin d'assurer le suivi de la mise en œuvre des exigences en capital et en liquidité (le mécanisme de surveillance unique) et pour proposer les dispositifs nécessaires à la résolution des banques en cas de défaut (le mécanisme de résolution unique et la directive de redressement et de résolution - BRRD).

Avec le recul, on peut dire que le cadre réglementaire a, depuis toujours, été établi de manière à protéger les déposants et les investisseurs plutôt que d'agir sur les incitations à la prise de risques, tant et si bien que les établissements de crédit ont progressivement accumulé des risques de nature diverse. Dans ces conditions, les révisions du cadre réglementaire sont apparues comme des réactions au coup par coup qui courent le risque d'être incohérentes. Une régulation, pensée de manière plus globale, et capable d'aborder et traiter la question des incitations adverses, pourrait la rendre plus efficace sur la durée.

Objectif de la thèse

L'histoire de la régulation s'articule autour de l'arbitrage que le régulateur est amené à faire pour assurer une meilleure résilience des systèmes bancaires, tout en garantissant de bonnes conditions de crédit. Le renforcement de la régulation, imposé après la crise des subprimes, a ainsi relancé le débat sur les conséquences que de telles normes peuvent avoir sur l'activité de financement.

L'objectif de cette thèse est donc d'apporter des réponses aux questions relatives à l'impact de différents changements réglementaires, et de Bâle III en particulier, sur la stabilité des établissements de crédit et des systèmes bancaires. Notre contribution à la littérature concerne trois questions. Tout d'abord, nous cherchons à évaluer l'impact des nouvelles exigences en capital et en liquidité sur le coût du capital et l'activité bancaire.

[12] En charge du chantier TBTF, le FSB a avancé une série de propositions pour limiter et essayer de résoudre les distorsions liées à l'activité de ces grandes banques: des mesures pour améliorer la capacité à absorber des pertes (TLAC), des mesures renforcées de supervision et les outils pour aborder la résolution de ces grandes institutions (*Key Attributes of Effective Resolution Regimes for Financial Institutions*). Ces normes seront appliquées à l'ensemble d'institutions désignées comme systémiques par la Banque des Règlements Internationaux (BRI). Aux Etats-Unis, le cadre équivalent pensé par le régulateur américain est le Dodd-Franck Act.

Ensuite, en jugeant la tarification du risque affectée par l'existence de nombreuses distorsions, nous souhaitons quantifier leur amplitude et analyser les déterminants de leur évolution dans le temps. Enfin, nous considérons nécessaire d'examiner les bénéfices de ces nouvelles exigences en fonds propres et en liquidité en termes de stabilité des institutions et des systèmes financiers dans leur ensemble. La thèse fera ainsi le lien entre, d'une part, la structure des bilans bancaires et des systèmes bancaires et, d'autre part, les incitations des réglementations bancaires.

Structure de la thèse

Cette thèse s'articule autour de six chapitres, organisés en trois parties principales. Basée sur une démarche méthodologique s'appuyant sur des études empiriques, elle permettra d'analyser ces différentes questions, pour les banques européennes qui ont subi plus de chocs et ont été assujetties à différents cadres réglementaires, qu'ils soient prudentiels, de supervision ou de résolution.

Dans la **première partie,** nous nous intéressons d'abord à la problématique de l'impact des exigences réglementaires plus élevées sur le coût du capital. Ce débat a émergé suite aux initiatives du Comité de Bâle de renforcer à la fois la qualité et la quantité des fonds propres capables d'absorber des pertes en cas de stress et d'imposer des normes de liquidité.

Tout d'abord, notre démarche consiste à étudier empiriquement l'impact des nouvelles exigences en fonds propres sur le niveau de risque et le coût du capital. Même si le théorème de Modigliani-Miller est souvent critiqué quant à son application au système bancaire, son utilisation comme benchmark théorique permet de mieux analyser l'importance des distorsions dans l'activité bancaire sur l'évaluation du risque et le coût du capital. Nous cherchons à analyser la relation solvabilité - risque pour différentes catégories de banques et nous nous focalisons sur les institutions systémiques pour permettre d'évaluer l'impact de l'existence des différentes asymétries sur le niveau de risque. Pour ce faire, nous considérons à la fois le ratio de capital pondéré des risques et le ratio d'endettement (le levier).

Nous complétons l'étude de l'impact de la nouvelle régulation prudentielle avec l'analyse de la liquidité des institutions bancaires. En effet, la principale amélioration du cadre réglementaire consiste en la mise en place des normes de liquidité, inexistantes auparavant au niveau international, et dont la nécessité a clairement été soulignée par la crise. Toutefois, la complexité du concept de liquidité, à plusieurs facettes, laisse la place à l'interprétation et peut faire apparaître toute mesure de liquidité comme insuffisante,

inappropriée, et susceptible d'engendrer des effets indésirables sur l'activité réelle[13]. Cette difficulté à mesurer la liquidité, rend l'exercice d'évaluation du coût de la mise en place de ces normes plus difficile.

L'indisponibilité des données bancaires nous a conduits à nous focaliser sur le ratio structurel de liquidité. Ainsi, trois principaux objectifs sont visés. Premièrement, nous évaluons le NSFR et portons une analyse comparative pour les banques européennes des pays de l'Union Européenne. Après un passage en revue des stratégies optimales (i.e. à moindre coût et favorables économiquement) pour atteindre les standards minimaux, nous examinons quelles ont été les stratégies mises en place effectivement depuis l'annonce d'adoption des exigences en liquidité en 2010. Finalement, nous souhaitons évaluer l'impact de la régulation structurelle de liquidité sur le coût de financement et sur l'activité de crédit des banques.

Dans la **deuxième partie**, nous analysons un autre chantier majeur de la réglementation bancaire: certaines institutions devenues trop grandes et trop interconnectées pour faire faillite. Même si la volonté des Etats d'éviter les faillites bancaires pourrait s'expliquer par leur coût économique très élevé, elles augmentent le phénomène d'aléa de moralité. En outre, le recours massif à ces injections de liquidité peut avoir des conséquences néfastes sur les finances publiques (le cas de crise de la dette souveraine de 2011). Ainsi, la stabilisation des systèmes financiers implique de réduire, voire éliminer, ces anomalies liées au fonctionnement des banques *"too-big-to-fail"* (TBTF).

Pour analyser cette problématique, nous nous focalisons sur la mesure des garanties étatiques et sur leur évolution dans le temps. A partir des données de notations financières des banques, nous estimons la valeur de ces garanties, pour les banques européennes, pour la période 2000-2014. Nous identifions les déterminants, à la fois du côté des structures bancaires et des garants (i.e. gouvernements). Il apparait essentiel d'identifier les caractéristiques des banques qui bénéficient de ces aides étatiques, au-delà de leur taille et leur importance pour le système financier.

Si les garanties implicites ont été ouvertement reconnues comme étant très profitables pour les banques, elles sont très coûteuses pour les autorités publiques. Il est donc nécessaire de réduire ces distorsions liées au statut "spécial" des grandes banques, et d'assurer, de cette manière, une application plus efficace du cadre de résolution. Pour répondre à cette question, nous proposons une analyse des mesures réglementaires prises jusqu'à présent, aussi bien au niveau national qu'au niveau européen (la directive de redressement et résolution - BRRD) et international (mesures proposées par le FSB pour les banques systémiques). Nous souhaitons évaluer l'impact que ces normes peuvent

[13] La difficulté de mesurer la liquidité vient du fait que toute mesure est vue comme une approximation. Ainsi, les ratios minimaux de liquidité ne seront probablement jamais suffisants (assez grands ou assez bien mesurés). De plus, une "formule magique" de liquidité, capable d'aborder à la fois la liquidité dans l'intermédiation du bilan et celle dans l'intermédiation de marché, ne parait pas abordable.

avoir sur les garanties implicites, une réduction de ces dernières pouvant être en partie expliquée par l'efficience des régimes et pratiques de résolution mis en place.

Enfin, nous consacrons la **dernière partie de la thèse** à l'analyse des bénéfices des exigences réglementaires renforcées. Les normes supplémentaires adoptées par le Comité de Bâle devront permettre de réduire d'une part le levier d'endettement, et d'autre part, la dépendance des banques au financement de marché de court-terme. Ainsi, elles devraient contribuer à l'amélioration de la stabilité des institutions et du système financier dans sa globalité.

En effet, la crise financière, et surtout le blocage du marché interbancaire qui a mis sous pression et de manière quasi-immédiate l'ensemble des institutions financières, a souligné l'état de dépendance (excessive) des banques européennes à l'égard du financement de marché à court-terme (Le Leslé, 2012). Nous proposons une étude permettant de mettre en évidence les implications liées à la structure des bilans bancaires, sur le niveau de risque de défaut et de risque systémique des banques. Nous souhaitons notamment évaluer empiriquement la contribution de chaque norme prudentielle (ratio de solvabilité pondéré des risques, ratio de levier, liquidité structurelle et de marché), mais également leur complémentarité dans la réduction des vulnérabilités des banques.

Dans la même démarche, une approche proposant une mesure de risque de défaut fondée sur les résultats du stress test de 2014 est utilisée. Alors que tout scénario de crise envisagé pourrait être critiqué, les informations recueillies grâce aux stress tests sont d'une finesse remarquable. Nous pouvons ainsi conduire une analyse comparative des différentes mesures de risque:

- la probabilité de défaut et le SRISK, basés sur des estimations de marché et des données historiques des bilans bancaires, et
- le shortfall du ratio de solvabilité fondé sur les résultats du stress test.

Alors que les résultats dépendent du choix d'échantillon, cette analyse permet d'identifier dans quelle mesure les normes prudentielles contribuent à la réduction des risques financiers, dans ses différentes dimensions.

Part I

"There is only one argument of doing something; the rest are arguments for doing nothing. The argument for doing something is that it is the right thing to do. Then, of course, comes the difficulty of making sure that it is right."

Francis Cornford (1874-1943) *English classical scholar*

Chapter 1

Estimating the impact of higher capital requirements on the cost of capital [1]

The crisis represented a "great" occasion to test both the resilience of banks and the efficiency of the regulatory framework. Two major concerns have been revealed. First, the underestimation with regard to risks issued from banking and financial activities and second, the unreasonably high level of the minimum prudential ratios that were unable to offer protection against large financial shocks. The way the banking regulation was developed has left room to bad incentives and led banks to take considerable risks without the regulator to have knowledge of these behaviours. Risk coverage was definitely a main issue, and it emerged from unthinkable degree of interconnection between banks, on the one hand, and between banking sector and capital markets on the other hand.

Capital requirements have been at the core of financial regulation ever since the creation of Basel Agreements. The initial framework, commonly called Basel I, has been revised on several occasions and became increasingly controversial over time. In depth debates, on the issue of the restructuration of the regulatory framework, imposed by the crisis, took place more recently between regulators, academics and bankers. While the argument advanced by practitioners concern the adverse impact of strengthened prudential requirement on financial and economic activity, the regulator and the academics responded with theoretical and empirical proof on the need of these measures. They emphasized the twofold aim of new capital standards. First, they should reduce the indebtedness and strengthen the loss-absorption capacity of banks by imposing both an

[1] Toader (2015a) has been issued from this chapter.

increase in the quantity and an improvement of the quality of regulatory capital. Second, it should strengthen the stability of the financial system as a whole, by taking into consideration the risk that can emerge from banks' interlinkages.

These important benefits, in terms of social welfare and financial stability, should compensate the impact that practitioners make reference to, and namely the higher cost of funding and the slowdown in economic activity. Indeed, higher requirements of stable funding are likely to generate lower rates of return than the ones recorded in the period up to the crisis, which were excessive. This is a necessary concession that should be made in order to improve the resilience of credit institutions and of the financial system, on the one hand, and to further reduce the frequency of financial crisis, on the other hand.

These different arguments have also been exposed in the post-Lehman literature, which has been very rich. Numerous studies suggest that net benefits should be recorded on medium and long term. The theoretical and empirical proofs brought up by academics indicate that an effective implementation of Basel III framework will have relatively low costs during the transition period and net profits in the long-term (Kashyap et al., 2010; King, 2010; Miles et al., 2013 ; Angelini et al., 2011; Conseil d'Analyse Économique, 2012; Oliveira and Elliott, 2012). All these theoretical and empirical studies demonstrate that the arguments put forward by practitioners IIF (2010) are not economically justified. An increase in both the quantity and the quality of banking capital is essential for the reestablishment of the stability of the financial system Admati and Hellwig (2013). Moreover, it should reduce banks' dependence on public bailouts and further help in improving crisis resolution policies.

This study has been also been motivated by public policy debates and theoretical arguments on the impact of Basel III framework on banks' health and funding costs. In addition, the changes observed during the last decades with regard to the financial institutions' implication in intermediation process, business strategies and reliance on financial markets provide us a new lead to explore: the impact of banks' business model on investors' assessment of systematic risk.

Our analysis focuses on a sample of 56 larger banks from 20 EU countries and is based on accounting data provided by Bankscope and public data on share prices and market indexes. It covers the period from 2003 to 2013.

Following this introduction, Section 1.1 provides an overview of the recent prudential rules, that has triggered the motivation for this study. We continue with a literature review which summarizes the main results obtained so far in both theoretical and empirical studies. Section 1.2 presents the theoretical background on banks' funding structures as determinants for their riskiness. The applicability of corporate finance theories to financial institutions is a concept that is worth discussing and will be addressed in this

section as well. In Section 1.3 we describe the data and provide some descriptive statistics. Furthermore, in Section 1.4 we perform our own empirical analysis in order to test for the impact of an increase in capital requirements on the riskiness of European banks and furthermore, on their cost of capital. In addition, our analysis provides evidence on the impact of capital requirements on the systematic risk and the cost of funding for a subsample of globally systemic banks. Last section concludes.

1.1 Implications of strengthened capital requirements for banks

In this section, we provide a large discussion on the reasons that justify the existence of capital regulation for financial institutions and the implications of stricter prudential requirements, as agreed under Basel III.

Indeed, they are at the core of banking regulation and represent the main regulatory instrument of Basel Agreements even since their adoption. The introduction of minimal solvency standards has been made with the aim of reducing the externalities of banks' excessive indebtedness and the taxpayers' contribution to loss-absorption. Hence, their objectives have been to address the issues related to financial instability, while preserving the efficiency of the system (i.e. the access to funding and lending rates)[2].

In this context, the measure of capital ratio defined by the Basel Committee, through the arbitrage between the objectives of stability and efficiency, left room to adverse incentives and became increasingly controversial over time. While the practitioners had always tried to persuade that tighter capital requirements could lead to adverse effects for the real activity, academics and regulators searched for more appropriate indicators to measure the solvency of financial institutions, in continuous innovation.

Nevertheless, the different measures of capital ratio were subject to regulatory arbitrages and provided bad incentives for the governance of financial institutions. More specifically, they were able to implement business strategies aimed to increase their rates of return and to reduce the amount of regulatory capital requirements.

The 2008 crisis has revealed these weaknesses of the regulatory framework in place. It failed in preserving the stability of the system for several reasons. Firstly, the minimum capital ratio proved to be too weak to cover the losses during the periods of financial distress (the minimum CET1 ratio was fixed at 2%). The quality of additional capital instruments was also called into question since they were not robust enough to absorb losses. Secondly, the risks were generally under-estimated: market risk was undervalued by the inappropriate evaluation tools (for example, VaR models), liquidity risks were actually neglected and the systemic risk was not even included in the calculation of

[2] Basel capital ratio can be seen as a second best solution since the optimal one from a stability point of view would had affected the efficiency of financial markets

capital. Moreover, the measurement of risk-weighted assets, very opaque, is still subject to large critics since it takes advantage of the weaknesses of the regulation and lacks consistency. In more general terms, the regulatory framework failed in evaluating the real level of solvency of financial institutions and dismissed the externalities emerged from interbank activities.

In this respect, the reaction of the Basel Committee on Banking Supervision (BCBS) consisted in a complex revision of the prudential framework, which incidentally, was not fully implemented for all countries when the crisis erupted[3]. In 2009, a first "piece of the puzzle" has been placed by the international community by proposing a new and tighter global regulatory framework for financial institutions. Specifically, the purpose was to addresses the risks revealed by the crisis in order to further ensure that banks have the capacity to carry on the risk emerged from their activities. Initially described in BCBS (2010c), the so-called Basel III framework focuses on capital requirements and imposes the reconstruction of funding structures from both qualitative and quantitative aspects.

The main propositions of the new prudential framework were focused on three main axis: the improvement of the quality and the increase of the quantity of core resources, the introduction of liquidity regulation, and the adoption of a special treatment of large institutions whose failure is a threat for the financial system.

More precisely, the proposals meant to deal with the weaknesses revealed by the last financial crisis were:

- an increase in the loss absorbing capacity of banks by increasing the quantity of core capital: the Common Equity Tier 1 (CET1) capital as to the amount of RWA should reach 4.5% in January 2015[4],
- a revision of the methodology for assessing the amount of risk-weighted assets for a more appropriate evaluation of risk, especially of counterparty and market risks,
- the introduction of a non-risk based leverage ratio acting as a supplementary measure to the risk-based capital requirements which aims to limit the risk of excessive leverage in the banking system BCBS (2013b),
- the introduction of two liquidity ratios, the first one that should protect against short-term liquidity shocks (30 days) and the second one that promotes a more stable funding structure by addressing risks emerged from maturity transformation activity, and
- an additional buffers for systemic institutions which should cover risks issued from interconnections between entities and protect against contagion effects.

[3] One should bear in mind that the existent regulatory framework Basel II was not even implemented for several countries (USA for example) when the Basel III proposal was revealed.

[4] Please see Appendix A for complete information on Basel III phase-in arrangements.

Broadly speaking, with Basel III, the system is experiencing a new and more complete dimension of the prudential regulation. More precisely, these measures come to address the inadequacy of micro-prudential rules and the lack of a macro-prudential framework. Later, these measures have been transcribed for European institutions within the Capital Requirements Regulation (CRR) and Directive (CRD IV).

Since then, the issue of the socially optimal level of capitalization occupy a prominent place in debates and academic literature. On one side, numerous studies highlight that an improvement in the quality of capital reduces banks' risks and increase their resilience to financial shocks (Chesney et al., 2010; Beltratti and Stulz, 2012; Demirguc-Kunt et al., 2013; Miles et al., 2013; Haldane, 2010; Admati et al., 2012). This theory is strongly supported by Admati and Hellwig (2013) sustaining that undercapitalized banks can generate considerable economic problems, worsen the development of financial activities[5] and engender exorbitant costs for public authorities and ultimately, for taxpayers. On the other side, certain studies argue that, given the amplitude of changes that have been proposed, the cost of higher capital requirements will affect the economic activity and financial intermediation (IIF, 2010)[6]. Additionally, practitioners sustain that the new regulatory measures can have important effects on banking activities in Europe and contribute to the development of shadow banking.

In what follows we summarize a number of studies that have evaluated the impact of new capital requirements on financial activity and economic developments.

Impact of capital requirements on funding costs

Although meaningful differences are recorded in terms of sample selection and methodological aspects, most studies indicate that the long-run impact of higher capital regulatory standards is likely to be modest. Among these, the majority focuses on the cost of equity transmission channel by making appeal to Modigliani-Miller theorem (henceforth, MM).

[5] Admati et al. (2012) argue that the "biggest credit crunch in recent memory, the total freezing of credit markets during the recent financial crisis, was not due to too much equity but to the extremely high levels of leverage in the financial systems. In other words, credit crunches arrive when banks are undercapitalized."

[6] The Institute of International Finance provides a wide analysis which concludes on a negative impact of Basel III on financial and economic activity. However, one can easily question the methodology that has been employed and the quality of their assessments, and therefore, their results.

Box 1.1. The Modigliani-Miller theory - theoretical background

The theory developed by Franco Modigliani and Merton Miller (Modigliani and Miller, 1958) states that, under certain hypothetical conditions, the value of the firm is independent of the structure of the balance-sheet. This theorem has become a reference in the literature and all future studies on this topic are mostly an analysis of the consequences of a release of its initial assumptions (also called "neutrality propositions" or "irrelevant propositions").

The explanation that supports the MM theory is economically founded. Naturally, the reduction of the proportion of debt in the balance-sheet will allow the bank to spread the risk on a higher number of shares. Thereby, the required return on equity will be lower as the risk taken on by each unit of equity will be lower. As a consequence, the value of the firm is expected to be unchanged given that the higher cost associated to a greater amount of "expensive" resources will be compensated by the reduction in the rate of return required by investors to hold company's shares.

However, the reasoning of the MM is valid under several conditions: i) no taxes, ii) no bankruptcy costs and no reputation loss in case of failure of the company, iii) perfectly competitive markets with no information asymmetries. Since these assumptions are not really characterizing the financial reality[7] the studies that employ this statement evaluate, in practice, the impact of the deviation from the Modigliani-Miller benchmark in terms of average cost of funding.

Kashyap et al. (2010) analyses the implications of changes in the structure of funding on the cost of funding for a sample of US banks. Based on the assumption that the minimum capital requirements can be fulfilled by replacing liabilities with equity, they find that the additional cost comes from the cost of issuing new shares and not from the cost generated by holding higher proportions of capital in their balance sheet. The importance of the transition period is also taken into consideration. Overall, they evaluate the impact of a 10% increase in the amount of core capital at 25 to 45 basis points (bps) to medium and long-term horizons. In parallel, central authorities drive impact assessment studies as well. The ECB's Financial Stability Review from December 2011 set out an evaluation of the link between risk and un-weighted capital ratio. Using simple calculations, they find that the MM theorem is only partially valid for financial institutions (41% of the MM effect). Similarly, the study driven by Miles et al. (2013) analyses a sample of 6 large UK banks and shows that if leverage is halved then the cost of funding will be reduced by 8 to 18 bps. According to their model, the MM theorem should be validated in a proportion of 45-70% of the total expected effect. The study goes one step further and estimates a net benefit of the regulation on a medium and long-term. Within an

[7] Merton Miller himself acknowledges in his article published in 1988 that the way they have conceived the theorem does not exactly express what they wanted initially to express. The use of the term of "independence of the company's value at the financing structure of the firm" is strong, however it sets a benchmark. "The view that capital structure is literally irrelevant or that 'nothing matters' in corporate finance, though still sometimes attributed to us (and tracing perhaps to the very provocative way we made our point), is far from what we ever actually said about the real world applications of our theoretical propositions. Looking back now, perhaps we should have put more emphasis on the other, more upbeat side of the 'nothing matters' coin: showing what doesn't matter can also show, by implication, what does" Miller (1998)

analysis applied to French banks, Bandt et al. (2014) analyses the relationship between systematic risk, leverage and liquidity. Their findings provide support to the application of Modigliani-Miller theorem to banking sector and evaluate the compensation effect of holding higher proportions of capital and the reduction of the expected return on equity at 54% as of the total effect. In addition, it concludes that market participants do not take into account banks' liquidity risk when evaluating the systematic risk.

Impact of capital requirements on lending

There is another set of studies that use accounting approaches to evaluate the impact of new capital requirements. King (2010) assumes that the increase of the proportion of core capital will lead to an increase in lending spreads while the ROE remains unchanged. By excluding any compensation effect mentioned in MM theorem, it estimates that a 1 pp (percentage point) increase in the capital ratio could be offset by increasing the lending spreads by 15 bps. In turn, the magnitude of the impact as estimated by BCBS (2010a) is considerable lower. Using a DSGE model, it evaluates that each 1 pp increase in the capital ratio could be recovered by a 7 bps rise in lending spreads while the ROE is unchanged. (Mendicino et al., 2015) highlights a differentiated impact across categories of loans for Euro area. It evaluates the impact on lending spreads for mortgage loans at 2.8 bps and to 4.9 bps for corporate loans[8].

The amplitude of the impact varies considerably across countries. The direct effect on lending spreads as a consequence of increases in capital requirements is estimated at 9.4 bps for one percentage point increase in capital requirements for UK banks (Ramon et al., 2012). For a larger sample of European banks, the decrease in lending spreads is evaluated at 19 bps (Sutorova and Teplỳ, 2013)[9]. The results of the sensitivity analysis of Oliveira and Elliott (2012), assessing the impact of Basel III capital requirements on the cost of credit[10], indicate an increase in lending rates of 18 bps in Europe, 8 bps in Japan, and 28 bps in the United States over a long-term horizon. A more precise analysis of Mésonnier and Monks (2014) highlights that banks that increased their capital ratios between 2011 and 2012 incurred a decline in loan growth in the range of 1.2-1.6 percentage points compared to banks that did not have to increase their capital ratio[11].

[8] The calibration of (Mendicino et al., 2015) is based on the DGSE model of Clerc et al. (2014) which is able to consider to financial intermediation and different layers of default.

[9] While the estimation of Ramon et al. (2012) use data from 1992 to 2012, Sutorova and Teplỳ (2013) analyses the same relationship for 594 European banks over the period 2006 to 2011.

[10] Results of Oliveira and Elliott (2012) and of previous analysis (Elliott, 2009; Elliott, 2010) should be interpreted with caution given their assumptions on the initial level of capital ratio and ROE which one can judge not in accordance with the real figures.

[11] The analysis is driven for a sample of EBA's supervised banks and uses the outcomes of the 2011/12 stress-test. It compares the volume of lending for banks that had to increase the risk-weighted capital ratio and banks that did not need to adjust their capital ratios. The results are estimated for an increase of one percentage point of the capital ratio.

There is empirical evidence than better capitalized banks favour long-term lending relationships and stabilize provisions of credit in times of economic downturn (Kapan and Minoiu, 2014; Gambacorta and Mistrulli, 2004). Nevertheless, Gambacorta and Marques-Ibanez (2011) give notice of the considerable impact that an increase in capital requirements during periods of crisis could have on lending volumes. Slovik and Cournède (2011) suggest that the adverse effects on lending can be offset by accommodative monetary policies.

The evaluation of the macroeconomic impact (economic growth, lending/GDP) involves more complex evaluations. While considering for interactions with the real activity seems to be a difficult exercise, the impact of an increase of 1 pp in capital ratio will have an impact on the steady-state GDP level of 0.1%-0.2%[12] (MAG, 2010; Slovik and Cournède, 2011).

Benefits of capital requirements

Admati et al. (2012) and Admati and Hellwig (2013) insist on the importance of better capitalized banks for the functioning of the financial system. Higher levels of capital should reduce distortions and therefore, banks are expected to perform better since risk will be more appropriately priced. Moreover, it is emphasized that financial institutions should be able to easily increase capital ratio by retained earnings[13].

But the studies evaluating the benefits of higher capital requirements are fewer than the ones assessing their costs. However, globally, the existence of net benefits is emphasized. The most common approach consists in evaluating the contribution of higher levels of core capital in terms of reduction of the frequency of financial crisis and their costs(Miles et al. (2013); BCBS, 2010b; Bandt et al. (2014)). This method is limited by the low frequency of crisis that makes more difficult the impact assessment exercise. Several studies should be mentioned. BCBS (2010a) indicated net benefits, of 5.8% increase in the level of steady-state GDP, if capital ratios are doubling (from 7% to 14%). The more innovative model of Clerc et al. (2014) introduces financial intermediation and three layers of default and therefore, is able to justify the role of capital regulation in reducing distortions. The calibration to Euro area data evaluates the impact of one percentage point in the capital to RWAs ratio at 0.04% deviation for the steady-state GDP (Mendicino et al., 2015).

Another stand of research examines the optimal level of capital ratios. Miles et al. (2013) evaluates the optimal level of risk-weighted capital ratio in the range of 16-20%. This finding is based on the assumption that the benefits of holding higher proportions

[12] Rochet (2014) provides a comparison analysis of main studies in this issue.

[13] Nevertheless, this involves a reduction in the rates of return. Although considerably higher than the one for non-financial firms, this solution is strongly contested by practitioners.

of capital will offset the additional costs. More recent studies suggest that the optimal Tier 1 capital ratio should be in the range 8%-14% (Nguyen, 2013; Martinez-Miera and Suarez, 2014). While still above the actual level imposed by Basel III, these findings are closer to the capital requirements imposed to systemically important banks BCBS (2016).

Additional issues

Tsatsaronis and Yang (2012) explore the idea of implementing countercyclical capital buffers given that banks' funding costs are lower in boom periods and significantly higher during downturn periods. They analyse the rates of return on equity for 22 globally active banks[14] by decomposing them into systematic and idiosyncratic component. Their findings reveal that leverage affects the systematic component of the risk and this latter differs across stages of business cycle. Therefore, their study brings support to the implementation of capital buffers (countercyclical buffer and additional loss-absorbency requirements for G-SIBs). On another issue, according to Klomp and Haan (2011), the effect of banking regulation and supervision depend on the ownership structure and the size of institutions. It is suggested, moreover, that prudential requirements should be completed with a stress-testing framework that will be able to evaluate the resilience of banks to future adverse scenarios (BIS, 2014). Stress-testing, as a supervision tool, is essential in ensuring the efficiency of capital regulation framework Fullenkamp and Rochon (2014).

The debates on the architecture of the new prudential framework are also about the complementary role of leverage and risk-weighted capital ratio. Historically, according to (BIS, 2014), Blundell-Wignall and Roulet (2013) and Haldane and Madouros (2013), the leverage seems to perform better than the risk-sensitive ratio in predicting the failure of banks. However, one could not conclude on the over performance of leverage in comparison to the capital ratio since it could probably fail in evaluating banks' riskiness on its own. Basel Committee's reports and central bankers' speeches suggest that the most appropriate approach for capital regulation is the use of the two complementary measures since they capture different types of risk (BCBS, 2016). Namely, the leverage ratio could provide greater resilience for (unpredictable) risks that are not addressed within risk-weighted ratio[15]. Meanwhile, the risk-weighted capital ratio is essential for a more appropriate risk-assessment, allowing to differentiate between low-risk and high-risk assets.

[14] 22 of 29 G-SIBs according to FSB classification in 2012.

[15] Small shocks could be amplified by higher leverage and become a treat for institutions and financial system as a whole; therefore the role of leverage can be easily justified.

Issued from this different axis of the debate, the analysis that is produced in this chapter focuses on capital adequacy framework (leverage and Tier 1 capital ratio) proposed within Basel III and its impact on banks' stability and funding costs[16]. Compared with the existent literature, our work brings additional evidence on the impact of Basel III capital ratios (both leverage and Tier 1 ratio) by taking into account banks' business strategies and temporal evolution of banks' structures and it applies to a sample of large European banks. However, we do not address in this chapter the question of the impact of higher capital requirements at a macro-economic level, but it will nevertheless be considered for further research.

1.2 The benchmark value of Modigliani-Miller theorem

In this context of controversial debates on the definition and efficiency of the new capital requirements, the theorem of Modigliani-Miller (MM)[17] provides a benchmark framework for the analysis of changes in capital structures at a microeconomic level. Its initial assumptions allow to demonstrate that the capital structure do not affect the value of a firm and it suggests that there is no optimal leverage ratio. Hence, the release of these theoretical hypothesis helps us understand the extent to which they can impact the value of the firm.

1.2.1 Some theoretical background

Risk and capital structure

Although the standard MM propositions can be easily contested in the actual context, it would be a mistake to dismiss the essential of this theorem suggesting that equity is more risky when leverage is higher. The irrelevance of the leverage ratio for the riskiness of banks can be easily be demonstrated using the Capital Asset Pricing Model (CAPM). Within this framework, the total risk of the bank (i.e. the risk of its assets,β_{assets}) can be decomposed as the sum of the risk on equity (β_{equity}) and the risk on debt (β_{debt}):

$$\beta_{assets,it} = \beta_{equity,it}\frac{E_{it}}{D_{it}+E_{it}} + \beta_{debt,it}\frac{D_{it}}{D_{it}+E_{it}} \tag{1.1}$$

Where D is the book value of bank's debt for period t and E is the book value of bank's equity. With the option of writing the beta of the economic assets as a weighted average of the betas of equity and debt, we aim to simplify calculations since β_{assets} cannot be

[16] The other measures proposed within Basel III prudential framework will be analyzed in following chapters of this thesis.
[17] Modigliani and Miller (1958)

accurately measured by using publicly available data. However, in order to determine the relationship between the risk associated with bank's own resources[18] and the level of debt, equation (1.1) becomes:

$$\beta_{equity,it} = \left(\beta_{assets,it} - \beta_{debt}\,\frac{D_{it}}{D_{it}+E_{it}}\right)\frac{D_{it}+E_{it}}{E_{it}} \tag{1.2}$$

Let us suppose now that $\beta_{debt,it} = 0$ meaning that the debt is riskless[19]. In this context the equity beta is written as:

$$\beta_{equity,it} = \beta_{assets,it}\frac{D_{it}+E_{it}}{E_{it}} \tag{1.3}$$

With the financial leverage defined as the ratio of the booking value of assets to the booking value of equity, $L_{it} = \frac{D_{it}+E_{it}}{E_{it}}$, the systematic risk of equity, i.e. equity beta, can be written as :

$$\beta_{equity,it} = \beta_{assets,it}L_{it} \tag{1.4}$$

Consequently, under the assumption of riskless debt, the risk of equity decreases linearly with leverage[20,21]. Supposing now that leverage is halved (or double the un-weighted capital ratio), the risk of equity will be halved as well and the total risk of the bank will be spread over a higher number of shares. In other terms, each unit of core capital will bear half of the risk supported before and, under this theoretical framework, β_{equity} will be reduced to half. Hence, the deleveraging process is likely to strengthen the health of financial institutions[22].

Funding structure and cost of capital

The relationship described in (1.4) allows us to further explain, in more concrete terms, the link between the CAPM and the MM theorem.

[18] Beta represents the systematic risk described as the sensitivity of the stock i at market fluctuations (Fama and French, 2004).

[19] With this assumption, a part of the volatility of the economic activity, more exactly the part of risk supported by creditors will be neglected. This can be justified by the existence of deposit insurance applied to deposits. For the other liabilities, this hypothesis is also appropriate: the risk under the CAPM is not the default risk but the market risk or the risk of fluctuations in the liabilities' value correlated with the market.

[20] In theory, this relationship has been verified and confirmed. However, the assumption of the independence of β_{assets} with respect to the leverage and across time seems to us quite strong (especially for crisis periods). It could be the case if banks' portfolios were composed in majority by medium and long-term claims. However, for our sample of European banks, they represent barely half of the balance sheets. The other assets that generate profits (securities) represent about one third. Therefore, the variations of the total risk of assets can be affected by the economic environment and market liquidity. The business model of banks can also be a determinant factor of different levels of risk.

[21] Baker et al. (2016) analyses the "risk anomaly" (i.e. high-risk equities do not earn proportional high returns) and finds strong empirical evidence that leverage is inversely related to asset beta. More important, it emphasises that firms with highly risky assets, the cost of capital is reduced at a low level of leverage. At the opposite, for firms with low-risk assets, the cost of capital can be minimized at higher levels of leverage.

[22] However, this reasoning supposes that there are no immediate interactions between capital structure (described either by the leverage or capital ratio) and β_{assets}) (Hamada, 1972).

Since higher amounts of equity are associated to lower β_{equity} and the expected return on equity is established according to the level of risk, the increase in the cost of capital caused by the higher proportion of stable resources should be offset by the reduction in the expected rate of return (Miller and Modigliani, 1961). Equation (1.5) illustrates the relationship between the funding structure - as described by the leverage L_{it} - and the expected rate of return, k_{it}.

$$k_{it} = R_f + \beta_{assets,it} L_{it}[R_m - R_f] \tag{1.5}$$

with R_f is the risk-free rate and $(R_m - R_f)$, the spread between market rate of return and the risk-free rate, defines the market premium. Therefore, the reduction of the systematic risk generated by the improvement of capital structure (i.e. an increase in the amount of equity as of total assets) will lead to a decline in the expected return on equity k_{it}.

Finally, this compensation effect can be assessed through the calculation of the weighted-average cost of capital (WACC):

$$WACC_{it} = k_{it}\frac{E_{it}}{D_{it} + E_{it}} + R_f\frac{D_{it}}{D_{it} + E_{it}} \tag{1.6}$$

The WACC is calculated as the average cost of equity and liabilities, weighted by their share in the balance sheet[23]. This equation highlights two main facts. First, an increase in the proportion of equity, which is a more expensive resource than debt, increases the overall cost of funding. Nevertheless, since the stability of the firm is reinforced, the expected rate of return on equity will decline. Second, strengthening the resilience of the balance sheet may indirectly impact the cost of debt, which will decrease in accordance to the riskiness of the bank (Admati et al., 2013).

The more concrete link between the Modigliani-Miller theorem and the CAPM is emphasized in equation (1.7). The weighted average funding cost is insensitive to the capital structure and the supplementary cost of a change in the proportion of equity should therefore be equal or close to zero.

$$WACC_{it} = R_f + \beta_{assets,it}[R_m - R_f] \tag{1.7}$$

This will be the case within a theoretical framework, although, in reality, the offset described by the theorem of MM cannot be fully validated. Banks have specific structures and their activities, by their very nature, are subject to strong asymmetries than non-financial firms. Indeed, the application of the MM theorem to the banking sector can be subject to debates and hence, the insensitivity of funding costs to changes in banks' funding structure needs to be questioned.

[23] With the assumption of risk-free debt, the cost of debt R_d is equal to the risk-free rate R_f.

1.2.2 Applying the MM theorem to banking sector

Firstly and certainly, the most disturbing element in applying the MM theorem to financial institutions is the existence of implicit subsidies for banks' debt. Of course, such reasoning can find justification in the willingness of public authorities to avoid huge costs of eventual bankruptcies and to ensure depositors' protection. But this financial support granted by governments for banks' unsecured debt represents, in fact, a guarantee for beneficiary institutions; they can be more or less explicit and more or less high (depending of the level of indebtedness of the bank). But the most disturbing consequence is that they provide bad incentives for banks and lead to an increase in moral hazard. This is because, with this public support, a part of the default risk is transferred towards the public authority. Hence, the risk premium for a potential supported bank will be lower than the one corresponding to its real level of risk.

Theoretically, one could deal with the problems generated by the existence of this distortion by addressing the governance problem. Improving capital structures and, implicitly, providing appropriate resolution tools could contribute to reducing bad incentives and reduce the need of public interventions. Risk could also more appropriately priced. Additionally, the increase of the proportion of core capital can also improve banks' capacity to absorb losses without impact on debtholders[24]. Therefore, the MM offset can be lower than one could expect according to the theory, due to the existence of these strong asymmetries.

Secondly, fiscal deductions (i.e. interest tax-deductions) are considered an advantage for liabilities relative to equity since dividends paid to investors do not benefit of any fiscal deduction. Therefore, this assumption is an incentive to borrowing rather than raising capital. In this context, massive deleveraging could lead to an increase in the average cost of capital by the simple fact that fiscal advantages mentioned previously will be reduced. Theoretical counter-arguments have been brought to this criticism along with empirical proofs (Miller, 1977; Ross, 1988; Miller, 1995). For a 33% tax rate, a 1% increase in the capital ratio seems to impact the average cost of capital by only 2 basis points (bps). Wherefore, the theoretical MM effect discussed previously may be biased by these strong information asymmetries.

Finally, another justification for the use of debt rather than equity can also make reference to their liquidity (Diamond and Kashyap, 2016). Specifically, one can assume that debt instruments are more liquid than shares. Nevertheless, it seems that these

[24] The adverse effects of massive government bailouts were even more obvious after the subprime crisis. A first implication, already discussed in the literature by Gropp et al. (2013), Fischer et al. (2014) and Brandao Marques et al. (2013), refers to banks' risk-taking behavior as a consequence of the anticipation of public support to avoid bankruptcy. The second one refers to the size of the banks' balance sheet. The government's implicit support eases access to funding and favors the increases in bank's capacity to invest, leading in the end to an expansion of balance-sheet. A cyclical effect may appear as the size of the bank and the interconnection of financial institutions play a key role in the allocation of government support.

latter have been as liquid (or even more liquid) than bonds during the recent periods of crisis.

Another point that should be brought into discussion is the nature of banks itself, which imposes a violation of initial assumptions of the MM theorem. Banks' main activities, based on maturity transformation (i.e. collecting deposits and transforming them into illiquid loans), are financed by debt. This explains their higher level of leverage compared to firms from any other sectors.

Finally, the assumption of riskless debt is strong, while not entirely wrong. For example, deposits can be considered a riskless resource due to the existence of the deposit insurance. Moreover, under the CAPM, the assumption of zero risk does not refer to the probability of default but rather to the risk of fluctuations of the value of debt instruments; therefore, to some extent, this assumption could be justified.

The relationship between debt, systematic risk and cost of capital will implicitly change if we take into account all these asymmetries (Admati et al., 2013). Therefore, the neutrality of the average cost of capital regarding to the funding structure is questionable and the deviation from the theoretical benchmark remains an empirical issue.

1.3 Implications of new capital standards. Methodology and descriptive statistics

We further propose to empirically analyse the neutrality of the MM theorem in the actual regulatory context. The economic-based question behind this study concerns the impact of a considerable deleveraging process on the funding cost of financial institutions, submitted to Basel III agreements.

1.3.1 Data and methodology

Our empirical analysis is applied to a panel of 56 large banks from 20 EU countries. The sample counts 12 G-SIBs from the total of 30 published by FSB in November 2013. The dataset is composed of consolidated balance-sheet statements provided by Bankscope, at an annual frequency. It covers the period from 2003 to 2013. The final sample has been obtained after applying a selection process which was based on banks' size and data availability. Additionally, the fact that certain banks have not been listed during the whole study period affects the structure of our panel which will be unbalanced. Publicly data on stock prices and stock-market indices is used for the assessment of our interest variable - the *Beta*.

Miles et al. (2013) use a sample of seven English banks and Bandt et al. (2014) four French banks. The study published in ECB's annual report uses a wider sample of

European banks and is based on private semi-annual data. Compared with this later study, our analysis uses a wider selection of indicators including a risk-weighted capital ratio. Another contribution of our analysis is the focus on the subsample of G-SIBs which is now of high interest for regulators.

The variables that we further employ in the empirical analysis are not defined exactly as mentioned in the MM theorem, but rather as the prudential ratios defined within the Basel III framework (the leverage and the risk-weighted capital ratio). We chose to use these indicators as they are more appropriately evaluating the riskiness of banks according to the new regulatory framework.

Dependent variable

Equity beta is the dependent variable in our econometric model and describes the systematic risk of the bank. It measures the sensitivity of the stock i to market fluctuations. The calculation formula is:

$$\beta_i = \frac{covariance(R_i, R_m)}{\sigma_m^2} \tag{1.8}$$

Both the covariance between the return on market index and the rate of return of the stock i and the variance of market index are calculated based on daily data over a one-year horizon. The market index return is measured using the EuroStoxx50[25]. The final *Beta* retained for our empirical analysis is the mean over one-year horizon.

Explanatory variables

Two indicators of solvency are employed: the *Leverage* and the *Tier 1 capital ratio*. The *Leverage* is calculated as the book value of assets divided by the book value of Tier 1 capital and it describes bank's capacity to invest. On the other side, the Tier 1 ratio is a risk-sensitive indicator and is calculated as the amount of Tier 1 capital divided to the amount of risk-weighted assets. The first one was introduced within Basel III framework while the latter has been just revised.

A first problem related to the Tier 1 ratio is the low availability of data on the amount of risk-weighted assets. Moreover, the definition of the risk-sensitive ratio is subject to strong criticism due to the lack of appropriate and transparent methodology (BCBS, 2013d; EBA, 2013a). In turn, the leverage has the advantage of a simplest and more

[25] We consider a common market index for all banks, the EuroStoxx50. We have also estimated the betas using national indexes (CAC40 for French banks, FTSE100 for English banks, DAX index for German banks etc) and results are similar.

transparent calculation. Recent literature on financial crises points out the outperformance of the simple leverage ratio on the T1 ratio (Blundell-Wignall and Roulet, 2013; Laeven et al., 2014b). We are therefore encouraged to analyse the two measures since both are to be adopted under Basel III regulation and their objectives are slightly different.

Control variables

In order to check for bank specific characteristics, we consider several control variables.

The business model (*BM*) is described by the proportion of the retail activity (sum of net loans and customer deposits) divided by the amount of total assets. Therefore, higher figures of this ratio, computed at an annual frequency as well, are associated with higher proportion of traditional activities in banks' balance sheets. For robustness check, the variable *Retail ratio* will be replaced with an equivalent indicator for the structure of assets' portfolio: the proportion of derivatives as to total assets. *Derivatives* is also measured at an annual frequency.

Size is measured by the logarithm of total assets and is used to control for any size effect in our variables. We suspect that large banks are more involved in market activities and therefore, their *Beta* could be strongly correlated with market fluctuations. Another reason for the use of this variable is given by the high interest of the question on the neutrality of MM theorem for large banks.

G-SIB is a binary variable that becomes 1 if the bank has been included at least once on FSB's list of global systemically important banks (G-SIBs). Our sample counts 12 G-SIBs of the total of 30 defined by Financial Stability Board in November 2013 (FSB, 2013b). This variable is hence time-invariant.

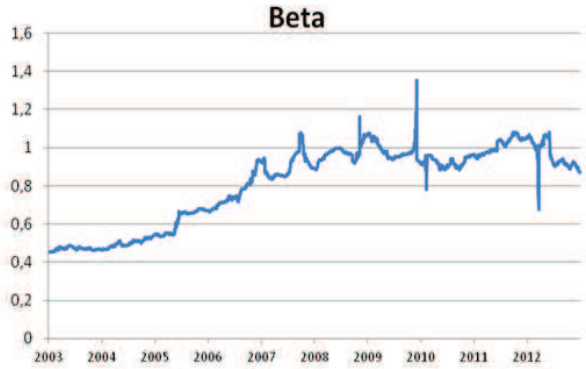
Detailed definitions of the variables employed within our empirical model is provided in Appendix A.

1.3.2 Descriptive statistics

Given that the analysis covers both relative stability and crisis periods, it is very likely that the value of the variables employed in the econometric model varies considerably over the study period. For this reason, we first drive a statistical study in order to identify the evolution of variables and the differences between the entities in our sample. Firstly, this can be observed in Figure 1.1 where the evolution of the average daily *Beta* is plotted over the period 2003 to 2013. We notice a general increase in the value of average *Beta* starting with 2005. Several peaks are identified during 2007-2009 corresponding to shocks in stock market when banks' stock returns were generally over-reacting to market

fluctuations. After a slight decrease in 2010, the average value of *Beta* is increasing again in 2012 to return, afterwards, to lower values in 2013.

Figure 1.1: The evolution of Beta between 2003 and 2013



Notes: Beta is computed according to the formula in (1.8) on a daily basis over a one-year horizon. Five extreme values were deleted from the sample.
Source: Publicly available data on shares prices and market indicator, author's calculations.

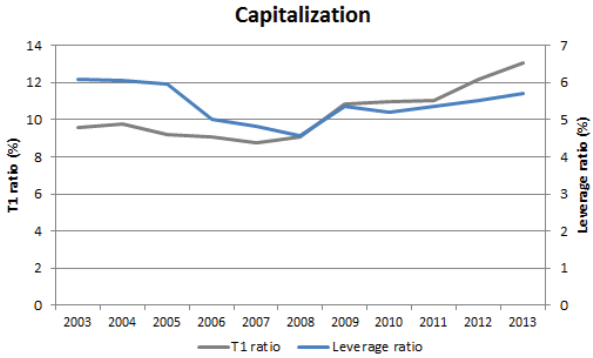
In order to harmonize the dataset, we further retain an annual value for the *Beta* that has been computed as the mean of daily betas over one year-horizon[26].

With regard to their funding structure, Figure 1.2 indicates that, in average, European banks had increased their indebtedness in the period up to the subprime crisis. Highly leveraged banks were at the core of the last global financial crisis. Indeed, the *Leverage ratio* seems to be negatively associated to the trend observed for *Beta* in Figure 1.1. But starting with the mid-2008 banks' balance sheets were considerably restructured. In average, the leverage ratio increased with more than 0.8% until end-2009. Since 2010, the leverage ratio continued to increase, although with a lower amplitude. Meanwhile, the Tier 1 ratio - providing a granular assessment of the risk in banks' portfolios - increased as well, with significant variations between end-2008 and 2013. This evolution could be explained by the raise in the amount of equity relative to the size of the balance sheet, as a result of the on-going efforts of recapitalization "commanded" by the crisis (and also by market pressure).

Beyond the regulatory pressure, supervisory actions could also explain the developments in banks' structures. Specifically, during our study period two stress-test exercises were driven by central European authorities and imposed to banks an alignment to regulatory and supervisory requirements. All these regulatory driven changes should be to be taken into account by investors in their risk assessments.

[26] Two different measures for annual beta were initially calculated: an end-year value and an annual average value. The two alternative measures are plotted in Figure 1.5 in Appendix B. The average value is finally retained for the empirical analysis since it is more relevant in capturing the level of risk of banks than the one-point in time value.

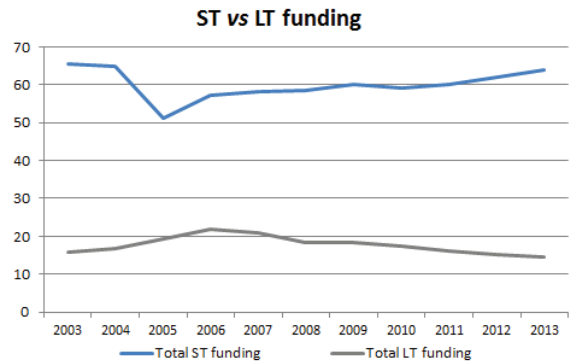
Figure 1.2: The evolution of solvency indicators over the period 2003-13



Notes: We plot in grey the average value for the risk-sensitive capital ratio, called T1 ratio, calculated as the amount of Tier 1 capital divided to the amount of risk-weighted assets. The blue line represents the evolution of the leverage ratio calculated as the amount of Tier 1 capital to total assets. For comparison reasons, we chose to plot the leverage ratio and not the level of leverage, although in the empirical analysis we use the level of leverage. Values for the leverage ratio can be read on the left horizontal axis.
Source: Bankscope

The restructuration was made through an increase in core capital and a reduction in non-core liabilities. Among these actions, one should notice the continuous decrease in the proportion of long-term borrowings in the post-crisis period (Figure 1.3). The dependence on short-term funding was reduced as well in several stages since mid-2008. Compared to the pre-crisis levels, the proportion of short-term borrowings was reduced with about five percentage points until the end-2013.

Figure 1.3: The evolution of funding structure over the period 2003-13



Notes: Both variables are expressed as proportions of total assets. Short-term funding includes deposits, short-term borrowings and other short-term liabilities (deposits from banks, repos and cash collateral). The short-term borrowings represent in average 17% of the balance sheet with greater values at the beginning of the period (over 20%) and smaller values after 2010 (below 16%). Long-term funding includes mainly debt instruments of maturities of one year or more.
Source: Bankscope, author's calculations

These structural changes had an impact on the financial strength of institutions but also on the stability of the financial system as a whole. Nevertheless, reinforcing the resilience of financial systems will have an impact on bank's profitability, which reached excessive levels before the crisis. Nonetheless, banks' profitability is still at high compared to non-financial firms, and continues at this level (BIS, 2014), suggesting that additional capital couldn't be all that expensive. The focus on the evolution of the rate of return on

equity (ROE) of largest banks in the sample, the so-called G-SIBs (global systemically important banks), indicate important shifts in the value of this variable during the crisis. Moreover, the structure of their balance sheet seems to be slightly adjusted in favour of traditional activities.

Furthermore, one question emerges from the descriptive analysis presented above: To what extent the recent capital requirements will affect the riskiness of European banks and the expectations on their return of equity?

1.3.3 Some methodological aspects

We take into consideration the business strategy of banks since we leave from the assumption that the value of shares from banks oriented on investment activities, holding higher proportions of trading activities, can be more correlated to market fluctuations. In other terms, the distress on stock markets can affect more easily investment activities than commercial ones. The difference in the amplitude of fluctuations are very likely to be transmitted to the value of equity. Our intuition is supported by the correlation coefficient between *Beta* and the *Retail ratio* (-0.39), statistically significant at a 1% confidence level. It is also in line with Klomp and Haan (2011) suggesting that the effect of banking regulation and supervision depends on the ownership structure and the size of institutions.

Given the evolution of variables during the study period, we have tested for the need of time-fixed effects within a specific statistic test. The aim of this test is to verify if dummies for all periods are equal to zero. If this is the case, then no time specific effects are needed. However, for our sample the results indicate that the coefficients for all years are not equal to zero and therefore the time fixed effects should be used (p-value$<$0.05)[27].

Our beliefs are strengthen by the more detailed descriptive statistics in Appendix indicating a common trend for banks within the same country. Countries' structural specificities are transcribed in differences in terms of leverage and, to a lesser extent, in terms of business model. According to Figures 1.6 and 1.7 in Appendix B, several typologies could be identified. Banks from Southern or Eastern Europe economies (Italy, Cyprus, Poland, Slovakia, and Lithuania) are less dependent on market borrowings (especially on short-term wholesale funding) and therefore should record lower exposure to market fluctuations. On the contrary, we identify more developed banking systems - accounting for large institutions (the so-called universal banks) - that favour investment activities. In this category, we identify countries like Germany, Netherlands and United

[27] This test is available in Stata as *testparm*.

Kingdom. An extreme case is represented by French banks that appear as more according to these indicators[28].

For the reasons mentioned above, the estimations will take into consideration time and country specific effects since they are supposed to impact the average riskiness of banks. We use several alternative econometric models that will confirm the robustness of our results (pooled OLS, fixed effects and random effects). Next section presents the empirical study and explains the main findings.

1.4 Empirical analysis and results

In this section, we drive a two-steps analysis. We first focus on the impact of the changes in funding structures generated by the new regulatory reform on the risk β. Then, we evaluate the compensation effect between the increase in the cost of equity and the reduction in the riskiness of the bank generated by a higher proportion of equity in its balance sheet. The results on the Modigliani-Miller effect are provided in the last part of this section.

1.4.1 The impact of regulatory driven changes on systematic risk

In this section, our aim is to test empirically the extent to which the hypothesis illustrated in equation (1.4) - describing the relationship between funding structure and systematic risk - can be validated for our sample of European banks. We run regressions using the following model:

$$Beta_{it} = \alpha_1 + \alpha_2 Solvency_{i,t-1} + \alpha_3 X_{it} + u_{it} \tag{1.9}$$

where *Solvency* describes the solvency of the bank i at time t. We use two different measures to define the level of solvency of banks - *Leverage* and *Tier 1 ratio* - which are consistent with Basel III capital requirements. As we argued in the previous section, the two measures are different through their definition and objective[29]; hence, we consider as necessary to test the effect of each indicator.

In accordance with the statistic analysis whose results indicate significant shifts in the value of our main variables during the study period, all specifications will include time and country specific effects, included as dummy variables (vector X_{it}). α_1 is the unobserved specific effect and u_{it} the idiosyncratic error.

[28] One should notice the weak level of the retail ratio and in the meantime, the high level of leverage. The strong dependence on money market funds and other short-term borrowings on the one hand and the important proportion of insurance and saving assets hold in their portfolios on the other hand, lead to different business models for French banks than for their peers.

[29] See Section 1.3 and Table 1.7 in Appendix B for more details on the definition and measurement of the two variables.

Three types of specifications are used to analyse the data: pooled OLS and two alternative specification with bank-specific effects, fixed (FE) and random effects (RE). The two last ones are used to control for unobserved bank-specific characteristics that are not explicitly introduced in the model: the FE model assumes that bank specific effects are correlated with the explanatory variables while the RE model supposes that the non-explicit effects are distributed independently from the regressors.

The results reported in Table 1.1 reveal that *Leverage* is a more relevant determinant than the *Tier 1 ratio* in explaining the level of systematic risk , as assessed by market participants. The positive and significant coefficient of *Leverage* indicates that (in average) a decrease of one unit in *Leverage* engenders a decrease between 0.004 - 0.009 units of *Beta*. Although estimated as an average effect for the sample of banks, the results clearly show that the level of core capital relative to liabilities partially explains banks' sensitivity to market fluctuations as described by *Beta*. The results of regressions 4 to 6 indicate that the risk-sensitive capital ratio is negatively associated with *Beta*, although the coefficients are not statistically significant. These results could explained, at this stage of the analysis, the irrelevance of the measure, driven by a lack of transparency and consistency of its components.

From another point of view, these results are transcribing investors' confidence in solvency measures. It is shown that the systematic risk is better explained by the leverage than by the Tier 1 ratio, which leads us to the conclusion that markets make more confidence to simple measures in their evaluation of the systematic risk. These results confirm somehow what has been proved in the literature with regard to the relevance of simplest measures (i.e. *Leverage*) compared to more complex ones (i.e. Tier 1 ratio), during the 2008 crisis (Haldane, 2012a).

Table 1.1: Results of regressions - level specification

VARIABLES	(1) Beta OLS	(2) Beta FE	(3) Beta RE	(4) Beta OLS	(5) Beta FE	(6) Beta RE
	Leverage			T1 ratio		
Solvency	0.00973***	0.00474**	0.00517**	-0.0105	-0.00687	-0.00669
	(4.135)	(2.010)	(2.266)	(-1.394)	(-1.151)	(-1.141)
Constant	-0.0191	0.298***	0.0483	0.570***	-0.107	0.440***
	(-0.139)	(4.034)	(0.174)	(4.623)	(-0.729)	(4.243)
Observations	508	508	508	457	457	457
R^2	0.465	0.345	0.456	0.086	0.730	0.2904
R^2 adj	0.432	0.245	.	0.0651	0.685	.
F-test or Wald test	13.83	21.04	284.17	4.176	15.97	154.60
Prob>F	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Country FE	yes	yes	yes	yes	yes	yes
Time FE	yes	yes	yes	yes	yes	yes

Notes: The dependent variable is *Beta*. The variable *Solvency* is described first by *Leverage* and afterwards, by the *Tier 1 ratio*. We run OLS, fixed effects and random effects regressions and we correct for the heteroscedasticity of errors. We use one-period lagged explanatory variables. All regressions include time and country specific effects. Robust t-statistics in parentheses*** p<0.01,** p<0.05,* p<0.1.

In order to compare fixed and random effects models we run a Hausman test which assumes under the null hypothesis that the difference in coefficients is not significant. Since the FE model is consistent under both hypothesis and we cannot reject the null hypothesis that differences are not systematic, the results indicate that the fixed effects are preferred[30].

Since the models using specific-effects seem to be relevant in explaining the variability of betas, we further search to examine the extent to which the business model of banks have an impact on the systematic risk, the beta.

1.4.2 Systematic risk conditioned by the business model

The figures analysed so far confirm that *Beta* is positively associated to the level of *Leverage* and negatively correlated with the *Tier 1 ratio*. However, one can assume that these relationships can be defined differently according to the business model of banks (assets portfolio and funding structure). In other terms, the nature of activities hold in banks' portfolios can have a direct impact on their level of risk.

Therefore, the introduction of the business model in our model is triggered by two main facts: the difference in the riskiness of institutions according to their business strategy[31] and the questions raised by policy makers and regulators with regard to the adoption

[30] The results of the test for the regression with (i) Leverage: $\chi^2(10)$=2.26 and Prob> χ^2=0.974 and (ii) Tier 1 ratio: $\chi^2(10)$=3.73 and Prob> χ^2 = 0.958.

[31] For example, investment-oriented banks are by definition strongly dependent on market-based activities which make them more vulnerable to stock market fluctuations.

of structural reforms for financial institutions. The main indicator of business model of banks is provided by the proportion of traditional activities (*Retail ratio*[32]) and their systemic importance. Greater values of this indicator correspond to higher proportions of traditional retail activities (lending and deposit collection).

Additionally, we chose to analyse the group of European G-SIBs for three main reasons:

- G-SIBs are among the largest banks worldwide; they have complex balance sheet structures that differentiate them from other banks;
- their importance for the system (driven by their size) may influence the relationship between funding structure and systematic risk; the existence of implicit guarantees for banks' debt may affect the offset effect mentioned by MM and CAPM;
- G-SIBs are highly leveraged; tax-deductions for debt is a strong limit to the MM theorem.

Our motivation is also triggered by the proposals for additional measures for large banks and more precisely, of higher loss-absorbency requirements. According to the methodology established by BIS (2015), large banks should fulfil additional requirements starting with 2016.

More globally, we expect that the average cost of capital will be lower for highly leveraged entities and implicitly for G-SIBs due to numerous advantages (tax deductions, implicit guarantees), proportional to the share of debt. Moreover, we assume that the regulatory driven changes in funding structure will have a greater impact on their cost of funding compared to smaller banks.

We run regressions using the model described in equation (1.10):

$$\begin{aligned} Beta_{it} = \alpha_1 + \alpha_2 Solvency_{i,t-1} + \alpha_3 BM_{i,t-1} + \alpha_4 \left(Solvency_{i,t-1}\ x\ BM_{i,t-1}\right) + \\ \alpha_5 GSIB_i + \alpha_6 (Solvency_{i,t-1}\ x\ GSIB_i) + \alpha_7 X_{it} + \varepsilon_{it} \end{aligned} \tag{1.10}$$

Where BM stands for the business model of bank i at time t and is describe by the *Retail ratio*. *G-SIB* is a dummy variable which becomes 1 if the bank i is on FSB's list of global systemically important banks. The interaction terms are introduced with the aim of testing for the impact of solvency ratios across structures (classes of business models or systemic importance). ε_{it} is the error term.

As in previous section, three different econometric models have been initially tested: OLS, bank fixed and random effects models[33]. However, since specific effects models are

[32] Definition of this indicator of business model inspired by Martel et al. (2012). Please see section 1.3.1 for detailed definition of variables.

[33] The equation changes marginally according to the specification that is tested. For instance, the error term α_{1t} is decomposed in α_1 and u_{it} for the random fixed effects model in order to capture both invariant error and between-entity error.

no longer relevant in explaining the relationship between beta and solvency indicators, we report results only for pooled-OLS specifications, with control for time and country specific effects. Explanatory variables are one-period lagged in order to deal with eventual endogeneity issues.

The results displayed in Tables 1.2 and 1.3 present a first series of regressions testing separately for the impact of *Leverage* and *Tier 1 ratio*, on *Beta*, while the business model is taken into account. It appears that the *BM* affects negatively the beta. According to the definition of BM (i.e. higher values correspond to greater proportions of retail activities), higher values of the BM are associated to lower betas. Consequently, our assumption of different beta according to the business model is validated. The introduction of an interaction variable Leverage x BM, with BM being commercial, universal or investment, brings additional information about the determinants of the level of risk. More precisely, we learn that the leverage has a considerable impact on the level of beta for universal banks and for investment banks, but to a lesser extent for this latter[34]. For commercial banks, the results indicate no significantly different effect compared to the average (column 3). The nature of these activities itself can bring an explaination for these results since both credit distribution and deposit collection are only marginally affected by stock market fluctuations. But from an alternative perspective, the results in column 3 are also emphasizing the importance of differences in the level of indebtedness.

We take the analysis one step further and focus on a specific group of large banks, the G-SIBs. The banks that have been designated as G-SIBs are more interconnected with and through markets. The estimates show that leverage has a stronger impact on the level of their beta than for other banks (column 5). The results are confirmed by the additional estimates made for each group of banks (please see Tables 1.10 and 1.11 in Appendix C).

[34] We distinguish three categories of business models: (i) investment-oriented banks for which the retail ratio has the lowest values and correspond to values up to the 25th percentile, (ii) universal banks whose retail ratio is in the range of values between the 25th and the 75th percentiles, and (iii) banks oriented on commercial activities for which the retail ratio has the highest values with values above the value corresponding to the 75th percentile of Retail ratio.

Table 1.2: Results of panel regressions with business model (level specification). Solvency described by the leverage

VARIABLES	(1) Beta	(2) Beta	(3) Beta	(4) Beta	(5) Beta
Leverage	0.00768***	0.00166*	0.00526**	0.00611**	0.00466*
	(2.931)	(1.768)	(1.983)	(2.442)	(1.851)
BM	-0.00171*	-0.00333**			
	(-1.730)	(-2.141)			
Leverage × BM		8.14e-05*			
		(1.718)			
Leverage × Universal			0.00406***		
			(2.737)		
Leverage × Investment			0.00631*		
			(1.733)		
Leverage × Commercial			-0.00121		
			(-1.150)		
GSIB				0.464***	0.293**
				(7.546)	(2.020)
Leverage × GSIB					0.0058*
					(1.708)
Constant	0.213	0.326	0.040	0.066	0.095
	(0.974)	(1.376)	(0.203)	(0.378)	(0.744)
Observations	463	463	463	508	463
R^2	0.453	0.455	0.468	0.511	0.571
R^2 adj	0.415	0.416	0.429	0.485	0.441
F	59.76	55.11	55.31	75.53	16.21
Prob>F	0.000	0.000	0.000	0.000	0.000
Country FE	yes	yes	yes	yes	yes
Time FE	yes	yes	yes	yes	yes

Notes: We run pooled-OLS regressions and we correct for the heteroscedasticity of errors. We use one-period lag for explanatory variables. All regressions include time and country specific effects that have been are introduced as dummies (consistent with Wooldridge (2003)). The variable *Solvency* in (1.10) is described by the *Leverage*. BM is defined by the *Retail ratio* and is a continuous variable. Categories of business model are defined in accordance with the variable retail ratio. G-SIB is a dummy variable which equals 1 if the bank is on FSB's list of global systemically important banks. The availability of data used to calculate the *Retail ratio* explains the lower number of observation than for the two last specifications, using a time-invariant variable, the *G-SIB*. Robust t-statistics in parentheses*** p<0.01,** p<0.05,* p<0.1.

Globally, the findings emphasized in this section bring support to Ayadi et al. (2011) suggesting that regulatory pressures could impact banks differently, according to their business strategy.

In what follows, the same exercise has been made for the alternative definition of solvency, the Tier 1 ratio. Although in basic specifications, presented in Table 1.1, the Tier 1 ratio has no significant effect, it appears that it is sensitive to the introduction of business model indicator (BM). Moreover, its impact is differentiated across business models, even if it is not significant for all categories of banks. The impact of the risk-sensitive capital ratio is considerable only for commercial banks. In this case, the result

is emphasizing the lower sensitivity of traditional banks to market fluctuations[35]. Finally, it appears that the impact of the *Tier 1 ratio* is not significantly different between the two categories of banks according to their systemic importance.

Table 1.3: Results of panel regressions with business model (level specification). Solvency described by the Tier 1 ratio

	(1)	(2)	(3)	(4)	(5)
VARIABLES	Beta	Beta	Beta	Beta	Beta
T1 ratio	-0.0168**	-0.0296**	-0.00562	-0.00629	-0.00661
	(-2.385)	(-2.014)	(-0.767)	(-1.160)	(-0.989)
BM	-0.00353***	-0.00537**			
	(-2.861)	(-2.146)			
T1 ratio × BM		0.000148*			
		(1.802)			
T1 ratio × Universal			-0.00412		
			(-1.058)		
T1 ratio × Investment			-0.00208		
			(-0.256)		
T1 ratio × Commercial			-0.0102***		
			(-3.239)		
GSIB				0.508***	0.453**
				(7.613)	(2.148)
T1 ratio × GSIB					0.00553
					(0.279)
Constant	0.623**	0.790**	0.342	0.202	0.209
	(2.367)	(2.401)	(1.537)	(1.031)	(1.430)
Observations	457	457	457	457	457
R^2	0.447	0.448	0.458	0.501	0.501
R^2 adj	0.408	0.408	0.417	0.465	0.464
F	59.25	63.03	48.67	80.16	13.75
Prob>F	0.000	0.000	0.000	0.000	0.000
Country FE	yes	yes	yes	yes	yes
Time FE	yes	yes	yes	yes	yes

Notes: The variable *Solvency* in (1.10) is described by the *Tier 1 capital ratio*.We run pooled-OLS regressions and we correct for the heteroscedasticity of errors. We use one-period lag for explanatory variables. All regressions include time and country specific effects that have been are introduced as dummies. BM is defined by the retail ratio and is a continuous variable. Categories of business model are defined in accordance with the variable *Retail ratio*. *G-SIB* is a dummy variable which equals 1 if the bank is on FSB's list of global systemically important banks. Robust t-statistics in parentheses*** p<0.01,** p<0.05,* p<0.1.

Nevertheless, the results of regressions reported in Tables 1.2 and 1.3 indicate that the two solvency measures, the leverage and the risk-sensitive capital ratio, have a different impact on the systematic risk of banks according to their business strategy. More

[35] According to the correlation matrix, the proportion of retail activities (*Retail ratio*) and the *Tier 1 ratio* are negatively correlated. This suggests that commercial-oriented banks have lower levels of Tier 1 ratio than investment-oriented banks. Therefore, the results of estimates in column 3 are not necessarily illustrating only the difference in the level of solvency, mainly because the relationship between beta and retail ratio is negative.

precisely, banks with important shares of market activities are more sensitive to market risk. This finding has important policy implications since it may suggest that the level of solvency ratios should be differentiated across different categories of banks, according to their business model.

Additionally, these findings could allow concluding with regard to the explanatory power of the two measures of solvency: the scepticism on the calculation of the amount of RWAs[36] seems to have a considerable influence on investors' assessment of market beta. Indeed, during the 2007-2009 crisis, the risk-sensitive ratios were disregarded and banks' riskiness was assessed on the basis of their leverage ratios which are more easily comparable across entities. In other terms, investors will rather focus on simple indicators, as the leverage, than on complex risk-sensitive solvency ratios, lacking of transparency.

For robustness check, we further run several additional regressions. We use an alternative measure to describe the business model of banks and namely, the proportion of derivatives hold by banks in their balance sheet (Table 1.12 in Appendix C). The use of this measure is motivated by the subprime crisis transmission mechanism, when market distress passed on to banks mainly through assets' revalorizations and particularly through derivatives. Moreover, these activities are somehow complementary to retail activity. From empirical findings it appears that a higher dependence on derivatives increases the *Beta*. It can therefore suggest that banks with high exposures to derivatives are more vulnerable to market distress.

To summarize, the business strategy of banks appears as a significant determinant of the level of systematic risk of banks, independently of other balance sheet patterns. It allows us to put a spotlight on the differentiated role of solvency in explaining the systematic risk of banks. We analyse the interactions between solvency indicators and the business model and emphasize the role of the *Tier 1 ratio* in explaining the variation of *Beta* when the business model is taken into account.

1.4.3 Leverage and Tier 1 ratio - complementary in explaining the systematic risk?

Previous results show that, separately, each of the two solvency indicators - *Leverage* and *Tier 1 ratio* - can have a significant impact on *Beta*, according to the econometric specification. Emerged from this analysis, one could address this additional question: to which extent the two measures of solvency, the *Leverage* and the *Tier 1 ratio*, are complementary in explaining the variation of *Beta*?

[36] This theory is also supported by Haldane and Madouros, 2013.

As reflected in the major reports of the Bank for International Settlements (BCBS, 2010d; BCBS, 2013b) and various Basel Committee's speeches, for a more effective resilience, these two indicators should be simultaneously considered in evaluating the level of capitalization of banks according to the structure of their activities[37]. One might consider this set of rules, based on both simple leverage and risk-based ratio, as too complex to be implemented (Haldane, 2012a). Nevertheless, their joint adoption is essential to avoid high levels of indebtedness and excessive risk-taking, respectively, and to further reduce bad incentives emerging in the setting up process. For this reason, we will test, within a simple empirical model, for the complementarity of leverage and risk-sensitive ratio to reducing the risk of European banks.

In what follows, we integrate simultaneously the two variables in the econometric model used to explain the variation of systematic risk:

$$Beta_{it} = \alpha_1 + \alpha_2 Lev_{i,t-1} + \alpha_3 CR_{i,t-1} + \alpha_4 BM_{i,t-1} + \alpha_5 X_{jt} + \varepsilon_{it} \tag{1.11}$$

With *Lev* measuring the leverage of bank i for the period t and *CR* the Tier 1 capital ratio. All specifications include time and country fixed-effects. By allowing us to account for unobserved structural and institutional differences (banking systems' structures and banks' recapitalization level), the introduction of country-specific effects changes marginally the values and the statistical significance for the estimates.

We run different specifications in order to test for the complementary of two solvency measures while considering for the business model of banking structures. Results are summarized in Table 1.4. The results are mixed but not unsatisfactory.

Within the first specification, a basic OLS regression, leverage is better supported by the data. More precisely, while the leverage has a positive and statistically significant impact in beta, the negative coefficient of the Tier 1 ratio is not significant. This will therefore represent the average effect of the leverage on beta for the whole sample. Nevertheless, the significance of the two solvency indicators changes according to the econometric model. That is the case, for instance, for bank-fixed effects and random effects models. We chose to present the results of the three different models since the analysis of their results brings more details on the relationship between beta and solvency ratios.

- Within pooled-OLS regressions, which capture the variation that emerges through both space and time, leverage seems to dominate the risk-weighted capital ratio, independently of the business model of the bank. Nevertheless, the estimates represent average of all time periods and entities.

[37] Leverage aims in "reinforcing the risk-based requirements, being a simple, non-risk based backstop measure" (BCBS, 2013b).

- The fixed-effects (FE) model in turn allows to "cover-up" of the ignorance of bank-specific characteristics. The FE estimate thus takes into account the time-variant changes within each entity. For these specifications, the Tier 1 ratio dominates the effect of the leverage. The result in column 2 suggests that the Tier 1 ratio had a considerable impact on Beta if their evolution in time is accounted for.
- The random-effect model accepts the contribution of time-invariant characteristics in explaining the variability of the predicted variable. Therefore, it appears that the differences in leverage across entities explain better than those in the Tier 1 ratio the variability of Beta.

The results of the Hausman test may suggest that the fixed-effect model is more appropriate since we cannot reject the null hypothesis that differences are systematic and fixed effect model is consistent under both hypothesis (results of Hausman test χ^2=2.82 and Prob> χ^2=0.992).

For reasons of consistency with previous regressions and in order to reduce the bias related to omitted variables, we introduce business model indicators in regressions. When the *Retail ratio* is considered, the risk-sensitive solvency ratio is more relevant across specifications. It appears that the difference between FE and RE models is not significant. As one could expected, the indicator of business model is not statistically significant in the last two models.

However, when the business model is described by the binary variable *G-SIB*, the results emphasize interesting results. Although the banks of systemic importance have structurally higher levels of beta (positive and significant coefficient of *G-SIB*). Moreover, it appears that the variability of beta is better explained by the leverage if time-invariant variables are removed, while it is better explained by the capital ratio when the differences across entities are taken into account. Globally, these findings suggest that time-changes in Beta are explained by the evolution of the leverage while the variability of Beta across banks is due to differences in their level of capital ratio.

We find that the two measures of solvency are not necessarily complementary in explaining the systematic risk of banks. The empirical results are nevertheless highlighting that banks with higher *Tier 1 ratios* have lower risk-taking incentives and this makes them safer and more insensible to market fluctuations. The reduction of *Leverage* in turn helps in reducing the amplitude of fluctuations for institutions since they become less dependent on markets.

Table 1.4: Results of panel regressions testing for the complementarity of the two solvency measures over the period 2003-13 (level specification)

VARIABLES	(1) Beta OLS	(2) Beta FE	(3) Beta RE	(4) Beta OLS	(5) Beta FE	(6) Beta RE	(7) Beta OLS	(8) Beta FE	(9) Beta RE
				Retail ratio			GSIB		
Leverage	0.0089***	0.00307	0.00358	0.00681***	0.00238	0.00278	0.00506**	0.00506**	0.00314
	(3.233)	(1.279)	(1.298)	(2.684)	(0.970)	(0.956)	(2.204)	(2.204)	(1.162)
T1 ratio	-0.0102	-0.0123**	-0.0120*	-0.0172***	-0.0162**	-0.0162**	-0.0095	-0.0095	-0.0118*
	(-1.635)	(-2.133)	(-1.756)	(-2.600)	(-2.536)	(-1.989)	(-1.619)	(-1.619)	(-1.726)
BM				-0.00272**	-0.00248	-0.00243	0.477***	0.477***	0.531***
				(-2.425)	(-1.598)	(-1.393)	(7.254)	(7.254)	(3.871)
Constant	0.0904	-0.0847	0.185	0.432*	0.191	0.457	0.138	0.138	0.190
	(0.438)	(-0.823)	(0.387)	(1.701)	(0.974)	(0.818)	(0.680)	(0.680)	(0.396)
Observations	457	457	457	457	457	457	457	457	457
R^2	0.453	0.734	0.443	0.460	0.736	0.452	0.509	0.509	0.505
R^2 adj	0.415	0.688	.	0.421	0.689	.	0.473	0.473	.
F	57.34	77.84	.	51.50	77.60	.	73.95	73.95	.
Prob>F	0.000	0.000	.	0.000	0.000	.	0.000	0.000	.
Country FE	yes	yes	yes	yes	yes	yes	yes	yes	yes
Time FE	yes	yes	yes	yes	yes	yes	yes	yes	yes

Notes: The dependent variable is the Beta. The business models of banks are described either by the Retail ratio or the dummy variable G-SIB (becomes 1 for banks included on FSB's list of global systemically important banks). All specification include time and country specific effects. We correct for the heteroscedasticity of errors and one-period lagged explanatory variables are considered. Robust t-statistics in parentheses *** p<0.01,** p<0.05,* p<0.1. Missing values in the table are due to technical aspects related to correlation matrix which is not of full rank.

From column 4, it appears that the two complementary requirements imposed under Basel III, leverage ratio and Tier 1 ratio, could reduce the systematic risk and drive to reevaluation of R_d. Moreover, their effect is likely to differ across business models which involves some strong policy implications and namely, the definition of capital requirements that should be differentiated across banks' business models.

Nevertheless, the definition of the business model significantly influences the impact of the two solvency ratios. If we refer to business model as the share of traditional activities (deposit collect and lending), then the risk-weighted ratio is more relevant in explaining the systematic risk. This finding could be explained by the level of leverage that is structurally low, but also by the importance of risk-taking behaviour in credit distribution. In turn, if reference to the business model is made through the label of "systemically important" - which is itself an indicator of complexity of structures and diversification of investments - the leverage is likely to influence stronger the variability of beta than the risk-weighted capital ratio.

1.4.4 The impact of changes in funding structures on the cost of funding

The highlights of the empirical analysis presented in previous sections point out that the systematic risk is lower for better capitalized banks. However, from the MM theory and the CAPM, we deduce that the funding cost should remain unchanged to changes in the funding structure.

Nevertheless, since the assumptions of the MM theorem can be easily contested in practice, we admit that there is no complete offset as mentioned in the theoretical framework, but rather a partial effect[38]. Furthermore, we aim to evaluate the spread of funding cost, relative to the theoretical benchmark, that can be driven by regulatory-imposed changes in banks' funding structures. Our further calculations are based on the theoretical framework presented in section 1.2.1. and empirical results from section 1.4.1.[39] A multi-steps evaluation approach is employed in order to first evaluate the expected rate of return on equity and afterwards, the weighted cost of capital.

The expected rate of return on equity (k) will therefore we calculated according to the formula:

$$k_{it} = R_f + [\alpha_1 + \alpha_2 L_{it}]\ P_r \tag{1.12}$$

With α_1 the constant and α_2 the coefficient of *Leverage* from the univariate regression using bank fixed effects[40].

According to the relationship described in (1.5) and the results of the regressions reported in Table 1.1, we expect that the return on equity will increase with the leverage. Following Welch (2001), Miles et al. (2013) and Bandt et al. (2014) we retain a market risk premium ($R_m - R_f$) of 5% and a risk free rate of 5%[41]. With these figures and the coefficients α_1 and α_2 from Table 1.1 we can compute the expected return on equity and we obtain k equal to 7.01%[42]. Then, the weighted cost of capital (WACC) worth 5.09%.

If a strong deleveraging takes place (a decline by half in leverage), the cost of equity should decrease to 6.75% (i.e. decline of 3.7%) while the weighted average cost of capital (WACC) will decrease to 5.16% (i.e. increase of 1.3%).

Supposing now that, even if leverage is halved, there is no MM compensation effect and hence the expected cost of equity (k) remains at the initial value of 5.39%. Within this framework, the WACC will be of 5.18%.

[38] A full MM effect could not be reached because of the limits of the MM framework. Among these, we remind the existence of multiple information asymmetries and distortions (particularly the implicit guarantees for banks too-big-to-fail), high leverage compared to other sectors that induce a considerable value of the tax shield of debt, and liquidity creation, although the role of this later can be discussed.

[39] Our evaluations are inspired by Miles et al. (2013) and Bandt et al. (2014)

[40] The univariate regressions were based on the model $\beta_{it} = \alpha_1 + \alpha_2 Solvency_{it} + u_{it}$, and Solvency is described by the leverage.

[41] For comparison purposes, we use the same fixed factors (the risk premium and the risk free rate) as existent empirical studies in the literature.

[42] According to equation (1.5) and the results of regressions in Table 1.1, we estimate the expected rate of return on equity for an average level of Leverage (Assets/Tier 1 capital) of 22.03 to 7.01%=5%+(0.298+0.00474×22.03) ×5%

Altogether, the increase in WACC is evaluated at 74% of what it would had been if there was no MM effect (i.e. no compensation). Our evaluation is similar to the one of ECB, made for a sample of European banks (78%)[43]. It is however larger than the one for UK banks evaluated by Miles et al. (2013) at 55% and the one for French banks evaluated by Bandt et al. (2014) at 54%.

Table 1.5 below summarizes the calculations. Additionally, it presents the estimation of the MM effect for two sub-groups of banks: G-SIBs and banks other than G-SIBs.

Table 1.5: Computing the magnitude of the compensation effect

	All sample		**G-SIBs**		**Other banks**	
	Leverage	Leverage/2	Leverage	Leverage/2	Leverage	Leverage/2
	22.03	11.02	31.87	15.935	19.8	9.9
expected rate of return on equity						
k	7.01%	6.75%	9.21%	8.30%	6.53%	6.31%
change in k		-0.26%		-0.92%		-0.23%
g(k)		-3.7%		-3.72%		-3.46%
if partial compensation effect						
WACC	5.09%	5.16%	5.13%	5.22%	5.08%	5.13%
change in WACC		0.07%		0.08%		0.05%
if no compensation effect						
WACC		5.18%		5.26%		5.15%
change in WACC		0.09%		0.13%		0.08%
offset		74.05%		56.50%		70.52%

Notes: Calculations are based on summary statistics reported in Table 1.8 in Appendix B.

Compensation effect for G-SIBs and other banks

We first run alternative regressions to evaluate the impact of leverage on Beta for each subsample of banks (according to regressions described in equation (1.9)). We learn that the impact of solvency indicators on *Beta* are strongly significant for both classes of banks (statistically significant at a 1% confidence level) but of a larger magnitude for G-SIBs compared to other banks[44].

We proceed to calculations of the offset for the two subsamples of banks, distinguished according to their systemically importance: G-SIBs and other banks. The main motivation for this additional analysis is provided by previous findings suggesting that the impact of the leverage and Tier 1 ratio beta is different across business models.

[43] The analysis driven by ECB (2011) for a larger but more heterogeneous sample.

[44] Additionally, we run regressions to test the impact of the Tier 1 ratio on Beta for each sub-sample. The results emphasize a significant impact only for G-SIBs. This finding suggest that an improvement of risk-weighted capital ratio could considerably reduce the sensitivity to market fluctuations since the loss-absorbing capacity would be improved. Moreover, these findings allow us to conclude that capital surcharge for G-SIBs could be profitable for the system since they could reduce significantly their risk and eventually the contagion effects.

A self-evidence with regard to these two categories of banks emerges from their level of leverage that is one of the main drivers of the offset under the MM theory. It is firstly reverberated on the expected rate of return on equity, computed according to (1.5). The figures indicate a considerable higher k for G-SIBs than for the rest of the sample.

When equity, the most expensive resource, is increased (i.e. leverage is supposed to decrease by half), the variation of the WACC becomes larger. Moreover, under the assumption that MM does not hold at all, the increase in the WACC for G-SIBs is even larger since a part of implicit advantages are lost as a consequence of a reduction in the proportion of debt and implicitly, an improvement of the funding structure. Furthermore, since the magnitude of these distortions is significantly higher for large banks than for smaller ones, the compensation effect will be weaker for G-SIBs.

Generally, our results on the MM effect are comparable to the literature and particularly to the study driven by the ECB on a sample of European banks although the assessment methodology is slightly different. With regard to other studies focused on national banking systems, the gap is greater.

Several explanations can justify our findings. First, considering their key role for the European economy, public authorities (ECB and national governments) intervened massively during the financial crisis in order to avoid greater distress. In other terms, they provide support to those banks whose bankruptcy represents a threat for the financial systems and for the whole economy. These reactions have been transcribed into greater distortions in the banking systems that have been felt also on stock markets, and particularly on share prices. The mispricing of assets, broadly speaking, is therefore likely to generate higher shifts from the MM benchmark. Another reason for the low MM effect evaluated within this study, compared to the literature, is given by the minor differences in the empirical methodology (for example, structural patters of banks, country specificities).

The findings of this study have some interesting policy implications since they allow to identify the effects of strengthen regulatory requirements across different types of financial institutions. First, consideration should be given to the introduction of an appropriate number of levels of the leverage ratio that institutions with different business models would be required to meet. BCBS (2013b) and Bank of England (2009) suggest the implementation of capital buffers in the leverage ratio framework in order to maintain the complementary to risk-weighted capital ratio which is already subject to capital buffers[45]. Nevertheless, one should bear in mind that the leverage has also a countercyclical component. Therefore, time-varying capital requirements are necessary to ensure that banks are sufficiently capitalized and in accordance with the economic cycle.

[45] US and Switzerland also propose a leverage buffer for G-SIBs. The leverage framework in these countries is based on a minimum and a buffer component.

Additionally, to guarantee an efficient adoption of new capital requirements supervision should be strengthened (especially, of internal models). Such measure could further enhance the credibility of investors with regard to the risk assessment through the amount of RWAs.

1.4.5 Alternative approach

The specification that come naturally in mind is the one described in (1.9). However, one could allow for non-linearities in the relationship between beta and leverage. This could be done by running log-log specification which supposes the relationship is curved rather than flat[46]. The advantage is that the log-log regression produces a constant elasticity estimate in contrast to the linear model which produces a constant slope estimate. Theoretically, within a log-log regression of Beta on leverage, the coefficient should be equal to 1.

Therefore, we run the model described in (1.9) using log-log specifications. The results reported in Table 1.6 are positive and highly significant, nevertheless lower than 1.

The impact of changes in Leverage given by α_2 suggests that a 1% reduction in Leverage engenders a decrease in Beta of 0.34% to 0.58% according to the econometric specification (pooled or specific-effects)[47]. One could therefore conclude that the compensation effect is about 34% of the full offset according to MM theorem[48].

[46] By transforming the variables using log and then estimating the model within a linear regression we obtain a non-linear specification.

[47] We have also tested the relationship within an alternative first difference model. The estimate measures the extent to what annual variation of Leverage affects the variation of Beta. Coefficients in both pooled-OLS and fixed-effects models lose in significance. Therefore, we choose not to report these results.

[48] Compared with the results issued from previous calculations, in this case the offset impact is evaluated at the level of risk.

Table 1.6: Results of univariate regressions - log-log specifications

VARIABLES	(1) Beta OLS	(2) Beta FE	(3) Beta RE	(4) Beta OLS	(5) Beta FE	(6) Beta RE
	Leverage			T1 ratio		
Solvency	0.580***	0.344**	0.376***	-0.172	-0.175	-0.170
	(4.173)	(2.365)	(2.633)	(-1.145)	(-0.716)	(-0.747)
Constant	-4.254***	-2.389***	-3.987***	-2.213***	-1.001*	-2.555
	(-8.621)	(-5.448)	(-6.403)	(-2.919)	(-1.762)	(-1.557)
Observations	481	481	481	481	481	481
R^2	0.466	0.320	0.4386	0.446	0.313	0.421
R^2 adj	0.430	0.210	.	0.409	0.297	.
F-test or Wald test	13.08	17.71	.	12.21	9.953	.
Prob>F	0.0000	0.0000	0.0000	0.0000	0.0000	.
Country FE	yes	yes	yes	yes	yes	yes
Time FE	yes	yes	yes	yes	yes	yes

Notes: The dependent variable is the *Beta* in log form. We run OLS, fixed effects and random effects regressions and we correct for the heteroscedasticity of errors. The variable *Solvency* is described first by the *Leverage* and afterwards, by the *Tier 1 ratio*, which are transformed in log form as well. All regressions include time and country specific effects. No time lag for explanatory variables. Robust t-statistics in parentheses*** p<0.01,** p<0.05,* p<0.1.

We notice that the variability in betas is better explained by the leverage than by the Tier 1 ratio. Nevertheless, since the intercept is strongly significant within log-log models and it is not within level specifications, we prefer this later model. The level specification is more in accordance with the relationship between beta and leverage described by the MM theorem (proof in (1.4)).

1.5 Conclusion

In this chapter we analyse the relationship between the level of capitalization, systematic risk and the cost of equity. The motivation for this study comes from recent debates that emerged from the publication of the Basel III framework in December 2009 and discusses the impact of higher prudential requirements on the financial activity and real economy.

In the first part of this study, we explain the extent to which higher capital requirements affects banks' riskiness and funding cost. We analyse first separately and then, simultaneously, the two measures of solvency that have been introduced under Basel III, the leverage and the Tier 1 ratio. We find that leverage, which has already been promoted in the literature as a good predictor for banks' distress, is a relevant determinant of the systematic risk (i.e. market beta).

Then, we question about the importance of banks' business models in defining the relationship between systematic risk and solvency. Our results show that banks with higher

implication in traditional activities (lending, deposit collection) are more resilient to market distress than those with stronger involvement in investment activities. Moreover, imposing different levels of Tier 1 capital ratio according to the BM could be more efficient in reducing financial risks. The results also show that prudential requirements should be higher for systemically important banks given their greater riskiness that emerges from stronger interconnections and more complex activities.

Finally, the effect of higher capital requirements on the funding cost. We admit that, in practice, there is no complete offset between the increase in the amount of core capital and the reduction in the expected rate of return on equity as mentioned in the Modigliani-Miller theorem. This is mainly due to various information asymmetries and distortions in banking activity. Nevertheless, we identify a partial compensation effect that leads us to the conclusion that the impact of an increase in capital requirements will not be as large as predicted by practitioners.

Moreover, an increase in core capital should be able to correct the anomalies and to improve the functioning of the banking system through more accurate pricing of banking risk. The adoption of the two solvency measures, the leverage and the Tier 1 capital ratio could significantly reduce banks vulnerability to market distress by reducing the governance problem which became larger in the run-up to the crisis. It is likely that the implementation of the leverage ratio will have even greater impact on banks with average low-risk weighted portfolios (mortgages, repos, sovereign bonds), with further effect on the demand for such classes of assets. At the opposite, for banks of systemic importance, by considering a countercyclical component of the leverage ratio can be useful to reduce their exposure to shocks but also to maintain the complementary to risk-weighted capital ratio which is already subject to capital buffers.

Although these additional measures are justified, there are some concerns with regard to their degree of complexity, which could engender adverse effects on the real activity (Fullenkamp and Rochon, 2014)[49]. One efficient solution to this issue could come from Pillars 2 and 3 of capital framework which should focus on information disclosure and transparency of released data and methodologies starting with risk-weighted capital system which is opaque and lacks confidence.

Several additional questions arise from this first chapter. It is essential to examine how the existence of the major distortions in banking systems affect banks' funding cost and to which extent the recent prudential requirements could improve the resilience of banks to complex shock. These questions will be addressed in the following chapters.

[49] Fullenkamp and Rochon (2014): "Supervision is essential for ensuring the efficiency of capital regulation framework".

1.6 Appendix

A. Basel III framework

Figure 1.4: Implementation of Basel III standards: phase−in timeline

	Phases	2013	2014	2015	2016	2017	2018	2019
Capital	Leverage Ratio		Parallel run 1 Jan 2013 – 1 Jan 2017 Disclosure starts 1 Jan 2015				Migration to Pillar 1	
	Minimum Common Equity Capital Ratio	3.5%	4.0%	4.5%				4.5%
	Capital Conservation Buffer				0.625%	1.25%	1.875%	2.5%
	Minimum common equity plus capital conservation buffer	3.5%	4.0%	4.5%	5.125%	5.75%	6.375%	7.0%
	Phase-in of deductions from CET1*		20%	40%	60%	80%	100%	100%
	Minimum Tier 1 Capital	4.5%	5.5%	6.0%				6.0%
	Minimum Total Capital		8.0%					8.0%
	Minimum Total Capital plus conservation buffer		8.0%		8.625%	9.25%	9.875%	10.5%
	Capital instruments that no longer qualify as non-core Tier 1 capital or Tier 2 capital		Phased out over 10 year horizon beginning 2013					

Source: BCBS (2010c)

B. Variables definition and descriptive statistics

Table 1.7: Definition of variables used in our empirical model

Variables	Definition
Beta	Also called systematic risk, it measures the sensitivity of banks' returns to market fluctuations. Positive values are associated to higher risk.
Leverage	Total assets to Tier 1 capital (source: Bankscope; author's calculations). Higher figures for this variable are associated to a stronger use of liabilities relative to equity.
T1 ratio	The solvency ratio as defined within Basel III. It is computed as the amount of Tier 1 capital divided to the amount of risk-weighted assets. (source: Bankscope)
ST funding	The share of short-term borrowings as to total assets (source: Bankscope)
Retail ratio	Ratio of retail activities (Total customer loans+Total customer deposits) as to total assets (Martel et al., 2012, Gambacorta and Rixtel, 2013) (source: Bankscope). This variable is employed in our study to describe banks' business models. Higher figures for this ratio are associated to banks oriented on commercial activities.
Liquid assets	The ratio of liquid assets as provided by Bankscope divided to the amount of total assets
Derivatives	The proportion of derivatives as to the amount of total assets (source: Bankscope)
Size	Logarithm of total assets (source: Bankscope)
G-SIB	Describes the systemic importance of banks. Defined as a binary variable; it becomes 1 if the banks is a G-SIBs and 0 otherwise (source: G-SIB classification cf Financial Stability Board (FSB, 2013b))
ROE	Ratio of net income to equity (source: Bankscope). It is employed as an indicator for the return on equity.
Net interest income/ Earning assets	The net interest income expressed as a percentage of total assets (source: Bankscope). Higher values indicate that the bank enjoys cheaper funding (or higher margins). It indicates how profitable is the institution.

Table 1.8: Descriptive statistics for the period 2003-13

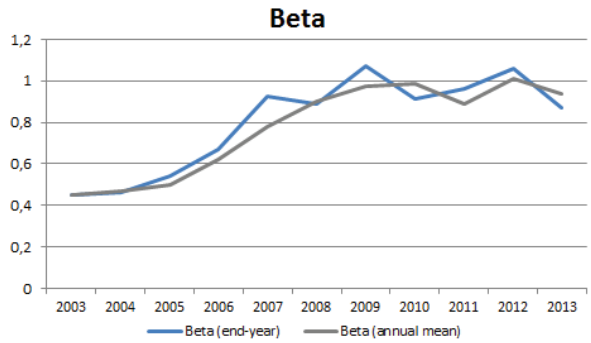
Variable	**Obs**	**Mean**	**Std.Dev.**	**Min**	**Max**
All sample					
Beta	587	0.79	0.55	-1.70	4.15
T1 ratio	567	10.48	3.51	-6.65	30.88
Leverage	573	22.00	10.78	-45.15	70.83
Retail ratio	585	96.09	29.57	6.86	160.76
Non−core liabilities	571	26.69	16.49	0.82	82.66
Core liabilities	573	59.19	16.57	8.99	92.19
ST funding	571	17.20	11.56	-38.05	60.92
LT funding	571	17.75	12.28	0.00	60.38
Derivatives	510	6.81	9.22	0.00	55.60
Liquid assets	526	19.50	12.23	2.92	63.49
G−SIBs					
Beta	125	1.15	0.45	0.25	2.90
T1 ratio	109	10.12	2.43	6.55	16.88
Leverage	113	31.87	11.38	16.89	70.83
Retail ratio	121	69.52	23.88	21.86	109.51

Table 1.9: Correlation matrix

	Beta	Leverage	T1 ratio	ST funding	LT funding	Derivatives	Liquid assets	Retail ratio
Beta	1.0000							
Leverage	0.3327*	1.0000						
T1 ratio	0.0052	-0.1269*	1.0000					
ST funding	-0.0056	-0.0425	-0.0276	1.0000				
LT funding	-0.0160	0.0431	-0.1367*	-0.1084*	1.0000			
Derivatives	0.3088*	0.5327*	0.1767*	0.0105	-0.2602*	1.0000		
Liquid assets	0.2008*	0.4348*	0.1906*	0.1615*	-0.2123*	0.4450*	1.0000	
Retail ratio	-0.3937*	-0.5737*	-0.2291*	-0.3429*	-0.0784	-0.6870*	-0.6402*	1.0000

Notes: Correlation coefficient statistically significant at a 1% confidence level noted with *

Figure 1.5: Annual alternatives measures for Beta



Notes: Two alternative annual measures for beta are calculated based on daily estimations. The first one in blue is the value for beta as at December, 31 of each year. The second measure in red is the annual mean over one year.
Sources: publicly available data on banks' stock prices and market index, author's calculations.

Figure 1.6: Average leverage by country

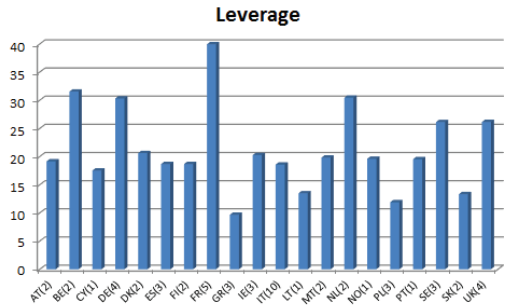
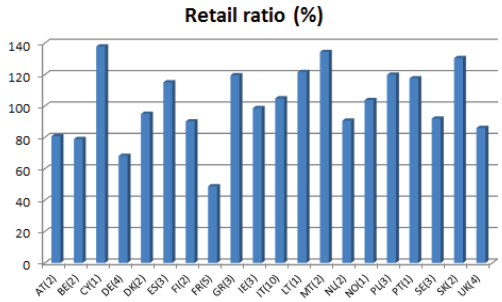
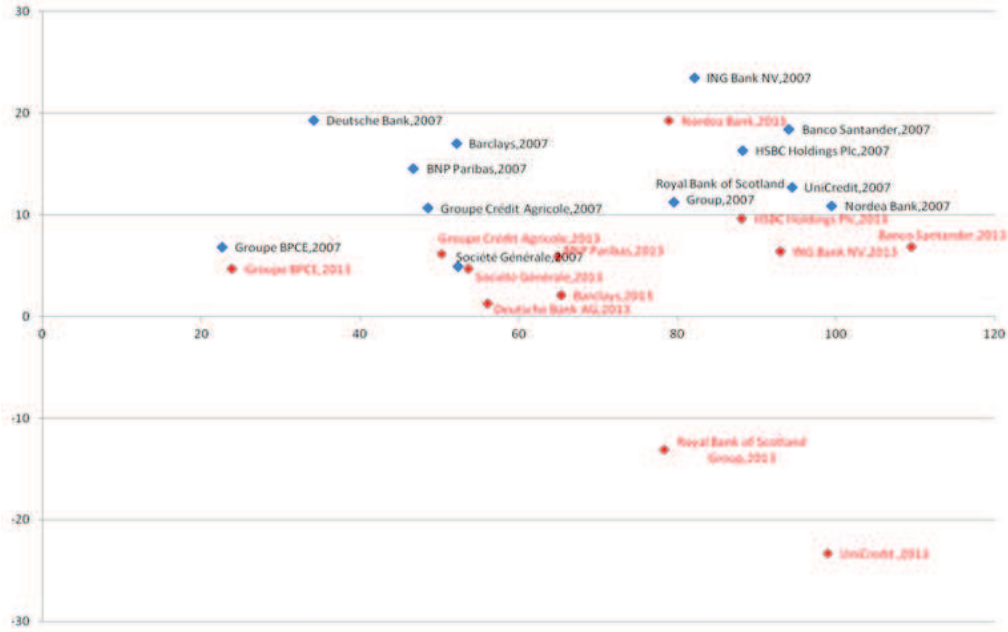


Figure 1.7: Average Retail ratio by country



Notes: Average values for banks by national banking systems.
Sources: Bankscope, author's calculations.

Figure 1.8: Evolution of ROE and Retail ratio for G-SIBs



Notes: We plot on x-axis values for the Retail ratio our indicator of business model. y-axis indicates values for the average ROE. Values are provided for two specific periods: 2007 in blue and 2013 in red.
Source: Bankscope

C. Robustness check regressions

Table 1.10: Results of regressions for G-SIBs - level specifications

VARIABLES	(1) OLS	(2) FE	(3) RE	(4) OLS	(5) FE	(6) RE
	Leverage			T1 ratio		
Solvency	0.0230***	0.0115*	0.0131**	-0.104***	-0.0711*	-0.0760**
	(4.236)	(1.814)	(2.190)	(-2.651)	(-1.936)	(-2.158)
Constant	-0.0953	0.476**	0.331	1.533***	1.534***	1.415***
	(-0.340)	(2.335)	(0.836)	(4.269)	(4.777)	(4.431)
Observations	95	95	95	85	85	85
R^2	0.631	0.537	0.616	0.383	0.768	0.4886
R^2 adj	0.561	0.412	.	0.300	0.700	.
F-test or Wald test	9.012	7.799	.	4.593	11.33	66.98
Prob>F	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Time FE	yes	yes	yes	yes	yes	yes
Country FE	yes	yes	yes	yes	yes	yes

Notes: The dependent variable is *Beta*. The variable *Solvency* is described first by *Leverage* and afterwards, by the *Tier 1 ratio*. We run OLS, fixed effects and random effects regressions for the subsample of G-SIBs. We correct for the heteroscedasticity of errors. One-period lag is used for explanatory variables. All regressions include time and country specific effects. Robust t-statistics in parentheses*** p<0.01,** p<0.05,* p<0.1.

Table 1.11: Results of regressions for other banks (non G-SIBs)

VARIABLES	(1) OLS	(2) FE	(3) RE	(4) OLS	(5) FE	(6) RE
	Leverage			T1 ratio		
Solvency	0.00606**	0.00456*	0.00460*	-0.00727	-0.00641	-0.00595
	(2.137)	(1.687)	(1.744)	(-0.957)	(-1.010)	(-0.959)
Constant	0.0150	0.216***	0.0443	0.483***	-0.111	0.343***
	(0.105)	(2.602)	(0.164)	(3.603)	(-0.709)	(2.969)
Observations	413	413	413	371	371	371
R^2	0.476	0.316	0.472	0.073	0.696	0.265
R^2 adj	0.434	0.206	.	0.0474	0.642	.
F-test or Wald test	11.55	14.92	210.75	2.842	12.86	109.00
Prob>F	0.0000	0.0000	0.0000	0.0021	0.0000	0.0000
Time FE	yes	yes	yes	yes	yes	yes
Country FE	yes	yes	yes	yes	yes	yes

Notes: The dependent variable is *Beta*. The variable *Solvency* is described first by *Leverage* and afterwards, by the *Tier 1 ratio*. We run OLS, fixed effects and random effects regressions for the subsample of banks other than G-SIBs. We correct for the heteroscedasticity of errors. One-period lag is used for explanatory variables. All regressions include time and country specific effects. Robust t-statistics in parentheses*** p<0.01,** p<0.05,* p<0.1.

Table 1.12: Results of panel estimations using an alternative measure of BM

VARIABLES	(1) Beta	(2) Beta
	Leverage	T1 ratio
Solvency	0.00495*	-0.0173**
	(1.737)	(-2.062)
Derivatives	0.0109***	0.0151***
	(3.348)	(4.911)
Constant	0.653	0.945**
	(1.448)	(2.104)
Observations	423	419
R^2	0.455	0.456
R^2 adj	0.411	0.412
F	10.51	10.46
Prob>F	0.000	0.001
Country FE	yes	yes
Time FE	yes	yes

Notes: We run OLS estimations and we include country and time specific effects. The solvency is defined simultaneously by the leverage (column 1) and Tier 1 capital ratio (column 2). We use the proportion of derivatives as of total assets to describe the business strategy of banks. One-period lagged explanatory variables are considered. Robust t-statistics in parentheses.*** p<0.01,** p<0.05,* p<0.1.

Chapter 2

Basel III liquidity requirements: issues and implications

The consequences of cumulative weaknesses in banking sectors has been considerable during the last financial crisis and policy makers were quick to respond to the shortcomings in regulatory frameworks. The most recent revision of Basel Agreements makes its contribution by imposing new liquidity standards. The aim of these new prudential rules is to address the weaknesses pointed out by the 2008 market liquidity crisis and namely, the vulnerabilities emerged from extreme dependence on short-term markets and poor liquidity of assets.

The two key metrics proposed by the Basel Committee for Banking Supervision (BCBS) are the Liquidity Coverage Ratio (LCR) whose aim is to reinforce banks' resilience over a 30-day crisis period and the Net Stable Funding Ratio (NSFR), intended to ensure that banks hold sufficient stable funding to cover losses in asset portfolio. This latter is rather a structural liquidity requirement while the former is a measure of stressed liquidity. Therefore, with these metrics, the Basel Committee aims to regulate the extreme risks issues by the two essential functions of banks: market intermediation and maturity transformation.

The reform agenda states that the fully implementation should be effective at January 1, 2019. Meantime, the Liquidity Coverage Ratio (LCR) should be progressively implemented starting with January 2015 when a minimum requirement of 60% should be fulfilled, rising in equal annual steps of 10 percentage points and reach 100% on 1 January 2019. For the Net Stable Funding Ratio (NSFR), Basel Committee has planned the introduction of minimum standards at 1st January 2018, and for instant this ratio is still under observation.

Although the necessity of a liquidity regulation has been clearly pointed out by the crisis, the release of the official statements triggered the reluctance of practitioners with

respect to the implementation of these measures. The main argument that is put forward relates to their adverse impact on the funding costs of regulated institutions. However, like any other regulatory framework, the achievement of higher liquidity standards is likely to engender immediate costs for regulate institutions. On the other hand, the NSFR takes aim at the preservation of banks' liquidity through a better management of maturity mismatches between assets and liabilities and the strengthening of banks' resilience to shocks on money markets. Academics and regulators responded on the issue with strong theoretical based arguments suggesting a positive effect on a medium and long-term horizon on financial stability (Goodhart, 2008; BCBS, 2010a; Conseil d'Analyse Économique, 2012; EBA, 2013b). Moreover, the study of Roger and Vlček (2011) suggests that the macroeconomic costs of such measures are sensitive to the length of the implementation period but also to the adjustment strategy employed by banks. Given the extensive timeline, the adoption of liquidity requirements should generate low costs. Nevertheless, the markets make pressure "obliged" on financial institutions to take more urgent actions to increase the level of liquidity ratios well prior to the time limit fixed by the regulator.

Emerged from these debates, the aim of this study is twofold. Firstly, we search to analyse the liquidity needs of financial institutions and secondly, the extent to which the stable funding requirements could affect their funding costs and the interest rates they are commanding on the interest earning activities.

The main difficulty in this study is given by the ambiguous definition of liquidity itself which makes the impact assessment exercise even more complex. In any case, when analysing the potential impact of liquidity requirements there is no question of total substitution of one liability with another but rather of adjustments in the proportions of different liabilities and assets according to their quality and maturity. We discuss and analyse the effects of different arbitrages that regulated institutions have to make in order to fulfil liquidity standards. Several strategies will hence be considered according to specific liquidity needs of banks and developments in funding conditions.

This chapter is organized as follows: In Section 2.1 we engage in discussion the concept of liquidity (and liquidity risk) with its different facets emphasized during the last decade. Furthermore, we turn towards the facts that justify the introduction of a liquidity regulation and present in detail the management framework for liquidity risks. Then, in Section 2.3 we provide a statistical study on the liquidity needs of European banks and their structural features. Within a more detailed analysis, we explain the level of the NSFR through balance sheet patterns. We provide representative balance sheets according to three main different criteria: country of origin, systemic importance (and implicitly, the size) and the business model. Then, we analyse empirically the impact of

higher liquidity requirements on changes in the balance sheet structure and more precisely, on lending. The last section concludes on the empirical findings and presents some policy implications.

2.1 The concepts of liquidity and liquidity risk

In this section we develop a framework for discussing the concept of liquidity and the risks that can emerge from an inappropriate liquidity management. The difficulty of defining the liquidity in banking systems comes from the use of the term *liquidity* to define several concepts, while for other economic concepts it is more common to use several terms to define a notion (capital for example).

In order to define the liquidity, we should first distinguish between different types of liquidity. In practice, one of the most common definitions of liquidity emphasises the ability of financial institutions to meet their commitments coming to maturity and to rollover debt (BIS, 2008; Brunnermeier, 2008; Strahan, 2008) or their capacity to exchange goods and services at fair price[1] (Williamson, 2008).

From a regulatory point of view, the definition of liquidity is also related to the main activities of banks. Firstly, the function of maturity transformation involves liquidity creation by using short-term resources (deposits) to provide loans. Also called structural liquidity, it represents the core activity of commercial banks. Secondly, the involvement of banks in market trading should reduce as much as possible transaction costs (buyer-seller price spreads) in order to ensure that the market price is moving towards the fundamental value. It represents the core activity of investment banks - as market liquidity providers.

The traditional literature focused on the narrow definition of the concept of liquidity that is the funding liquidity based on their function of transforming maturities. The post-crisis literature continues to analyse and develop measures for assessing risks generated through the maturity transformation of assets, although there is an increasing interest in analysing the impact that market liquidity can have on the liquidity of banks as institutions. This comes as the consequence of facts revealed by the 2008 financial crisis, which emphasized different facets of the concept of liquidity. The most obvious evidence pointed out by the last crisis was the systemic dimension of liquidity, amplified by the coordination of banks activities and the similarity of their structures. Namely, the increasing popularity of universal bank model and the commonality in assets portfolio structures transformed individual isolated defaults into a systemic crisis.

[1] The definition of liquidity can vary considerably according to the perspective of which the definition is provided (market participants, regulators, central bank etc). In our study, the study of liquidity is made from a regulatory point of view, where we deal with the liquidity of banks, as institutions submitted to prudential regulation.

In what follows we discuss the role of liquidity management in the context of relative stability and crisis periods.

2.1.1 Liquidity: linkages in normal times

In period of relative stability, there are two main aspects that can describe liquidity. First, solvent banks have the capacity to fund their activity by transforming short-term liabilities into long-term illiquid assets (loans for example). Second, they can address the financing gaps by short-term borrowings on the market. While the former is decided according to bank's business strategy and intrinsic patterns, for the latter markets have a considerable influence on the pricing of funding.

Although not the only manner of liquidity creation, modern economies are based on the essential function of banks of transforming maturities. It is at the basis of financial intermediation and plays an important role for the functioning of the economic activity as a whole, by providing funding for long-term activities.

Banks focused on traditional activities (collect deposits and provide credits) are practicing the so-called "good transformation" since they dispose of large shares of stable funding[2] to cover inherent risks emerging from more illiquid operations (Davanne, 2015). Nevertheless, the lack of monitoring and regulation for the bad incentives, which were generated by this bank-specific function of transforming maturities, lead to an extreme use that became a vulnerability under certain specific conditions (for example, distress on money markets).

The relaxed regulation in the period up to the subprime crisis and lower price of short-term borrowings compared to long-term debt and capital have indeed led to excessive gaps between assets and liabilities structures. In this context, banking structures become increasingly exposed to shocks without the regulator having knowledge of these imbalances since no regulation was in place[3].

But the liquidity of banks is not limited to the liquidity creation through maturity transformation. The financial institutions may provide liquidity to investors by participating to market trading on secondary markets[4]. Their ability to exchange short-term securities on secondary markets is driven by several factors. First, the presence of investors being interested in the securities exchanged by banks and second, the quality of

[2] Davanne (2015) argues that the "good transformation" is practised by banks that issue long-term securities (bonds) and raise capital to fund long-term lending. At the opposite, banks can be tented to further distribute the illiquid loans using securitization techniques and shifting towards the "bad" transformation of maturities where long-term loans are funded using short-term liabilities, more volatile.

[3] Nevertheless, in certain countries, measures have been imposed to ensure the monitoring of banking structures. In France, for example, the national regulator imposed a measure of liquid assets (both short-term and long-term) related to the amount of short-term liabilities. This was not the case in the majority of European countries, and even less in other countries.

[4] Defined by Brunnermeier and Pedersen (2009) as funding liquidity.

information at the disposal of counterparties. Therefore, the borrowing capacity describing their funding liquidity is not only a function of bank's intrinsic creditworthiness but it also depends on the general state of market liquidity.

It is assumed that, in "normal" times, solvent banks could raise funds whenever they need and without paying any substantial premium over the market price. The "having the money when they need it"[5] has been essentially the idea that prevailed in the pre-crisis period with respect to the funding liquidity of financial institutions despite the existence of numerous information asymmetries in banking activities[6]. Indeed, solvency was dominating any type of liquidity. This explains as well the focus on capital regulatory framework and the negligence of any form of liquidity requirements at international level. Nevertheless, this theory is true in times of relative stability when investors have confidence and are able to evaluate the creditworthiness of their counterparties based on publicly available information.

However, the perception of liquidity changed significantly during the last decade due to the growing involvement of banks in market activities and the changes in business models - "originate and distribute" - through securitization techniques. The market liquidity, in particular, got a new dimension with the Lehman Brothers episode. Additionally, the interactions between maturity transformation and market liquidity became stronger and induced a systemic dimension of liquidity. This issue represents the aim of the next subsection.

2.1.2 (Il)Liquidity: linkages in times of financial distress

During times of financial turmoil the liquidity of banks, in presence of information asymmetries, is more uncertain due to serious concerns on the quality of securities and to increased reluctance among investors to act as counterparties. Both functions of liquidity creation (i.e. maturity transformation and market intermediation) are affected, with stronger interactions between them.

On the one hand, the funding liquidity is distorted since the capacity of banks to raise funds is affected by the lack of confidence of investors that can lead to the freeze of money markets. On the other hand, in stressed market conditions, the interactions between funding liquidity, as function of the liquidity available on markets, and structural liquidity become more subtle and stronger. For example, when global market liquidity is low (i.e. poor exchanges, overrated premiums), banks' funding liquidity problems are gaining in importance if investors are not creditworthy[7]. Therefore, when one of

[5] Charles Goodhard, "The Basel Committee on Banking Supervision", 2011

[6] citettirole2006theory highlighted the importance of the symmetry of information in determining the liquidity and the value of claims on secondary markets.

[7] According to Warsh (2007), "liquidity exists when investors are confident in their ability to transact and where risks are quantifiable".

the dimensions of market liquidity is affected - depth, tightness or resiliency[8] - banks' incapacity to roll-over debt could affect seriously their function of transform maturity transformation, independently of the level of core capital.

However, the increasing exposure to shocks cannot be attributed to exogenous factors. There is clear evidence that it emerges from misfunctioning of banking-related activities. First, the lack of monitoring and regulation of liquidity creation functions provided bad incentives for banks that engage in excessive maturity transformation. Second, financial innovations and the extreme use of new techniques like securitization led to the development of more liquid securities but more vulnerable to markets' fluctuations. Hence, banking structures become more vulnerable and could be more easily affected by external events (herding behaviour, negative spillovers, systemic shocks, etc). Moreover, the last global financial crisis highlighted that liquidity, broadly speaking, is correlated across markets and classes of securities (Chordia et al., 2000; Brunnermeier and Pedersen, 2009).

Under stressed market conditions as it has been the case in the second half of 2008, an insufficient level of liquidity can lead to considerable dysfunctions and to systemic crisis. That sequence of events imposed naturally an immediate reaction from regulators. Nevertheless, in order to regulate, one should be able to measure the liquidity risk. Prior to the presentation of the new regulatory standards, we consider necessary to emphasize the difficulty of measuring the risk of illiquidity that emerge from banking activity.

2.1.3 The risk of liquidity

Given their nature, the two types of liquidity described previously generate different types of risks. However, according to their business model, banks are exposed more or less to each type of (il)liquidity risk; while commercial-oriented banks could be more affected by the incapacity to roll-over debt, investment-oriented banks are more exposed to shocks on stock markets and assets' revaluations. In what follows, we provide a more detailed discussion framework on each type of risk and the main drivers.

In evaluating the spreads between the inflows (interest earning assets) and outflows (interest bearing liabilities), the bank can assess future surpluses/deficits and adapt, in due course, its strategy: reinvestments of extra surpluses and assets' liquidation or, at the opposite, short-term borrowings if a deficit is likely to incur. If poor forecasts are made with regard to the value and the due date of incomes and outcomes, the bank is exposed to imbalances. Nevertheless, unexpected shortcomings can arise and affect the functioning of banks.

[8] The main dimensions of market liquidity are: depth - large number of agents ready to trade on the market, tightness - significant volume of transactions which do not induce price variation and resiliency - fast adjustment of any imbalances (Nikolaou, 2009).

Traditionally, two main type of risks can be associated to funding structure. First, the literature has been studying in depth the risks emerged from the activity of collecting deposits. The most quoted reference is undoubtedly the theory of Diamond and Dybvig (1983) arguing that one of the most important risk that banks are facing is the risk of runs emerged from irrational and self-fulfilling expectations of depositors that withdraw their funds before term. For banks, the unplanned outflow can drive to an incapacity to satisfy investors' demand of liquidity, and furthermore to insolvency. Moreover, in presence of information asymmetries, an isolated bank run could engender contagion and lead to systemic crisis (Bhattacharya and Thakor, 1993). Second, banks may find themselves in the situation of incapacity to roll-over debt.

Second, when banks need additional short-term liquidity to cover its funding needs, markets may not have the capacity to provide a favourable reply to their demand of funding. Beyond the availability of investors and liquidity, bad signals on the health of the institution or other concerns on its interconnections with the rest of the economy could have meaningful implications on the borrowing capacity of the bank and its funding cost.

However, to respond to these concerns, deposit insurance schemes could be activated (Kahane, 1977; Kareken and Wallace, 1978) and/or public authorities could intervene by providing liquidity to banks facing short-term horizon problems of liquidity with the aim of avoid stronger disruptions in financial activities (Bagehot, 1873)). In modern economies, where banking structures are very complex and no longer based essentially on deposit collect, the lender of last resort theory is a real source of moral hazard. These bad incentives affect the functioning of financial activity by facilitating risk accumulation and the built-up of financial imbalances (Freixas and Gabillon, 1999).

Specifically, banks were "encouraged" to develop structures based on short-term market borrowings to fund long-term illiquid assets. The excessive use of maturity transformation function lead banks to become more dependent on market funding and implicitly, more vulnerable to market reversals. Although maturity transformation allows increasing profits since the funding cost is lower for short-term liabilities compared to long-term resources, in times of distress, it can become a weakness and sharply increase the exposure to default.

But the liquidity risk is not limited to liabilities structure and maturity mismatches. It goes beyond a good liquidity management: it can also affect trading activity, broadly speaking. Specifically, the concerns on the intrinsic quality of assets[9] held in their portfolio, can put a stop to banks from covering funding shortcomings by selling assets at their

[9] We can refer to concerns related to the instrument but also to the issuer. Both dimensions can affect considerably the liquidity of assets on secondary markets.

fair value. Moreover, asset commonality and synchronized reactions of dealing with funding shortcomings through assets liquidations (fire sales), can engender downward spirals in assets revaluation (Allen et al., 2012).

Therefore, the complex interactions between assets and liabilities structures together with instable funding structures represent a real vulnerability of banking structures. In this context, liquidity inadequacy can transform even a relatively small shock into a systemic crisis, through domino effects and negative feedback effects[10].

The 2008 shock was undoubtedly a liquidity crisis to remember, by the nature of its drivers - of which markets themselves and regulators were not aware - but also its systemic dimension and its consequences on public finances and real economy.

Namely, the trigger for the systemic crisis, particularly for European banks, was the dependence on short-term borrowings (Huang and Ratnovski, 2011) and the freeze of repos markets due to concerns on the quality of collateral (Gorton and Metrick, 2012). To the extent that the fire-sales and contagion effects proved to last longer than one could imagine, the "dominos effects" have been stopped by wide public interventions. Nevertheless, these measures - even if efficient in reducing the amplitude of financial shocks - made distortions even greater.

The perverse incentives emerged from banks' function of liquidity creation should be enough to justify the existence of a liquidity regulation. The interactions between financial structures are necessary for economic developments, but strongly interconnected systems may be difficult to control during times of economic uncertainty. This observation provides additional arguments for the introduction of a liquidity prudential regulation beyond the already implemented risk-sensitive capital regulation. While attending for a more efficient monitoring of market activities, prudential rules could be a good compromise.

2.2 Regulating the liquidity of financial institutions

In the post-Lehman period, the challenge was to establish liquidity standards. The difficulty of defining a liquidity framework comes on the one hand from the complexity of the concept itself, and on the other hand, from the difficulty to clearly distinguish between the two liquidity creation functions. This could explain why the Basel Committee did not achieve a liquidity management framework before the subprime crisis, although debates on the necessity of having one have already been undertaken by the members of the Basel Committee since its creation (Goodhart, 2011).

[10] Higher fluctuations of these liquidity gaps are observed in periods of turmoil (Pastor and Stambaugh, 2001) and in general, the variations are closely related to the economic cycle Drehmann and Nikolaou, 2013.

Basel III introduces for the first time a concrete quantitative liquidity framework at an international level. It comes as the response to the shortcoming revealed by the 2008 crisis and aims to complete the capital framework considered as "the foundation of bank regulation" (BCBS, 2010d).

The real challenge comes from the ability to create measures that reach a compromise between liquidity management and liquidity creation. It is important to remind that a very tight balance between assets and liabilities' maturities, even if it could reinforce the stability of banking structures, would not be efficient since it would reduce banks' capacity to create liquidity. However, the threshold proved to be very difficult to define.

Hence, the liquidity framework presented in December 2010, proposed two separate but complementary standards for banks' liquidity that are designed to address both funding and market liquidity risks; the two types of liquidity have to be measured and regulated separately. However, since it is impossible to define clear standards for these functions - i.e. an optimal level - the regulator had to define a proxy measures to avoid excessive liquidity risks. Based on this, one can easily criticise any measure of liquidity since the definition of liquidity itself leaves place to interpretations.

The two measures introduced under the Basel III liquidity framework are the followings:

- The *Liquidity Coverage Ratio (LCR)* aims to ensure banks' resilience to significant stress. It requires banks to hold sufficient high-quality liquid assets (cash, government bonds and other liquid securities) to meet the net cash outflows over a 30-days period of stress scenario. It is calculated as the ratio of HQLA to net cash outflows (stressed outflows minus contractual inflows) and has to be greater than 1 at the end of the phase-in period in January 2019 (BCBS, 2010d; BCBS, 2013c).

$$LCR = \frac{stock\ of\ HQLA}{total\ net\ cash\ outflow\ over\ 30\ days} \geq 100\% \tag{2.1}$$

- The *Net Stable Funding Ratio (NSFR)* imposes that the amount of *available* stable funding exceeds the amount of *required* stable funding over a one-year period of extended stress. Its purpose is to encourage banks to appropriately match funding structure in order to reduce risks emerged from maturity mismatches, without compromising maturity transformation. The ratio of available stable funding (ASF) to required stable funding (RSF) should be greater than 1 (or 100%) at 1st January 2019.

$$NSFR = \frac{Available\ Stable\ Funding}{Required\ Stable\ Funding} \geq 100\% \tag{2.2}$$

Overall, the liquidity framework encourages banks to increase their holdings of high-quality liquid assets in order to ensure the survival over one month stress scenario, and to find a balance between available stable funding and assets illiquidity in order to increase their resilience to more persistent shocks (BCBS, 2010d). While the NSFR is a structural liquidity requirements, the LCR is rather defined as a stress liquidity indicator.

In practice, the achievement of liquidity requirements could be realised through a stronger reliance on high quality liquid assets, associated to higher stability factors in the calculation of required stable funding - RSF (for example, governmental bonds and cash). Nevertheless, less liquid assets but higher yielded are also supposed to be strongly demanded by banks (for example, mortgage and corporate bonds receive a factor of 40%)[11]. On the other hand, core resources are promoted in the calculation of the available stable funding - ASF, while the short-term wholesale funding is penalized in the calculation of the outflow since it is the first to be touched in the case of a liquidity withdrawal.

The items that define the NSFR and the LCR are interacting and the compliance of these two measures should not generate any conflict. Moreover, the objective of NSFR is complementary to the one of LCR and encourages the reliance on medium and long-maturity liabilities and capital rather than short-term borrowings, which proved to be very vulnerable in times of distress. In other words, these two proposed liquidity measures should help in better balancing the structure of balance sheets and increase their resilience to both short-term and longer-term liquidity shocks, with the aim of reducing the systemic liquidity risk. It is important to mention that these ratios are nevertheless conventional indicators than genuinely accurate measures of banks' liquidity.

In addition to the objective of regulating the function of liquidity creation, the new liquidity measures contribute to the improvement of supervision and market discipline. It could also reduce the role of *Lender-of-last-resort* (LOLR) and implicitly, the moral hazard problem. Nonetheless, the implementation of these standards received stronger objections; the role of the NSFR is strongly criticized by the practitioners, even strongly than the LCR.

The arguments against the liquidity standards concern four main points. Firstly, several studies sustain that the regulation of liquidity may have a similar effect as the capital requirements and reduce liquidity creation since the net interest margins are likely to decline King (2013)[12]. Secondly, in periods of lower global liquidity, if banks are supposed to increase their holdings of liquidity assets and revise their funding structure, their funding costs are very likely to be higher compared to the one for non-regulated institutions. Nevertheless, over the last years the very lax monetary policy and numerous

[11] Please see Appendix A for further details on the different categories of ASF and RSF and the associated factors.

[12] However, Laeven and Levine (2009) show that the magnitude of the impact of capital requirements varies considerably with banks' ownership structure and banking system's developments.

non-conventional policies helped in providing the necessary liquidity to financial systems. Third, the main concern of regulator is related to the adverse effects of the implementation of the liquidity framework. Specifically, any eventual shortening of the maturity of loans could have important consequences on the real economy. Finally, since higher funding costs are projected for regulated financial institutions, regulators fear the "migration" of several activities to the shadow banking system. These aspects related to the possible adverse effects of implementing liquidity standards will be discussed within a next section.

2.2.1 Calculation of liquidity ratios

While the Net Stable Funding Ratio (NSFR) seems more easily to evaluate, quantifying the Liquidity Coverage Ratio (LCR) could turn out to be more complicated. The latter requests more detailed data on flows and a better knowledge of banks' activities according to their counterparty and maturity. The former can be evaluated using the publicly available balance sheet data. For these reasons, but also to respond to the debates contesting the implementation of the structural liquidity ratio, our analysis we be further focusing on the NSFR.

The NSFR is measured by the amount of available stable funding (ASF) divided to the amount of required stable funding (RSF) and aims to ensure that banks maintain a stable funding structure relative to the illiquidity of assets over a one-year horizon. Therefore, it can also be used as an indicator of the degree of maturity transformation practiced by banks[13].

It is assumed that the threshold of 100% of NSFR should be enough to ensure that the banks will surpass periods of distress over a time horizon of one year. The amounts of ASF and RSF are risk-weighted with the weights ranging from 0 to 100% associated to each category of resources and assets that reflect the stability of funding and the liquidity of assets, respectively. Explicitly, higher ASF-factors are associated to more stable funding (100% for capital, 95% for deposits) and lower RSF-factors correspond to high-quality liquid assets (0% for cash and central banks reserves).

Furthermore, based on a methodology inspired from Gobat et al. (2014) we seek to evaluate the NSFR for European banks in our sample. Nevertheless, for the calculation of both ASF and RSF we need to make several assumptions (especially, on their maturity) that will allow us to estimate the NSFR with the data that we have at our disposal[14]. The factors, in line with BCBS definitions (BCBS, 2010d), are resumed in Table 2.1 below.

[13] Before the publication of the Net Stable Funding Ratio within the Basel III framework, the widely used measure for the maturity gap between assets and liabilities was the loan-to-deposits (LTD) ratio.

[14] Appendix A present the detailed methodology as decided by the BCBS for both categories, ASF and RSFs.

Table 2.1: The components of NSFR

Available Stable Funding (ASF)	
Liability and Equity Items	***ASF Factor (%)***
Customer deposits	
Customer deposits − current	90
Customer deposits − savings	95
Customer deposits − term	95
Deposits from Banks	50
Other Deposits and Short−term Borrowings	0
Total Long Term Funding	100
Derivative liabilities	0
Trading liabilities	0
Other liabilities	0
Equity	100
Required Stable Funding (RSF)	
Asset Items	***RSF Factor (%)***
Gross Loans	
Net Loans	
Retail loans	50
Residential mortgages	65
Other loans	85
Mandatory Reserves included above	100
Loans and Advances to Banks	0
Total Securities	50
Government Securities included Above	5
At−equity Investments in Associates	100
Other Earning Assets	100
Cash and Due from Banks	0
Non-interest earning assets	100
Off Balance Sheet Item	5

Note: The RSF and ASF factors were assigned according to BCBS (2010d),BCBS (2013c) and Gobat et al. (2014). Deposits, loans, repos from banks, funding provided by central banks and all securities designated for repurchase or cash received as collateral as part of securities lending. Money market instruments, certificates of deposits and other deposits. Derivatives are treated on a net basis, i.e. receivable less payables. When positive we assign a 100% factor, otherwise a 0% risk factor will be associated to this category. Other liabilities is computed as the difference between Total Liabilities and Funding Liabilities. Off Balance Sheet Items include Managed Securitized Assets reported Off-balance sheet, other off-balance sheet exposure to securitizations, Guarantees, Acceptances and documentary credits reported off-balance sheet, Committed Credit Lines and Other Contingent Liabilities.

In what follows we provide additional information on the different levels of ASF and RSF, and on the changes undertaken with respect to the official version published in BCBS (2010d).

Available Stable Funding (ASF)

First, equity and long-term liabilities with a maturity of one year or more are the most stable funding structures and receive an ASF factor of 100% since they can fully back

assets even in extended periods of distress.

Second, we deal with deposits for which we have no data on their maturities. The factors that have been assigned reflect their relative stability in a way that stable or non-maturity deposits are weighted at least at 95%. For example, saving and term deposits are considered more "stable" than current deposits and receive an ASF factor of 95% compared to 90% for current deposits (disregarding their maturity).

Third, central banks or other financial institutions funds with a maturity between 6 and 12 months should receive an ASF factor of 50%. Nevertheless, since we are not able to distinguish between 1-6 months and 6-12 months maturities of debt, we cannot differentiate the risk factors either. We take conscience on the impact that this additional information has on the amount of ASF. However, we decide to make the assumption of a 0% ASF factor for all wholesale funding (*Other Deposits and Short-term Borrowings* in the table) and obtain under-estimated NSFR which is preferred to an over-estimated value in the context of our study.

Required Stable Funding (RSF)

The factors (or haircuts) that are assigned to various categories of assets describe the ease to liquidate the related asset. The NSFR is designed so that available-for-sale-securities receive a more favourable treatment than held-to-maturity assets since they can be exchanged or sold more easily.

First, the most liquid assets (cash, reserves to central bank and interbank claims) receive a 0% RSF factor since we consider that they will not need to be funded even during longer distress periods.

Second, government bonds are considered as unencumbered Level I assets (highly liquid assets) and hence, receive a risk factor of 5%. Then, for the other securities we make the assumption of a residual maturity of less than one year[15] and we assign a RSF factor of 50% as they are considered as liquid assets with residual maturities of less than 1 year[16]. In other words, all trading securities, excepting sovereign bonds, receive a RSF factor of 50%.

Third, several assumptions have been made with regard to RSF factors associated to loans. Since we do not dispose of information on the maturity of each category of loans, according to the indications in the last version of the assessment methodology published by the Basel Committee (BCBS, 2014a), we assume that retail loans are of maturity of

[15] The securities in this category are: Reverse Repos and Cash Collateral, Trading Securities and at FV through Income, Derivatives, Available for Sale Securities, Held to Maturity Securities and Other Securities.

[16] This category of assets with a 50% RSF factor excludes Government Securities and securities backed by governments or central banks included in each of these categories. They have been assign with 5% risk factor.

less than one year and therefore we associate a RSF factor of 50%. Then, residential mortgages are associated with a 65% haircut and finally, we assume that all other loans have a maturity of more than 1 year and will be assigned to a RSF factor of 85%.

Finally, the assets considered as illiquid (non-performing loans, fixed assets, pension assets) qualify for a 100% RSF factor.

Box 2.1. Changes in liquidity framework between 2010 and 2014

Since the release of the text describing the liquidity standards in December 2010, numerous debates surge with regard to their relevance and their measurement. The bankers' strong adverse reactions sustain that their implementation will have a significant negative impact on banking activity and especially on lending (IIF, 2010). Since then, QIS studies were conducted and the methodologies defining the two liquidity indicators were revised on several occasions, in order to better align the rules to structural specificities of banks and to address the unintended consequences for the financial and economic activity.

Among the changes made with respect to the definition of HQLA and the factors associated with these assets, both the LCR and the NSFR are affected. Specifically, the expansion in the range of assets eligible as HQLA and some refinements to the assumed inflow and outflow rates make the requirements less stringent. While certain Level 2 assets have been included in the category of HQLA and become subject to higher haircuts in order to better reflect actual experience in times of stress scenario (BCBS, 2013c). For example, corporate debt securities rated to A+ to BBB- receive 50% haircut. Other categories have been revised and left at the discretion of national supervisors to decide if they are considered or not as HQLA (for example central banks reserves). Overall, the modifications with respect to the definition and the methodology applied to HQLA aim to reduce arbitrage opportunities and to further improve the ability of the global banking system to finance a recovery (Mervyn King, BIS speech, January 2013).

With regard to the funding structure, in the methodology for the LCR, downward revisions have been applied to factors for non-financial corporate deposits (shift from 75% to 40%), interbank and inter-financial credit and liquidity facilities (from 100% to 40%) and insured deposits (from 40% to 20%); all these changes are globally indicating a lower risk of withdrawal for the liabilities in question. For the NSFR in particular, the methodology has been revised several times, with important changes in the 2014 published version (BCBS, 2014a). A new category of assets and liabilities with remaining maturities from 6 months to one year has been introduced in order to allow for a more appropriate evaluation of banks' stability to shocks. Then, the Basel Committee decided to use the same definitions and RSF weights as for the LCR and ensure for a better consistency of the framework. The factors associated to deposits have been revised upwards by recognising a better stability than has been initially foreseen. Figure 2.18 in Appendix A summarizes the main changes in the definition of the NSFR since the first publication (BCBS, 2010c).

Comparing the two frameworks, beyond the upward revision for deposits, the new version also reviews the ASF factor for secured funding from 0 to 50%. These decisions should have a positive effect on the NSFR by increasing the numerator of the ratio. Gobat et al. (2014) show an improvement of 7 points from 96% to 103% in the NSFR

following the factors' revision from 2014[17]. Revisions have been made with respect to the methodology for the available stable funding requirements as well. Namely, the value of weighted factors assigned to retail and SMEs loans has been cut down; this action should increase the NSFR, all else being equal. In turn, encumbered HQLA and other loans with a maturity of less than one year receive a greater factor according to Committee's judgments establishing that their liquidity has been initially overestimated.

While the final version of the LCR has been published in January 2013, the framework for the NSFR is still under revision and may still be subject to changes during the observation period (until 2018).

We compute historical values for the NSFR for our sample of 75 European banks from 18 countries over the period from 2006 to 2013 on an annual basis[18] (so even for the periods preceding the publication of the liquidity framework). The dataset that we have at our disposal consists in consolidated balance sheet and income statements, at an annual frequency. The use of consolidated data allows to take into consideration the whole group's funding structure. It is important to mention that the analysis is driven using an unbalanced panel since data for certain banks is unavailable at the beginning at our study period.

2.2.2 Descriptive statistics

In this section, we analyse the average NSFR for the sample, but also for other several sub-groups created according to explicit criteria. Some important facts will be presented and discussed within this section.

In a first step, we present the evolution in time of the average value of the NSFR. The annual average showed in Figure 2.1 indicates that the net stable funding ratio experienced several stages between 2006 and 2013:

- In the pre-crisis period the average level of the NSFR was above the minimum standard of 100% and this could be explained by the relative low level of risk exposures compares to the amount of ASF (described by the RSF in Figure 2.2). It could also be explained by the strong reliance to funding provided by the central bank and other money market instruments with maturity between six months and less than one year.

- During the crisis, the value of the ratio has decreased of more than 10 percentage points to the lowest value on record (90%). This important decrease reflects a series of shocks from the mortgage crisis in US to the sovereign crisis in Europe that hit financial markets and affected the stability of financial institutions. At the

[17] The results of Gobat et al. (2014) result from an empirical analysis of end-2012 financial data for over 2000 locally incorporated banks covering 128 countries at different stages of economic and market development.

[18] Initially, the sample covered the period from 2003 to 2013. We decided to drop the 3 first periods for reasons of lack of data for several large banks in the sample.

wake of the financial crisis (2007 and early 2008) the higher dependence of short-term market funds together with a stronger use of off-balance sheet commitments, increased considerably the maturity mismatches between assets and liabilities.

- A considerable increase is recorded since 2011[19]. The most significant improvement has been made through a reduction in the exposure to risky assets driven by the phase-in agenda for prudential and supervisory measures taken at European level (especially stress-test exercises).

Figure 2.1: NSFR (annual mean value)

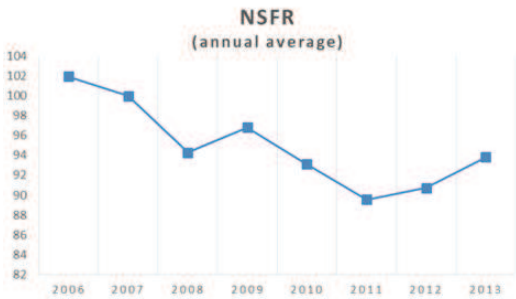
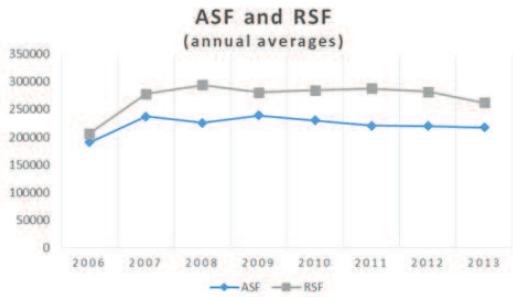


Figure 2.2: ASF and RSF evolution (annual mean values)



Notes: The charts show annual weighted means for European banks (the weights are based on the size of the banks). It is important to remind that we use an unbalanced panel with lower frequency of observations for the two first years (i.e. 2006 and 2007). The average value for the smaller balanced panel is not significantly different than the one for the unbalanced panel for the period 2008-2013. For this reason, we can consider the unbalanced panel for further analysis.
Source: Bankscope, author's calculations

The improvement in the NSFRs recorded starting with 2011 also corresponds to a raise in the solvency level for European banks. The capital ratio measured as the Tier 1 capital divided by the amount of risk-weighted assets has been continuously improved since 2008 and recorded an even more significant increase starting with 2011 (Figure 2.3). The evolution of the leverage ratio (Tier 1 capital/total assets) illustrates slight deleveraging between 2008 and 2009, and more stable values for the following periods. While the share of equity as of total assets remains relatively stable, the banks re-evaluated their risk exposures (i.e. RWAs) which helped to improve the level of risk-weighted ratio.

Funding structures in turn, record a slight decrease in the proportion of wholesale funding, broadly defined. Particularly, a meaningful decline is recorded for the proportion of short-term borrowings[20] at the end of the study period (Figure 2.4). Therefore, the regulatory efforts made after 2011 promote stable funding structures (and capital in particular) and aims reducing the reliance on short-term borrowings. These developments help in increasing the value of NSFR.

[19] The last report of the EBA on the implementation of the NSFR, published in December 2015, emphasizes a considerable increase in the average level of the NSFR for EU banks. The average NSFR is estimated at 104% for the whole sample 279 banks in December 2014, with 70% of banks already compliant and only 14% of the banks with NSFRs below 90% (EBA, 2015).

[20] Short term debt, excluding repos and cash collateral and also all deposits from banks.

Figure 2.3: The evolution of capital ratio

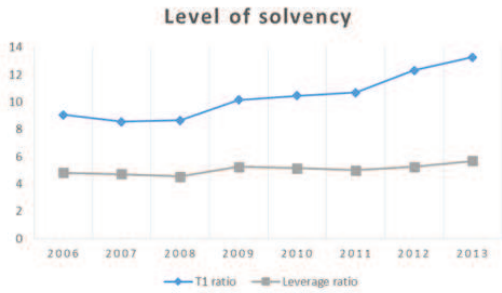
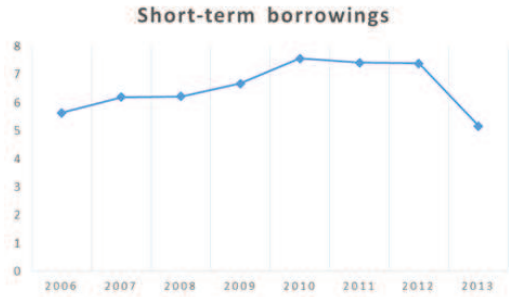


Figure 2.4: The evolution of funding structures



Notes: We plot average values for risk-weighted solvency ratio, the leverage ratio (Tier 1 capital to total assets) and the proportion of short-term borrowings as of total assets.
Source: Bankscope

The descriptive statistics are confirmed by the correlations (Table 2.2), which confirm the significant relationship between the NSFR and the size. It is also emphasized that a heavier involvement in traditional activities, is positively associated to the NSFR. The *Retail ratio* is strongly and positively correlated with the NSFR indicating that banks whose predominant activity is based on traditional loan distribution and deposits collect are more close to the minimal NSFR regulatory standards than banks with a stronger dependence on market funding and trading activities. One could therefore deduct that commercial-oriented banks are closer to the minimum standards than investment-oriented banks.

Table 2.2: Correlation matrix

	NSFR	T1 ratio	Leverage ratio	ST borrowings/ TA	Gross loans/ TA	Size	Retail ratio
NSFR	1.0000						
T1 ratio	0.0862	1.0000					
Leverage ratio	0.1937*	0.3776*	1.0000				
ST Borrowings/TA	-0.3439*	-0.0201	-0.1421	1.0000			
Gross loans/TA	-0.0207	-0.1429*	0.3985*	-0.3400*	1.0000		
Size	-0.3200*	0.0755	-0.4980*	-0.0685	-0.3361*	1.0000	
Retail ratio	0.3117*	-0.1560*	0.4655*	-0.6128*	0.7973*	-0.3899*	1.0000

Notes: $*$ indicates a 1% confidence level.

Better capitalized banks have also higher levels of stable funding ratio which may suggest that solvency and liquidity requirements are somehow complementary. This assumption will be tested within the empirical study.

With this overview of banks' liquidity, in what follows we explore the determinants that lead to considerable differences between banking structures.

2.3 Fulfilling liquidity requirements - where do we stand?

In this section, we first aim to examine the structural drivers of liquidity ratios and then, to quantify the level of the NSFR for different sub-groups of banks. This intermediary analysis is essential for a better understanding of the differentiated impact across banks and national banking systems of the implementation of liquidity standards. Three main criteria are considered: the country of origin, the systemic importance (and implicitly, the size), and the business model[21].

2.3.1 Structural liquidity, by country

The implementation of the NSFR will allows for a better and easier comparison of maturity transformation activity and of risks emerged from funding mismatches across banks from the same system, and above all, across banks from different countries.

At a country-level (Table 2.3), the analysis of balance sheets' structures reveal important differences.

First, in terms of asset portfolios, in more developed banking systems, the *originate-to-distribute* model is more common. For instance, in France and UK banks turned towards trading activities and developed important investment banking structures, with greater maturity mismatches between assets and liabilities structures. Although trading is an important share of their portfolio, it turn out that the holdings sovereign bonds, of a high quality, are quite weak compared to countries as Slovakia, Poland, Greece, and Belgium, where cross-borders diversification is lower and banks focus on assets issued by domestic structures. In Scandinavian countries (Denmark, Finland, Norway, and Sweden), where banks had better surpassed the financial crisis, we notice that the share of trading is not negligible and the reliance on domestic sovereign bonds is low compared to their European peers.

Second, with regard to funding structures, one can identify almost the same classes of baking systems as for the asset portfolios. Banks located in peripheral countries are clearly favouring core funding. Their level of deposits collect is at high levels (Poland, Slovakia, Greece, and Portugal). In core countries where capital markets are generally bigger, banks have generally developed more complex funding structures and increase their reliance on wholesale funding. This is the case of UK, France, Germany, and Netherlands, where funding needs are fulfilled by interbank and wholesale funding[22].

[21] Additionally, we consider an alternative criteria for distinguishing between Euro area members and other EU countries.

[22] Modern banks, based mainly in advances economies, use various form of funding instruments, from secured wholesale funding like repurchase agreements and cover bonds to less secured instruments (interbank deposits, senior unsecured debt instruments - commercial paper, wholesale certificates of deposit).

Generally, the banking systems that are more concentrated and banks are of a larger size, asset portfolios are based on mix of market based activities and traditional activities[23]. The proportion of credit distribution in banks' activity reveals structural patterns of banking systems that are furthermore explaining (partially) the magnitude of the impact of financial and sovereign crisis. Since the very beginning of the financial crisis finds its roots in real estate sector's dysfunction, countries where banks are focused to retail activities have been more affected by the crisis.

Now, the important differences in the structure of balance sheets explain the differential level of the NSFR across countries (Figure 2.5). A first-self evidence is that the level of NSFR is close to the threshold, with the exception of UK, Finland and Greece[24]. Several peripheral countries and other domestic-oriented banking systems report levels of NSFRs close or above the minimum standard. The use of higher proportions of core capital (deposits and equity) and of stable funding (long-term liabilities) has a considerable impact in reaching the threshold of 100% of NSFR[25].

[23] Namely, in countries like France, Germany, United Kingdom, Netherlands, Austria, and Belgium, the amount of loans as of total assets is lower than in counties with banking systems oriented domestically (Ireland, Italy, Greece, Spain, Portugal).

[24] Typically, France could also be cited as being below the 100% threshold. This is the case if we consider the four large groups. Nevertheless, in our sample other French banks are included, which report considerably higher levels of NSFR and drive upwards the mean.

[25] The validity of these findings is reinforced by the loan-to-deposits (LTD) ratio, the measure of maturity mismatches widely used in the pre-crisis literature. The average values for the LTD ratio are illustrated in Figure 2.20 in Appendix B. As expected, we find a negative relationship between NSFR and LTD ratio. Moreover, the ranks according to average values are generally confirming the positions of countries in terms of maturity transformation risk. Nevertheless, several differences are noticed since the LTD does not consider other stable resources (long-term liabilities) that are in turn heavily weighted under the NSFR.

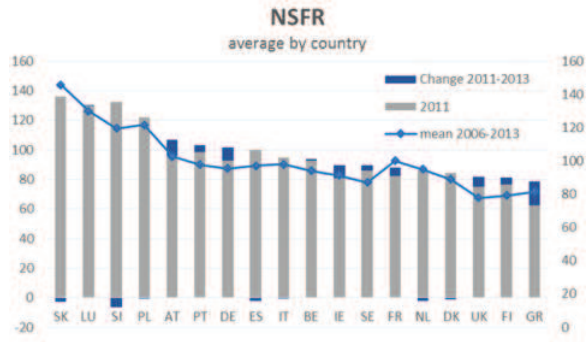
Table 2.3: Representative balance sheet for European countries. Average values for 2006-13.

	AT	BE	DE	DK	ES	FI	FR	GR	IE	IT	LU	NL	PO	PT	SE	SI	SK	UK	EA	non EA
Assets (RSF)																				
Gross loans	48.8	47.6	47.9	64.7	67.9	58.2	39.8	68.9	68.9	68.4	23.5	61.6	74.5	66.5	68.3	55.2	58.3	43.6	56.8	59.3
Net Loans	47	46.2	47.2	63.8	65.6	57.8	38.4	64.6	64.3	66.1	23.3	61.3	71.4	64.6	67.9	49.7	56	42.5	54.9	58.0
Reserves for NPLs	1.8	1.4	0.8	0.9	2.5	0.5	1.4	4.3	4.6	2.4	0.3	0.3	3	1.9	0.4	5.5	2.2	1.1	2	1.3
Loans and Advances to Banks	19.9	7.8	15	7.5	5.3	12.8	14.9	4.2	4.7	8.7	26.1	6	2.9	5.5	8.2	26.3	9.3	9.9	11.8	7.6
Total Securities	26.5	38.8	34.6	21.7	19.1	19.5	40.5	19.3	23.6	17.7	47	24.5	18.3	19	14.7	16.9	28.9	40.3	26.1	25
Government Securities	6.4	15.9	6.5	0.7	7	1.3	11.1	13.3	7.8	7.6	10.6	4.6	14.5	9.3	2.6	8.8	22.9	6.4	8.6	5.8
Non−Interest Earning Assets	4.5	6.2	2.8	3.7	6.7	5.9	7.3	9.6	6.1	6.3	6.8	5.4	6.1	6.5	6.4	5.2	4.6	6.8	5.7	5.8
Off balance sheet	20.9	22.6	11.1	5.4	19.5	89.9	22.1	12.2	16.1	13.7	10.3	7.6	15.5	16.6	17.2	11.9	22.5	22.3	19.4	15.7
Liabilities (ASF)																				
Total Customer Deposits	36.8	44.7	26.6	31.3	48.3	40.9	26.7	53.6	46.3	41.1	56.1	30.8	74.9	51.9	28.9	40.9	72.1	38.9	40	42.2
Deposits from Banks	28.5	13.2	22.8	15.8	10.2	9.8	20.3	8.5	18.6	17.4	16.9	6.3	2.8	6	11.2	26.7	7.2	11.2	16.8	10.8
Other Deposits and ST Borrow.	3.6	4.7	2.7	9.4	5.5	11.2	8.8	23.4	0.1	1.5	3	10.9	1.2	6.1	14	3.1	1.6	6.8	6.6	7.4
Total Long Term Funding	18.7	8.6	29.9	29.8	21.2	13.6	15.4	6.8	19.3	24.9	8.8	30.6	9	17	32.8	21.3	9.1	11.4	20.8	19.3
Derivatives	4.6	7.6	12.9	6.9	3	13.2	8.8	1.9	2.7	2.8	2.2	6.5	1	1.8	4.3	0.2	1	17.9	5.2	9.4
Trading Liabilities	1.1	3	6.4	0.8	0.5	1.7	8.7	0	0.1	0.8	4.6	3.8	.	0.3	1.5	0.2	0	5.4	3.1	4
Total Equity	7	5.5	4	5.3	6.3	6.8	5.7	5.2	6	7.9	7.1	3.9	9.7	5	4.6	8	9	4.8	6.2	5.8

Notes: We compute averages by national banking system. The last two columns display mean values for banks in Euro area and banks from other EU countries, non-Euro area members.
Source: Bankscope, author's calculations.

If the analysis is focused on the evolution of the NSFR over the last three years of the study period (Figure 2.5) - corresponding to a considerable shift in the average value - it can be deducted that the level of the NSFR has been improved in the majority of participating countries.

Figure 2.5: Changes in the level of NSFR, by country

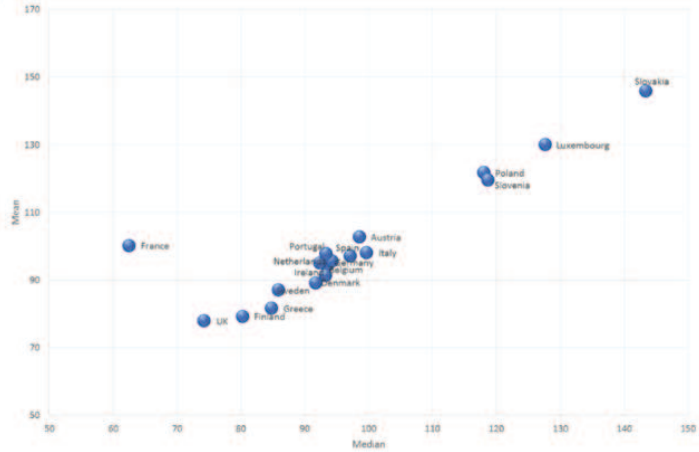


Notes: We plot the value of NSFR as in 2011 in grey and the changes between 2011 and 2013 in dark blue. For comparison, we plot the mean value over the whole period (2006-2013). The NSFR is the mean value by country and is reported in percentages. Countries are ranked according to the average level of NSFR as in 2013.
Source: Bankscope, author's calculations

Greece, which had a very low initial level due to weak economic developments, recorded meaningful improvements and so did Austria, Germany, Ireland, France and UK. Additionally, Greek banks hold higher shares of illiquid assets than their European peers and this affects their level of liquidity according to Basel standards. For British banks, the low level of NSFR could be explained by the universal bank model oriented on investment activities that prevails. For Finnish banks it could be explained by their strong dependence on short-term borrowings and derivatives.

Figure 2.6 indicates that the difference between mean and median values is generally below 4 percentage points (pp), excepting France for which the spread over passes 30 pp. Nevertheless, France is an atypical case since the banking system is very concentrated. The four large French banking groups have a universal bank profile, with high use of market activities and very active at international level. The level of NSFR for these banks is better described by the median. In turn, the mean NSFR for France is driven up by one commercial bank (Banque Postale) reporting very high levels of NSFR due to its strong reliance on deposit collect.

Figure 2.6: Average and median level of NSFR, by country (2006-13)

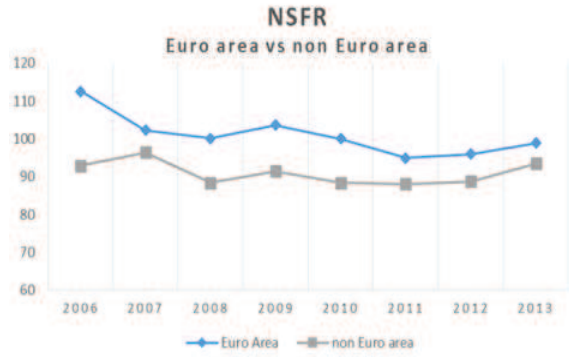


Notes: We plot averages (y-axis) and medians (x-axis) over the period 2006 to 2013. The NSFR is reported in percentages.
Source: Bankscope, author's calculations

Therefore, it appears that banks in the medium range of values for the NSFR have in general better diversified assets portfolios and mix traditional and market activities. Moreover, their funding structures are generally stable, with higher reliance on long-term debt but average shares of core capital.

Furthermore, when the distinction is made between Euro area countries and other EU members, the most important difference is noticed for interbank activities (Figure 2.7). The single market facilitates the access to interbank markets for member states' institutions and intensifies interconnections between banks. Nevertheless, a strong dependence on interbank borrowings affects the level of ASF and furthermore, the NSFRs. Moreover, according to IMF (2013a), changes in funding structures have been smaller in non-Euro area than in advanced economies since the last financial crisis. This can therefore explain why the level of NSFRs is still significantly lower for non-Euro area institutions than for the rest of banks. For the rest of balance sheet items, the differences between the two categories are not statistically significant. Therefore, it appears that banks from Euro area state members are generally closer to the minimum liquidity standards than banks from other EU countries. We evaluate an average spread between the two sub-samples of 10 units, although the difference has decreased considerably after 2011 and reaches values of 5 percentage points in 2013.

Figure 2.7: NSFR evolution for banks in Euro area country member and non-Euro area members



Notes: We plot average NSFR for the two sub-groups distinguished by their affiliation to the Euro area over the period 2006 to 2013.
Source: Bankscope, author's calculations

Euro area countries reach annual average values of NSFR in the range of 98%-112% between 2006 and 2013, while banks from non-Euro area countries report lower NSFRs, with annual averages between 88%-96%.

From this first part of our statistical analysis, one could draw several conclusions. First, in countries where the access to market funding is favoured, banks have greater incentives to use wholesale funding while core capital and deposits are at lower levels. Second, the structure of asset portfolio appears as a determinant element of the structural liquidity ratio, while interbank lending and holdings of high quality securities reduce considerably the amount of RSF. Third, there is a significant difference in the value of the NSFR between countries with developed banking systems and peripheral countries.

Furthermore, at a more detailed level of the analysis we examine the structural patterns of balance sheets for two classes of banks, widely recognized in the post-crisis debates: large banks considered as systemically important and smaller banks.

2.3.2 Structural liquidity and the systemic importance of banks

In our view, it is important to examine the extent to which G-SIBs' structures are different than the ones of smaller banks, beyond their size, and what is the level of their structural liquidity ratio since the strengthening of the resilience of systemic banks is a matter of acute interest for policymakers.

Our sample counts 12 large banks classified as globally systemic important[26] which are also among the largest in our sample. The systemically important banks (i.e. G-SIBs) are among the largest banking groups worldwide. Their "special status" is due to their

[26] There are 13 G-SIBs in European countries. Nevertheless, our sample counts only 12 since BBVA (ES) is not included in our sample which corresponds to the sample of banks subject to European credit assessment and stress-test exercises. One should bear in mind that the sub-sample of G-SIBs is build according to the classification of the Financial Stability Board (FSB, 2013b).

large size relative to the GDP, but also to their very complex structures, increasingly interconnected with the rest of the financial system and the real economy.

Significant differences are observed on both sides of the balance sheet between the two categories of banks: G-SIBs and other banks. Globally, the G-SIBs are heavily oriented on market activities. One worrying aspect is given by their funding structures, which are oriented on short-term market borrowings, trading liabilities and above all, derivatives[27]. These resources intensify the interconnectedness among banking structures, making them strongly vulnerable to funding market shortcomings.

Another specificity of G-SIBs is the structure of asset portfolios and more precisely, the important share of high yielded trading activities. The other banks (non G-SIBs) have in turn significantly higher shares of loans. Differences are also recorded with regard to the structure of lending portfolio: while G-SIBs favour corporate and commercial loans, the rest of banks (non G-SIBs) are more involved in residential mortgages and retail loans. Market funding is an important part in G-SIBs funding structures while smaller banks boost deposit collect and long-term funding.

Table 2.4: Representative balance sheet, by systemic importance (and size, implicitly). Average values for 2006-13.

	G−SIBs	**Other banks**
Assets (RSF)		
Gross loans	39.5	60.9
Net Loans	38.4	58.9
Reserves for NPLs	1.1	2.1
Loans and Advances to Banks	11.2	11.2
Total Securities	46.3	23.0
Government Securities	6.3	8.4
Non-Interest Earning Assets	8.3	5.2
Off balance sheet	20.4	18.5
Liabilities (ASF)		
Total Customer Deposits	33.0	41.9
Deposits from Banks	14.2	16.2
Other Deposits and ST Borrowings	6.3	6.9
Total Long Term Funding	12.6	22.2
Derivatives	15.6	3.7
Trading Liabilities	6.9	1.9
Total Equity	4.6	6.5

Notes: We compute averages for each sub-sample: (1) banks classified by FSB as globally systemic important and (2) other banks, called non G-SIBs. We do not report statistics for balance sheet items with weak shares in the balance sheet that do not influence the value of the NSFR.

Although the short-term funding and trading activities allowed G-SIBs to increase considerably their profits and develop complex structures, they appear as very vulnerable

[27] British G-SIBs are heavily involved in derivative markets, while French G-SIBs are rather using trading liabilities and wholesale funding.

to shocks. The considerable public interventions helped them to surpass the last financial shock, the risks that emerge from the excessive maturity transformation activity remains a real threat for these large banks and for the whole financial system. Therefore, these vulnerabilities are explained by the mix of high proportions of market funding on the one hand, and strong reliance on risky trading securities and derivatives on the other hand.

G-SIBs are "penalized", due to their structural patterns, in achieving the minimum liquidity standards set by the Basel Committee. First, it appears that the relationship between NSFR and the size of the balance sheet is negative (Figure 2.8). Since size is the main determinant of the systemic nature of banks, this can further explain the differences in the level of NSFR for the two categories of banks: G-SIBs and other banks (Figure 2.9).

Figure 2.8: NSFR and Size, 2006-13

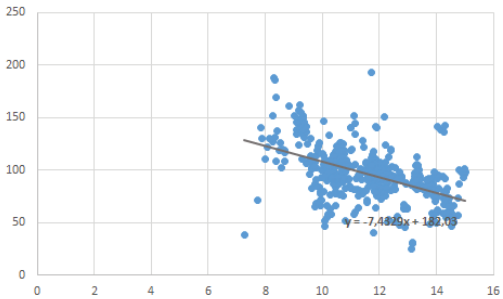
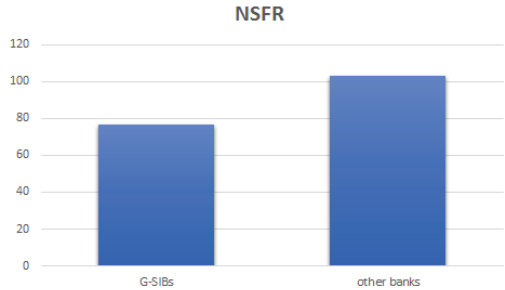


Figure 2.9: NSFR, average values (2006-13)



Notes: Figure 2.8 illustrates the relationship between the NSFR and the average size of the balance sheet (i.e. average for each bank over the whole period) issued from a linear estimation. Figure 2.9 illustrates global averages for G-SIBs and non G-SIBs where G-SIBs are defined according to FSB (2013b).
Source: Bankscope, author's calculations

Finally, the myth of universal bank did not last very long since it is based on extreme maturity transformation, which has otherwise been revealed by the crisis[28]. Figure 2.9 shows that G-SIBs have structurally lower levels of NSFR than smaller banks. Therefore, it appears that complex banking structures must include more adjustments in order to achieve the 100% threshold. This could also lead higher costs associated to the implementation of the NSFR standards for G-SIBs since it involves significant changes in balance sheet structures and business strategies. The magnitude of changes may be even greater since the prudential rules imposed so far by the Basel Committee are not the only ones that G-SIBs are facing. Additional capital and liquidity buffers (TLAC)[29] are to be adopted for banks whose default could represent a real threat for the global financial system, and supplementary bail-in procedures are expected to be adopted for the G-SIBs. Nevertheless, the improvement of the financial stability involves the strengthening of large institutions.

[28] Also called "bad" transformation according to Davanne (2015). It refers to the use of short-term borrowings to fund long-term loans, which are further transformed into more liquid assets through securitization practices and sold on markets.
[29] The Total Loss-Absorbency Capacity (TLAC) framework imposes additional requirements for G-SIBs that will be considerably higher than the ones set up in the Basel III framework

2.3.3 Structural liquidity and business models of banks

We further take a closer look to the level of NSFR across different business models. The European banking structures experienced significant changes during the last two decades: increase in the size of balance sheets - in a direct relationship with the increase in leverage - and higher concentration in banking systems. Once with the increase in their size, financial institutions also proceed to a greater diversification of their activities, in line with financial innovations and developments in economic activities. Additionally, large banks have continuously developed their cross-border activities, proceeding to a greater geographical diversification. According to ESRB (2014b), lending to the Euro area economies represents only 31% of the activities of Euro area banks.

Although the difference between G-SIBs and other banks is evident, with this last category, we assume that the level of liquidity is very likely to differ according to the business strategies. For this additional study, we chose to define the business model of banks by the proportion of retail activities as of total assets[30]. For further analysis, we distinguish three categories of business models:

- Investment-oriented banks with low values for the retail ratio. This first class of banks correspond to banks for which values of Retail ratio are up to the 25th percentile.
- Universal banks have retail ratios in the range of values between the 25th and the 75th percentiles. The structure of banks in this category is given by a mix of market based activities and more traditional activities (loans, deposit collect).
- Banks oriented on commercial activities for which the retail ratio has the highest values with values above the value corresponding to the 75th percentile of *Retail ratio*.

Representative balance sheets for each category of business model are reported in Table 2.5. Although the differences with regard to the proportions of lending and core funding are not surprising, given that they are naturally associated to the business strategy undertaken by the bank, it is important to point out the elements that drive to gaps between resources and assets in terms of maturity.

[30] This indicator of banks' business model has already been used in the first chapter of this thesis and the distribution of the Retail ratio is illustrated in Figure 2.21 in Appendix B.

Table 2.5: Representative balance sheet, by type of business model. Average values for 2006-13.

	Investment	Universal	Commercial
Assets (RSF)			
Gross loans	34	61.9	72.2
Net Loans	33.1	60.4	68.7
Reserves for NPLs	0.9	1.7	3.7
Loans and Advances to Banks	22.1	8.5	5.1
Total Securities	39.9	22.8	18.7
Government Securities	7.8	6.7	11.7
Non-Interest Earning Assets	5	5.9	6.1
Off balance sheet	29.1	14.7	16.7
Liabilities (ASF)			
Total Customer Deposits	22	40.3	60.7
Deposits from Banks	27	13.8	8.3
Other Deposits and ST Borrowings	5.8	7.8	5.5
Total Long Term Funding	18.8	23.7	15.4
Derivatives	13.2	4.5	1.2
Trading Liabilities	7.5	1.8	0.4
Other liabilities	3	2.6	1.5
Total Equity	5.1	6	7.7

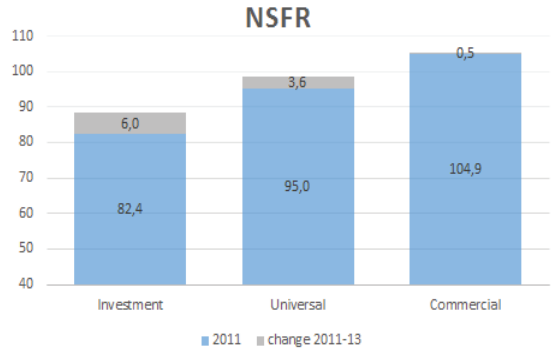
Notes: We mean values of balance sheet items over the period 2006-13 for the three categories of business models identified on the basis of the proportion of retail activities in the balance sheet. We count 15 investment-oriented banks, 36 universal banks and 24 commercial-oriented banks.
Source: Bankscope, author's calculations

For banks oriented on investment activities, the ratio of lending to deposits is close to one, but the strong reliance on trading engenders a greater gap between the amounts of stable funding and illiquid assets. Moreover, the trading securities hold by banks in this category are generally riskier and implicitly, highly yielded. At the opposite, commercial-oriented banks are already well above the minimum NSFR standards. Despite the important proportions of loans considered as illiquid assets in the NSFR assessment methodology, the consistent amount of customer deposits allow them to reach more easily the minimum standards. Moreover, market based activities are at the lowest level among all banks in the sample.

Figure 2.10 illustrates average values for the NSFR for each business model for the periods when the most considerable change have been recorded (i.e. from 2011 to 2013). First, we notice a considerable difference between the two types of specialized banks on the one hand, and between specialized banks and universal banks, on the other hand. It appears that the NSFR is closer to the threshold for banks favouring liquidity creation through good transformation than those focused on liquidity creation through market trading[31].

[31] A recent report of EBA indicates a moderate impact in terms of funding for banks specialized in trading. In turn, no impact will be incurred by retail banks. EBA, 2015, page 114.

Figure 2.10: NSFR - average values by BM (2011-13)



Notes: The banks are split in 3 categories on the basis of values for Retail ratio. Methodology is described in the text in this section and more details are provided in Appendix. We plot values for each category for 2011 and average changes recorded between to 2011 and 2013. The differences between the 3 categories are not changing for means over the whole period (2006-13). The annual averages by type of business model are provided in Figure 2.22 in Appendix B.

For universal banks, the strong reliance on risky trading securities could be a source of vulnerabilities in times of a long-horizon stressed scenario[32]. Nevertheless, it appears that their funding structure has been lately adjusted to better respond to regulatory (and market) pressures.

To summarize, it should be pointed out that:

- firstly, commercial-oriented banks have higher structural liquidity ratios since their funding structures are based on core funding and therefore, the maturity gaps between assets and liabilities are weaker. Generally, the loans are kept in their banking book; the "originate and hold" model is still very common across these banks. We find that banks from this category are already in accordance with regulatory standards.
- secondly, the strong dependence on market based activities of investment-oriented banks make them more vulnerable. Among large banks, those considered as too-big and too-interconnected-to-fail are far below the 100% threshold.
- finally, these shifts in the level of liquidity standards across various categories of banks come undoubtedly from banks' specific management patterns, but their amplitude depend as well by the structure of domestic financial system.

Overall, our findings highlight important structural differences and their impact on the stable liquidity standards have important policy implications for future banking reforms.

[32] The existence of this type of business model could be justified through the efficiency gains generated by the setting up of a different range of activities (credit distribution to households and real economy and trading securities). But there is no theoretical or empirical strong evidence that universal bank are more efficient than specialized banks. Moreover, Laeven and Levine (2007) suggest that the cost due to the presence of agency problems are not compensated by the economies of scope acquired by being a universal bank. Moreover, ESRB (2014b) suggests that the social costs for universal banks in Europe exceed the private benefits. Nonetheless, the universal business model, favouring cross-border lending and funding, dominates the European banking system.

2.4 Achieving minimum liquidity standards: balance sheet adjustments and impact on core activities

The choice of strategy that should allow to achieve the requested level of stable funds relative to assets' illiquidity is a question of arbitrary decisions and it should be based on a cost-benefit analysis. Nevertheless, the assessment of the cost of implementing the liquidity requirements is a complex task since the possibilities of fulfilling the minimum standards can vary considerably across banks, according to their business strategy.

In what follows we focus on the approaches that allow an optimal implementation of the structural liquidity ratio and affect both sides of the balance sheet. Of course, the simpler solution will be to adjust exposures according to the value of risk factors. Namely, one could propose to increase the proportion of stable liabilities, to which higher ASF weights are associated, and reduce the exposure to assets with high risk factors. Nevertheless, the availability of resources and the associated cost should be considered.

2.4.1 Strategies to achieve the minimum NSFR

In this sub-section we discuss the strategies that could be envisaged by banks either to increase the amount of available stable funding or to reduce their exposure to illiquid assets.

Increasing the ASF

First, banks could envisage an increase in the amount of deposits. A higher ASF factor is associated to saving and term deposits (95%) than to current deposits as for these latter the expected probability of run in stressed conditions is higher. This could be an optimal solution to increase the NSFR since these resources are very liquid, cheap and guaranteed by deposit insurance schemes. However, one should bear in mind that the increase in the proportion of deposits is likely to be submitted to a limited supply and in the same time to a strong competition according to national markets and structural feature of the financial and economic activity.

Secondly, banks can make adjustment with respect to liabilities' structure. Specifically, by lengthening the maturity of debt to more than one year, they could significantly increase the numerator of the ratio since the ASF factor for liabilities increases with the maturity. In normal times, this type of adjustment should take into account the term structure of interest rates. However, in the post-crisis period the low spreads between long and short-term interest rates do not represent an impediment for the implementation of this strategy.

Finally, another option could be the increase of the amount of equity. Associated to a factor of 100%, an increase in the proportion of equity will significantly increase the numerator of the NSFR. Moreover, in strengthening the stability of their funding structure, banks could also improve their level of capitalization and facilitate the achievement of minimum capital ratio. Although the cost of rising capital is well above the cost of indebtedness, improving the level of capitalization can significantly reduce the risk of the bank (Chapter 1). Moreover, it could have positive indirect effects on the cost of debt. We quantify the impact of such changes in balance sheet structure in next section of this chapter.

Decreasing the RSF

Banks could also adjust their asset portfolio in order to increase the NSFR. The first and the most desirable alternative consists in the improvement of the quality of assets. An increase in the amount of government bonds or other guaranteed securities, considered as high quality liquid assets and being assigned with low RSF factors (5%), should be considered for this purpose. Any other improvement of the quality of investments (corporate debt securities[33], residential mortgage-backed securities and other security with a maturity of less than one year) will also contribute to the reduction of the total amount of RSF. These adjustments actions for regulatory purposes are likely to reduce the profits since highly liquid assets have lower returns than lower-quality ones.

A second option to reduce the denominator could be the restructuring of loan portfolio. In the last version of NSFR methodology published by the Basel Committee, the risk weight for all retail and SMEs loans is decreased from 85% to 50%, while the RSF factor for residential mortgages remains at 65% factor. The risk factors for other loans of longer maturities (>1 year) have been revised as well and are henceforth equal to 85%. Globally, these revisions have a positive impact on reducing the risk exposures. Nevertheless, the business strategies that could be envisaged by banks might consider the level of risk factors associated to each category of loans.

In what follows, we are going to expose some of the potential negative effects of the adoption of the structural liquidity requirements.

Adverse effects

Historical facts show that all type of prudential measure have been subject to regulatory arbitrages and the adoption of the NSFR is not an exception to the "rule". Firstly,

[33] Investing in corporate debt securities with a credit rating of at least AA- allows to assign a 15% RSF factor rather than a 50% factor for corporate debt securities rated between A+ and BBB-.

asset portfolio's adjustments for regulatory purposes could lead to the concentration of investments on assets that are associated to low risk factors. The most concrete example is provided by sovereign bonds for which a strong demand has been recorded in reasons of regulatory requirements since they are considered as high quality liquid assets (HQLA). While government bonds are guaranteed, the other high liquid assets are not (in general). Such solution could therefore become opposite to additional regulatory and fiscal efforts, aimed to reduce the sovereign-bank debt negative loop. A raise in the proportion of low-risk assets, as designated within the regulatory framework, could hence lead to a higher concentration of investments and strong correlation across banks' asset portfolios. This could ultimately amplify negative shocks and drive the financial system towards systemic crisis.

Secondly, the last revision of risk weights associated to different categories of loans favours commercial and residential loans compared to retail loans. Such decisions may lead to adverse effects on households and SME's access to funding and, furthermore, amplify the financial and economic cycle; the eventual impact on real estate prices could generate systemic risk and become a real threaten for financial stability ESRB (2015).

Nevertheless, the capacity to substitute different types of loans depends on external factors like the elasticity of loan demand and the degree of competitiveness in the banking systems. Although banks are internationally active and access to foreign markets is easy, the structural and regulatory patterns of the domestic banking system could have a strong effect on the future management strategy of the banking group as a whole.

Taken together, the strategies that should be employed to reach the required level of NSFR could reduce the net interest income and implicitly, the rate of return on equity. Questions are raised with regard to banks' willingness to revise their expected rates of return and also, to the impact of regulatory driven changes in balance sheet structures on core businesses, in exchange for an enhancement of their resilience to shocks.

2.4.2 How banks have actually increased their liquidity standards?

In this section we examine the strategies employed by banks, between 2011 and 2013, in order to improve their level of NSFRs[34].

2.4.2.1 Overall adjustments

One way of understanding how the changes in structural liquidity ratio have been done is to evaluate the variations of different business activities. We use two representative balance sheets, chosen on the basis of the changes in the level of the NSFR between

[34] The two years following the announcement of the adoption of a liquidity prudential framework have been marked by a decline in the value of the net stable funding ratio. Starting with 2011, the changes in balance sheets structure helped in adjusting upward the NSFR and until end-2013 the average value of the NSFR is increasing.

2011 and 2013: i) the bank whose variation in NSFR corresponds to the mean value of the sample and ii) the bank with the variation equal to the median value[35]. The aim of analysing these two structures is not necessarily motivated by the amplitude of the variation, but rather by the difference in terms of strategies undertaken to achieve higher levels of NSFR. Table 2.6 reports the growth rates for several balance sheet items that are likely to influence considerably the value of the NSFR given their risk factors.

In column 1 we report changes for the first bank (i.e. corresponding to the medium NSFR). We learn that the balance sheet has been downsized and considerable reductions have been made in both retail and market-based activities. We notice a decline in both lending portfolio and trading securities, which are due to the downsizing of the balance sheet. Stable funding declined as well with the size of the balance sheet. Overall, since the absolute rate growth for required stable funding is higher than the absolute rate growth for available stable funding, the NSFR will increases of 8%.

In turn, the second representative structure (i.e. corresponding to the mean value of change in NSFR) illustrates a slight increase in the size, but major reorganisation of the balance sheet. The growth rate of deposits and core capital is well above the growth rate of total assets and has thus a meaningful contribution in raising the NSFR. Asset portfolio has been restructured as well: loans have decline slightly while more liquid assets (especially trading securities) saw a steep increase between 2011 and 2013. Higher holdings of a better quality-liquid assets contributed to the reduction of RSF and ultimately, to the rise of the NSFR. This latter increase of 5.3% during the study period.

[35] The bank with the median change in the value of the NSFR between 2011 and 2013 is identified to Royal Bank of Scotland Group (variation of 5.4%) and the bank with the mean value corresponds to Svenska Handelsbanken (variation of 4.2%).

Table 2.6: Balance sheet adjustments and their contribution to the change in NSFR between 2011 and 2013

Growth rates in balance sheet items between 2011 and 2013		
	(1)	(2)
	Median ΔNSFR	**Mean ΔNSFR**
Total assets	-31.7%	1.8%
Total Customer Deposits	-17.4%	14.5%
Interbank Deposits	10.9%	-14.1%
Total Long Term Funding	-32.7%	14.7%
Total Equity	-22.0%	18.5%
ASF	-18.3%	13.1%
Net loans	-13.8%	7.2%
Reserves for NPLs	27.5%	-5.6%
Total Securities	-42.9%	-21.6%
Government Securities	.	14.1%
Non−Interest Earning Assets	-18.7%	28.1%
Off balance sheet	-16.2%	-11.2%
RSF	-26.3%	7.8%
***g*NSFR**	8.0%	5.3%

Notes: We provide growth rates for balance sheet items with a considerable weight in the assessment of NSFR. The growth rate is evaluated as the variation between 2011 and 2013 divided by the value in 2011. The two representative banks are chosen according to the distribution of the variation of the NSFR between 2011 and 2013: in column (1) we report values for the bank that recorded a variation equal to the median for the whole sample and in column (2) the bank that recorded a change in the value of the NSFR equal to the mean. Calculations have been made on the basis of the level of balance sheet items multiplied by the risk factors defined within the NSFR assessment methodology. Data for the proportion of government securities for the median bank is not reported since not available for 2011. Detailed methodology and calculations are provided in Tables 2.12 and 2.13 in Appendix C.

The main facts that have been emphasized within this statistical analysis are:

- The variation of available stable funding goes beyond the variation of the size of the balance sheet and contributed in improving the structural liquidity ratio.
- Asset portfolios experienced important changes, and there is statistical evidence that, for certain banks, the volume of lending has slightly decreased between 2011 and 2013.

Since the adverse impact on lending is a major concern of policy makers, we are further conducting an empirical analysis to evaluate the impact on lending for the whole sample. The aim of this simple empirical analysis is to evaluate the impact of changes in NSFR on the volume of lending.

2.4.2.2 Impact on lending

The main objective of reinforcing regulatory standards is to improve stability; however, this should not be done in the detriment of lending to the real economy, either in terms of

volume or interest rates. Hence, the question now being asked is whether the improvement of funding structures has been made by cutting down lending only isolated or this has been the case for the majority of regulated institutions?

To respond to this question, we use an econometric model that allows to evaluate whether the shifts in the level of NSFR generated significant changes in lending. First-difference specifications are tested on the basis of the following model:

$$\Delta Lending_{it} = \alpha \ \Delta NSFR_{it} + \beta \ X_{it} + \varepsilon_{it} \tag{2.3}$$

Lending is therefore described by the proportion of net loans as of total assets, X is a vector time fixed effects and ε_{it} is the error term. The first-difference specification is tested within an OLS model where the use of first differences allows to solve the problem of time-invariant unobserved variables. Time specific effects are introduced in the model in order to control for the presence of common time-specific effects in the errors. The relationship is tested for the period from 2011 to 2013 but also for the whole period (2006-2013). The aim of this alternative specification is to evaluate the impact of changes in NSFR on the volume of lending even for the periods prior to its official announcement.

The estimates reported in Table 2.7 highlight two important results. Firstly, it appears that, between 2011 and 2013, the adjustments in banking structures, aimed to increase the NSFR, had led to a negative variation of the share of lending. Nevertheless, when we control for changes in the size[36], the effect of changes in NSFR on the evolution of lending portfolio becomes insignificant. Secondly, we find that over the whole period, the changes in the level of NSFR had no significant impact on the volume of lending. Our findings are in line with the study of Banerjee and Mio (2015), highlighting that the impact of tighter liquidity requirements imposed to British banks since 2010[37] had no impact on the amount of lending.

[36] This is motivated by statistical evidence showing that, in average, the size of balance sheets has declined after 2010.
[37] The UK Financial Services Authority (FSA) agreed in 2010 on the adoption of a new quantitative liquidity requirement called the Individual Liquidity Guidance (ILG). It is equivalent to Basel III's LCR framework.

Table 2.7: Impact of the NSFR on lending. First difference specifications

VARIABLES	(1) ΔLending 2011−2013	(2) ΔLending 2006−2013	(3) ΔLending 2011−2013	(4) ΔLending 2006−2013
ΔNSFR	-0.0919**	-0.0259	-0.0956	-0.0956
	(-2.578)	(-1.376)	(-0.921)	(-0.921)
ΔSize			-1.881	-1.881
			(-0.533)	(-0.533)
Constant	-1.827***	0.523	0.810**	0.810**
	(-4.008)	(0.945)	(2.196)	(2.196)
Observations	207	423	207	423
R^2	0.089	0.071	0.030	0.030
R^2 adj	0.0760	0.0558	0.00235	0.00235
F	9.179	4.326	0.637	0.637

Notes: The dependent variable is the annual variation of the proportion of net loans as of total assets and is expressed in percentages. We run OLS regression and time specific effects are considered for. We use an unbalanced panel. Robust t-statistics in parentheses *** p<0.01, ** p<0.05, * p<0.1

Our results are also in line with more recent findings of EBA (2015) based on European banks' activities, as in December 2014. Although descriptive statistics indicate a slight decrease in lending to real sector during 2014, empirical analysis provides strong evidence that changes in NSFRs had no significant impact on credit, with the exception of very large banks that reduced slightly the volume of SME lending[38].

Overall, it seems that banks were able to improve their NSFR by employing strategies other than cutting lending. It is therefore possible that the increase of the NSFR has been made through other channels, such as funding costs or interest rates commanded on loans. For these reasons, we further provide an simple empirical analysis that will allow to answer to these additional questions.

2.4.3 Assessing the cost of achieving minimum liquidity standards

As it has been previously discussed, optimal strategies suppose simultaneous adjustments on both sides of the balance sheet, and should not generate adverse effects on core banking activities and real economy.

The main assumptions in choosing the adjustment strategies are made on the basis of NSFR factors: liabilities with higher ASF weights and assets with lower RSF weights (Table 2.8). According to the discussion in Section 2.4.1, two alternative strategies combining adjustments in both assets and funding structures are undertaken:

- On liabilities side, we first assume that banks will lengthen the maturity of debt, now that the flattening of yield curves will not engender important shifts in the

[38] EBA (2015), Table 15, page 106.

cost of funding. Namely, we presume that a part of short-term borrowings will be substituted with long-term liabilities, which have a greater ASF factor. With regard to asset portfolios' structure, we first assume that riskier securities will be replaced with high quality liquid assets (HQLA) and more precisely with government bonds (column C).

- Alternatively, we imagine that banks will proceed to a recapitalization, and the raise in equity will replace short-term borrowings. Simultaneously, this alternative scenario assumes that lending activity, as of total assets, will be partly replaced with more liquid assets. Although not economically optimal, this strategy is not unrealistic in the current context, when policymakers are dealing with the debate of favouring the access of SMEs to capital markets and reduce banking intermediation.

While the reduction in the exposure to risky activities should drive a decline in the amount of RSF, the increase in the proportion of stable liabilities or equity, associated to the highest ASF factor (100%), will increase considerably the numerator of the NSFR ratio.

Although the deposits could be a very efficient strategy (low rates, high quality and strong stability in times of distress[39]), we do not propose this strategy since the capacity of banks to collect deposits does not depend only on their intrinsic strength and its funding needs, but also on the "supply" of savings in the system. Moreover, this later can differ considerably across banking systems. The most obvious example is provided by the French banking system whose architecture is strongly committed to money market funds and private savings in life insurance products. The capacity of French banks to attract new deposits is even lower than for their European peers.

The starting point for our simulations is given by the representative balance sheet that will be subject to the proposed changes. We chose to present the results of a representative balance sheet, that has already been used in the previous section[40]. Then, by applying the two alternative strategies to the initial balance sheet structure, we are able to evaluate the shifts in the NSFR. The results of these calculations are reported in Table 2.8 below.

By considering marginal shifts in the balance sheet structure (i.e. one percentage point of longer-term debt replace short-term borrowings and one percentage point of high-yielded securities will be substituted with government bonds), we estimate an increase of 3.7 percentage points (pp) in the value of the NSFR. The second strategy, not desired from a regulatory point of view since it involved a reduction in lending, could drive a

[39] The stability of deposits in times of crisis is mainly due to the existence of deposits insurance schemes.

[40] The representative balance sheet corresponds to the Royal Bank of Scotland Group, which has recorded an increase in the level of NSFR between 2011 and 2013 equal to the median for the whole sample. We chose to use this since its average level of NSFR over the whole period (2006-2013) is below the threshold of 100%. The other bank that has been used in previous estimations (i.e. Svenska Handelsbanken, corresponding to the mean change in NSFR between 2011 and 2013) has an average level of NSFR over the period 2006-2013 above the threshold.

slightly higher shift in the NSFR (4.4 pp). Nevertheless, this latter scenario supposes a reduction in the proportion of lending and could have important effects on the real activity. It is therefore not optimal from a regulatory and economic point of view.

Table 2.8: Examples of strategies to increase the NSFR

(1)	*(2)*	*(3)*	*(2) x(3)*	(A)		(B)		(A'): ΔNSFR of 10%	
	Basic scenario	RSF factor		Substituting risky securities with HQLA		Substituting non−interest earning assets with HQLA		Substituting risky securities with HQLA	
Assets									
Residential Mortgage Loans	8.1	65%	5.2	8.1	5.2	8.1	5.2	8.1	5.2
Retail loans	2.2	50%	1.1	2.2	1.1	2.2	1.1	2.2	1.1
Corporate and Commercial Loans	23.6	85%	20.1	23.6	20.1	**22.6**	19.2	23.6	20.1
Net Loans	32.4	85%	27.5	32.4	27.5	32.4	27.5	32.4	27.5
Loans and Advances to Banks	8.6	0%	0.0	8.6	0.0	8.6	0.0	8.6	0.0
Total Securities	46.9	50%	21.5	45.9	20.5	46.9	21.0	**44.2**	18.8
of which: Government Securities	3.9	5%	0.2	4.9	0.2	**4.9**	0.2	**6.6**	0.3
At−equity investments in associates		100%	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other earning assets	0.6	100%	0.6	0.6		0.6		0.6	
Cash and Due From Banks	2.5	0%	0.0	2.5	0.0	2.5	0.0	2.5	0.0
Non−Interest Earning Assets	5.6	100%	5.6	5.6	5.6	5.6	5.6	5.6	5.6
Off balance sheet	20.0	5%	1.0	20.0	1.0	20.0	1.0	20.0	1.0
RSF			**54.5**		**53.5**		**53.1**		**51.8**
	Basic scenario	ASF factor		Lengthening maturity of debt		Increasing capital in favour of other liabilities		Lengthening maturity of debt	
Liabilities									
Total Customer Deposits	35.6	95%	33.8	35.6	33.8	35.6	33.8	35.6	33.8
Deposits from Banks	11.4	50%	5.7	11.4	5.7	11.4	5.7	11.4	5.7
Other Deposits and ST Borrowings	5.3	0%	0.0	**4.3**	0.0	**4.3**	0.0	**2.7**	0.0
Total Long Term Funding	8.5	100%	8.5	**9.5**	9.5	8.5	8.5	**11.2**	11.2
Derivatives	27.7	0%	0.0	27.7	0.0	27.7	0.0	27.7	0.0
Trading Liabilities	3.4	0%	0.0	3.4	0.0	3.4	0.0	3.4	0.0
Other liabilities	1.5	0%	0.0	1.5	0.0	1.5	0.0	1.5	0.0
Total Equity	5.1	100%	5.1	5.1	5.1	**6.1**	6.1	5.1	5.1
ASF			**53.0**		**54.0**		**54.0**		**55.7**
NSFR			**97.4%**		**101.1%**		**101.7%**		**107.5%**
ΔNSFR					**3.7%**		**4.4%**		**10%**

Notes: Data in column (1) reports initial values for the main balance sheet elements, which represent the average proportions of each item as of total assets, over the period 2006 to 2013. The ASF and RSF are calculated as the proportion of liabilities, respectively assets, multiplied by the associated factor. In column (A) we impose that one percentage point of trading securities is replaced with government bonds. In the same time, one percentage point of short-term borrowings is replaced with long-term debt. In column (B) we illustrate an alternative strategy that supposes a cut in lending and simultaneously, a raise in capital. Column (A') corresponds to more considerable changes in order to increase the level of NSFR of 10 percentage points (A'). In order to reach an increase of 10 units of the NSFR, the change in balance sheet items is evaluated at 2.6 units (i.e. percentage point as of total assets).

2.4.3.1 A static approach

According to this approach, the results suggest that the NSFR could be easily increased through minor adjustments in the balance sheet. Nevertheless, the strategies should absolutely involve changes on both sides of the balance sheet and take into account ASF and RSF factors. Generally, the adjustments are likely to generate shifts in funding costs

since (i) lengthening the maturity of debt will involve higher refunding rates and (ii) the lower risk premiums for better rated securities will affect the interest income.

Changes in ASF

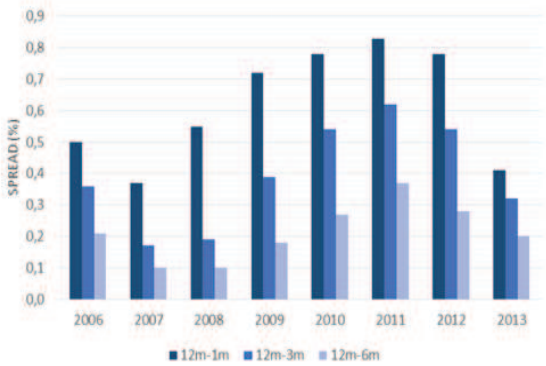
If interest rates remain constant, the shift in the amount of interest expenses will be equal to:

$$\Delta IntExpenses = (r_{LTdebt} - r_{STdebt}) * \Delta LTdebt \tag{2.4}$$

where $\Delta LTdebt$ is the variation of the proportion of long-term debt as of total assets, r_{LTdebt} and r_{STdebt} are interest rates associated to bonds and short-term borrowings, respectively. Within our exercise, under the basic scenario the $\Delta LTdebt$ is equal to one unit (i.e. one percentage point, column (A)).

During the period 2011-2013 when the NSFR of European banks has been considerably improved, the cost of the substitution of short-term debt with more stable funding has been slightly higher ranging 28-67 bps (28 bps spread between 12-month and 6-month interest rates and up to 67 bps spread between 12-month and 1-month interbank interest rate). Nevertheless, in the actual context of almost flat yield curve any change in the funding structure is likely to have a considerably lower impact. The difference between very short-term interest rates (1 month) and one year maturity interest rates reaches 0.4% (according to the evolution in spreads in interest rates illustrated in Figure 2.11). If a smoother transition is imagined and 6-month liabilities are replaced with 1-year debt instruments, the funding cost will rise of 0.2% (i.e. spread of 20 bps).

Figure 2.11: Spreads in interbank interest rates in the Euro area over the period 2006-13



Notes: We plot spreads between interest rates for different maturities: dark blue bars illustrate the spread between 12-month and 1-month interest rates while light blue bars give the spread between 12-month and 6-month debt. The values of interest rates and the yield curve are reported Figures 2.24 and 2.25 in Appendix D.
Source: Eurostat

Nevertheless, an increase of 10 units in the ratio of NSFR should be reached, the cost of lengthening the maturity of debt is evaluated at 52 bps[41].

The second adjustment in funding structure that we considered was the deleveraging. Namely, the short-term debtwill be substituted with equity. We could doubt about the adoption of this strategy since it could impact shareholders' revenues. Nevertheless, raising capital reduces the riskiness of banks and helps in revising downwards risk premiums. Moreover, this approach, which has the same effect on the NSFR as long-term funding since both are associated to a 100% ASF factor, could help to reach minimum capital requirements[42].

Changes in RSF

Turning now to asset portfolio structure, the liquidity framework enforces banks to increase holdings of liquid and safer assets in order to reduce exposure to systemic shocks and avoid contagion effects generated by fire sales. The effect of this strategy could be quantified by evaluating the change in interest income on investments. More precisely, the interest income is likely to decrease because of the difference in risk premiums associated to each type of assets (ΔPr), multiplied by the proportion of assets that are replaced. It could be calculated according to the following equation:

$$\Delta Interest\ Income = \Delta Pr\ \Delta HQLA \tag{2.5}$$

The negative spread between the yields for HQLA and the yields for lower-rated assets leads to a negative variation in the interest income. The magnitude of the decline is function of the he proportion of high-rated investments that replace riskier assets.

The current flatter yield curve, compared to historical levels, lead to weaker spreads between the two categories of assets and make the exercise more difficult since the actual (low) premiums do not reflect the real level of risk. For instance, the spread between AAA and other high grade Euro area government bonds was evaluated at 3.9 bps in 2013 with even lower values for the previous three years (1 bp). The substitution of one percentage point of risky securities (as of total assets) with HQLA has a minor impact on net interest margins[43].

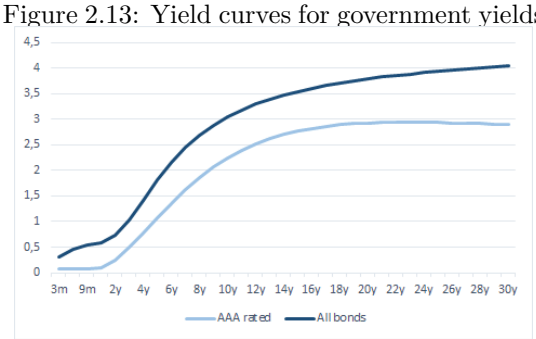
[41] Spread of 20 bps × 2.6 units of short-term debt that should be substituted in order to add 10 units to the level of NSFR.

[42] For robustness check, we test empirically the impact of the changes in the level of NSFR on the funding cost. The description of the methodology and the results are reported in Appendix D. We find that there is no significant increase in funding costs due to the considerable rise in NSFRs between 2011 and 2013.

[43] We make reference to the period 2010 to 2013 since during these years more important improvements in the NSFR have been recorded. We do not dispose of data on corporate bonds that should provide higher yields than government bonds. The substitution of corporate securities with high rated government bonds should be therefore more costly.

Figure 2.12: 3m government bond yield rates

Figure 2.13: Yield curves for government yields

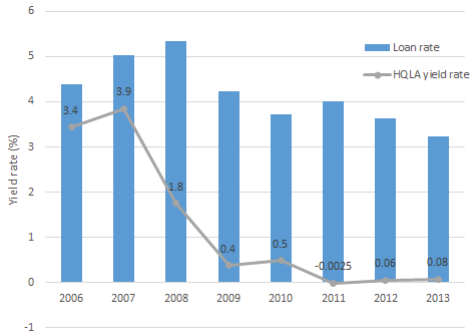


Notes: Data cover Euro area central government bonds. The yield curves in Figure 2.12 indicate the spot rate based on all government bonds (dark blue) and AAA-rated bonds only (blue light) as in December 2013.
Source: ECB

The reduction in net interest margins that should be incurred as a result of replacing a part of risky securities with government bonds is evaluated in the range of 0.21% to 1.13% according to the maturity of securities[44].

For the second alternative strategy that has been proposed to reduce the amount of RSF, the cost of substituting long-term loans with high-quality securities is very likely to be higher than in the former case. Although loan rates are significantly lower than in the pre-crisis period, the considerable decrease in high-rates government bonds - the safest trading securities that bank can hold in their asset portfolio - leads to a higher cost of switching in these two business activities.

Figure 2.14: Yield rates for loans and HQLA



Notes: Composite cost-of-borrowing indicator for loans to both households and non-financial corporations in EMU is used as indicator for loan rate. The yield curve in grey describe the evolution of spot for AAA-rated government bonds of Euro area members.
Source: ECB

All the more, since the implementation of liquidity requirements is ongoing, the demand for HQLA is likely to increase continuously in the next period and yields to adapt to market conditions. In addition, if the need of governments (or high rated corporations) to issue debt are lower and/or debt ceilings are about to be reached, the "supply" of high-rated bonds (especially government bonds) could not be enough to meet the increasing

[44] The impact is given by the spread between the yields associated to the two categories of securities illustrated in Figure 2.13. One should bear in mind that values of bond yields are as in December 2013 (i.e. the end of our study period).

demand of regulated institutions. Finally, this could lead to higher yields for these safe assets and increase more the cost of achieving liquidity requirements.

In order to evaluate the impact of the implementation of liquidity standards, we cannot dismiss the eventual change in yield curves since it plays a key role in regulatory arbitrages[45]. This issue is developed in the next part of this section.

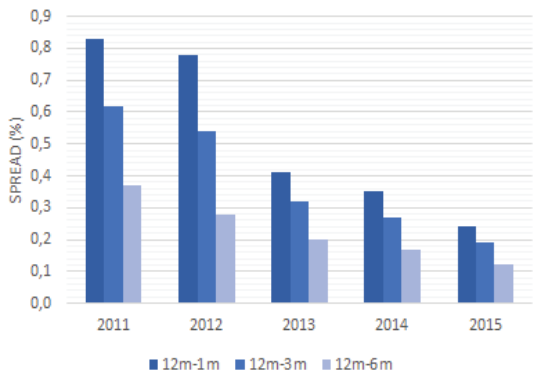
2.4.3.2 A dynamic approach

Although the analysis provided in previous sub-section illustrates the cost of achieving higher levels of NSFR under certain market conditions, we should not dismiss the impact of reaching higher liquidity standards when changes in yield curves are considered. If accommodative monetary policies are pursued, the implementation of liquidity standards should be done with even less unimportant costs. However, if interest rates will be raised, then the achievement of NSFR standards will become more costly.

In absolute terms, the magnitude of the shift in funding cost, induced by replacing one percentage point of short-term liabilities with long-term funding (maturity of at least one year), will be affected if interest rates are revised upwards. For instance, if the yield curve become steeper the shift in the amount of interest expenses (described in equation (2.4)) will become more apparent.

Nevertheless, the reality shows a declining trend of interest rates and a marked flattening of interest-rate curves in the two years following 2013, and this should remain low for the following periods. With a spread of 24 basis points between 12-month and 1-month interbank rates, the cost of lengthening the maturity of wholesale debt is very likely to be lower than it is argued by practitioners.

Figure 2.15: Evolution in interbank interest rates in the Euro area in the periods after 2013



Notes: We plot spreads between interest rates for different maturities: dark blue bars illustrate the spread between 12-month and 1-month interest rates while light blue bars give the spread between 12-month and 6-month debt.
Source: Eurostat

[45] However, this is not the case at the moment in Europe even if the American policy makers announced already a slight rise in Treasury yields.

Low rates penalize savers and those who rely on high yields. The flattening of yields curves have a consistent impact on the return on interest earning assets. With a level of yields rates structurally lower than in December 2013, the revenue is lower than the level corresponding to periods when risks are more appropriately priced. Meantime, the reduction of spreads between the two yield curves leads to a lower cost of substitution of risky assets with high-quality assets.

Figure 2.16: Yields for government bonds, as in 2013

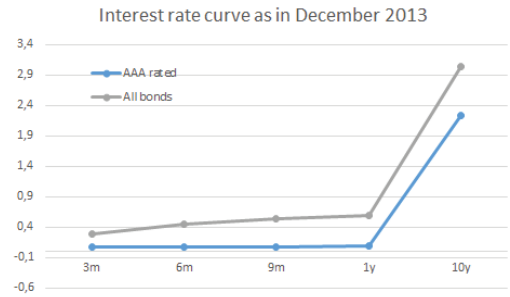
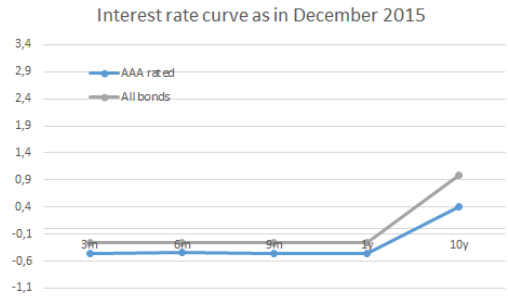


Figure 2.17: Yields for government bonds, as in 2015



Notes: Data cover Euro area government bonds. The yield curves indicate the spot rate based on all government bonds (grey) and AAA-rated bonds only (blue) as in December 2013 in Figure 2.16 and as in December 2015 in Figure 2.17.
Source: ECB

Additionally, with small spreads between short-term and long-term rates, financial institutions are encouraged to over-invest in long-term assets such as long-term government bonds. In turn, if interest rates will rise in the future in an extraordinary manner, the decline in the value of these assets could expose banks to considerable losses.

Persistent low rates could lead to further distortions in financial markets and generate asset price bubbles. Although naturally, an increasing demand for the high-quality assets, all else equal, raises their price. Nevertheless, it appears that the increase in the holdings of HQLA that allowed to improve the quality of asset portfolios during the last years had no considerable effect on their prices.

Another benefit of low interest rates is the improvement of banks' capacity to lend. However, since lending is not favoured by the assessment methodology of liquidity standards, the core business activity of banks may be affected. Namely, the request of a better quality of collateral and credit rationing could be adopted by banks, but again, up to the date when this thesis is written no significant decline in lending has been recorded in European economies. This is mainly due to low interest rates and flatter yield curves than the one prevailing during crisis periods (and even pre-crisis periods).

Overall, the cost of reaching the 100% threshold of stable funding relative to assets illiquidity is likely to be higher for banks with stronger dependence on market activities that should come up with more complex strategies to reduce the significant maturity

gap between assets and liabilities structures. This could furthermore affect their business model.

At this point one essential question is raised: Since the changes in balance sheets that have been employed to improve the level of structural liquidity (mainly between 2011 and 2013) had no significant impact on borrowing costs, to what extent the interest rates for core business activities have been affected by these structural changes?

2.4.4 Evaluating the effect of NSFR on loan rates

Since previous analysis indicates that the increase of NSFRs have not been made by downsizing the lending portfolio (i.e. adjustment in volume terms) and did not significantly impacted funding costs either, one last channel should be tested. Namely, we examine the extent to which banks' adjustments to reach NSFR requirements had an impact on rates commanded on interest earning assets.

The model that will allow us to answer to this question is the following:

$$\Delta IR_{it} = \alpha \ \Delta NSFR_{it} + \ \beta \ X_{it} + \varepsilon_{it} \tag{2.6}$$

The dependent variable IR represents the interest rate commanded by the bank on lending. It is defined as the total amount of interest income on loans divided to the amount of gross loans. The vector X contains control variables as business model and time fixed effects. While the former allows to control for structural differences in interest rates according to the business model, the latter controls for time variant specificities in the series. $\varepsilon_{it}$is the error term.

Therefore, within a first specification, we are able to estimate the change in loan rates driven by changes in the level of NSFR. Additionally, two alternative specifications, using different definitions of the dependent variable, will be tested. We first define a global yield rate generated by interest earning assets and then, a rate of fees and commissions applied to interest earning assets[46]. It is important to highlight that, just like the measure for the funding cost, the main limit of these measures is that it does not take into account the maturity and the type of instrument.

The results reported in Table 2.9 are estimated within OLS regressions. It is clear that the improvement of NSFRs does not generate a considerable variation in interest rates commanded on interest earning assets and, more particularly, on loans, despite the considerable efforts has been undertaken in acquiring the NSFR requirements between 2011 and 2013. In turn, the increased holdings of HQLA imposed by the NSFR framework and the historical low levels of interest rates had a considerable impact on the rate of

[46] The net fees and commissions include non-insurance related operating fee and commission income, net of associated expenses. They can be typically earned on commercial, investment and trust activities (source: Bankscope).

return on financial assets and generated lower returns on financial assets in the period after 2011[47]. Finally, it seems that no shift in fees and commissions has been driven by regulatory-driven changes in the level of NSFR.

Table 2.9: Estimating the impact of higher NSFR on interest rates commanded by banks. Panel regressions

VARIABLES	(1) ΔLoan rate	(2) ΔInterest income/ IEA	(3) ΔNet fees and commissions/ IEA	(4) ΔLoan rate	(5) ΔInterest income/ IEA	(6) ΔNet fees and commissions/ IEA
	2006−2013			*2011−2013*		
ΔNSFR	0.00801	0.00117	-0.000649	0.00149	-0.0135**	-0.000794
	(1.610)	(0.444)	(-0.756)	(0.170)	(-2.589)	(-0.921)
BM	0.00204	-0.000447	-0.000394**	0.000143	-0.000872	-0.000308
	(1.044)	(-0.410)	(-2.095)	(0.0484)	(-0.780)	(-1.200)
Constant	0.0390	-1.399***	0.0251	-0.496	0.312**	-0.00149
	(0.115)	(-8.400)	(1.055)	(-1.523)	(2.472)	(-0.0534)
Observations	411	423	423	204	207	207
R^2	0.391	0.516	0.138	0.202	0.307	0.074
R^2 adj	0.379	0.507	0.121	0.186	0.293	0.0558
F	28.33	41.63	8.449	17.93	20.33	5.007

Notes: All alternative dependent variables are expressed in percentages. Loan rate is defined as the interest income on loans divided to the amount of gross loans. IEA states for Interest Earning Assets. Robust t-statistics in parentheses *** p<0.01, ** p<0.05, * p<0.1

Using simple econometric tools, we evaluate the variation of interest rates due to changes in structural liquidity requirements and we emphasize the lack of impact on loan rates. Results are in turn suggesting that there had been a considerable reduction in the income on financial assets between 2011 and 2013. Our findings are in line with Banerjee and Mio (2015) suggesting that the ILG framework imposed to British banks since 2010 did not increased the lending rates.

These results are of major importance, showing that higher stable funding requirements had no considerable effect on lending activities, either in terms of volume or price. These findings have important policy implications by showing that the regulatory standards imposing banks to adjust the degree of stability of liabilities and liquidity of assets over a one-year horizon can be reached without generating meaningful adverse effects to the real economy.

[47] Nevertheless, after testing the relationship described in (2.6) within a level specification, we find that there is a significant relationship between the level of interest rates commanded on loans and also on financial assets, and the indicator of business model - the retail ratio. We find that banks with higher levels of retail activities are commanding in general lower average interest assets.

2.5 Conclusion

The question of assessing the impact of new prudential regulation has caught a lot of attention over the recent years. Although the evaluation of higher capital requirements has been more easily achieved, the cost of the adoption of liquidity ratios proved to be more difficult to evaluate. Firstly, the complexity of defining the liquidity of banks and secondly, the difficulty of measuring it, have made the exercise even more complex. We can nevertheless discuss and analyse the effects of different arbitrages that have to be made by regulated institutions in their objective of fulfiling liquidity standards. Therefore, this chapter comes to complete our impact assessment study driven in the first chapter.

In the first part of this chapter we emphasize differences in terms of liquidity for different sub-panels. More precisely, comparisons are made for several categories of banks according to the country of origin, systemic importance, and also by their business model. Important differences in the level of NSFR are emphasized between small and large banks, but also between investment and commercial - oriented banks. These findings are interesting since they bring into light important links between the business strategies banks and the weaknesses of their funding structures. They are also pointing out the bad incentives and strong vulnerabilities emerging from excessive trading activity. The spreads in the level of NSFR across countries show structural differences in banking systems' architecture and customer relationships procedures.

With respect to the developments made so far to improve the level of NSFR, a simple sensitivity analysis suggests that the increase in NSFR has been made through a mix of adjustments in the size of the balance sheets and important restructurings in funding structures and asset portfolios. We find that the volume of lending has been slightly reduced for certain banks, but the magnitude of the variation in lending portfolios remains statistically insignificant at European level. Additionally, we present different adjustment-strategies adopted by banks as response to regulatory requirements. The result consists in more resilient funding structures, closer to regulatory standards.

In a second part of this chapter, we assess the impact of the implementation of the NSFR on funding costs and on lending rates. More precisely, we examine the impact of optimal strategies that could be envisaged by banks to fulfil the minimum liquidity requirements while considering for the evolution of funding costs. We find that, in the current context of flatter yield curves, the cost of substituting short-term borrowings with more stable debt instruments should be relatively weak (increase of 20 bps in the cost of funding and an average reduction of ROA of 50 bps). Overall, our calculations indicate that an increase of 10 percentage points of the NSFR should add 52 bps to the cost of funding and reduce the ROA of 130 bps.

Then, using a simple empirical analysis, we show that, in average, the increase in NSFRs since 2011 has been made without meaningful shift in funding cost. Likewise, this later raise considerably if the yield curve becomes steeper. Nevertheless, there is no reason to believe that policy rates will be increased considerably in the next periods.

Since the adjustments did not significantly affect the cost of funding, we had also examined the extent to which the additional cost had been passed on loan rates. We find no evidence that banks raised the interest rates commanded on lending activities, as a result of adjustments in their funding structure. In turn, the income on financial assets have been affected by the historically low levels of interest rates and the regulatory-driven changes in assets portfolios requesting for larger proportions of high-quality liquid assets had a significant contribution to the decline of the income on interest earning assets.

The liquidity framework defined by the Basel Committee in 2010, and particularly the long-term liquidity standards, is therefore complementary to capital regulation - being the foundation of banking regulation. The capital and liquidity requirements are conceived to address different problems. While liquidity requirements deal with stressed liquidity over short-term periods and disturbances over longer-time periods due to maturity mismatches between assets and liabilities, the capital standards address the risk issued through assets' substitution and ensures that it is appropriately covered through a mix of equity and liabilities. Nevertheless, there are strong interactions between these two frameworks since the instruments that allow to their compliance are very similar. Their compliance should therefore not generate any conflict. An optimal definition of the liquidity framework is mandatory for further impact assessment studies and they should deal simultaneously with the two sets of rules, and not only isolated as it has been done until now. This step is essential for regulators and public authorities, which should be able to clearly distinguish between illiquid and insolvent banks in times of distress[48].

[48] The issue of the interactions between capital and liquidity frameworks and their joint contribution in improving the resilience of banks will be addressed in detailed in the fifth chapter of this thesis.

2.6 Appendix

A. NSFR methodology

Available stable funding (ASF)

The amount of available stable funding is calculated as a weighted sum of the effective amount of each category of liability multiplied by the corresponding ASF factor. These weights reflect the stability of funding sources taking into account the maturity and the counterparty.

The table below summarizes the different ASF categories and the associated weights, with greater weights assigned to stable sources of funding that are less susceptible to be affected by stressed market conditions.

Table 2.10: Stable funding and ASF factors

ASF factor	Components of ASF category
100%	• Total regulatory capital • Other capital instruments and liabilities with effective residual maturity of one year or more
95%	• Stable non-maturity (demand) deposits and term deposits with residual maturity of less than one year provided by retail and SME customers
90%	• Less stable non-maturity deposits and term deposits with residual maturity of less than one year provided by retail and SME customers
50%	• Funding with residual maturity of less than one year provided by non-financial corporate customers • Operational deposits • Funding with residual maturity of less than one year from sovereigns, public sector entities (PSEs), and multilateral and national development banks • Other funding with residual maturity of not less than six months and less than one year not included in the above categories, including funding provided by central banks and financial institutions
0%	• All other liabilities and equity not included in above categories, including liabilities without a stated maturity • Derivatives payable net of derivatives receivable if payables are greater than receivables

Source: BCBS (2014a)

Required stable funding (RSF)

The amount of required stable funding is calculated as a weighted sum of the book value of each category of assets to which a RSF factor is associated. The RSF factors reflect first of all the liquidity of assets. High-quality assets can be used as collateral to secure future funding and don't need to be fully funded with stable resources in times of distress for the bank. Secondly, the assessed weights are calibrated in such a way to

preserve credit creation and avoid that banks roll over already existing loans with the aim of ensuring the continuity of intermediation activity.

According to the BCBS's consultative document issued in January 2014, the categories of assets and their assigned RSF factor are summarized in the next table:

Table 2.11: Definition of variables used in our empirical model

RSF factor	**Components of RSF category**
0%	• Coins and banknotes • All central bank reserves • Unencumbered loans to banks subject to prudential supervision with residual maturities of less than six months
5%	• Unencumbered assets defined as Level 1 including marketable securities guaranteed by sovereigns, central banks assigned with a 0% risk-weight under Basel II Standardized approach. It excludes coins, banknotes and central bank reserves.
15%	• Unencumbered assets defined in Level 2A category for LCR including marketable securities assigned with a 20% risk-weight under Basel II Standardized approach and corporate debt securities and covered bond with a credit rating equal or equivalent to at least AA−.
50%	• Unencumbered Level 2B assets (RMBS with a credit rating at least AA, corporate debt securities with a credit rating between A+ and BBB−, common equity shares from non-financial corporations). • HQLA encumbered for a period of six months or more and less than one year • Loans to banks subject to prudential supervision with residual maturities six months or more and less than one year • Deposits held at other financial institutions for operational purposes • All other assets not included in the above categories with residual maturity of less than one year, including loans to non-bank financial institutions, loans to non-financial corporate clients, loans to retail and small business customers, and loans to sovereigns, central banks and PSEs
65%	• Unencumbered residential mortgages with a residual maturity of one year or more and with a risk weight of less than or equal to 35% • Other unencumbered loans not included in the above categories, excluding loans to financial institutions, with a residual maturity of one year or more and with a risk weight of less than or equal to 35% under the Standardized Approach
85%	• Other unencumbered performing loans with risk weights greater than 35% under the Standardized Approach and residual maturities of one year or more, excluding loans to financial institutions • Unencumbered securities that are not in default and do not qualify as HQLA including exchange-traded equities • Physical traded commodities, including gold
100%	• All assets that are encumbered for a period of one year or more • Derivatives receivable net of derivatives payable if receivables are greater than payables • All other assets not included in the above categories, including non-performing loans, loans to financial institutions with a residual maturity of one year or more, non-exchange-traded equities, fixed assets, pension assets, intangibles, deferred tax assets, retained interest, insurance assets, subsidiary interests, and defaulted securities

Source: BCBS (2014a)

Figure 2.18: Changes in the definition of NSFR between 2010 and 2014

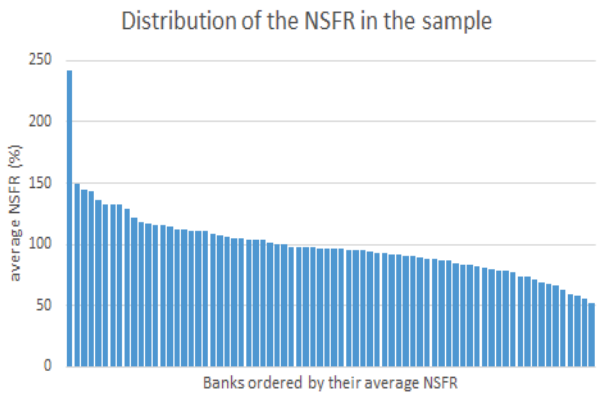
ASF	Dec 2010	Jan 2014	Effect
Capital, hybrid, and long term wholesale funding	100%	100%	↔
Stable deposits	90%	95%	↑
Less stable deposits	80%	90%	↑
Operational deposits	0%	50%	↑
Wholesale funding 6m-1y	0%	50%	↑

RSF	Dec 2010	Jan 2014	Effect
Central bank reserves, cash, banknotes, and unencumbered loans to banks< 6m	0%	0%	↔
Unencumbered HQLA securities < 1y	0%	5%	↑
Unencumbered Level 2a and 2b securities ≥1y	20/50%	15/50%	↔
Encumbered HQLAs 6m - 1y	0%	50%	↓
Non HQLA securities and non renewable loans to NBFIs with RM < 1y	0%	50%	↓
Wholesale lending (6m-1y)	0%	50%	↓
Unencumbered loans to retail and SMEs (with RW ≤ 35% under SA and RM of < 1y)	65%	50%	↑
Unencumbered loans to retail and SMEs (with RW > 35% under SA and RM of < 1y)	85%	50%	↑
Unencumbered loans to large corporates, government, PSEs with RM of < 1y	50%	50%	↔
Unencumbered loans with RW≤ 35% under SA with RM ≥ 1y)	65%	65%	↔
Unencumbered residential mortgages (with RW≤ 35% under SA with RM ≥ 1y)	65%	65%	↔
Other unencumbered performing loans (with RW> 35% under SA with RM ≥ 1y)	100%	85%	↑
Encumbered assets for 1 year or more	100%	100%	↔
Encumbered Non HQLA securities with RM ≥ 1y	100%	100%	↔

Notes: The sign of the effect indicated in the last column represents the impact of the change in the weights associated to different categories of inflows and outflows by assuming that all other positions are unchanged.
Source: Gobat et al. (2014), BCBS (2010d), BCBS (2014a)

B. Additional descriptive statistics

Figure 2.19: The distribution of NSFR by banks

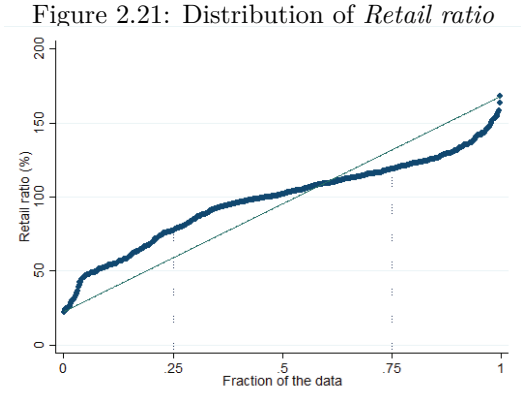


Notes: The highest value corresponds to Banque Postale (FR) which has a profile of commercial bank. The lowest level is associated to Nordea Finland (FI).)

Figure 2.20: Loan-to-deposits ratio (LTD) - average values for 2006-13

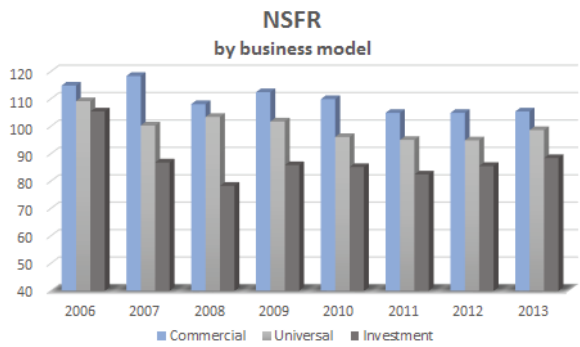
Notes: We plot averages for the whole period and 2013 values of the loan-to-deposits ratio by country.
Source: Bankscope, author's calculations

Figure 2.21: Distribution of *Retail ratio*



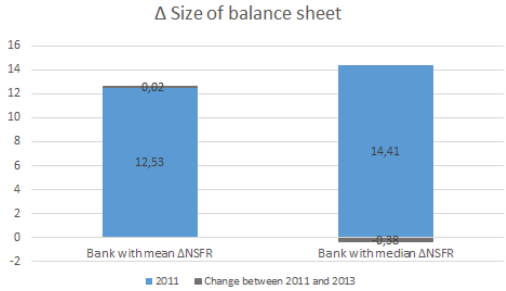
Notes: The partition of banks in three categories is highlighted by the intermediary vertical lines: the two specialized business models, investment and commercial, at the extremities, and the universal business model in the middle. The value corresponding to the 25th percentile is 77, 101 corresponds to the median and 118 to the 75th percentile. The mean for the variable Retail ratio is 97.5. The distribution is in line with Martel et al. (2012) and Gambacorta and Rixtel (2013).
Sources: Bankscope, author's calculations

Figure 2.22: Annual means for NSFR, by business model



C. Evaluating the changes in balance sheet structures driven by regulatory-changes

Figure 2.23: Changes in the size of balance sheet for representative structures



Notes: The size of banks is defined by the logarithm of total assets. Values for 2011 are illustrated in blue, while the change between 2011 and 2013 is plotted in grey.

Calculating the growth rates for balance sheet items

We calculate growth rates for balance sheet items for two representative banking structures according to their variation of the NSFR between 2011 and 2013.

The growth rate for each balance sheet item is evaluated as the variation between 2011 and 2013 divided by the value in 2011. Column A reports the level of the variation between 2011 and 2013 and column B the level as in December 2011. Furthermore, we calculate the value of available stable funding and request stable funding by multiplying the level of liabilities and assets respectively, and the associated factors reported in column C.

Table 2.12 report calculations for the bank whose change in NSFR is equal to the median value for the sample and Table 2.13 reports the same calculations for the bank with the variation of the NSFR corresponding to the mean value for the sample.

The growth rate of the NSFR between 2011 and 2013 we use the following specification:

$$g_{NSFR} = log\left(\frac{NSFR_t}{NSFR_{t+1}}\right) \tag{2.7}$$

After simple calculation we obtain that the growth rate for the NSFR can be simplified to:

$$g_{NSFR} = g_{ASF} - g_{RSF} \tag{2.8}$$

Table 2.12: Growth rates of ASF and RSF components for the representative a bank (1)

	Δ2011-13	**2011**		**Δ2011−13**	**2011**	**g**
Variable	*A*	*B*	*C*	*A* × *C*	textitB × C	
Total assets	-571071.9	1803983.0				-31.7%
			ASF Factor			
Total Customer Deposits	-105068.5	602125.0	95%	-99815.1	572018.8	-17.4%
Deposits from banks	14234.6	130257.4	50%	7117.3	65128.7	10.9%
Other deposits and ST borrowings	-62624.5	82472.2	0%	0.0	0.0	
Total Long Term Funding	-47048.2	143722.0	100%	-47048.2	143722.0	-32.7%
Other liabilities	-16382.0	27684.7	0%	0.0	0.0	
Total Equity	-20022.0	91048.7	100%	-20022.0	91048.7	-22.0%
			ASF	-159767.9	871918.2	-18.3%
			RSF Factor			
Net loans	-74867.6	543651.4	85%	-63637.5	462103.7	-13.8%
Reserves for NPLs	6514.2	23656.2	100%	6514.2	23656.2	27.5%
Loans and Advances to Banks	-48649.0	173355.7	0%	0.0	0.0	
Total Securities	-439385.4	1023363.0	50%	-219692.7	511681.5	-42.9%
Government Securities			5%	0.0	0.0	
At−equity investments in associates			100%	0.0	0.0	
Cash and Due From Banks	4248.3	94898.8	0%	0.0	0.0	
Non−Interest Earning Assets	-30031.8	160937.4	100%	-30031.8	160937.4	-18.7%
Off balance sheet	-54048.1	333795.0	5%	-2702.4	16689.8	-16.2%
			RSF	-309550.2	1175068.0	-26.3%
			NSFR		**74.2%**	**8.0%**

Table 2.13: Growth rates of ASF and RSF components for the representative bank (2)

Variable	**Δ2011-13** *A*	**2011** *B*	*C*	**Δ2011−13** *A* × *C*	**2011** textitB × C	**g**
Total assets	5070.9	275400.1				1.8%
			ASF Factor			
Total Customer Deposits	11848.8	80440.6	1.0	11256.3	76418.6	14.7%
Deposits from banks	-3320.4	23551.4	0.5	-1660.2	11775.7	-14.1%
Other deposits and ST borrowings	-12658.1	46931.1	0.0	0.0	0.0	-27.0%
Total Long Term Funding	12454.0	84957.5	1.0	12454.0	84957.5	14.7%
Other liabilities	2.5	3890.5	0.0	0.0	0.0	0.1%
Total Equity	1961.4	10606.4	1.0	1961.4	10606.4	18.5%
			ASF	24011.5	183758.1	13.1%
			RSF Factor			
Net loans	12702.5	177003.9	0.9	10797.1	150453.3	7.2%
Reserves for NPLs	-26.3	466.9	1.0	-26.3	466.9	-5.6%
Loans and Advances to Banks	-14605.7	27447.7	0.0	0.0	0.0	-53.2%
Total Securities	-7482.8	34642.2	0.5	-3741.4	17321.1	-21.6%
Government Securities	693.1	4932.5	0.1	34.7	246.6	14.1%
At-equity investments in associates	7.7	23.0	1.0	7.7	23.0	33.5%
Cash and Due From Banks	9530.5	28260.4	0.0	0.0	0.0	33.7%
Non-Interest Earning Assets	9090.9	32299.8	1.0	9090.9	32299.8	28.1%
Off balance sheet	-6442.1	57493.0	0.1	-322.1	2874.7	-11.2%
			var RSF	15840.6	203685.4	7.8%
			NSFR		**90.2%**	**5.3%**

D. Implications for the cost of funding

Figure 2.24: Interest rates in the EA over time

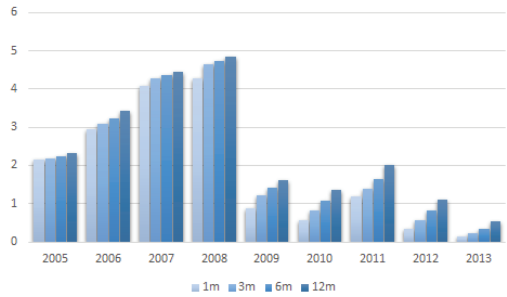
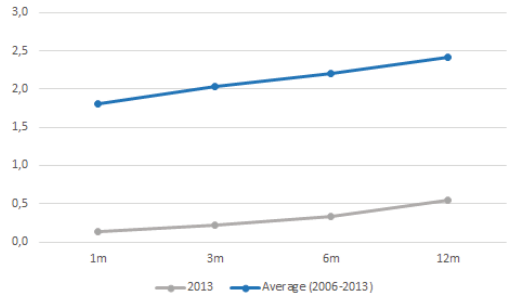


Figure 2.25: Yield curves



Notes: We plot annual interbank interest rates for the Euro area in Figure 2.24 and the yield curves as in 2013 and average over the period 2006-2013 in Figure 2.25. Since our aim is to examine low cost strategies of implementing the NSFR, we are not interested in longer-maturity interest rates.
Source: Eurostat

Estimating the impact of liquidity standards on the cost of funding

We provide simple empirical analysis that will allow us to examine if the increase in liquidity requirements recorded between 2011 and 2013 had significantly affected the cost of funding of European banks. Although the stable resources have higher interest rates than wholesale funding, the extremely accommodative monetary policies might had compensate the increase in interest expenses due to the increase in the share of stable funding.

The funding cost (FC) whose measure is based on income statement and balance sheet data from Bankscope, is measured by the amount of interest expenses as of the amount of total interest-bearing liabilities. This accounting based measure does not take into account either the maturity or the type of debt instrument. Therefore, it is very likely that the decline in the riskiness of banks generated by the improvement of funding structures is dismissed involuntary in the assessment of funding rates.

Interest expenses of banks depend firstly on the funding structure and more precisely on the proportion of debt used to fund the activity, and secondly, on the general level of interest rates in the economy. Although interest expenses were globally higher before the financial crisis, starting with 2009 they have been exceptionally low; this contributed to the reduction, in a more general manner, of the cost of funding of financial institutions. Our aim is to test if the funding cost of the 75 European banks in our sample has been considerably affected by the changes in funding structures between 2011 and 2013. The following model is tested:

$$\Delta FC_{it} = \alpha \ \Delta NSFR_{it} + \ \beta \ X_{it} + \varepsilon_{it} \tag{2.9}$$

The vector X contains control variables: the business model measured as the proportion of retail activities in the balance sheet and time specific effects. Accounting for the business model is mandatory since the sources and the structure of funding can differ considerably between different types of business model. ε_{it} is the error term. We run OLS regressions since first difference specification is already takes into account individual trend effects.

The different specifications that have been tested emphasize a main result: independently of the period, the changes in the NSFR has no significant effect on the cost of funding. Although the shifts in the funding cost were different across business models between 2011 and 2013 (column 4), within the three categories of banks, no considerable effect is recorded.

Table 2.14: The impact of the changes in NSFR on the cost of funding

VARIABLES	(1) ΔFC	(2) ΔFC	(3) ΔFC	(4) ΔFC	(5) ΔFC	(6) ΔFC	(7) ΔFC
	2006-13		2011-13				
	All banks	*All banks*	*All banks*	*All banks*	*Investment*	*Universal*	*Commercial*
ΔNSFR	0.00183	0.00123	-0.00324	-0.00296	-0.00325	0.00149	0.00462
	(0.699)	(0.399)	(-0.697)	(-0.703)	(-0.523)	(0.243)	(0.411)
BM		-0.0108		-0.0119*			
		(-0.879)		(-1.677)			
Constant	2.734***	4.856***	2.150***	3.691***	2.152***	2.206***	1.971
	(9.616)	(3.759)	(4.846)	(4.148)	(3.955)	(3.742)	(1.660)
Observations	500	460	217	216	64	89	64
R^2	0.588	0.613	0.300	0.314	0.238	0.183	0.537
R^2 adj	0.582	0.606	0.290	0.301	0.199	0.154	0.514
F	59.85	50.40	18.89	14.87	7.115	10.42	12.23
Number of id	75	75	75	75	15	36	24

Notes: The dependent variables is the change in funding cost. This latter is evaluated by the ratio of interest expenses to interest bearing liabilities. Robust t-statistics in parentheses *** p<0.01, ** p<0.05, * p<0.1

Level-specifications have been tested for robustness check but results are not reported since they provide no additional relevant evidence on the relationship between the NSFR and the cost of funding.

We could therefore conclude on the existence of an unimportant effect of changes in the cost of funding driven by changes in the NSFRs and we are aware that this is mainly due to historical low levels of borrowing cost. Although the accommodative policy measures are not supposes to change for the next periods, it is mandatory to bring into discussion the different scenarios for the future evolution of interest rates and their impact on the cost of funding of banks.

Part II

"A standard example of time inconsistency dilemma relates to people building their homes in a flood plain. When a flood comes, do your rescue them, or not?"

Charles Goodhart (2008)

Chapter 3

Quantifying and explaining the value of implicit public guarantees [1]

The 2008 global financial crisis brought into light the inadequacies of the financial system to be addressed by financial regulators and academicians. Beyond the need to restructure the current regulatory framework in order to improve the liquidity and capital adequacy of financial institutions, governments had to approve and grant large fiscal support to prevent the risk of run-over of banks in the distressed financial system, acting as a "guarantor of last resort". Therefore, unprecedented amounts of public money have been injected in banking systems in order to prevent banks' failure. In turn, public authorities' actions highlight the importance of "implicit guarantees" for financial institutions in distress.

Public authorities' reaction to the crisis focuses on a particular characteristic of the banking system: the activity of certain banks is essential and irreplaceable for the whole economic activity, mainly due to their size and interconnections with other sectors of the economy. In other words, the estimated cost of liquidation for such "systemically-important" financial institutions is so high that public authorities can not overlook the funding needs of such banks in times of distress. Therefore, the risk of default for financial institutions considered as "too-big-to-fail" or "too-interconnected-to-fail", can be reduced by the (near) certainty as the government will support them in order to avoid bankruptcies and greater financial and social distress. The concept of systemic importance is strongly reliable to banks' size and the institutions classified to be systemically important are the largest in the world. Nevertheless, the rankings on size and on systemic importance are slightly different since banks' interconnectedness takes part as well to the assessment of the systemic importance of institutions for the global financial system. Our evaluation of the value of implicit subsidies takes into consideration this key element by examining the dependence of banks on wholesale funding.

[1] The work carried out in this chapter has contributed to the publication of Toader (2015b)

The financial support provided by governments and public authorities have some important implications for beneficiary banks. Firstly, the expectation of public guarantee can provide incentives to increase the value of liabilities for beneficiary banks relative to non-beneficiary banks or similar corporate entities from other sectors. Secondly, they gain access to funding markets and to cheaper resources since the bank's effective exposure to risk is "shared" with the guarantor. Consequently, the risk premiums paid to investors do not reflect the losses they would have to incur in case of default. Therefore, this drives to a funding cost advantage for beneficiary banks although the guarantee itself is "implicit".

To the extent that this subvention is tacit, there is no ex-ante commitment either a concrete evaluation method. Hence, this chapter aims to provide a measure for implicit public guarantees and to identify the major determinants. We use a rating based approach to evaluate the value of implicit subsidies for a sample of 135 large European banks from 17 countries (OECD members) over the period of 2000 to 2014[2]. We focus on European banks as our topic has a major interest in the new context of the creation of an Economic and Monetary Union in Europe. Recent empirical literature focuses on American and English banks and present important differences in estimates that are mainly due to the methodology employed. In a comparative study, Noss and Sowerbutts (2012) provide support to the rating based model which gives according to their study the most realistic estimation of the value of implicit guarantees.

Using different types of credit ratings, we are able to evaluate the value of implicit guarantee for financial institutions in number of notches. In section 3.1 we describe some background information about implicit public guarantees and in section 3.2 we present our dataset and the methodology. Then, we raise questions that were discussed only marginally before the financial crisis. In a first step of our empirical analysis presented in section 3.3, we explain why certain banks receive greater implicit support compared to other similar institutions. Then, we test for the extent to which the financial strength of guarantor (government) affects the value of implicit guarantees over time. After presenting and interpreting the results of our empirical analysis in Section 3.3, we conclude and explain the policy implications for our findings.

3.1 Implicit public guarantees

The concept of implicit guarantees is closely linked to the expectation that the government will bailout an institution for which the risk of default is considerable. It can be materialized through a transfer of resources from the government to the benefit of a banking institution in order to avoid its bankruptcy and further distress. During the

[2] The initial study period was 1997-2012. The starting period has been pushed to 2000 for reasons of data availability for several banks. The database has been afterwards been updated with data for 2013 and 2014.

last financial crisis, public authorities had several interventions in the form of liquidity injections and/or repurchase of banks' risky assets, the aim of these interventions was to avoid the default of large institutions. Moreover, if one should take stock of public interventions, the results would certaintly highlight the public willingness to support "too-big-to-fail" (TBTF) or "too-interconnected-to-fail" (TITF) institutions as their disorderly failure could be a real threaten for the stability of the financial system.

Generally speaking, guarantees are "strategic instruments" since they provide protection and stability to consumers on one hand and by facilitating access to market funds, on the other hand. In addition, if there is an appropriate pricing, then they can become efficient instruments. Specifically, for explicit guarantees, the insurer is able to elaborate transparent and balanced contracts based on fair prices for the services that they provide. Nevertheless, this is not the case for "implicit" guarantees. As the name suggests itself, there is no ex-ante legal and explicit commitment for these guarantees and the amount is rarely made public. Therefore, no premiums can be charged in return for these implicit guarantees. From an economic point of view, given that an institution enjoys external support without paying any corresponding fee, one could analyse this support (guarantee) as a subvention.

Although costly for governments and ultimately, for taxpayers, public bailouts could be justified by a simple (and "rational") calculation. Specifically, in the case of a crisis, the default of a bank will generate losses, that one can imagine as largely higher than the cost of an *ex-ante* punctual support. This deduction is, of course, based on the assumption that the government will not allow large banks to fail since their default would cause major disruptions for the financial system and for the whole economic activity.

Nevertheless, beyond their positive effect in avoiding bankruptcy once the intervention is realized, implicit public guarantees have significant adverse effects that should be discussed. First, the crisis highlighted that many investors, senior unsecured or subordinated debt-holders, were the beneficiaries of public interventions even though the main objective of public bailouts should be taxpayers' protection rather than creditors' protection. Second, the existence of implicit guarantees affects market discipline as investors had no longer incentives to supervise banks' risk-taking behaviour Acharya et al. (2013). This could be even more disturbing given that expectations of public support for large banks provides incentives to risk-taking on both market and loan portfolios (Gropp et al., 2013; Brandao Marques et al., 2013; Moussu and Petit-Romes, 2013). Investors' perception on the value of implicit guarantees is therefore a real source of moral hazard and one of the most significant distortions of the financial activity especially as there is no price for the protection granted by governments (Freixas et al., 2004; Morrison, 2011).

Third, in the aftermath of the systemic crisis, banks which benefited from public support enjoyed funding cost advantages and became bigger and even more complex than in the wake of the financial crisis Haldane (2012a). As a result, beneficiary institutions are nowadays "too-systemically important-to-fail" and "too-important-to-regulate" becoming increasingly influential. Nevertheless, implicit public support does not have an impact only on the size of beneficiary banks, but also on the structure of their balance sheet. Specifically, they could lead to misrepresentations of the liability-equity structure concretized through sub-optimal levels of leverage as discussed in Admati and Hellwig (2013). Forth, the existence of implicit guarantees raises fiscal risks. The implicit subsidies, even if they are budgeted, are submitted to different fiscal frameworks being as well a source of distortion for financial activity, increasingly internationalized. Not only this could have competitive consequences for smaller banks but it could also lead to geographical biases in financial markets (Kane, 2009). Finally, one of the most evident adverse effect of public bailouts was the excessive risk transferred towards public finances, and the appearance of the sovereign crisis in Europe is the most concrete prove for that. Ultimately, public support granted to financial institutions was supported by taxpayers. For the UK alone, Morrison (2011) evaluates the taxpayers' exposure to banking sector losses at £955 billion proving that at some point, the implicit guarantees become explicit.

Due to the subprime crisis, implicit government guarantees are no longer seen as a myth, but rather as a real distortion of financial intermediation. Policy makers have also recognised the problematic effects of implicit subsidies and established a complex reform agenda to deal with the shortcomings in banking activity revealed by the financial crisis. Among the objectives of the regulatory framework, the improvement of banks' resilience to shocks and the dissolution of banks-sovereign loop are of key importance. The Capital Requirements Directive IV (CRR/CRD IV) framework, beyond the capital and liquidity requirements, demands additional capital buffers for systemically important banks (for example, the TLAC). In Europe, additional measures have been considered within the Economic and Monetary Union project with regard to a set of supervision and resolution policies that should be centralized and harmonized at a European level.

For these reasons, it is essential to quantify these distortions in order to get insights on the magnitude of their adverse effects and to better adapt future policy measure. A measurement based on considerable historical dataset will allow to better analyse these subsidies, to draw conclusions on their determinants and to provide previsions on future evolutions.

3.2 Quantifying the value of implicit public guarantees

This section starts with a brief literature review of the measures and indicators proposed so far in the literature. It focuses afterwards on the methodology that we have employed to quantify and analyse the value of implicit guarantees. First, we describe the sample and the dataset that allows us to produce estimates of the value of implicit guarantees. Second, we analyse the evolution of the indicator for the European banks in our sample. Finally, we perform an empirical analysis where the main determinants of the implicit subsidies and their effect in time are identified and quantified.

3.2.1 Literature review

The literature dealing with the issue of implicit subsidies is quite recent and made significant progress since the beginning of the financial crisis. Empirical studies and methodological reflection for quantifying implicit guarantees for banks' debt experienced a new dimension after Lehman Brothers default in 2008 and most of the following literature has been focusing on British and US banks. Since there is no established measurement, researchers and central bankers struggle to propose new measures for the value of implicit guarantees. One thing is clear, they exist and could no longer be ignored.

Early literature measured the value of implicit guarantees as a funding cost difference between a privileged bank and a non-privileged bank or similar financial corporation (Kwast and Passmore, 2000; Soussa, 2000; Baker and McArthur, 2009). More recent literature, focusing more closely on the value of implicit guarantees and the analysis of their effect on funding cost, uses two main estimation methodologies: one based on observed data (*Funding advantage model*) and another one based on assumptions and previsions on the future value of banks' assets (*Contingent claims model*).

The results obtained in the empirical studies are quite heterogeneous and sensitive to the measurement methodology. The main concern is the magnitude of the value of implicit guarantees evaluated using different methodologies (funding advantage model, the contingent claims approach or even event studies[3]). We will further detail the advantages and limits of each approach with references to the already existent literature.

<u>The funding advantage approach</u>

The funding advantage model estimates the implicit subsidy as a reduction in the cost of funding obtained thanks to the expectation of a future public support. Two

[3] We do not detail the literature and methodologies employed in papers using event studies since they are typically based on equity benefits. Nevertheless, implicit guarantees should be analysed through funding advantages on banks' debt. For this reason, we discuss only funding advantage and CC approaches.

alternative approaches can be distinguished according to the instrument employed, the size or the ratings. They are based on publicly available data and allow for an easier comparison between institutions relative to estimated that could be produced through contingent-claims models.

The first one compares institutions by their size and evaluates the value of implicit guarantees as the funding cost difference between small and large banks. It was employed especially in the pre-crisis literature when the concept of implicit guarantee was associated mainly to the size of banks and hence, to the concept of "too-big-to-fail" (TBTF). The second model takes into account ratings for different types of debt and compares them for supported and not supported debt in order to estimate the value of implicit subsidies.

For the size-based model, the main critic is linked to the simplistic hypothesis at the basis of the model: the evaluation of the value of implicit guarantees is based only on a comparison of the cost of institutions according to their size. Moreover, the assumption that only large banks receive government support could be easily dismissed. Another issue could be raised by the choice of the threshold allowing to distinguish between large and small banks. Using a sample of US banks and assuming that only banks with total assets larger than $100 billion can be bailout, Baker and McArthur (2009) estimate the funding advantage due to implicit guarantee at 49 bps. The corresponding annual amount of government support is estimated at $34.1 billion for 18 US banks. Using another definition of large banks (ie. the 90th percentile of the sample of 500 US financial institutions in terms of size), Acharya et al. (2013) evaluate the funding cost advantage to 28 bps before the crisis, and to 120 bps during the crisis. The effective amount of government support according to them is approximately $200 billion during the period of string distress[4].

The rating-based model is more often employed than the previously described size-based model, being considered as more complex and more relevant in measuring the value of implicit guarantees. Moreover, it allows for a more relevant comparison of results for banks from different countries since the rating methodology is the same for all rated institutions. Although one could criticize the use of this approach for reasons of relevance of credit ratings in the early periods of the subprime crisis, we should bear in mind that markets are using credit ratings in pricing debt instruments and what we are interested in is the way market integrates this implicit advantage. Therefore, the informative power of credit rating cannot be disregarded. Specifically, the rating agencies provide different evaluations for the probability of default of listed institutions: ratings taking into account the expectation of a public bailout in case of bankruptcy and ratings excluding any

[4] Jacewitz and Pogach (2011) suggest that uninsured depositors, just like debt holders, can incur losses if a bank goes bankrupt. Using a size-based approach, they find that largest bank pay 15-40 bps lower than other banks for comparable deposits during the period from 2005 to 2008.

external support. Therefore, from the spread between these two evaluations, commonly called uplift, one gets an assessment of the value of implicit public support measured as the expectations of public bailout as evaluated by rating agencies. Among the empirical studies using this methodology to evaluate implicit guarantees, the ones driven by the OECD and the Bank of England are in our opinion the most relevant. Haldane (2012a) evaluates the value of implicit guarantees for 29 large systemically important institutions designed by FSB at 1.3 notches before the crisis. According to its study, the value of implicit guarantee increased in 2009 to 3 notches. Haldane (2012a) evaluates the amount of annual government support to $70 billion for the pre-crisis period and to $700 billion in 2009. Li et al. (2011) find that public guarantees for TBTF banks could be translated into a funding cost advantage for about 56 bps during period of crisis. Schich and Lindh (2012) find an average uplift of 2.2 notches by analysing a sample of 118 European banks. According to their study, the value of implicit subsidy reached its peak in 2009 (3.14 notches). Using a larger sample (900 banks from 16 OECD countries), Ueda and Mauro (2013) evaluate the funding advantage of around 60 bps in 2007 and 80 bps in 2009.

Important differences are noticed across these punctual studies using funding advantage models. This heterogeneity in results is especially due to the size of the samples and the selection of the institutions that compose the samples. For example, Haldane, 2012a focuses on English banks, Baker and McArthur (2009) and Acharya et al. (2013) analyse US banks while other studies use cross section analysis using multi-countries datasets. A second explanation comes from the choice of the study period. Most studies focus on the crisis period or even on a specific point in time to evaluate the implicit subsidies. Finally, the choice of the measurement variables is crucial for the magnitude of the results: on one hand, for the size-based model the choice of the threshold that allows to distinguish between large banks and other banks and, on the other hand, for the rating-based model the choice of credit ratings.

The contingent claims approach (CCA)

The CCA is mainly based on the Merton's option pricing model where the value of the government support is estimated as the difference between the observed value of assets and a threshold based on the minimum capital requirement at a future point in time[5]. Therefore, by evaluating the difference between the observed and the estimated value according to their capitalization, one gets a measure of the expected government support needed to restore the value of assets to the minimum amount Li et al. (2011). Since it

[5] The value of the implicit subsidy is similar to a put option.

requires the modelling of the future distribution of banks' assets, this method is very sensitive to the initial assumptions. To evaluate the value of future assets, one could use either the prices of equity options or estimates based on historical shares prices. Using an equity option price approach, Oxera (2011) evaluates the annual amount of public support for English banks to be more than £120 billion with £5.9 billion state support in 2010 only for the five largest banks.

Even if this approach allows for a continuous evaluation of the government support as perceived by market participants, when a systemic event is accounted for, the results are very sensitive to the initial assumptions: the time horizon describing the timing of government intervention, the choice of the discount factor for the tail distribution of asset returns.

From their comparative study, Noss and Sowerbutts (2012) conclude on the overestimation of the value of implicit guarantees using the CCA. This can easily be explained by the fact the equity prices include investors' risk aversion which may overestimate the cyclicality of default risk. This conclusion has been lately reinforced by the study driven by Siegert and Willison (2015) bringing support to funding-advantage models. They suggest the use of assessment measures that can be updated on a regular basis in order to allow for a tracking of the evolution of implicit subsidies over time.

3.2.2 Data and Methodology

Our assessment of the value of implicit guarantees uses the rating based model following the approach adopted in Estrella and Schich (2012) and Schich and Lindh (2012). We exploit different assessments of rating agencies and compare the evaluations for supported and not supported debt in order to estimate the value of implicit subsidies. We will further present the advantages and the issues raised by the use of this approach.

The rating based model has the advantage of a common methodology used by the rating agencies for all rated institutions. This is a real advantage of ratings compared with other indicators when samples of international banks from different countries are analysed[6]. Moreover, they allow for a forward-looking estimation of the government intervention given the parameters and the criteria used in their evaluations[7]. Moreover, the rating agencies' judgments allow controlling for banks' business strategies and somehow for the risk level associated to each business model. Finally, a very strong argument for the rating based approach is that market participants do rely on these evaluations when valuate bank's debt. There is clear evidence on the effect of credit ratings on bond spreads

[6] Yield spreads, for example, also include domestic market specific features that can bias the assessments and that should be taken into account in comparison analysis.

[7] Please see Moody's Investors Service (2011) and Moody's Investors Service (2015b) for more details on rating methodologies.

even if the relationship changes over time (Resti and Sironi, 2005). They represent tools in defining the collateral requirements for wholesale and central bank funding operations, therefore the reliance on credit ratings in practice is obvious.

The mistakes in the default judgments, at the beginning of the crisis, have been criticized given for reasons of their serious implications on financial activity and the worsening of the crisis[8]. Although we are aware of this problematic aspect, it does not influence our assessment. The most important aspect of the use of credit ratings is the strong reliance of market participants and of certain regulatory measures on credit ratings as pricing debt instruments. We present in what follows the methodology and the dataset used to compute our measure of implicit guarantees.

3.2.2.1 Our methodology

To quantify the value of implicit guarantees granted by governments, we manually collected data from Moody's website. We chose Moody's ratings for several reasons: for the clarity of ratings' definition, better transparency of rating methodology compared with the one provided by Fitch and finally, the greater availability of the data for Moody's ratings. Our choice is supported by comparative studies of Van Roy and Vespro (2012) and Packer and Tarashev (2011) which provide evidence on a more proper evaluation of banks' creditworthiness and also a better compatibility of ratings with our topic than Fitch and Standard and Poor's assessments[9].

We retain two different ratings provided by Moody's, one representing an assessment of banks' ability to meet its commitments on time by taking into account the possibility of an external support when necessary and a second one, excluding for any type of external support. Thus, the difference between the "all-in credit rating"-AICR (accounting for the global strength of the bank) and the "stand-alone credit rating"-SACR (the intrinsic strength of the institution), measured in number of notches, gives an assessment of the implicit guarantee[10]. We finally obtain a consistent dataset with historical time series for individual institutions.

The stand-alone credit rating (SACR) is proxied by the Baseline Credit Assessment reported by Moody's[11]. To calculate the uplift, three candidates to proxy the all-in credit

[8] Heavily criticism has been brought to ratings agencies for the error assessments that underestimate the systemic component of risk ahead to the last financial crisis (Casey, 2009) but also for having overrated structural products just before the financial crisis.

[9] Please see Packer and Tarashev (2011) for more details on comparison criteria and methodology.

[10] The debates on the use of rating based model also raised the question of the components of the spread between the AICR and the SACR. Moody's rating methodology precise that the AICR rating takes into account the possibility of an external support, either from its parent-company or from the government. In our case, only large banks (the largest from Europe), on a consolidated base are considered. Therefore, the eventual external support comes from the government.

[11] Our previous research studies were use the Bank Financial Strength (BFSR) rating to describe the SACR. Since 2014, Moody's replaced it with the Baseline Credit Assessment and since, the BFSR was no longer available. Compared to the previous rating, the BFSR, the actual one - the BCA - has the advantage that it follows exactly the same rating categories as the (proxies for) the all-in credit rating.

rating (AICR) were considered: the long-term issuer, long-term foreign currency deposit and senior unsecured foreign currency credit rating. All three types of ratings are reported only for some banks and only two or often just one type of ratings is reported for most banks[12].

The spread between the two ratings, that can be referred as rating "uplift" (Schich and Lindh, 2012), is obtained by subtracting (the numerical equivalent of) the stand-alone rating from (the numerical equivalent of) the all-in rating. The ratings are mapped to numerical values starting from the highest rating (AAA, set equal to 20) and decreasing by one notch down to the lowest rating observed (Caa2, equivalent to 3)[13]. Box 1 describes the different credit ratings that have been employed in our assessment of the value of the implicit guarantee.

Box 3.1. Description of different credit ratings

Stand-alone credit rating
The *Baseline Credit Assessment - BCA*, represents Moody's opinion on the standalone intrinsic strength of the issuer. The judgment is absent of any extraordinary support from an affiliate or a government[14]. Computed as the standalone probability of failure, it has three main determinants. First, the financial profile of the entity is analysed using financial ratios as indicators of transformation undertaken and resulting risks. Second, the macroeconomic profile described by the economic and institutional strength, susceptibility to risk events, economic growth perspectives, private-sector credit and the assets prices level. Finally, the evaluation takes into account other non-financial qualitative judgments like portfolio diversification, complexity and opacity of activities and finally, the management strategy. It scales between Aaa (corresponding to the numerical value of 20) to C[15].

All-in credit ratings *Long-Term Issuer Rating* is assigned to the issuer and describes Moody's judgment on the ability of entities to honour financial counterparty obligations and contracts with a maturity of one year or more. Long-term ratings are assigned to issuers and reflect both on the likelihood of a default on contractually promised payments and the expected financial loss suffered in the event of default. Global long-term ratings scale from AAA (highest quality) to C.
Bank Deposit Rating - and more precisely the *Long-term Bank Deposits (Foreign currency)* - is Moody's opinion of a bank's ability to repay its deposit obligations punctually. Deposit ratings (foreign currency) are intended to incorporate those aspects of credit risk relevant to the prospective payment performance of rated banks with respect to deposit obligations, and include the following: a) intrinsic financial strength; b) sovereign

[12] In some cases, the numerical equivalents of three ratings are not always the same for each bank (at one point in time); in fact, while the difference is typically equal to zero, senior unsecured foreign currency credit rating tends to be slightly more different from the other types of ratings. In several cases, the difference reflects differences in the timing of rating changes (e.g. one rating is adjusted up or downwards only with some delay). The maximum difference observed in the sample is two notches. There is no systematic pattern in the sense that one type of rating is always higher than the other two ratings.

[13] For robustness concerns, we also consider an alternative rule to define the uplift. We calculate the maximum of the three types of ratings as proxy for the all-in credit rating in order to compute the uplift. In some cases, when higher frequency data is analysed (for example, monthly data) differences can appear between the results of the two approaches. However, in the empirical analysis which uses annual data, results are very similar.

transfer risk and c) implicit external support elements. In turn, they do not incorporate the benefits that the bank could enjoy from deposit insurance schemes. In general, ratings for foreign currency deposits are lower relative to the bank's rating for domestic currency deposits.
Senior Unsecured Rating describes Moody's opinion of the ability of entities to honor senior unsecured financial counterparty obligations and contracts. It incorporates any external support that is expected to apply to all current and future issuance of senior unsecured financial obligations and contracts, such as explicit support stemming from a guarantee of all senior unsecured financial obligations and contracts. Senior unsecured rating is expressed on its long-term global scale going from AAA to C.

Source: Moody's Investors Service (2012); Moody's Investors Service (2011); Moody's Investors Service (2015b)

Being computed as the difference between the all-in rating and the stand-alone rating, the uplift is interpreted as an implicit measure for the public implicit guarantee offered to banks. This indicator is used in our empirical model as dependent variable since we search to identify the factors that drive the evolution of these distortions in banking activity. We consider the end-period values for credit ratings and calculate the value of the uplift for each bank i at each end of period t. Explanatory and control variables accounting for banks' riskiness and structural features are explicitly described in Table 3.7 (Appendix C).

While credit rating dataset is available for the period from 2000 to 2014, we dispose of balance sheet historical data only for the crisis period going from 2007 to 2014. Therefore, the empirical analysis that will be driven in section 3.3 is based on the dataset counting 135 European banks from 2007 to 2014 (8 periods).

3.2.2.2 Sample

The choice of the methodologies had an impact on the size of the sample since only rated banks have been included. The final sample consists of annual observations for 135 banks from 17 countries from January 2000 to December 2014. Banks were retained in the final sample as long as two conditions were fulfilled. First, that balance sheet and credit rating data were available for the full sample period (for example, data was not fully available for Banco Pastor, Agricultural Bank of Greece, Cajamar Caja Rural Sociedad Cooperativa de Crédito, Banco Español de Crédito SA). Second, when more than one bank from the same group was present in the sample, only the headquarter bank was retained (with the exception of the subsidiaries Nordea Bank Finland, BNP Paribas Fortis Belgium, ING Belgium, Nordea Bank Norway, UniCredit Bank Austria AG-Bank Austria which hold over 10% of total banking assets in that country and were

[14]More recently, with the aim of improving the transparency of its assessments, Moody's made publicly a new rating, the Adjusted BCA. This latter is very similar to the BCA, the only difference consists in the fact that it distinguishes between the government support and the support provided by affiliate entities. However, time series for this rating are available only starting with 2011. For reasons of data availability, we use it only for robustness check.

[15]Please see Appendix B for the mapping scale.

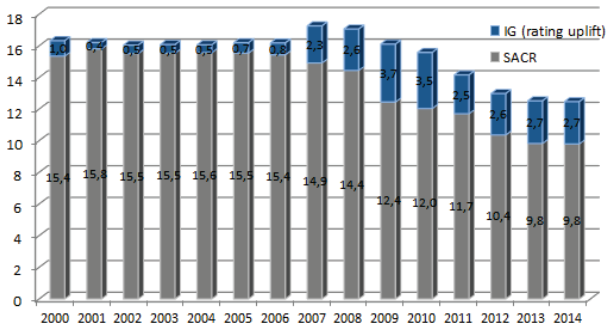
retained so as to have a more representative group of banks for that countries). The final sample consists of 135 banks for 17 countries, with only 2 banks per country in one case (Luxembourg) and 3 banks in one country (Finland) and otherwise four or more banks (remaining 15 countries). Unconsolidated data was considered as it relates more closely to our objectives of determining the drivers of implicit support (Chapter 3) and domestic bank failure resolution costs (Chapter 4) since it allows for a more granular view of the stability of the institution. For 7 banks for which unconsolidated data was unavailable, consolidated data was used instead (four from Austria, two from Spain and one from Belgium). Nonetheless, we have also performed the same analysis based on consolidated data and we obtain very similar results (robustness check analysis in section 3.4). The complete list of banks included in the sample is available in Appendix A.

3.2.3 Descriptive statistics

In this section we are going to analyse the evolution of the value of implicit subsidies calculated using the methodology described in previous section. Figure 3.1 illustrates the evolution in time for the stand-alone rating and the uplifts. Important differences in the average values before and after the crisis can be observed. The financial strength of institutions is continuously lowered starting with 2007 given general economic developments while the value of the uplift is considerably higher for the same period. According to this plot, there is clearly evidence on the importance of external support during the crisis, but also on the extent to what implicit support become explicit in times of distress.

Overall, the average value of the all-in credit rating is increasing in 2007 and 2008 and decreasing continuously from 2009. Table 3.8 (Appendix C) presents summary statistics for the credit ratings and uplifts.

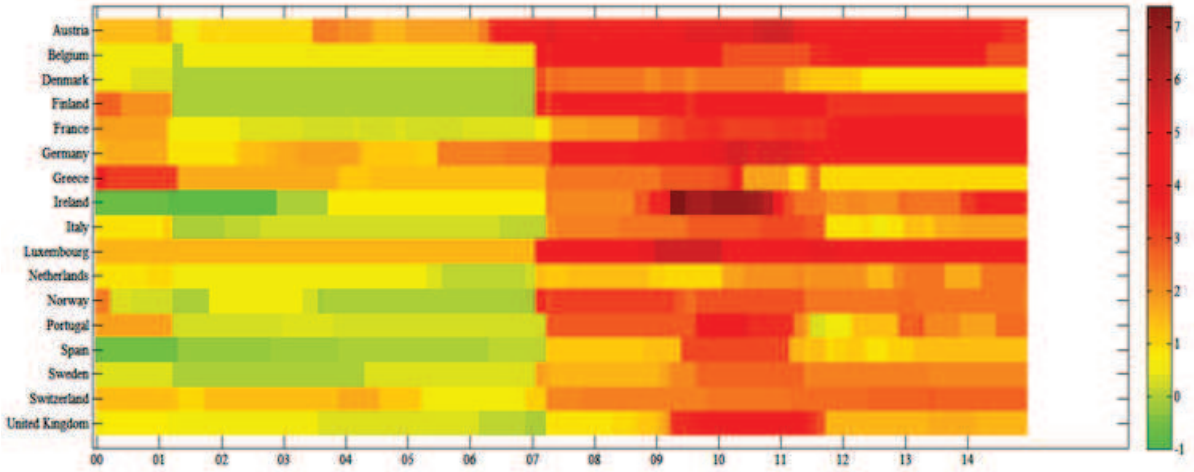
Figure 3.1: Changes in the stand-alone credit rating and uplift from 2000 to 2014 (average values)



Notes: We plot annual average values of the stand-alone rating and the uplift. The sum of the SACR and the uplift gives the value of the AICR. The sample consists in 135 European banks for which we dispose of time series for credit ratings from 2000 to 2014.
Source: Moody's, author's calculations

Although there is clear evidence on the evolution in time for both stand-alone ratings and uplifts, the annual average values can conceal important differences between entities on the one hand, and between banking systems on the other hand. By plotting the average estimated values of implicit subsidies for each country, we notice that there are considerable changes in the wake of the financial crisis that are considerably different among countries.

Figure 3.2: Evolution of the estimated value of implicit subsidy for each banking between 2000 and 2014



Notes: We plot simple averages of the uplifts for each country. Averages are calculated on a monthly frequency for each banking system (Appendix A for complete list of participating banks from each country). On the right, the scale illustrates the mapping of colours with numerical values of the uplifts, expressed in number of notches.
Source: Moody's, author's calculations

In countries like Austria, Germany or Luxembourg there are, in average, higher expectations of public bailouts (represented by the dark red in the heatmap). Nevertheless, for most countries the value of implicit guarantees reaches higher values only in periods of strong distress from 2009 to 2012 (for example in Ireland, Spain, Sweden, and United Kingdom).

We notice important changes in stand-alone ratings (Figure 3.1) and also in the value of implicit guarantees (Figure 3.2) since 2000. However, we chose to focus on the evolution of implicit subsidies for the period 2007 to 2014 when there is more explicit evidence on the existence of this governmental support for large financial institutions but also for reasons of balance sheet data availability[16].

From the beginning of the crisis, one could identify three main "episodes" in the evolution of the value of implicit guarantees corresponding to the subprime crisis, the sovereign crisis and the most recent years that could be considered as a post-crisis period. Figures 3.3 to 3.5 illustrates the changes in the value of uplifts for each banking system in our

[16] In the published article emerging from this chapter, we empirically analyse the evolution of implicit guarantees in the pre-crisis period. Nevertheless, the policy interest on the results is lower than for crisis periods.

sample for three key years: 2007, the wake of the financial crisis; 2010, the wake of the sovereign crisis in Europe and the most recent value from end-2014.

We notice that there is a systematic increase in the value of the uplift between 2007 and 2010 in all European countries. A remarkable observation is that the value of the uplift is associated to a general worsening of banks' intrinsic strength (banks with weaker quality of the stand-alone ratings enjoy greater support from public authorities) which is indicated by the lower numerical values corresponding to the *SACR.*

However, even if the financial health of banks did not improve between 2010 and 2014, the value of the uplift is decreasing and even reaches very low levels for certain countries in difficulties in 2014 (Greece, Portugal, and Italy). This evolution could be associated to the concerns about the solidity of public finances raised starting with 2009 and concretized starting with 2010 through rating downgrades (Figure 3.5). This assumption will be further tested within our empirical model.

Although Figure 3.5 shows that the value of implicit guarantees is generally decreasing since 2010, the implicit guarantees - even if considered as one of the most disturbing distortion in banking system - continue to persist.

Figure 3.3: The average values of the SACR and the uplift by country as in 2007

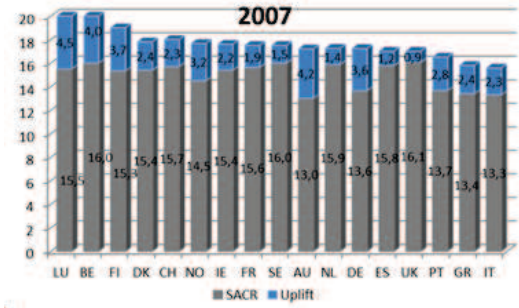


Figure 3.4: The average values of the SACR and the uplift by country as in 2010

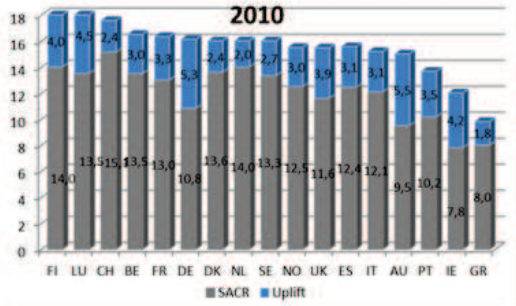
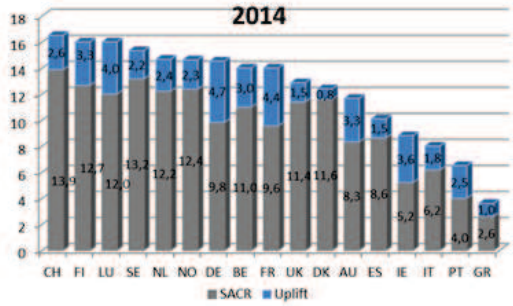
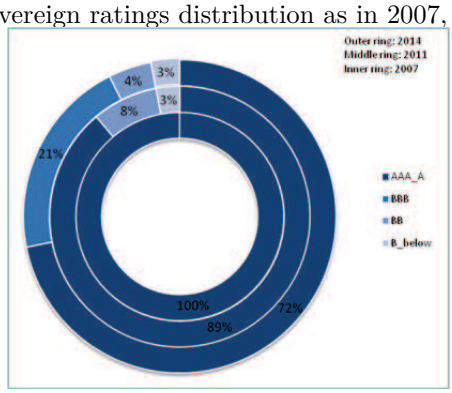


Figure 3.5: The average values of the SACR and the uplift by country as in 2014



Notes: We plot annual average values of the stand-alone rating and the uplift. Countries are ranked by their all-in rating (average value as well), which is the sum of the stand-alone rating and the uplift.
Source: Moody's, author's calculations

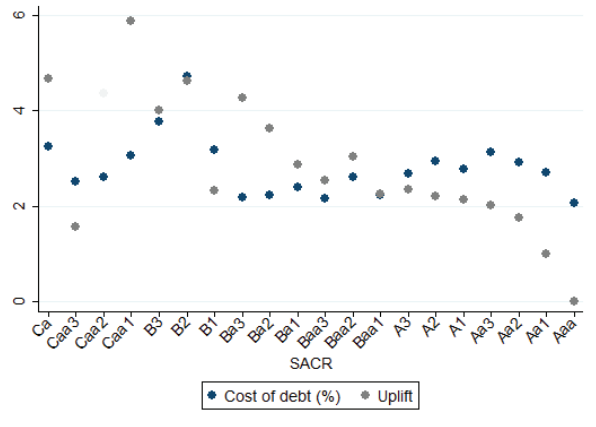
Figure 3.6: Sovereign ratings distribution as in 2007, 2010 and 2014



Notes: We construct 4 categories of ratings for presentation reasons. The arcs illustrate the distribution of sovereign ratings for each category as in 2007 (inner ring), 2011 and 2014 (outer ring). Percentages are calculated based on the 135 observations corresponding to each period.
Source: Moody's, author's calculations

Furthermore, we expect that higher uplifts will be transcribed into lower funding costs for beneficiary banks compared to similar entities not enjoying governmental support. Nevertheless, risky banks should pay in average highest rates for their debt despite the high expectations of government support in times of distress. At the opposite, safer banks (upper medium and high grade ratings) are likely enjoy generally lower implicit guarantees and should spend more on interest expenses. Figure 3.7 illustrates the average values of the cost of debt and the implicit guarantee by class of stand-alone rating.

Figure 3.7: Cost of debt and Uplifts by value of SACR



Notes: We plot average values for the cost of debt and for the uplift, by class of stand-alone rating. The cost of debt is calculated as the ratio of interest expenses to interest bearing liabilities.

Middle class ratings seem to enjoy the most the implicit guarantees since for relatively high levels of risk, their average cost of funding is similar to the one for better rated banks due to the expectations of public support. For the banks with the highest values for the stand-alone rating (Aa and Aaa ratings), the implicit support is considerably lower and hence, the cost of funding is not much lower than for other banks.

Two main questions emerge from the stylized facts. First, what will be the determinants of the implicit support, beyond the intrinsic strength of the institutions? And second, how these determinants evolve over time?

We aim through this study to respond to these questions. Section 3.3.1 treats the question of the determinants of the value of implicit guarantees from banks' perspective. Specifically, we examine the extent to which several characteristics of banks' balance sheet explain the evolution of the implicit guarantees in European banking systems. Section 3.3.2 goes one step further and tests for impact of several factors describing the guarantor capacity to support. Finally, we jointly analyse the evolution of banks and sovereigns' strength in order to explain the time variation of uplifts.

3.3 Empirical analysis and results

The aim of this empirical study is to analyse determinants from two perspectives corresponding to the main actors "deciding" the need and the agreement on the magnitude of the support: the financial institution - the beneficiary, and the government - the guarantor. We first analyse the determinants of the estimated value of implicit guarantee by looking at the structural characteristics of banks and then we focus on the systemic importance of institutions and the impact that the G-SIB status[17] may have on the value of implicit guarantees. We proceed next with the empirical analysis that evaluates the support capacity of governments.

3.3.1 Why certain banks receive greater implicit subsidies?

Generally speaking, the ratings are opinions about the creditworthiness of an organisation, reflecting both a quantitative risk assessment and a subjective evaluation of a rating agency on the expected amount of losses that the entity could incur in the future (Moody's Investors Service, 2011). However, one could still judge the rating methodology as subjective with a lack of explicit detailed rule that can formally explain financial, non-financial or sovereign ratings.

Several factors are commonly identified as important drivers of credit ratings and implicitly of the value of implicit subsidies. For example, the importance of the bank is recognized to be a crucial determinant for the financial and for overall economic activity. Size and more precisely, the *too-big-to-fail* status, has been largely used in the literature as a major indicator in assessing the impact of institutions' failure. With the 2008 liquidity crisis, the viewpoints evolved and recognized the key role of the interconnectedness of the institution with the rest of the system in evaluating the expectation of a public support. Since they have been strongly criticized for the lack of consistency in the evaluation in the wake of the financial crisis, rating agencies are continuously intensifying their efforts to improve rating methodologies in order to provide more realistic and credible evaluations (Moody's Investors Service, 2015b).

The common practice of rating agencies consists in assessing quantitative coefficients to different criteria that will further serve to compute an average score, the rating. By analyzing the different types of ratings for banks with similar structural patterns, we notice considerable differences in their evolution. This could be partly explained by the weights assessed to each factor that seems to vary considerably among banks.

[17] In writing, we distinguish between the recognition of banks as globally systemic important (noted G-SIBs) and the official attribution of the status (noted G-SIB status). This distinction has more implication for further analysis in Chapter 4.

We search to test for the explanatory power of several bank's structural patterns that are not explicitly included in the assessment of stand-alone ratings[18] and that we consider as crucial elements for the resilience of banks facing financial distress. We assume that additional information about the probability to be bailout in time of distress could be given by funding structure and business strategy characteristics. The funding structure is essential since it provides information about bank's capacity to finance its activities under different economic scenarios and the business strategy, described here by the composition of asset portfolio, indicates counterparties to which a bank can be exposed (Hau et al., 2013).

The model described in (3.1) indicates the characteristics of banks that may have a main role in explaining the variability in the value of implicit guarantees. First, we consider the stand-alone rating as the main explanatory variable since it assimilates several banks' key features (capitalization, profitability, efficiency) and allows us to account for the "intrinsic" level of risk (that could also be considered as the initial risk level). From a technical viewpoint, accounting for the *SACR* will also allow us to take into consideration the evolution of uplifts according to the credit rating class (investment, speculative, etc)[19]. Second, we test for the impact of the size on the value of the implicit guarantees by taking into consideration the eventual nonlinearities in the relationship. Our intuition is based on statistical analysis of the data showing that banks with similar size of their balance sheet enjoy different levels of governmental support. The non-linearity is tested by including in the model the squared value of the size. The following equation describes our model:

$$IG_{it} = \alpha_1 SACR_{it} + \alpha_2 Sizebank_{it} + \alpha_3 X_{it} + \varepsilon_{it} \tag{3.1}$$

where *SACR* states for the intrinsic strength of the bank i at time t. X is a vector of control variables that could affect the value of implicit guarantees since they could be overweighed by public authorities in their decisions to bailout (such as the dependence on wholesale markets, asset portfolio structure, and business model). ε_{it} is the error term.

We first run a baseline regression explaining why some banks receive greater implicit guarantees from public authorities than others and to identify the determinants that are not explicitly mentioned in rating methodologies. Several additional regressions will be tested in regression 2 to 5, integrating one by one the additional control variables describing bank's characteristics.

The results of regressions are presented in what follows.

[18] For more detailed information, please see Moody's Investors Service (2013): "Rating methodology. Global banks"

[19] This brings us back to the idea that an uplift of one notch is not the same for all banks, but it rather depends on the rating class.

IG explained by bank's characteristics

Table 3.1 reports the results for the first series of estimations. There is clear evidence on the explanatory power of the stand-alone rating in explaining the variability of implicit guarantees. The negative coefficient indicates that banks with weaker quality of their stand-alone rating enjoy greater implicit support. In other terms, there are greater expectations on public bailout for the banks with weaker intrinsic strength. Moreover, this result is robust for all specifications that have been tested. After all, the stand-alone rating is the key driver of the value of the implicit public guarantee since there should be no expectation of public support if it is not needed[20]. However other features of bank's balance sheet could explain the variability of the dependent variable.

Looking at the results of regressions that account for the size of the bank, we learn that larger banks generally take more advantage of government support than smaller banks. These results confirm the TBTF theory sustaining that large banks enjoy government "protection" in case of distress.

In order to identify additional structural indicators, we check for the impact of banks' dependence on market based activities, and more precisely of derivatives and marketable debt. We learn that the funding structure affects significantly the estimated value of the *IG* while the structure of their business activities has no considerable influence[21]. Our intuition is given by the OECD/CMF survey's results which indicate, on the basis of statistical or anecdotal information, that banks interconnections pass through short-term market debt. The results of the survey are presented in Schich and Aydin (2014).

In our model, the funding structure is described by the proportion of marketable debt (i.e. wholesale funding), which sums short-term and long-term borrowings, as of total assets. Results indicate that greater dependence on wholesale funding is associated to higher implicit subsidy. Generally, banks with funding structures based mainly on wholesale funding are generally more vulnerable to maturity mismatches generated by an excessive activity of maturity transformation. This makes them more sensitive to funding shortcomings (which could be due to loss of market confidence) and subsequently, to contagion effects. The excessive use of wholesale funding is also associated to strong interconnectedness which has proved to be a source of distress under uncertain market

[20] In a very recent study using Fitch ratings, Barth and Schnabel (2013) highlight a significant impact of intrinsic creditworthiness rating on markets' expectations on public support during crisis periods.

[21] We also tested for the impact of liquid assets and we find that higher proportions of liquid assets are associated to higher uplifts. Although this result is counterintuitive at a first view, it could be more easily explained given that the study covers periods of highly distress. Specifically, during periods of distress, the lack of confidence in counterparties and concerns about the intrinsic value of assets drive to fire sales and spillover effects, with major adverse impact on financial markets. Therefore, for banks with important holdings of these short-maturities assets, of which considerable proportions of government bonds, the expectation of a future government intervention becomes stronger. We chose not to focus on this indicator given the susceptibility raised by the calculation of the amount of liquid assets as provided by Bankscope.

conditions. We identify this feature of banks as a key driver of the value of the implicit guarantee since it may amplify systemic vulnerabilities.

Table 3.1: Results of regressions testing for banks' balance sheet patterns, over the period 2007-14

	(1)	(2)	(3)	(4)	(5)
VARIABLES	IG	IG	IG	IG	IG
Bank strength (SACR)	-0.174***	-0.198***	-0.104***	-0.195***	-0.200***
	(-8.439)	(-8.829)	(-4.311)	(-8.851)	(-7.880)
Size of bank		0.352***	0.235***	0.358***	0.306***
		(10.49)	(4.232)	(10.52)	(7.281)
Derivatives			0.204		
			(0.233)		
Marketable debt				1.319***	
				(4.040)	
Retail ratio					-0.352**
					(-2.245)
Constant	4.891***	1.276***	1.086*	0.594	2.143***
	(17.49)	(3.123)	(1.744)	(1.363)	(3.740)
Observations	1 036	990	617	987	840
R^2	0.095	0.164	0.065	0.189	0.159
R^2 adj	0.0944	0.162	0.0607	0.186	0.156
F	71.22	72.29	13.71	52.70	37.06

Notes: Size of the bank is the logarithm of total assets. Wholesale funding is the sum of short-term and long-term borrowings. All balance sheet variables are reported as of total assets. Retail ratio describes the proportion of retail activities on assets and liabilities sides as of total assets and is a business model indicator. The number of observations varies from one column to another since data requested to calculate the retail ratio is not available for all banks and for all periods in Bankscope. Robust t-statistics in parentheses *** p<0.01, ** p<0.05, * p<0.1.
Source: Moody's, Bankscope, author's calculations

As mentioned in EC study (ECB, 2014c), the business profile of the bank (retail oriented, wholesale or investment oriented) may affect investors' expectation on governments' intervention to bailout banks in distress. Using the variable *Retail ratio* inspired by Brandao Marques et al. (2013) we show that the business model of banks has significantly affected the variability of implicit guarantees from 2007 to 2014. More precisely, banks oriented on "traditional" activities have generally higher proportion of loans in their portfolios and of customer deposits in their liabilities. The results in column 5 indicate that retail activities are negatively associated to the value of implicit guarantees. This finding has important policy implications for structural reforms since it proves that banks oriented on traditional activities are less "claimant" of public support.

We chose not to present results of regressions testing for solvency and liquidity since these two factors are central in the assessment of stand-alone ratings and do not provide any additional information.

Furthermore, one could imagine that the value of implicit guarantees does not vary linearly with the intrinsic strength and the size of the banks. For this reason, we will

test in what follows for a specific type of non-linearities. Namely, we examine if the relationships between *IG* and *SACR*, on one hand, and *IG* and *Size*, on the other hand, can be represented by a quadratic function.

In order to account for specific nonlinearities (i.e. quadratic) in the relationships described in equation 3.1, we define the model:

$$IG_{it} = \alpha_1 SACR_{it} + \alpha_2 SACR_{it}^2 + \alpha_3 Sizebank_{it} + \alpha_4 Sizebank_{it}^2 + \varepsilon_{it} \tag{3.2}$$

The results in Table 3.2. confirm partly our intuitions. While the findings on the non-linearities between *IG* and *SACR* are not very convincing[22], the one with respect to the impact of *Size* are more interesting. More exactly, we find that the relationship between the *IG* and *Size* is described by a concave function[23].

These findings bring additional evidence with respect to the distribution of the implicit subsidies according to the size of institutions. The greater estimated value of the implicit guarantee is obtained for Crédit Agricole CIB belonging to the group of the 10% largest banks in our sample by size.

Table 3.2: Testing for non-linearities (2007-14)

	(1)	(2)	(3)
VARIABLES	IG	IG	IG
Bank strength (SACR)	-0.00566	-0.194***	0.0725
	(-0.0682)	(-8.557)	(0.766)
$SACR^2$	-0.00812**		-0.0128***
	(-2.363)		(-3.289)
Size of bank		0.897***	0.921***
		(3.325)	(2.971)
Size of $bank^2$		-0.0251**	-0.0253*
		(-2.019)	(-1.795)
Constant	4.144***	-1.670	-3.106*
	(8.300)	(-1.124)	(-1.664)
Observations	1 036	990	990
R^2	0.101	0.166	0.179
R^2 adj	0.0994	0.163	0.176
F	65.05	50.57	52.07

Notes: Size of the bank is the logarithm of total assets. Non-linearities are described by quadratic relationship between the value of implicit guarantees (IG) and the SACR and the Size, respectively. Robust t-statistics in parentheses *** p<0.01, ** p<0.05, * p<0.1.
Source: Moody's, Bankscope, author's calculations

[22] The analysis driven in Toader (2015b) over a longer period, from 1997 to 2012, highlight a significant non-linear relationship between IG and SACR. The choice of the study period, including pre-crisis historical data, can explain the difference in results.

[23] Please see Figure 3.13 in Appendix C.

In this section, we investigate the extent to which size, funding structure and business strategies explain the evolution of the estimated implicit guarantees. The results highlighted through our regressions can be summarized in four main points. First, we show that banks with weaker strength given by low stand-alone ratings are benefit from greater implicit guarantees. Second, we find that large banks benefit from greater implicit guarantees than smaller banks. Since government support is granted for banks' debt, the positive relationship between the size of banks and the uplift is explained by the larger proportion of liabilities held by large banks. Third, the importance of funding structure patterns is emphasized by showing that there are greater expectations of governmental support for banks with greater dependence on wholesale funding. Our findings are contrary to the ones of Ueda and Mauro (2013), whose analysis is based on Fitch ratings, suggesting that the support does not depend on the indebtedness of banks (Debt/Total assets). Finally, we estimate lower uplifts for retail oriented banks which are generally focused on traditional activities and hence, less dependent on short-term borrowings.

Nevertheless, we have still not investigated for the systemic importance of banks in explaining the evolution of the implicit guarantees. Given several technical aspects, the treatment of this characteristic requests more attention. For this reason, we are going to focus on the issue in the next sub-section.

IG explained through the systemic importance of banks

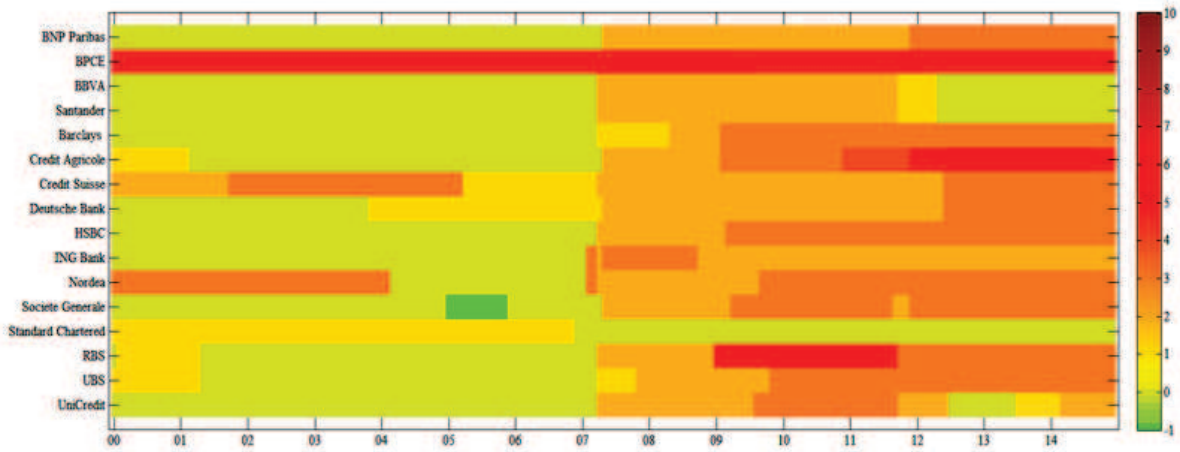
In addition to the intrinsic strength of the balance sheet and other several banks' characteristics, the systemic importance of institutions is likely to considerably influence the estimated value of implicit guarantees.

We evaluate the systemic importance of banks using the BCBS and FSB's assessments and classifications of globally systemic banks that are publicly available since November 2011. We compute a binary variable that equals one if the bank received the G-SIB status[24]. The list of G-SIBs from European countries is unchanged since November 2012, after several changes incurred since November 2011 and November 2012 when Commerzbank (DE), Dexia (FR) and Llyods (UK) have been excluded since their systemic importance was reduced.

In Figure 3.8 below we notice a significant change in the value of implicit guarantees in 2007 for all G-SIBs, excepting BPCE (FR). A second wave of changes intervenes in 2009/2010. Globally, we have reasons to believe that the relationship between the estimated values of implicit guarantee is structurally different for G-SIBs than for the rest of the banks in our sample.

[24] In line with the list published by FSB in November 2014

Figure 3.8: Evolution of the estimated value of the implicit guarantee for European G-SIBs



Notes: We count 16 G-SIBs in Europe from the list of 30 worldwide G-SIBs published by FSB in November 2014. On the right, the scale illustrates the mapping of colours with numerical values of the uplifts, expressed in number of notches. For comparison reasons, we consider the last or respectively, the first available rating when values are not available (for example, for BPCE, before 2009).
Source: Moody's, author's calculations

Based on the considerations presented before, we aim to test for the impact of the main determinants identified in the first part of the empirical study while considering for the G-SIB status that 16 banks in our sample are enjoying.

Within the recently developed literature on systemic risk, the measure proposed by the regulator (BCBS, 2014b; BCBS, 2013a) is strongly correlated with banks' size[25]. In order to test for the impact of the systemic importance on the value of implicit guarantees, two approaches will be employed[26]:

- adding the binary variable G-SIB (1 if the bank has the G-SIB status and 0 otherwise) in the model tested previously;
- testing the model described in (3.3) only for the subsample of G-SIBs that counts 16 institutions and a total of 123 observations.

So, the model to be tested becomes:

$$IG_{it} = \alpha_1 SACR_{it} + \alpha_2 Sizebank_{it} + \alpha_3 GSIB_{it} + \alpha_4 X_{it} + \varepsilon_{it} \tag{3.3}$$

Table 3.3 reports the results for the specifications corresponding to different definition of the systemic importance.

Hence, columns 1 to 4 report the results for the regressions including the binary variable *G-SIB*, while columns 5 to 7 report the results of estimations for the sub-sample of G-SIBs.

[25] Please Table 3.11 in Appendix D for the distribution of G-SIBs by categories of size.
[26] An additional measure of systemic importance is suggested in Appendix E. For technical reasons related to the methodology, we chose not to present it in the main text.

While the results for the stand-alone strength, the size and the structural indicators (*Wholesale funding* and *Retail ratio*) have the expected sign, the results on the impact of the G-SIB status, in presence of size (column 2), are somehow surprising. They are counterintuitive since one would expect that widely recognized systemically important banks benefit from larger implicit guarantees. And yet, the negative coefficient of the variable *G-SIB* indicates the opposite. This result can nevertheless be explained by the strong correlation between *G-SIB* and *Size* since the size is the main factor in assessing the systemic importance of banks. When the two variables are tested separately (Tables 3.1 and 3.3), the results are both significant and in the right direction.

Table 3.3: IG and systemic importance of banks. Results of regressions (2007-14)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
VARIABLES	IG	IG	IG	IG	IG	IG	IG
VARIABLES	All sample	All sample	All sample	All sample	G-SIBs	G-SIBs	G-SIBs
Bank strength (SACR)	-0.175***	-0.180***	-0.175***	-0.181***	-0.277***	-0.235***	-0.244***
	(-7.405)	(-7.988)	(-7.726)	(-7.055)	(-4.705)	(-4.907)	(-4.593)
G−SIB	0.247***	-1.080***	0.0783	-0.198			
	(11.37)	(-6.569)	(0.595)	(-1.287)			
Size of bank		0.462***			0.271*	0.613***	0.120
		(11.59)			(1.910)	(4.693)	(0.924)
Marketable debt			1.241***			3.976***	
			(2.892)			(5.320)	
Retail ratio				-0.665***			-2.313***
				(-3.620)			(-5.718)
Constant	-0.149	-0.0253	4.364***	5.670***	2.779	-3.904*	5.812***
	(-0.300)	(-0.0523)	(13.30)	(15.18)	(1.154)	(-1.728)	(2.957)
Observations	1 036	990	987	840	123	123	109
R^2	0.180	0.186	0.115	0.118	0.249	0.410	0.418
R^2 adj	0.178	0.183	0.113	0.115	0.236	0.395	0.401
F	79.21	57.98	22.39	22.53	18.69	25.46	26.54

Notes: *G-SIB* is a binary variable which values 1 of the bank has the G-SIB status according to FSB classification from November 2014 and zero otherwise. Size of the bank is the logarithm of total assets. Balance sheet variables are reported as of total assets. Results in the last column are based on fewer observations for reasons of lack of data for the variable *Retail ratio*, for several banks. Robust t-statistics in parentheses *** p<0.01, ** p<0.05, * p<0.1. Sources: Moody's, Bankscope, FSB (2014), author's calculations

In the last part of the table, we present results of estimates for the sub-sample of G-SIBs. Previous results on the impact of the strength of the bank, the funding structure and the business model are confirmed. It is important to notice that impact of the funding structure on the value of the *IG* has greater amplitude in the case of G-SIBs compared with the average for the whole sample (it is three times higher for G-SIBs). The G-SIBs are inevitably strongly dependent on wholesale funding and this structural feature seems to have a considerable impact on the value of the implicit guarantee, which

is generally larger for the G-SIBs than for other banks. Short-term funding has been a key driver of negative shocks the last financial crisis and revealed in the same time important vulnerabilities of banks. It can be considered as a key indicator of the degree of interconnectedness of these large and complex institutions of institutions.

We also find that G-SIBs with higher proportions of traditional activities (higher values for *Retail ratio*) enjoy in average lower implicit guarantees than other G-SIBs. The main explanation is given by their greater stability in times of distress, given their longer-term maturities and lower sensitivities to changes in risk aversion and market fluctuations.

It seems that, for regressions applied to the sub-sample of G-SIBs, when the funding structure (*Marketable debt*) or the business model (*Retail ratio*) are controlled for, the quality of regressions improves. The value of the R^2 and adjusted R^2 is higher than for the basic regression[27].

Although the intrinsic strength of the bank is the main determinant of the value of the implicit guarantee, since it assesses the need of the institution to be supported in order to avoid bankruptcy, other elements had contributed to the assessment of the magnitude of implicit guarantees. In the next section, we focus on the capacity of support of the sovereign, playing the role the guarantor for banks' debt.

3.3.2 Banks - sovereign debt nexus. Implications for the implicit guarantees

The two waves of the global financial crisis, the subprime and the sovereign crisis, highlighted the key role of banks for the functioning of the European financial system and put a spotlight on the link between banks' and sovereign debt. Although, in the wake of the financial crisis there were no considerable concerns on sovereigns' capacity to support the domestic financial system, nowadays the strength of the sovereign is jointly analysed when taking about the strength and stability of financial systems. Conceptually, the sovereign strength is as a key determinant of the value of implicit guarantees since it fully takes part in bailout procedures.

Once we get clear statistical evidence on the correlated evolution of estimated implicit guarantee and the weakening in public finances, we do search to empirically quantify the magnitude of the impact of sovereigns' capacity to support on the expectation of public bailouts, in addition to the intrinsic strength of the bank Estrella and Schich (2012).

The economic performance is essential for banking systems since their evolution is strongly correlated with macroeconomic developments. The interconnections between banks and sovereigns are explained through two main channels and will be discussed in

[27] The adjusted R^2 is a modified version of R^2 that has been adjusted for the number of predictors in the model. The adjusted R^2 increases only if the new term improves the model more than would be expected by chance. It decreases when a predictor improves the model by less than expected by chance. The adjusted R^2 can be negative, but it's usually not. In any case, it is always lower than the R^2.

what follows. The structure of assets portfolio represents the first interaction channel. In times of distress, banks tend to increase their exposure to sovereign debt (that used to be considered as riskless) to the benefit of other risky assets. Therefore, when banks face financial distress periods the investor's base for sovereign bonds can be reduced. On the other side, if sovereign credit ratings are subject to downgrades, banks' portfolios will be affected by sovereign debt revaluations through mark-to-market losses. Within European countries where banking systems are strongly interconnected, these interactions are even stronger. In addition, governments "responded" to financial shocks by acting as a "guarantor of last resort" for banks' debt and this represents the second transmission channel between banks and sovereigns. The massive public interventions destabilized the budgetary policy and lead to rating downgrades and to further spillover effects on financial activity. The weakened financial capacity of European governments had an impact on their ability to guarantee banks' debt. As a result, the estimated value of implicit guarantees has been reduced. Hau et al. (2013) show that the sensitivity of changes in long-term ratings of banks to changes in sovereign ratings depend on the economic cycle and countries' economic conditions.

We further analyse the extent to which sovereign strength affects the value of implicit public guarantees, beyond the effect that is already taken into consideration by the intrinsic strength of banks. Our assumptions concerns the two interaction channels described previously and state that the downgrades in sovereign credit ratings had a considerable impact on banks' bailouts.

The model described in (3.1) has been improved by including a variable that describes the strength of sovereigns. Specifically, we consider the sovereign credit rating (SCR) and an indicator of the strength of the sovereign since it include a set of macroeconomic indicators[28]. The econometric specification in a panel setting is:

$$IG_{it} = \alpha_1 SACR_{it} + \alpha_2 SCR_{it} + \alpha_3 Sizebank_{it} + \alpha_4 Sizebank_{it}^2 + \alpha_5 GSIB_{it} + \alpha_6 X_{it} + \varepsilon_{it} \quad (3.4)$$

One should bear in mind that the sovereign credit rating is mapped according to the same numerical scale as ratings for banks' debt. Hence, higher numerical values of SCR are associated to stronger health of public finances and higher capacity of support of governments. Comparing to Ueda and Mauro (2013) that employ a similar approach but based on Fitch ratings, we control for any possible variation of the initial intrinsic value of banks' balance sheet due to anticipations on public interventions.

The results reported in Table 3.4 indicate that, beyond the impact of the determinants from inside the bank that have been previously explained, determinants residing from

[28] We have also tested separately for the size of the governments (log of GDP) and we find that the results are robust with regard to the SCR. The size of sovereigns is positively associated to the value of implicit guarantees. Since SCR is already taken into account the size of sovereigns, we report the estimates only for the SCR.

outside the bank also have a considerable impact on the evolution of the value of implicit guarantees. More precisely, the results highlight the importance of the solidity of public debt in explaining the variability in the level of our interest variable.

An important fact revealed within this empirical analysis is that the strength of the guarantor, as described by the sovereign credit rating is a significant driver of implicit guarantees for banks' debt. The positive and significant coefficient α_2 confirms our assumption and explains partly the reduction in the value of uplifts recorded since 2011 given the worsening of the health of public sector after the subprime crisis and the sovereign debt crisis. The governments that are themselves in distress, exposed to the risk of being downgraded, will therefore have a weaker capacity to support the domestic banking system in distress. The results indicate that downgrades in sovereign credit rating of one notch will lead in average to reduction in the value of the implicit guarantee of 0.2 notches.

Overall, the weakening of public financial strength has significant consequences on the implicit support grated to financial institutions and the general reduction in uplifts observed since 2011 is partially explained by developments in public debt. Although a decline in the value of implicit guarantees is desirable, a reduction as the result of a weakening of the financial capacity of the sovereign is, under any circumstances, undesirable.

Table 3.4: IG and sovereign strength. Results of regressions (2007-14)

VARIABLES	(1) IG	(2) IG	(3) IG	(4) IG	(5) IG	(6) IG	(7) IG
	All sample	All sample	All sample	All sample	All sample	G-SIBs	Other banks
Bank strength (SACR)	-0.392***	-0.387***	-0.389***	-0.406***	-0.359***	-0.378***	-0.371***
	(-17.59)	(-17.11)	(-18.15)	(-15.78)	(-15.78)	(-12.85)	(-16.13)
Sovereign strength (SCR)	0.361***	0.365***	0.360***	0.358***	0.343***	0.379***	0.357***
	(21.28)	(21.36)	(21.97)	(20.02)	(19.25)	(15.41)	(20.50)
Size of bank	0.409***	1.418***	0.415***	0.392***		0.358***	0.521***
	(13.33)	(4.024)	(13.93)	(10.02)		(2.875)	(15.23)
Size of bank^2		-0.0464***					
		(-2.930)					
Wholesale funding			1.280***			3.389***	1.111***
			(5.225)			(5.920)	(5.406)
Retail ratio				-0.135			
				(-0.948)			
G-SIB					0.218***		
					(2.204)		
Constant	-3.673***	-9.175***	-4.320***	-3.174***	0.783***	-5.475***	-5.453***
	(-8.866)	(-4.493)	(-10.13)	(-5.699)	(3.318)	(-3.207)	(-11.34)
Observations	990	990	987	840	1036	123	864
R^2	0.422	0.428	0.445	0.420	0.329	0.734	0.447
R^2 adj	0.420	0.425	0.443	0.417	0.328	0.725	0.445
F	200.8	147.7	174.4	129.9	127	111.4	167.4

Notes: G-SIB is a binary variable (1 of the bank has the G-SIB status and zero otherwise). Size is the logarithm of total assets. Balance sheet variables are reported as of total assets. Robust t-statistics in parentheses *** p<0.01, ** p<0.05, * p<0.1.
Sources: Moody's, Bankscope, FSB (2014), author's calculations

Nevertheless, the reduction in the value of implicit guarantees is not due only to the reduction on sovereigns' capacity to support. Changes in the funding structure patterns and assets' portfolio driven by regulatory agenda and market pressure had also an impact. The results in column 3, showing a positive and significant coefficients of *Wholesale funding*, suggest that the reduction in the value of implicit guarantees recorded since 2011 could also be due to a reduction in the dependence on market funding and, implicitly, through the improvement of the loss-absorbing capacity. Figures 3.14 and 3.15 in Appendix C illustrate the evolution of the funding structure of banks and come to reinforce our results.

Additionally, the effects of *Size* and systemic importance are confirmed. Systematically, large banks receive greater implicit guarantees. Moreover, those banks recognises as systemically important for the global financial activity enjoy greater support independently of their intrinsic strength or their funding structure. Our additional measure of systemic importance conditional of the size of the institution confirms the TBTF theory despite the very recent measures that have been taken to reduce this distortion.

Given these findings, in the next section we proceed to an empirical analysis that examines the relationship between the cost of debt and the implicit guarantees.

3.3.3 The impact of implicit guarantees on the cost of funding

Although the estimations of the value of implicit guarantees using the rating-based approach provide relevant assessments of the advantage that certain banks enjoy given their importance for the functioning of the financial system, one could find fault to this model since it does not give a more concrete measure of the implicit support. Of course, the most precise evaluation could be done by using detailed private data on bond rates. Nevertheless, since we do not dispose of this type of data, we are going to use an approach based on accounting dataset and more precisely, we are going to exploit income statement data on bank's interest expenses to evaluate the cost of funding of financial institutions.

Generally, the cost of debt for the stand-alone debt should be higher than the cost of debt for the debt considering for the implicit support (AICR). Since detailed data on interest expenses by type of debt is not publicly available, we dispose of one value for each bank and for each period from 2007 to 2014.

We assume that banks with greater implicit subsidy have access to funding markets and enjoy lower cost of debt since the debt is guaranteed by an external party, here the government. Precisely, we expect a negative relationship between the value of implicit guarantees and the cost of debt.

In what follows, we test this hypothesis within a simple econometric model described in equation (3.5)

$$FC_{it} = \alpha_1 IG_{it} + \alpha_2 SACR_{it} + \alpha_3 X_{it} + \varepsilon_{it} \tag{3.5}$$

Where the dependent variable is the funding cost, FC. IG is the main explanatory variable and the $SACR$ allows to control for the intrinsic risk of the bank i. X is a vector of fixed effects and ε_{it} the error term. The funding cost is assessed on the basis of the ratio of interest expense to interest bearing liabilities, and evaluates the average rate of interest that an institution is paying on its interest bearing liabilities. Generally, banks with higher stand-alone ratings corresponding to more resilient structures, should bear lower funding costs. We therefore expect a negative relationship between $SACR$ and the funding cost, while for the IG the sign of the coefficient should be positive.

For parsimony reasons, we chose a simple model that is easier to understand and provides more concrete evaluation of the relationship between the two variables that we are interested in. We run two different specifications. First, we use a level-specification to evaluate the impact of the level of implicit guarantees on the level of the funding cost. And then, we use a first difference model that allow us to examine the extent to which

annual changes in the uplifts affect the annual variation of the cost of debt. In addition, we apply the model to the complete sample but also to the subsamples of G-SIBs and other banks, respectively. The results for these regressions are reported in Table 3.4.

The results show that the cost of debt is negatively associated with the value of the uplift and the results are robust across different specifications. The estimates indicate that an increase in the uplift (IG) of one notch is likely to reduce (in average) the cost of debt of 0.11 bps. A first self-evidence is the stronger and significant estimate of the impact of the implicit guarantee for smaller banks compared to G-SIBs. The results in column 3 indicate that the cost of debt for the globally systemic banks is not necessarily influenced by the value of implicit guarantees although their level is significantly higher than for other banks (i.e. non G-SIBs). We explain this finding by the implicit advantages provided by the status "G-SIB" than the amplitude of the implicit support itself. For smaller banks, the advantage in terms of funding cost is genuinely given by the expectation of governmental support in case of distress.

Another important evidence is the stronger significance for first-difference estimates compared to the ones from the level-specification for the subsamples. We can therefore conclude that analysing the changes in the funding cost driven by changes in the value of implicit guarantees is more relevant when examining specific groups of banks.

Table 3.5: Impact of IG on the cost of debt. Results of regressions (2007-14)

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	FC	FC	FC	FC	FC	FC
	All sample		G-SIBs		Other banks	
	level	FD	level	FD	level	FD
IG	-0.113***	-0.283***	-0.125	-0.574**	-0.113***	-0.277***
	(-3.182)	(-6.671)	(-1.663)	(-3.631)	(-3.043)	(-6.434)
SACR	0.267***	0.0832	0.251***	-0.0952	0.268***	0.0950
	(6.327)	(1.334)	(4.505)	(-1.596)	(5.515)	(1.385)
Constant	-0.321	-0.458***	-1.240	-0.495***	-0.210	-0.460***
	(-0.565)	(-10.04)	(-1.408)	(-9.710)	(-0.333)	(-9.333)
Observations	749	635	74	63	675	572
R^2	0.223	0.082	0.350	0.175	0.215	0.083
R^2 adj	0.221	0.0792	0.332	0.148	0.213	0.0796
Number of id	114	113	11	11	103	102
F	44.16	24.70	14.72	6.943	30.49	22.27

Notes: The funding cost is described by the ratio of interest expenses to total interest bearing liabilities, expressed in percentages. The regressions include time fixed effects. We use the option *cluster* to control for the fact that observations may be correlated within countries. These supposes to control for country-specific funding conditions. Regression 3 use the log of the implicit guarantee as dependent variable in order to estimate a percentage point change in the IG. Robust t-statistics in parentheses *** p<0.01, ** p<0.05, * p<0.1.
Sources: Moody's, Bankscope

The results highlight the importance of the intrinsic strength of banks in determining their funding cost. The changes in $SACR$ are not a significant explanatory variable for

the *FC* and this could be explained by the low variation of the *SACR* over the study period.

Our findings provide empirical evidence on the adverse effects of implicit guarantees on the funding cost for beneficiary institutions. Although the estimates are statistically significant and robust across different specifications, it is important to remind that the funding cost is an accounting-based measure, which leaves room to various limits. Specifically, it does not take into account the maturity and the date of issue of the debt that can bias our estimation of the cost of funding. For this reason, we introduce in our model time fixed effects that should control for specific evolution of funding conditions. A market-based measure should provide a better evaluation of the funding advantage generated by public bailouts. This issue will be considered for further research.

Overall, the results of our empirical study have important policy implications. The existence of such interconnections between bank and public debt embody a considerable source of contagion for negative shocks. Moreover, it represents an additional source of distortions in terms of funding costs between banks on the one hand, and between banks from different countries, on the other hand. Overall, the banking-sovereign debt nexus is undoubtedly a key element in explaining the European sovereign crisis and recent developments in banks' and sovereigns' statements. The supranational interventions, mainly through unconventional policies, had a vital role in reducing negative spillovers between banks' and sovereign debt.

Given these strong interdependencies between sovereigns and banking systems, important measures have been considered. European authorities have established new directives in order to implement recovery and resolution policies for banks developing their activity in Europe in order to pass over the cost of bank bailouts on shareholders and creditors rather than sovereigns and taxpayers. Recognising the importance of these measures, they we will analysed in detail in the next chapter.

Meantime, we are going to test for the robustness of our results. The first point with regard to our analysis that could be questioned is the choice of the sample and the dataset. Secondly, the choice of variables and the empirical model can be also a source of eventual bias. Finally, the methodology could also be considered a limit for our results.

In section 3.4 we test if the type of data is a source of bias. We are also considering an alternative rating to evaluate the intrinsic strength of the bank that should lead a more accurate evaluation of the implicit public guarantee. Since this alternative measure is available only since 2011, we use it only in robustness check analysis. With regard to other critics, the research article that is the basis of this chapter studies a smaller sample containing only the 56 largest banks in Europe and employs alternative econometric tools (fixed effect model, Poisson and negative binomial models) and the results are changing

only marginally. With regard to the methodology, ideally should be to estimate the value of implicit guarantees starting from bond rates. Since we do not dispose of this type of data, further in this chapter we are going to use income statement data to evaluate the financial cost of banks according to their ratings.

3.4 Robustness check analysis

To verify the robustness check of our results, we run two different specifications of the model described in (3.1). In a first time, we test the relationship between the estimated value of implicit guarantee and its main determinants using banks' consolidated statements. The motivation behind this exercise is given by changes in the size of the banks that sometimes drive to changes in ranking by the size of the balance sheet. In a second time, we analyse the extent to which the results of regressions are changing when the intrinsic strength of banks is defined by the adjusted stand-alone rating, the recently published adjusted BCA.

In what follows, we explain the two approaches and we comment the results.

3.4.1 Explaining the value of implicit guarantee using consolidated statements

In our initial exercise, unconsolidated data was considered since it fitted better to our empirical objectives for Chapters 3 and 4. First, unconsolidated statements allow for an easier comparison between institutions from countries of different size. Second, it relates more closely to domestic bank failure resolution costs (the aim of our forth chapter). While unconsolidated data was unavailable for seven banks, consolidated data is available for all entities in our sample.

We run a robustness check analysis using consolidated statements since one could get a complex measure of internationally active banks from this type of data since they integrate the statements of subsidiaries. The main problem with consolidated statements is that the relevance of consolidation is not clear and it may be different from country to country. The rules for consolidation are similar in international accounting standards but can still vary across markets. Bankscope does not provide detailed information about consolidation methodologies[29].

Table 3.6 reports the results of regressions explaining the value of implicit guarantees (IG) using the same variables as our main model but balance sheet data is based on

[29] The only information provided by Bankscope with regard to the consolidation methodology is that "the method of integration varies according to the importance of the interest owned by the parent company in its subsidiaries". Consolidated data is reported according to data provided by banks' themselves, no further additional treatment is processed by Bankscope.

consolidated statements. More precisely, the variables that change compared to the initial analysis are the size of the bank, the probability of being G-SIBs (p) since its calculation is based on the size of the balance sheet and the proportion of wholesale funding.

The results for the systemic importance are robust as well, and their impact is considerably higher in this approach. The funding structure in turn seems to impact significantly the value of the implicit guarantee only for the sub-sample of G-SIBs. For these large banks, the dependence of market funds is determining investors' expectations of an eventual government bailout in case of distress.

Table 3.6: Explaining the determinants of the implicit guarantee using banks' consolidated statements

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	IG	IG	IG	IG	IG	IG
	All sample	All sample	All sample	All sample	G-SIBs	Other banks
Bank strength (SACR)	-0.244***	-0.431***	-0.392***	-0.431***	-0.426***	-0.422***
	(-12.60)	(-21.74)	(-20.19)	(-21.53)	(-12.08)	(-19.81)
Size of bank	0.532***	0.554***		0.571***	0.479***	0.680***
	(18.90)	(22.03)		(19.57)	(8.637)	(19.41)
Sovereign strength (SCR)		0.362***	0.352***	0.364***	0.392***	0.366***
		(22.11)	(20.18)	(22.10)	(12.41)	(21.09)
G-SIB			0.619***			
			(7.571)			
Wholesale funding				0.591	2.013***	0.00528
				(1.505)	(4.092)	(0.0115)
Constant	-0.798**	-5.327***	0.791***	-6.023***	-6.918***	-6.858***
	(-2.123)	(-14.94)	(3.303)	(-9.915)	(-5.618)	(-10.03)
Observations	1,412	1,412	1,676	1,403	186	1,217
R^2	0.234	0.477	0.337	0.477	0.609	0.486
R^2 adj	0.233	0.476	0.335	0.476	0.601	0.484
F	211.7	346.3	174.0	261.3	60.13	243.3

Notes:Size of the bank is the logarithm of total assets. Wholesale funding is the sum of short-term and long-term borrowings and is reported as of total assets. Results for Retail ratio are not reported as they are not statistically significant. The results of regressions including the squared of Size are not reported for parsimony reasons as it does not proceed to any change either in estimations or in the coefficients of determination of regressions. Robust t-statistics in parentheses *** p<0.01, ** p<0.05, * p<0.1.
Source: Moody's, Bankscope, author's calculations

It is interesting to notice that the impact of *Size* on the value of the *IG*, evaluated by the coefficient, is higher when consolidated statements are used to evaluate banks' balance sheet characteristics. The main explanation states in the distribution of banks by their size which records several changes according to the type of accounting statements since their wider activities through subsidiaries are also accounted for. By running a Wilcoxon signed-rank test for the ranks of banks by their size using consolidated and unconsolidated data, we conclude that the median difference is significantly different from 0 since the

p-value is below the 0.05 threshold (0.0079)[30]. Although the majority of G-SIBs will still be among the largest banks, their position may change as well.

Two large French banks illustrate clearly the importance of consolidation codes in ranks by balance sheet's size. BNP Paribas is on the third largest bank in our sample using unconsolidated data and has only the thirstiest position when consolidated data is considered. At the opposite, Credit Agricole goes up in the standings from position 11 to 4 according to consolidated statements. More generally speaking, consolidated statements can provide more information about banks' interconnectedness with the real economy throughout the activity of their affiliate subsidiaries.

The choice between consolidated and unconsolidated data should be made in accordance with the aim of the analysis. Consolidated data is undoubtedly more relevant for estimation of the value of bailouts since it takes into consideration the activity of the parent entity but also of the related subsidiaries. Hence, it allows for an estimation of the quantity of support that could be request in order to avoid bankruptcy. Consolidated financial statements may provide a clear picture of the total resources that are under the control of the parent company. However, given the aim of our analysis and specifically, the assessment of the funding advantage that banks enjoy at the issue of new debt given the implicit support of the government if needed, we have chosen unconsolidated data for our estimations. Moreover, unconsolidated data also allows us to account for intra-companies transactions that sometimes can be reach important volumes between parent companies and their subsidiaries and more generally, all transactions regardless of the source of the funds. Another argument in favour of unconsolidated data comes from the nature of our interest variable itself: explaining rating-based variables using consolidated statements make sense if and only if the fundamentals (risk, growth etc) of the parent company and its subsidiaries are similar. If not, individual statements are more appropriate to make comparisons. In any case, there are not significant differences in the results from the two approaches.

3.4.2 Explaining the value of implicit guarantee using alternative measure for the stand-alone strength of banks

Since 2011, Moody's stated to publish an alternative rating for the BCA, called the adjusted BCA, that accounts for the eventual parental and cooperative support but it still not includes the governmental support. This latter measures the probability of a bank requiring support to avoid default beyond the support provided by affiliate entities (Figure 3.9) and could be (at least theoretically) a most appropriate measure of the

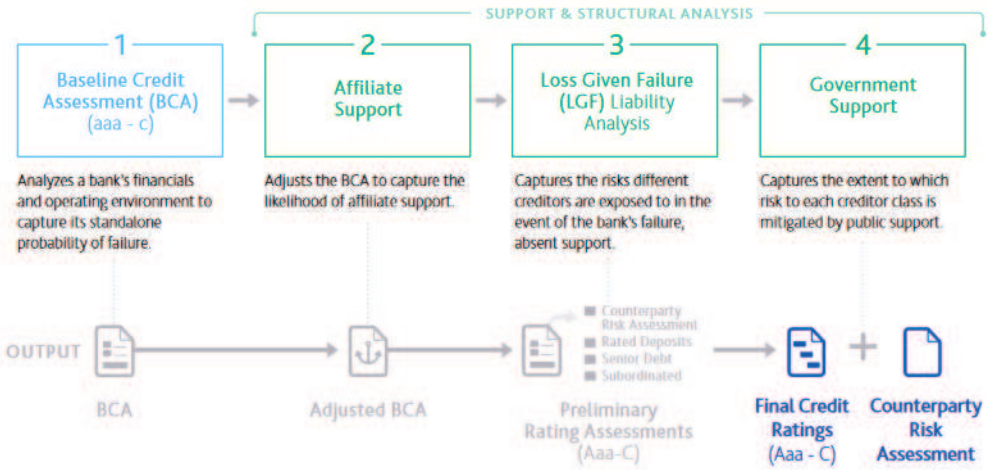
[30] The null hypothesis of the rank test is that the average signed rank of the two variables, *Size* using consolidated data and *Size* using unconsolidated data, is zero.

intrinsic strength of financial institutions since it is supposed to lead us to a more accurate measure for the implicit support provided by the governments.

The difference between the BCA and the adjusted BCA is therefore the assessment of the support that can be occasionally supported by other external entities. Given the composition of our sample, in many cases this difference is small or zero.

In this case, the value of the implicit guarantee is calculated as the difference between the all-in rating (as in initial model) and the stand-alone rating measured by the adjusted BCA. The methodology for the calculation of the adjusted-BCA is illustrated in Figure 3.9.

Figure 3.9: Stand-alone ratings assessment



Source: Moody's Investors Service

The main inconvenient with regard to the use of the adjusted BCA is that the times series are very limited, providing observations only for three or four periods included in our study period according to each institution (from 2011 to 2014). Figure 3.10 illustrated the comparison of the two measures of uplift.

Figure 3.10: Annual averages for the two alternative measures of the implicit guarantee (uplifts)

Notes: While *Uplift* is calculated using the BCA, the *Uplift** is based on adjusted BCA. 10 banks do not dispose of observations for the adjusted BCA. Hence, annual averages are calculated based on 135 observations for the *Uplift* and 125 observations for the *Uplift**.
Source: Moody's, author's calculations

Although, annual minimum and maximum values are not different for BCA and adjusted BCA, the difference in annual averages is driven by the distribution of the two ratings. Figures 3.11 and 3.12 below illustrate the distributions for the two measure of the stand-alone strength, for two key periods: 2011 - the introduction of the adjusted BCA, and 2014 - last available period considered in our study. The figures show that there is no important difference between the distributions of two measures[31] for the two periods.

Figure 3.11: The distribution of SACR (BCA)

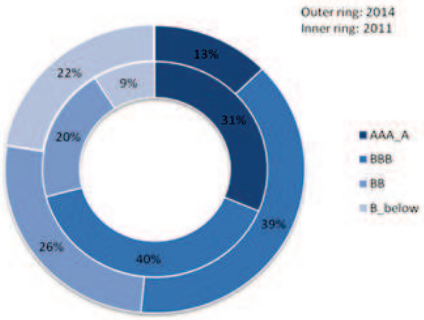
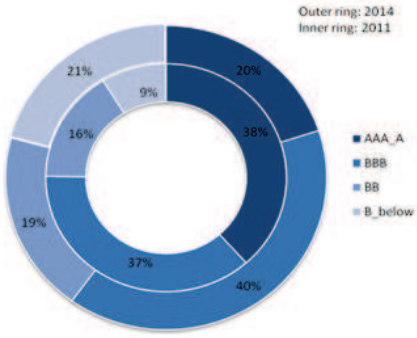


Figure 3.12: The distribution of SACR* (adj.BCA)



Notes: The distribution of ratings in 4 categories that have been disposed in arcs as in 2011 (inner ring) and 2014 (outer ring). Percentages are calculated based on the total observations corresponding to each period (135 observations for the BCA and 125 observations for the adjusted BCA). Please see Figures 3.16 and 3.17 in Appendix F for more detailed information on the distribution of ratings.
Source: Moody's, author's calculations

We run least square regressions for the same specification as in the main analysis presented in Section 3.3. The results reported in Table 3.7 confirm the robustness of our previous findings. The value of the implicit guarantee is negatively associated to the strength of the institution as described by the adjusted BCA. Moreover, the values of the coefficients are not significantly different from the ones in the main analysis using the stand-alone rating as described by the BCA. Comparing the estimations for the two sub-samples, G-SIBs and other banks, we notice that the difference between the values of the coefficients is slightly higher using this approach (0.027) compared to the BCA based approach (0.007). This result could be somehow surprising since one would have expected that the G-SIBs enjoy greater implicit support. The results should however be interpreted with precaution since the study period is limited and it can play an important role on estimates.

Results with regard to the strength of the guarantor are robust as well. The strength of the guarantor is positively associated to the value of the implicit guarantee indicating that banks from countries where the financial capacity of sovereigns is greater enjoy generally

[31] It is important to notice that the marginal differences are mainly characterising the smaller banks in our sample that have, in any case, total assets superior to 213 million EUR even during the crisis periods.

of higher support. The size of the bank is statistically significant as well and confirms previous results suggesting that larger banks receive higher implicit support.

Table 3.7: Explaining the determinants of the implicit guarantee using an alternative measure for the SACR, the adjusted Baseline Credit Assessment

VARIABLES	(1) IG*	(2) IG*	(3) IG*	(4) IG*	(5) IG*	(6) IG*
	All sample	All sample	All sample	All sample	G-SIBs	Other banks
Bank strength* (SACR*)	-0.132***	-0.313***	-0.297***	-0.309***	-0.274***	-0.301***
	(-4.641)	(-8.520)	(-8.061)	(-8.906)	(-7.123)	(-8.123)
Size of bank	0.258***	0.319***		0.331***	0.420**	0.364***
	(6.332)	(8.246)		(9.163)	(2.607)	(8.430)
Sovereign strength (SCR)		0.243***	0.233***	0.245***	0.307***	0.239***
		(10.45)	(9.772)	(11.17)	(12.58)	(9.848)
G-SIB			0.594***			
			(5.236)			
Wholesale funding				1.036***	3.232***	0.962***
				(4.574)	(4.851)	(4.550)
Constant	0.637	-2.240***	1.193***	-2.881***	-6.662***	-3.156***
	(1.230)	(-4.505)	(4.726)	(-5.700)	(-2.943)	(-5.353)
Observations	483	483	500	483	63	420
R^2	0.116	0.330	0.269	0.356	0.841	0.334
R^2 adj	0.112	0.326	0.264	0.351	0.830	0.327
F	24.92	53.39	40.59	47.97	95.05	36.21

Notes: The SACR is measured by the adjusted BCA (Moody's) and the calculation of the uplift corresponding to the estimated implicit subsidy is based on the adjusted BCA. Size of the bank is the logarithm of total assets. Wholesale funding is the sum of short-term and long-term borrowings and is reported as of total assets. Results for Retail ratio are not reported as they are not statistically significant. The results of regressions including the squared of Size are not reported for parsimony reasons as it does not proceed to any change either in estimations or in the coefficients of determination of regressions. Robust t-statistics in parentheses *** p<0.01, ** p<0.05, * p<0.1.
Source: Moody's, Bankscope, author's calculations

Generally, the results from these alternative models are more stable than the initial model in the sense that the value of coefficients is varying only marginally across specifications. One could conclude from this comparison that the adjustment proceeded by the rating agency to evaluate the strength of the bank by considering the eventual support from affiliate entities (parental or cooperative entities) stabilize the results by eliminating the information that is not relevant for our topic. It would be interesting to continue the assessment of implicit guarantees using both approaches in order to better evaluate the consistency of the two alternative measures in time.

3.5 Conclusion

The question of analysing and explaining the evolution of implicit public guarantees emerged from governments' reaction to important financial shocks that hit the worldwide

financial system within the subprime crisis. Massive amounts of public funds were "offered" to financial institutions in order to avoid spillovers effects and further worsening of the whole economic activity. The interest for this topic comes from the very controversial role of these injections and their adverse effect on the public debt and taxpayers. Another reason for the increased interest in analysing implicit public guarantees is strictly related on the lack of measures on the one hand, and the lack of indicators, explaining their evolution, on the other hand.

Our study provides an historical measure for public subsidies for a sample of large listed European banks from OCDE member countries. We quantify the annual value of the implicit guarantees from 2007 to 2014 using a rating based approach. To this extent, we use different types of ratings provided by Moody's that allow to distinguish between the stand-alone strength of the bank and the all-in creditworthiness, this later taking into account the probability of a governmental intervention to avoid bankruptcy. The credit uplift allows us to evaluate the advantage in terms of creditworthiness given by the probability that the government will bailout the bank in times of distress in order to avoid its failure.

The implicit guarantee is evaluated at 2.8 notches for the whole period, reaches greater values in 2009 (3.6 notches) to afterwards decrease progressively until 2014 to 2.6 notches. Our results are in line with Schich and Lindh (2012) and ECB (2014c). We take caution in comparing our estimations of the value of the implicit guarantees with the results from the existing literature since both the sample and the period of study differ significantly.

The objective of our empirical study is to identify the determinants of government guarantees as estimated by the rating based model and to analyse their impact over time. Our findings provide evidence for the key role of the strength of the bank: the weaker the bank, the higher will be the governmental support. The size and the systemic importance of banks are significant determinants of implicit guarantees and these findings come to confirm the TBTF theory. Certain balance sheet indicators seem to have a greater impact than others. Namely, the funding structure described by the dependence on wholesale funding provides signals that increase the expectations of public bailout. In other terms, banks with short-term market based funding structures are more vulnerable to financial distress and furthermore, have more chances to be bailout in times of distress for reasons of string interconnections with the rest of the system through its funding structure. We further find that the business model indicator, the retail ratio has a considerable impact on the value of implicit guarantees in the sense that retail-oriented banks received in average lower support from the government between 2007 and 2014 than investments-oriented banks. This result confirms that banks with stronger implication in traditional activities are more stable and hence, less exposed to the risk of being bailout. At the

opposite, banks with lower retail ratios, the so-called investment-oriented banks, have been as well considerably supported. This distortion had important policy implications for structural reforms. Our findings allow to identify bank's weaknesses that drive to governmental interventions. In addition, they explain why the expectations of public bailout are greater for certain banks given their structural patterns.

Nevertheless, the more recent decrease in the value of the implicit guarantee had to be more closely analysed. Since we cannot discuss about an improvement in the intrinsic strength of banks in 2011 when a significant decrease in uplifts is observed, we are questioning about the role of public authorities and more exactly, on their financial capacity to support domestic banks in distress. The strength of the guarantor (the government) is revealed as a key driver of the value of implicit guarantees. The worsening of public finances revealed at the wake of the sovereign crisis affected considerable the strength of banks but also investors' expectations with regard to the probability of future public interventions. Therefore, the value of the implicit guarantee has been revised downward. The decrease that can be noticed in the value of implicit subsidies starting with 2011 is partially explained through the reduction in the capacity of support of sovereigns.

Our attempt to evaluate the funding advantage using income statement data on the cost of debt may be subject to criticism since it does not allow distinguishing between different types of funding sources and their costs. Nevertheless, by comparing the cost of debt for banks with different levels of intrinsic strength and different values of uplift, our previous results are confirmed.

To conclude, the analysis provided in this chapter brings clear evidence on the existence of a funding cost advantage for European banks and explains its evolution in time. We believe that more relevant indicators could be obtained from bond yields analysis. However, bonds rates for each bank in our sample are not publicly available. Future research should develop and use more appropriate data in order to estimate the debt funding rate advantage due to implicit guarantees and so, bring more concrete evidence on this issue.

Important statements related to the impact of resolution policies are conceivable in future research. In next chapter, we are going to analyse the recent resolution regimes that have been adopted and/or conceive and their contribution to reducing distortions in banking systems.

3.6 Appendix

A. List of banks included in the sample

Austria	BAWAG P.S.K. AG
	Erste Group Bank AG
	Hypo Tirol Bank
	Oesterreichische Volksbanken AG
	Raiffeisen Bank International AG
	UniCredit Bank Austria AG-Bank Austria
	Vorarlberger Landes-und Hypothekenbank AG
Belgium	Belfius Banque SA
	BNP Paribas Fortis SA/ NV*
	ING Belgium SA/NV-ING*
	KBC Bank NV
Denmark	Danske Bank A/S
	Jyske Bank A/S
	Nordea Bank Danmark A/S
	Nykredit Bank A/S
	Spar Nord Bank
	Sydbank A/S
Finland	Aktia Bank Plc
	Nordea Bank Finland Plc*
	Pohjola Bank plc
France	Credit Agricole CIB SA
	Banque Fédérative du Crédit Mutuel
	Banque PSA Finance SA
	BNP Paribas SA
	BPCE SA
	Crédit Agricole S.A.
	Dexia Crédit Local SA
	RCI Banque SA
	Société Générale SA
Germany	Bayerische Landesbank
	Commerzbank AG
	DekaBank Deutsche Girozentrale AG
	Deutsche Apotheker- und Aerztebank eG
	Deutsche Bank AG
	Deutsche Pfandbriefbank AG
	Deutsche Postbank AG
	DZ Bank AG-Deutsche Zentral-Genossenschaftsbank
	HSH Nordbank AG
	Hypothekenbank Frankfurt AG
	Landesbank Baden-Wuerttemberg
	Landesbank Berlin AG
	Landesbank Hessen-Thueringen Girozentrale
	Münchener Hypothekenbank eG
	Norddeutsche Landesbank Girozentrale
	Sparkasse KölnBonn
	Volkswagen Bank GmbH
	Portigon AG
	WGZ-Bank AG
Greece	Alpha Bank AE
	Eurobank Ergasias SA
	National Bank of Greece SA
	Piraeus Bank SA
Ireland	Allied Irish Banks plc
	Bank of Ireland
	Depfa Bank Plc
	Permanent TSB Plc
	Ulster Bank Ireland Limited*
Italy	Banca Carige SpA
	Banca delle Marche SpA
	Banca IMI SpA
	Banca Monte dei Paschi di Siena SpA
	Banca Popolare di Milano SCaRL
	Banca Sella Holding SpA
	Banco Popolare - Società Cooperativa
	Cassa di Risparmio di Bolzano SpA
	Cassa di risparmio di Ferrara SpA
	Credito Valtellinese Soc Coop
	Intesa Sanpaolo
	UniCredit SpA
	Unione di Banche Italiane Scpa-UBI Banca
Luxembourg	Banque et Caisse d'Epargne de l'Etat Luxembourg
	Banque Internationale à Luxembourg SA
Netherlands	ABN AMRO Bank NV
	Credit Europe Bank N.V.
	ING Bank NV
	Nederlandse Waterschapsbank
	NIBC Bank N.V.
	Bank Nederlandse Gemeenten NV, BNG
	Rabobank Nederland
	Royal Bank of Scotland NV (The)-RBS NV
	SNS Bank N.V.
Norway	DNB Bank ASA
	Nordea Bank Norge ASA*
	Sparebank 1 Nord-Norge
	SpareBank 1 SMN
	SpareBank 1 SR-Bank ASA
	Sparebanken More
	Sparebanken Sor
	Sparebanken Vest
	Storebrand Bank ASA
Portugal	Banco BPI SA
	Banco Comercial Portugues, SA
	Banco Espirito Santo SA
	BANIF - Banco Internacional do Funchal, SA
	Caixa Economica Montepio Geral
	Caixa Geral de Depositos
Spain	Banca March SA
	Banco Bilbao Vizcaya Argentaria SA
	Banco de Sabadell SA
	Banco de Valencia SA
	Banco Popular Espanol SA
	Banco Santander SA
	Bankia, SA
	Bankinter SA
	Caixabank. S.A.
	Caja Laboral Popular Coop de credito
Sweden	Landshypotek Bank AB
	Länsförsäkringar Bank AB (Publ)
	Nordea Bank AB (publ)
	Skandinaviska Enskilda Banken AB
	Svenska Handelsbanken
	Swedbank AB
Switzerland	Banque Cantonale Vaudoise
	Clientis AG
	Credit Suisse AG
	EFG Bank AG
	Raiffeisen Schweiz Genossenschaft
	St. Galler Kantonalbank AG
	UBS AG
	Zuger Kantonalbank
United Kingdom	Bank of Scotland Plc
	Barclays Bank Plc
	Co-operative Bank Plc (The)
	Coventry Building Society
	HSBC Bank plc
	Leeds Building Society
	Lloyds Bank Plc
	National Westminster Bank Plc
	Nationwide Building Society
	Principality Building Society
	Royal Bank of Scotland Plc (The)
	Skipton Building Society
	Standard Chartered Bank
	West Bromwich Building Society
	Yorkshire Building Society

Notes: Bank name in bold and italics for banks designated as G-SIB as part of the end-2014 exercise by the FSB and published on 3 November 2014. ∗included as foreign-owned subsidiary holding over 10% of domestic banking assets.

B. Mapping ratings and numerical values

Rating	Numerical value	Rating Class	Description
Aaa	20	High Grade	Obligations rated Aaa are judged to be of the highest quality and are subject to the lowest level of credit risk.
Aa1	19	High Grade	Obligations rated Aa are judged to be of high quality and are subject to very low credit risk.
Aa2	18		
Aa3	17		
A1	16	Upper medium grade	Obligations rated A are judged to be upper-medium grade and are subject to low credit risk.
A2	15		
A3	14		
Baa1	13	Lower medium grade	Obligations rated Baa are judged to be medium-grade and subject to moderate credit risk and as such may possess certain speculative characteristics.
Baa2	12		
Baa3	11		
Ba1	10	Non-investment grade (speculative)	Obligations rated Ba are judged to be speculative and are subject to substantial credit risk.
Ba2	9		
Ba3	8		
B1	7	Highly speculative	Obligations rated B are considered speculative and are subject to high credit risk.
B2	6		
B3	5		
Caa1	4	Substantial risks	Obligations rated Caa are judged to be speculative of poor standing and are subject to very high credit risk.
Caa2	3		
Caa3	2		
Ca1	1	Extremely speculative	Obligations rated Ca are highly speculative and are likely in, or very near, default, with some prospect of recovery of principal and interest.
C	0	In default	Obligations rated C are the lowest rated and are typically in default, with little prospect for recovery of principal or interest.

C. Descriptive statistics

Table 3.8: Definition of variables employed in the empirical analysis

Variables	Definition
SACR	Stand-alone credit rating measuring the intrinsic strength of the banks. It is given by the Baseline Credit Assessment of Moody's (source: Moody's)
AICR	All-in credit rating is taking into account the probability of a external public support. Described by the long-term global rating provided by Moody's (source: Moody's)
IG (or Uplift)	The credit uplift obtained from the difference between AICR and SACR. It measures the implicit support granted by public authorities to financial institutions.
Sovereign credit rating (SCR)	Sovereign credit rating provided by Moody's; describes the sovereign capacity to support.
Marketable debt	The proportion of short-term and long-term borrowings as of total assets, used in addition to core deposits (source: Bankscope)
Retail ratio	Sum of total customer loans and total customer deposits as of total assets (Martel et al. (2012), Gambacorta and Rixtel (2013)) (source: Bankscope)
Equity/TA	The amount of equity as of total assets. It described the level of capitalization of the bank (source: Bankscope)
Size	Logarithm of total assets (source: Bankscope)
G-SIB	Binary variable with 1 if the bank is G-SIBs and 0 otherwise. We consider the G-SIBs classification as in FSB (2014)
Cost of debt	Ratio of interest expenses to interest bearing liabilities (source: Bankscope)

Table 3.9: Descriptive statistics for variables used in the empirical analysis

Variable	Obs	Mean	Std. Dev.	Min	Max
2007-14					
IG (Uplift=AICR-SACR)	1035	2.83	2.04	-2.00	11.00
AICR	1035	11.88	3.60	1	20
SACR (BCA)	1062	14.72	3.52	3	20
SCR	1072	18.35	3.39	1	20
Total assets (mil eur)	1015	185648.7	295393.8	271.48	2246381
Size of bank	1015	11.10	1.58	5.60	14.62
Marketable debt (%TA)	1012	43%	0.21	0%	130%
Total equity (%TA)	1014	6%	0.04	-7%	73%
Retail ratio	858	94%	0.53	2%	552%
2011-2014					
IG (Uplift=AICR-SACR)	535	2.61	2.1	-2	11
IG (Uplift=AICR-SACR*)	499	2.1	1.77	-2	11
AICR	539	13.4	3.75	3	20
SACR (BCA)	535	10.44	3.71	1	20
SACR* (adj. BCA)	499	10.94	3.81	1	20
SCR	539	17.3	4.32	1	20
Total assets (mil eur)	520	186328.5	292786.3	296.87	1915046
Size of bank	520	11.15	1.52	5.69	14.47
Marketable debt (%TA)	520	40%	0.20	2.1%	92.03%
Total equity (%TA)	520	6%	0.04	-7%	18.86%
Retail ratio	495	96%	0.55	2%	552%

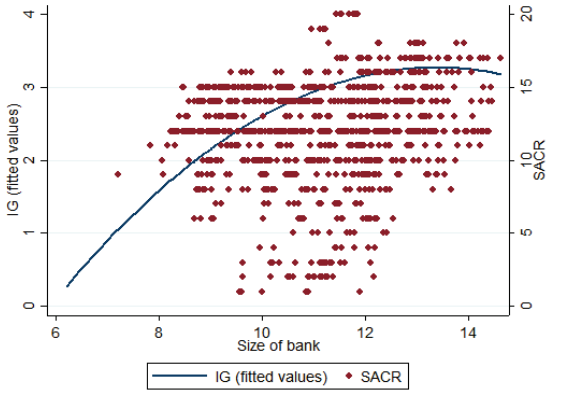
Notes: We exclude values for Banco Espirito Santo (PT) for 2014 when calculating the descriptive statistics since the bank incurred important losses in 2014. These values are considered as extreme for our sample.

Table 3.10: Correlation matrix

	IG	AICR	SACR (BCA)	Size of bank	SCR	Marketable debt	Equity	Retail ratio
IG	1.0000							
AICR	0.2585*	1.0000						
Bank strength (SACR)	-0.3086*	0.8391*	1.0000					
Size of bank	0.2215*	0.2672*	0.1391*	1.0000				
Sovereign strength (SCR)	0.2327*	0.6893*	0.5512*	-0.0052	1.0000			
Marketable debt	0.1603*	0.0561	-0.0400	-0.0148	-0.0170	1.0000		
Equity	-0.0563	0.0712	0.1023*	0.0885*	0.0676	-0.5489*	1.0000	
Retail ratio	-0.1546*	-0.1888*	-0.0985*	-0.3844*	-0.1149*	-0.0296	-0.4399*	1.0000

Notes: $*$ indicates the significance of the correlation at a 1 per cent confidence level. Balance sheet indicators expressed as of total assets.

Figure 3.13: Relationship between the implicit guarantee and the size of the bank



Notes:The turning point corresponds to the maximum of the estimated IG. It is described by the 94 percentile of *Size* (value of 13.3)

Figure 3.14: Liabilities structure (2007-14)

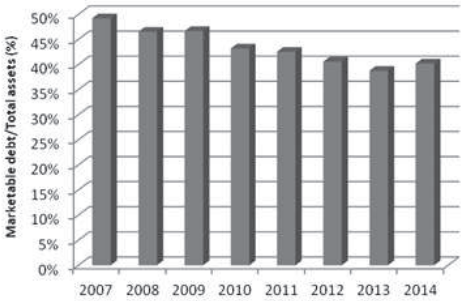
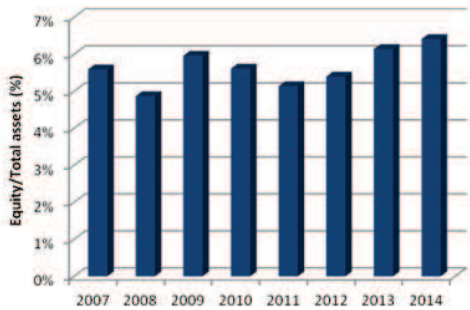


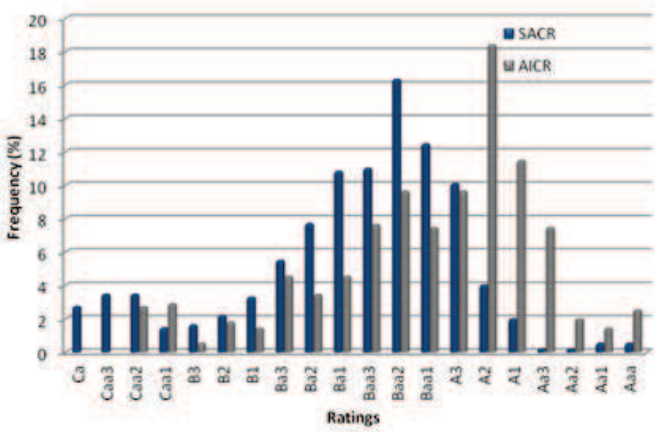
Figure 3.15: Equity/Total assets (2007-14)



Note: Marketable debt (sum of short-term and long-term borrowings) and Equity are expressed as of total assets. We illustrate annual average values for the 135 banks.
Source: Bankscope, author's calculations

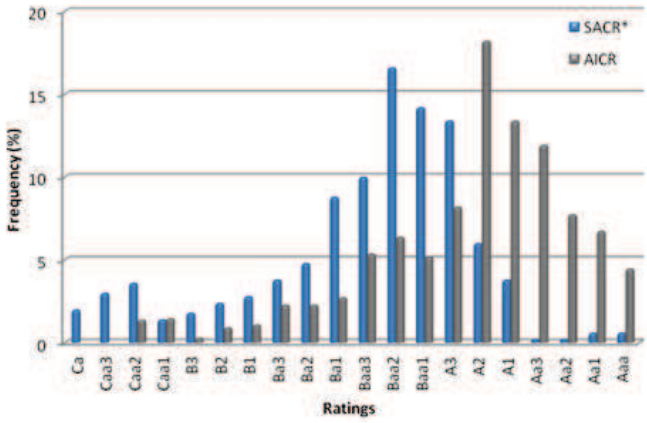
D. Measuring the implicit guarantee using the cost of debt

Figure 3.16: Histogram of ratings SACR (BCA) and AICR (values from 2011 to 2014)



Notes: The vertical axis indicates the percentage of observations for each class of rating (AAA, Aa1 etc) as of total number of observations (1086).
Source: Moody's

Figure 3.17: Histogram of ratings SACR* (adjusted BCA) and AICR (values from 2011 to 2014)



Notes: The vertical axis indicates the percentage of observations for each class of rating (AAA, Aa1 etc) as of total number of observations.
Source: Moody's

E. Suggested methodology for computing an additional measure of systemic importance

The regressions in Table 3.3 in Section 3.3 indicate that the results of estimations using simultaneously *Size* and *G-SIB* are biased because of the strong correlation between the two explanatory variables. This is not surprising given that the G-SIB assessment methodology itself explains that the size of the banks represents 20 per cent weight in the score factor used to determine the systemically importance of banks. The distribution of G-SIBs according to their size (Table 3.11) confirm these facts.

Table 3.11: Distribution of G-SIBs banks according to their size

	4 quantiles of Size of bank				
G-SIB	1	2	3	4	Total
0	254	254	243	142	893
1	0	0	11	112	123
Total	254	254	254	254	1 016

Notes: G-SIBs status is defined according to FSB (2014). We compute 4 categories of size corresponding to the four quartiles of the variable *Size* whose values range between 5.4 and 14.6. Balance sheet data was not fully available for 3 G-SIBs (BPCE and Barclays for 2007, 2008 and Societe Generale for 2014, in total 5 missing observations).
Sources: Bankscope,FSB (2014), author's calculations

Therefore, in order to account for the two features of banks, we propose an alternative methodology that provides a new variable, describing the probability of banks to become G-SIBs. In what follows, we will detail this methodology.

We run a logistic regression where the output is the binary variable G-SIB and the independent variable is the size of the bank. According to this logistic regression analysis

(described in equation (3.6)) we are able to describe the relationship between *Size* and the log odds[32] of becoming G-SIB[33]:

$$logit\,(p) = \beta_0 + \beta_1 Size_{it} \tag{3.6}$$

Where p is the probability of a bank to be G-SIB (p = prob(G-SIB=1)) and *Size* is a continuous predictor variable. The results of the regressions are reported in Table 3.11 below. The estimate in column 1 suggests the amount of increase in the predicted log odds of *G-SIB* begin one that will result from a one unit increase in *Size*. For one unit increase in the *Size*, we expect a 2.5 increase in the log-odds of a bank to become G-SIB.

Otherwise, by analysing the result in column 2 that report the odds ratio, we learn that one unit increase in the size of the bank will drive an 11.73 per cent increase in the odds of becoming a G-SIB.

Table 3.12: Results of logistic regressions

	(1)	(2)
VARIABLES	G-SIB	G-SIB
	Logit coeff	Odds ratio
Size of bank	2.462***	11.73***
	(0.200)	(2.344)
Constant	-32.34***	0***
	(2.556)	0
Observations	1016	1016

Notes: One should bear in mind that logistic regressions use maximum likelihood, which is an iterative procedure. The iterating is stopped when the difference between successive iterations is very small (i.e. the model "converged"). And then, the results are displayed. The model is statistically significant because the p-value is 0.000. The coefficients are in log-odds units. We have also tested for a non-linear relationship between Size and G-SIB status and it proved not to be statistically significant. Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1.
Source: Moody's, Bankscope, author's calculations

For other banks (binary variable *G-SIB*=0), the estimation predicts more than it should do and therefore the residuals are negative. In turn, for G-SIBs, the relationship is underestimated and the residuals have to be positive.

Our objective goes beyond the simple logistic regression and focuses on the post-estimation predictions. More precisely, we use the individual intercepts to further assess the probability of a bank to become G-SIB[34] given its size (i.e. the probability of a positive outcome). Using this approach we are able to evaluate the probability of large European banks that are not classified as G-SIBs by the FSB to "obtain" the G-SIB

[32] logit(p) = log (odds) = log(p/(1-p)) with p the probability of G-SIB to be 1. The odds ratio can be computed by raising e to the power of the logistic coefficient (β_1 in our model).

[33] OLS regressions were tested as well for robustness check only. Given the nature of the dependent variable (binary variable), the logit model is the most appropriate.

[34] Technically, we use logistical postestimation commands from Stata.

status, if changes in size intervene, and the probability of already recognized G-SIBs to lose their status.

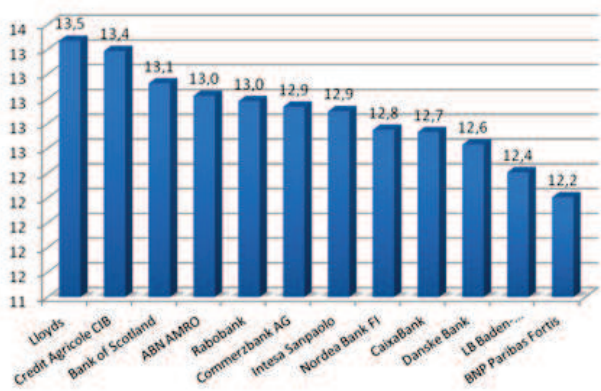
These calculations have been made for all banks in the sample. We therefore dispose of a variable that evaluates the systemic character of banks given the size of their balance sheet. This new variable is given by the odds ratio of the logistic regression described in equation (3.6) and provides an assessment of the probability to get the G-SIB status, probability which will henceforth be called p.

Table 3.13: Descriptive statistics for p, the probability of being G-SIB

p	Obs.	Mean	Std. Dev.	Min	Max
All sample	1016	12.1%	0.23	0.0%	97.5%
G-SIBs	123	54.7%	0.29	1.6%	97.5%
non G-SIBs	893	6.2%	0.14	0.0%	80.1%

We further present the results for these estimations. For clarity reasons, we chose to illustrate the results for the largest 10 per cent non G-SIBs banks according to their size as in 2014[35,36]. According to this criterion, we construct a sub-sample of 12 institutions from 9 different countries whose ranking according to the size as of end-2014 is shown in Figure 3.18 below.

Figure 3.18: Largest non G−SIBs according to size of the balance sheet as in 2014 (end of period)



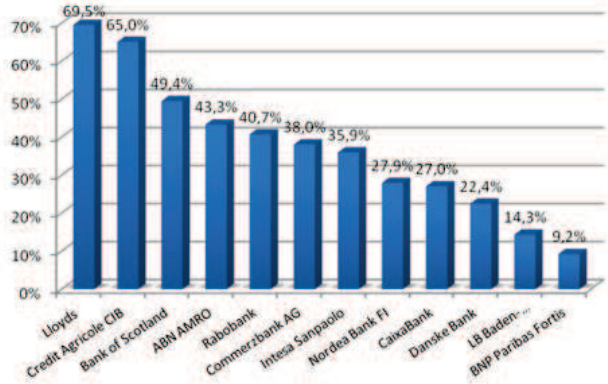
Notes: Non G-SIB banks are ranked according to their size as in 2014 where size is computed as the logarithm of the total assets. For clarity reasons, we chose to plot values only for the 10 per cent largest non G-SIBs in the sample (corresponding to values above the value corresponding to the 90th percentile of *Size* for other banks).

The estimated probabilities of becoming G-SIB given their size as in 2014 are illustrated in Figure 3.19. In accordance with the results of the logistic regression analysis in Table 3.11, we learn that largest banks have also the greatest chances to acquire the G-SIB status.

[35] We classify the non G-SIBs by the *Size* as in 2014 and we consider for the presentation only values above the value corresponding to the 90th percentile.

[36] We made the same exercise by taking into account the average value of Size for the period 2007-2014 in order to account for longer-term tendency. The ranking is not changing even of the values of Size in 2014 are in general higher than their average for the period 2007 to 2014.

Figure 3.19: Estimations of the probability of becoming G-SIBs for the large non-G-SIBs banks in Europe. Estimations as of 2014



Notes: We rank non G-SIB banks by their size as in 2014 and we plot values for the probability to become G-SIBs (given their size) of the 10% largest non G-SIBs in our sample.

With this alternative measure of the systemic importance, conditioned on the size of the bank, we run alternative regressions. Although one could contest it for technical reasons, it provides a measure of the systemic importance, beyond the size effect. The use of this indicator could be more relevant in explaining the value of *IG* for banks other than G-SIBs.

The results of regressions following similar approach as in section 3.3 are presented in Table 3.14 below.

Table 3.14: Results of regressions using alternative measure of systemic importance (2007-14)

VARIABLES	(1) IG All sample	(2) IG Other banks	(3) IG Other banks	(4) IG Other banks
Bank strength (SACR)	-0.195***	-0.186***	-0.184***	-0.173***
	(-8.629)	(-7.845)	(-7.805)	(-6.546)
p	1.266***	3.137***	3.142***	0.248
	(6.203)	(7.222)	(7.204)	(0.382)
Marketable debt			1.175***	1.016***
			(2.792)	(4.115)
Retail ratio				-0.241**
				(-2.414)
Size of bank				0.413***
				(6.365)
Constant	4.999***	4.840***	4.302***	0.124
	(16.72)	(15.62)	(12.96)	(0.157)
Observations	990	867	864	730
R^2	0.112	0.125	0.145	0.190
R^2 adj	0.111	0.123	0.142	0.183
F	45.65	52.03	34.85	23.35

It appears that banks with a higher probability of being G-SIBs, conditional on their size, tent to enjoy greater implicit guarantees. This finding is stable regardless of the

other terms that are considered, independently of the dependence on market funding or the business strategy.

Chapter 4

Ending "Too-Big-To-Fail"

"If the crisis has taught a single lesson, it is that the too-big-to-fail problem must be resolved."
ex-U.S. Federal Reserve Chairman Ben Bernanke, 2010

The existence of implicit guarantees emerge from the expectation that governments will intervene to avoid the bankruptcy of banks whose failure is a real threat for the global financial system. During the last decade, the magnitude of these implicit subsidies has reached historical levels and increased moral hazard. The literature analyses the evolution of these distortions and identifies the driving factors. The intrinsic strength of the bank and the sovereign's capacity to provide support are the main determinants of the value of implicit guarantees, as discussed in more detail in chapter 3. In this chapter, we take the analysis one step further and examine the extent to which the recent regulatory framework and particularly, recovery and resolution policies, contribute to the "ending" of too-big-to-fail implicit advantages.

While such frameworks have been adopted only recently at European level, national jurisdictions have imposed conditions and defined resolution mechanisms to be applied in case of failure since 2008. More recent debates are somehow focused on the design of resolution frameworks and their viability in dealing with cross-borders active banks, and especially with globally systemic important banks.

The reasons for the growing interest in global systemically important banks (G-SIBs) are provided by the negative externalities that the failure of such institutions could have on the rest of the financial system compared to smaller banks. For these reasons, interest in reinforcing the strength of global systemically banks (key attributes defined by the FSB, capital buffers) and providing additional tools that could be addressed in case of recovery or/and resolution of cross-borders banks (the total loss-absorbency capacity - TLAC, the Bank Recovery and Resolution Directive - BRRD and the agreement on a Single Resolution Mechanism - SRM) are key instruments of the recent reform agenda.

Meanwhile, several policy makers were faced with banks' default during the crisis and have already experienced different resolution practices which changed the perception on implicit guarantees. One of the most noteworthy was the Cypriot experience that changed creditor's expectations of bailout although no apparent threat could come from the small island's banking system. Compared with Cyprus bail-in practices, the resolution of Banco Espirito Santo experienced by Portugal in 2014 had a greater impact at national level but no long-term significant impact on European activity (Schäfer et al., 2016).

The analysis undertaken in this chapter investigates empirically the effects of changes in regulatory frameworks on the estimated value of implicit guarantees. Our work focuses on resolution policies (regimes implementation and policy makers' practices) and explains the recently observed decrease in the expectations of public bailouts. Then, we address several questions that have been raised by the results of chapter 3 with regard to the difference in the treatment applied to banks according to their specific structural patterns. The empirical framework employed in this chapter (difference-in-difference model) allows us to identify the impact of different regulatory measures and resolution practices on the expectation that sovereigns will intervene to provide support. Since systemically important banks were those that enjoyed most of public support, we expect that the policy makers' decisions designed to reduce distortions and public interventions will affect harder the G-SIBs than smaller banks.

The analysis that we carry out in this chapter completes the study from the previous one and our results emphasize a reduction of distortions in banking activities driven by the adoption of various policy measures to end the TBTF. The literature on resolution policies and practices is very recent and consists in central banks' reports and institutional impact assessment studies. This study is to the best of our knowledge the first one to empirically evaluate and distinguish the effects of the reforms on different types of institutions. Nevertheless, results of our analysis should be interpreted with caution and take into account that at the moment of the analysis the reforms were not fully implemented. The study conducted in this chapter is very likely to be continued and updated according to developments in ending-TBTF agenda.

This chapter is structured as follows. The next section outlines the existent regulatory frameworks designed to reduce distortions in the banking system, at both national and international levels. We provide a description of the main regulatory tools and the progress made in implementation by national jurisdictions. Then, we discuss the expected effects of different resolution regimes and practices experienced by European authorities and we highlight the key tools recently employed in the resolution of Banco Espirito Santo in Portugal. We continue with the identification of the framework for the empirical analysis

and the presentation of the data. Using different econometric methodologies, we analyse the extent to which resolution regimes implemented at national and supra-national level affected the expectation of public bailout for European banks. We also test for the impact of resolution practices and the extent to which policy makers' decisions changed investors' perceptions on the probability that the government lends support to banks in distress. Next, we propose an empirical framework that allows us to evaluate evaluating the difference in the evolution of implicit guarantees for G-SIBs and the other banks as a consequence of regulatory developments. Finally, we present the policy implications of our results and conclude.

4.1 Overview of recovery and resolution measures

Although debates with regard to the introduction of additional tools, compatible with new financial developments and active at international level, existed before the financial crisis (Ingves, 2006), their creation and, most importantly, their implementation is easy to fulfil. In 2012, EU officials came up with concrete propositions that have been gradually revised and, finally, partially implemented. At the time when this thesis was prepared, several countries had fixed objectives on the adoption of resolution regimes and among them, certain had already transcribed into national jurisdictions the internationally agreed reforms.

During the crisis, policy makers dealt with banks' insolvencies in an inefficient way and adverse effects came into being shortly after. The absence of appropriate policies led to massive public interventions and emphasized the ineffciency of market discipline (Brandao Marques et al., 2013). Moreover, public debt increased significantly and caused large output losses. Subsequently, the worldwide economy suffered considerable damages. This phenomenon was even more obvious in developed countries, where the real economy has been severely hit and unemployment still reaches higher levels than before the crisis.

Past experiences suggest that the harmonization of regulatory and fiscal tools is mandatory for the improvement of financial stability. Specifically, an important shortcoming of the European integration agenda has been the lack of appropriate policies that policy makers could address when confronted with banks' failures, as was the case during the subprime and sovereign crises. More precisely, the resolution regimes are supposed to establish a priority order for debt and shareholders in case of liquidation and to improve both the capacity of the banking system to absorb losses and the taxpayers' protection.

In the post-crisis period, national and international authorities made significant efforts in improving the regulatory and policy shortcomings revealed by different financial shocks recorded since 2008. Policy makers came up with additional tools and reforms

to deal with vulnerabilities observed during the last financial crisis in order to prevent similar future disruptions in financial activity and higher distress in the wider economy. Specifically, measures have been taken at national level in the post-Lehman period with the aim of reducing public interventions through "bailout" procedures and move ahead towards "bail-in" practices (bank's recapitalization by shareholders and creditors funds mobilization). Therefore, implicit public guarantees are directly linked to banks' failure resolution practices (Schich and Kim, 2012).

In the absence of such policy tools, public authorities intervened and bailed out several banks in distress. Therefore, the changes in the resolution regimes and practices might affect the willingness of sovereigns to intervene and to provide financial support to banks in distress. Moreover, the changes in policy makers' decisions in terms of resolution practices can affect investors' perception on the implicit support granted by sovereigns to domestic banks if they are credible enough.

Moreover, central recovery and resolution policies are necessary given the cross-countries activities of banks. Thus, public authorities published in 2012 a proposal for a harmonized resolution scheme at European level, which has been approved in 2013 and will come into force starting with 2016. Overall, the reforms that have been proposed so far and for certain countries, partially implemented, are conceived to support financial stability and sustainable growth. Progresses have been made on several axes:

- improving the stability of institutions through Basel prudential framework,
- designating the global systemically important banks (G-SIBs) and therefore, recognising the threat for the global financial stability that a large bank would pose if it were to fail,
- imposing higher loss absorbing standards and special supervisory treatments for the G-SIBs,
- defining and implementing resolution policies domestically and furthermore, at an international level, and
- imposing additional measures to address risks issued from market activities, OTC derivatives reforms.

In what follows, we discuss the role of prudential rules implemented by the Basel Committee and national authorities. Then, we focus on capital requirements for G-SIBs and on the implementation of resolution mechanisms. The reforms for market-based activities will not be addressed in this thesis, they will make the subject of future research.

4.1.1 The implementation of prudential rules

Overall, the aim of the reform agenda imposing higher capital and liquidity requirements is to improve banks' loss-absorbing capacity and strengthen the resilience of the global financial system, in order to reduce the probability of future crises. Since in chapters I and II we have already presented these regulatory measures and analysed their impact, we are now only discussing the developments in the implementation of these rules.

Overall, banks' efforts to fulfil regulatory requirements may be observed mainly through better quality capital, decreasing leverage and lengthening the maturities of liabilities. Undoubtedly, the implementation of Basel III prudential regulation plays a key role in improving the soundness of financial institutions especially since January 2013, although most regulated banks took the lead in increasing capital and liquidity regulatory standards. This decision of banks could be explained by market pressure but also by banks' willingness to reassure investors of the strength of their balance sheet. Nevertheless, it implicitly proves that capital is not as expensive as practitioners used to argue when regulatory standards have been publicly released. Among the countries monitored by the FSB, seven countries with G-SIBs headquartered in them (France, Germany, Italy, Netherlands, Spain, Switzerland, and United Kingdom) had implemented risk-based capital Basel III rules. The liquidity framework in turn, has been applied only in Switzerland while the other six countries have published the final draft for the liquidity regulation that should be adopted. Although Basel framework also includes macro-prudential policies aiming at enhancing arrangements for international policy coordination, the implementation of these instruments is not coordinated yet at international level.

European countries are submitted to CRR/CRD IV packages, which transcribed the Basel III framework into European legislation and whose aim is to harmonize prudential frameworks (micro and macro) while ensuring a level playing field for all banks in the European Union. This step is mandatory for further harmonization of recovery and resolution regimes and practices at European level. The prudential regulation deals with the issue of the safety of large institutions and a first step in this direction has been the setting up of the methodology that allows to identify those institutions whose failure is a threat to the global financial system.

4.1.2 Designing the G-SIBs

The crisis revealed, among others, that the TBTF phenomenon is not only a size distortion and that interconnectedness and complexity of activities should be taken into account as well when judging the systemically importance of institutions. One of the main challenges for the regulator was to identify these financial institutions whose distress or disorderly failure, because of their size, complexity and systemic interconnectedness, would cause

significant disruption to the wider financial system and economic activity (FSB, 2011). In order to address the TBTF problem, policy makers had to analyse an integrated set of policies (international prudential standards, harmonized supervision, additional requirements to reduce G-SIBs' probability of failure) and to evaluate the macroeconomic impact of such requirements.

Progress made in designating the global systemically important banks (G-SIBs) has been significant compared to other sectors (insurance for example). In November 2011, the BCBS published the methodology for identifying the G-SIBs, focusing on five main features: size, interconnectedness, availability of substitutes, global activity and complexity (BCBS, 2011). Based on a score analysis, a new typology of banks has been identified. An initial list of 28 G-SIBs (17 from Europe, 8 from the US, and 4 from Asia) was published in November 2012 by the FSB. This list, revised and published annually by the FSB, incurred several important changes since its creation.

The publication of a complete and transparent methodology allowing the identification of the global systemically important banks is in accordance with international efforts to enhance cross-borders supervision. The G-SIBs methodology and classification in buckets were conceived to facilitate further implementation of additional capital requirements[1], macro-prudential framework and regulatory measures taken within the recovery and resolution reform.

Beyond their principal objective of strengthening the resilience of institutions, the previously presented measures will have a considerable contribution in facilitating the implementation of recovery and resolution mechanisms.

4.1.3 Resolution regimes and policies

We chose to present different measures to implement resolution mechanisms in three distinct sub-sections. First, we describe the measures taken at national level since they came up before all other international agreements. Second, more recent European structures and reforms that have been established within the banking union creation project will be discussed. Finally, we focus on large institutions and on the additional requirements that have been agreed lately and will be adopted in the foreseeable future.

4.1.3.1 National resolution regimes

The latest global financial crisis has raised a range of problems that required immediate treatment. First, dealing with distortions in financial activities, including public implicit

[1] The minimum capital requirements requested for G-SIBs are higher compared to other banks. According to the FSB (2015a), the requirements could reach a level of 7-10 times compared to those prior to the crisis. For example, the prudential capital requirements for these institutions should be above 11.5% (CET1 to RWA). More details in FSB, "Thematic Review on Supervisory Frameworks and Approaches for SIBs", May 2015.

guarantees, is of a crucial importance. Second, the failure of a financial institution, compared to firms from other sectors, can have considerable adverse effects on other institutions and on the rest of the economy. Third, banks' failures lead to freeze of activities that have important direct costs for the economy, and also indirect costs due to assets' revaluations.

A first answer came from national regulators that made proposals for new policy tools that will enable authorities to deal with banks' failure and to ultimately reduce the bank-sovereign loop. "Banks, not taxpayers, should be responsible for bearing the cost of the risks they take"[2].

Since 2008, several European countries made progress in the implementation of resolution regimes with the aim of limiting "bailout" procedures and moving ahead towards "bail-in" practices (bank's recapitalization by shareholders and creditors funds mobilization). We present in Appendix A the major developments in the implementation of resolution schemes in 11 European countries. Comprehensive resolution tools, particularly policies that allow the transfer of the rights and obligations of banks entered into resolution to third parties, were provided to policy makers.

The efforts made at national level aim to reinforce policy framework and to provide appropriate tools for effective resolutions. Although the frameworks vary across jurisdictions for reasons of specific structural feature, policy makers had a common objective, which is the reduction (limitation) of negative spillovers engendered by banks' disorderly failures.

4.1.3.2 European reforms

Although national resolution regimes proved to be helpful and efficient in dealing with domestic banks' failure (for example, the case of Denmark Amagerbanken), they could not allow dealing with internationally active banks (the case of Banco Espirito Santo in Portugal). Hence, national resolution mechanisms were reinforced by international measures.

Although signals about the necessity of a cross-border organisation for financial supervisory were made well before the sovereign crisis[3], the first official reaction of the Basel Committee with regard to this issue was publicly released in 2010. The implementation of supervisory and resolution frameworks at supra-national level become a topic of high interest for the international community and has been more seriously addressed within

[2] From the open letter addressed to the president of the European Commission, José Manuel Barroso, by European leaders in February 2012.

[3] Stefan Ingves, the Governor of the Sveriges Riksbank, came with the proposition to create a European Organization for Financial Supervision within the international conference taking place at the Federal Reserve Bank of Chicago in October 2006: "We need to move forward and find a modified framework before problems arise [..] and create a separate agency to follow the major cross-border banking groups in Europe".

G20 meeting in 2010 and concretized in 2011 with the publication of the "Key Attributes of Effective Resolution Regimes for Financial Institutions" defined by the FSB.

Several additional structures have been set up since 2011 with the aim of addressing the important lacks in European architecture and the imperfections of the monetary union functioning revealed by the crisis. The European Stability Mechanism (ESM) has been created for crisis management reasons in order to provide financial assistance to public authorities and avoid direct public bailouts. In addition, for ensuring more efficient setting up of different regulatory measures, policy makers appealed to a second structure, the Single Supervisory Mechanism (SSM). Entered into force in 2014, the SSM aims at harmonizing national resolution regimes and deposit insurance schemes in order to provide suitable tools for an efficient supervision of both internationally active and domestically-oriented banks. With supervision at the European level, the monitoring of the risks emerged from banking activities, or to which they are faced, should allow for a more efficient allocation of capital and liquidity. It should also contribute to the reduction in national imbalances.

The European convergence went one step further with the proposal for the Single Resolution Mechanism (SRM) whose aim is to reduce the negative feedback loop between sovereigns and banks. As the SSM, the SRM covers banks from the 19 Eurozone member states and it should be operational starting with 1st January 2016[4]. This structure is designed to organise orderly resolutions. Not only should it reduce resolution costs like it was the case for Fortis and Dexia in the aftermath of Lehman's collapse, but it should also deal with cross-border activities implying both national and international resolution authorities. These different structures, parts of the European architecture, are monitored and directed by the ECB, the central authority in the Banking Union's implementation.

For the SRM to be efficient, it has to be supported by another crucial regulatory change: the Bank Recovering and Resolution Directive (BRRD). Probably one of the most important regulatory tools, the BRRD promotes the shift from bailout to bail-in procedures. The implementation date for European countries was 1st January 2015 (with the exception of the part on the bail-in resolution tool, which enters into force one year later). However, 11 EU countries have failed to implement these rules into their national law at 1st January 2015[5] (European Commission, 2015) and the implementation process is ongoing.

The bail-in tool came into effect on 1st January 2016 and ensures a full implementation of the SRM. Starting with this date, the shareholders and creditors of banks entering resolution have to ensure at least 8% of total liabilities for loss absorbency. Once this

[4] Banks from Euro area countries are directly supervised but banks from other countries of the European Union can join.

[5] Bulgaria, the Czech Republic, France, Italy, Lithuania, Luxembourg, the Netherlands, Malta, Poland, Romania, and Sweden

threshold is reached, the resolution fund can support the bank with up to 5% of its total liabilities. Only after these procedures are completed, public authorities (national or supra-national) will have the right to intervene, as a lender of last resort. The decisions with regard to the timeline of interventions is ensured by the Single Resolution Board which is the central decision-making body of the Single Resolution Mechanism[6].

With this priority order to intervene, the bank-sovereign nexus should be broken up and external discipline should be improved, under the condition that pre-resolution procedures are efficiently implemented and transparency is at optimal levels, in order to facilitate the resolution. At European level, the efficient implementation of these structures should end the TBTF paradigm[7], significantly reduce moral hazard and avoid any taxpayers' contribution in restoring banks' activities. One should bear in mind that costs for taxpayers were not only due to direct public interventions, but came also from financial instability, or the effect of this latter is felt in the medium and longer term (Constâncio, 2014).

The Banking Union, which is "based on a single supervisory, resolution and deposit insurance mechanism that complements the single monetary authority"[8] is still a work in progress. Nevertheless, the activity of the SSM joint with the BRRD implementation ensured by the SRM represent crucial steps in the creation of the Banking Union in Europe. The efficiency of resolution regimes and practices is conditioned by the credibility of supervisory measures and also by the credibility of European authorities' efforts to jointly monitor the implementation[9]. The SRM must deal with contagion and negative spillovers for all banks under the supervision of the ECB, especially for banks with cross-border activities for which the magnitude of feedback effects can be much higher.

Box 4.1. Resolution practices in Portugal

We discuss in what follows the recent case of banking resolution practised by Portuguese authorities. Banco Espirito Santo entered into resolution in the summer of 2014 after several months from the first signals of serious accounting problems noticed within audit procedures. The irregularities emerged from fraudulent funding schemes developed between BES and the Swiss entity Eurofin, part of Banco Espirito group. Beyond the interest in this case given the resolution procedures employed, we chose to present it since it is among the most recent in Euro area and presents important features for national banking system and cross-borders structures.
BES was the third largest bank in Portugal and held €80.2 billion of assets, €36.7

[6] Please find details on the composition and the functioning of the Single Resolution Board on *http://srb.europa.eu/*

[7] Ending too-big-to-fail is probably too ambitious. Implicit guarantees for TBTF banks will certainly continue to exist, although it should be reduced to minimal levels.

[8] Danièle Nouy speech in at the Banca d'Italia conference "Micro and macroprudential banking supervision in the euro area", Milan, November 2015. Nevertheless, deposit insurance scheme at European level is not even clearly defined.

[9] Nevertheless, the implementation at European level is still very challenging since the directives have to be transcribed in national jurisdictions. This process can lead to variations in the interpretation of rules and goes somehow directly against the main objective of unique European prudential framework (Nouy, 2015).

billion in customer deposits and €5.8 billion in resources from other credit institutions, as of 30 June 2014 (European Commission, 2014b). It operates in 25 countries on 4 continents and is part of Banco Espirito Santo Group, the second largest Portuguese banking private group by total reported net assets.

The huge amount of losses revealed in June 2014, led BES to file for bankruptcy protection from creditors on 18 July 2014. Soon after that, given its financial difficulties and the rumours on fraudulent funding schemes practiced with other entities of the group, the ECB's Council decided to cut off funding at the beginning of August.

Given the importance of Banco Espirito Santo (BES), controlling about 20 per cent of the banking market, the Portuguese authorities decided to proceed to resolution of the "bad" bank in order to avoid greater disruptions in the national activity. The policy decisions related to the resolution have been taken during one weekend and were in line with the national resolution regime, the Legal Framework of Credit Institutions and Financial Companies (Decree Laws no 298/92 and 157/2014) and the Key Attributes of Effective Resolution Regimes for Financial Institutions defined by the FSB. One should bear in mind that at that moment, the SRM was no in place but the text was defined and agreed by European authorities. The last amendment made to the national resolution regime, in 2012, mentioned two solutions for the resolution of financial institutions: the sale of assets and liabilities to other financial institutions and the creation of a bridge entity that should take over the activity of the "bad" bank. The resolution procedure has been applied by Banco de Portugal and EU authorities.

On Monday, 4 August 2014 a new bank was born. Novo Banco, the bridge-entity received a €4.9bn injection of new capital from Bank of Portugal's Resolution Fund (Financial Times, 2014)[10]who became the unique shareholder of the bridge-bank.

The activity and the assets of BES have been transferred to the bridge bank, where deposits and preferential bonds have been fully preserved. In turn, Novo Banco received the rights and obligations transferred from BES and had to ensure the continuity of the activities undertaken by BES towards its clients and markets. It has also the "mission" to maximise the value of its assets in the sale process. For the resolution to be effective and efficient, Banco de Portugal was in charge of ensuring the transfer of information between BES and the bridge-bank.

Meantime, the Board of Directors and the Board of Auditors of BES were suspended when the decision of resolution was taken. Since the bank in resolution has no longer the right to proceed to any financial activity, the following step was the liquidation of assets and liabilities that had not been transferred to Novo Banco. The shareholders and subordinated debt holders incurred losses in accordance with the burden-sharing rules in place. Within the ring-fencing process, aimed at isolating the bridge bank from the Grupo Espirito Santo, risky activities with an important exposure to losses remained in the balance sheet of BES.

The resolution practised by Banco de Portugal was designed in compliance with supranational resolution standards. Nevertheless, several aspects have not been employed. First, bail-in procedures would have been difficult to implement given the weaknesses of the banking system as a whole. The general low profitability of the bank due to significant losses on credit portfolios and a reported loss of €3 billion, well above the expected amount, led to increasing difficulties for the group. Second, the cross-borders cooperation was not employed either in this resolution. This could be explained by the fact that the supervisory tools and the assessment of the international activities were not yet concretized and, in such conditions, an international cooperation for the resolution

of a "bad" bank might have taken more time. The decision of Bank of Portugal to release funds for BES resolution could be considered as a signal on the real situation of BES. The very quick reaction of the central bank may suggest that the health of BES was probably even more fragile than the communication referred to. Finally, another "opaque" point with regard to this resolution concerns the transfer of liabilities to the bridge bank. The liabilities designed to transfer under the Facility Agreement were, in fact, not transferred to Novo Banco and remained in BES balance-sheet, leading to conflicts with creditors.

Nevertheless, the resolution scheme adopted by Bank of Portugal in the case of BES succeeded in stabilising the system (at least in the short-term) and most importantly, avoided the taxpayer contribution to loss-absorption. Overall, the Portuguese banking system, which was already among the weaker in Europe, experienced an additional shock through the resolution of BES. Over the past three months preceding the resolution, the CDSs spreads for BES had increased by 208 bps. During the very short period corresponding to the decision taking, both share and bond prices dropped sharply as it is shown in the figure below:

The national stock market has been troubled and it recorded a sharp variation in stock-market benchmark which lost 22% during one month, reflecting investors' concerns on the solidity of financial institutions and of the entire Portuguese banking system. This episode "highlights the vulnerability of Portuguese banks to external shock" (Moody's Investors Service, 2014). Nevertheless, the banks from peripheral countries did not incur significant changes. This may be due to markets anticipations estimating a low systemic threat of BES default for the European banking system, since the bank is considered as important only for the domestic banking system.

Overall, this experience revealed the problems that the European authorities still have to undergo in order to reduce distortions and the probability of banking crises[11]. The most obvious problem pointed out by BES case could be considered as a consequence of numerous shortcomings in supervision of cross-borders activities. One should bear in mind that BES passed all stress tests driven by the ECB between 2009 and 2011 and did not request any support within the Portuguese bailout program. The latest stress test driven by ECB and EBA were ongoing in the summer of 2014. The results for BES or Novo Banco were published in October 2014. Although it might aim to avoid additional market distress, one could judge the decision of European authorities of not to publish these results as a lack of transparency.

The case presented in this box reinforces the reform agenda proposing the implementation and improvement of the supra-national supervision through the SSM before the implementation of any international resolution scheme.

All banks have been facing new regulatory developments since the latest financial crisis and the global systemically important banks have been subject to additional requirements. In what follows we present and analyse the additional measures imposed to large and complex financial institutions.

4.1.3.3 International reform agenda to deal with failures and resolution of systemic banks

The crisis clearly pointed out the need of cross-border cooperation in order to efficiently address the resolution of large and complex institutions. At the G20 summit in 2013, the FSB together with its members and international financial institutions have been designated to develop an additional framework for evaluating and improving G-SIBs' capacity to absorb losses in case of liquidation.

In addition to the *Key Attributes for Effective Resolution Regimes*[12] which were already in place in 7 different jurisdictions (France, Germany, Italy, Netherlands, Spain, Switzerland, and United Kingdom) at the end of 2015[13], the FSB addresses the issue of G-SIBs riskiness within the total loss-absorbency capacity (TLAC) framework. It provides a series of stabilisation tools to reinforce the existent regulatory procedures for G-SIBs[14] and to avoid future failures of large and interconnected banks or, in the case that it happens, to reduce the costs of resolution and taxpayers' exposures to losses issued from banks' liquidations.

TLAC

The recognition of the need of special tools for all banks, but especially for systemically important institutions may be summarized in three main points: loss absorbency, supervision and resolution policies. With the TLAC framework, the FSB, together with the BCBS, reinforces the existent reform agenda and goes one step further towards "ending" TBTF distortions. The framework focuses on high quality instruments (equity but

[10] The Portuguese State has the obligation to pay back the Resolution Fund using mainly the funds obtained through the eventual sale of assets of the bridge bank. This latter is established as a temporary credit institution to ensure the continuity of financial activities and avoid greater disturbances (systemic adverse effects). The Resolution Fund was established in 2012 through the contributions of the Portuguese banks.

[11] Although the Portuguese experience is not the only one in Europe since 2008. Austria's Hypo Alpe-Adria, Cyprus and Danish banks, and the Dutch SNS Reaal have already been subject to internal recapitalizations and resolution practices through shareholders and creditors participations to burden-sharing. More details in Dübel (2013) and Schich and Aydin (2014).

[12] The *Key Attributes of Effective Resolution Regimes for Financial Institutions* have been published for the first time in November 2011 and the last update has been made in October 2014. More largely, the implementation of Key Attributes implies cross-border crisis management groups (CMGs), institution-specific cross-border cooperation agreements (COAGs), recovery and resolution plans (RRPs) and resolvability assessments for all G-SIBs. Meantime, several progress reports have been published.

[13] These jurisdictions have at their disposal recovery and resolution planning for institutions considered as systemically important. Italy and Switzerland are requiring special measures for banks considered as domestically too important to fail but, for instant, recovery and resolution measures are applied only to G-SIBs.

[14] The presentation of the TLAC framework is based on the Consultative Document available at *http://www.financialstabilityboard.org/wp-content/uploads/TLAC-Condoc-6-Nov-2014-FINAL.pdf*

also stable long-term claims) that should be immediately available for bail-in procedures "without disrupting the provision of critical functions or giving rise to material risk of successful legal challenge or compensation claims".

The TLAC is of crucial importance for financial stability since, by improving their loss-absorbing capacity, the G-SIBs should reduce the probability of being in distress (and cause a systemic crisis) while ensuring central authorities and market participants that they dispose of sufficient resources to allow an efficient resolution if needed.

The TLAC is very similar to the European BRRD by its aim of reducing the negative effects that could emerge from resolutions and avoiding taxpayers' exposure to losses. Nevertheless, compared to the BRRD it is specially conceived for G-SIBs. Moreover, beyond its objective of limiting public bailouts for banks in distress, the TLAC could have several indirect positive effects: ensuring a better credit provisioning at a global level, reducing risk-taking incentives for large institutions that used to benefit from various advantages induced by their TBTF status and finally, establishing confidence in policy measures, in more general terms, and improving market discipline. Nevertheless, liabilities that are not TLAC-eligible may be exposed to losses during the resolution process. Moreover, the total amount of losses incurred during the resolution may reach higher levels than the amount of TLAC evaluated ex-ante.

Box 4.2. The implementation of the TLAC

The framework imposes specific minimum requirements for each G-SIB. Authorities have to evaluate a specific minimum TLAC for each G-SIB in accordance with its recovery plan, risk profile and business model. The methodology has been planned so that G-SIB's specific TLAC should be above the value of the threshold imposed by the FSB in order to ensure a fair playing field at an international level. To reach its objectives, the TLAC includes the existing Basel III minimum capital requirements since it is complementary to the micro prudential framework but excludes Basel III capital buffers. Therefore, the minimum requirements will be considerably higher than Basel III requirements and should reach 16% of the RWAs and at least 6% of the Basel III leverage ratio denominator[15]in January 2019[16]. The G-SIBs should fulfil these requirements by end-2019.

The resolution process has to be applied according to the resolution strategy proposed by the institution, in which the G-SIB should also name the entity that will be subject to resolution (either holding company, top tier parent, intermediate or operating subsidiary). More than one resolution entity can be proposed, however each resolution entity will be treated in a unique resolution group. When a bank enters resolution, the TLAC eligible debt-instruments held by external creditors have to be converted into equity of the resolution entity.

[15]The denominator of the Basel III leverage ratio is the exposure measure and namely, the amount of total assets.

[16]From January 2022, the minimum requirements should reach 18% RWA and 6.75% of Basel III leverage ratio denominator. Values provided by FSB, 2015b.

4.1.4 Implementation and efficiency of resolution regimes

If there is no possibility of recovery, the main responsibility of the resolution authorities is to intervene at a sufficiently early point in order to preserve value[17]. The possibility of additional losses in the period following the resolution should however not be neglected. It is important to mention that the resolution is not ensuring the continuity of the entity emerging from resolution (i.e. the bridge institution). The new structure should respect conditions and obtain authorisations and disposes of a 24 months limit to come in terms with the regulatory requirements. Moreover, it should be sufficiently capitalized in order to gain markets' confidence and continue the financial activity.

For the resolution framework to be efficient, ex-ante transparency of banks' activities is essential. Public authorities and market participants need to be reassured on the capacity of banks to absorb losses from resolution but also additional losses due to revaluations. Moreover, public disclosures should be improved by providing detailed information on the priority order in absorbing losses from burden-sharing (shareholders and other holders of ownership instruments, unsecured and uninsured creditor claims). The efficiency of all forms of resolution plans depends in general on the credibility of the framework and authorities' efforts to apply them, which implicitly depend on market discipline.

All these elements taken together should reduce the risk-taking behaviour[18] and the distortions in banking activity, especially the implicit guarantees. A first step has been made by individual national jurisdictions that fully implemented a series of reforms, especially redressing and resolution regimes.

<u>The effects of European resolution practices</u>

We expect stronger effects of the European resolution scheme and additional reforms to be observed starting from January 2016 when the bail-in tool of the BRRD becomes effective. Banks' efforts to align with regulatory standards improve risk-coverage and ensure on their loss absorbing capacity. Sovereign' willingness to provide support is likely to be strongly affected by the new standards. In other terms, under the new prudential and resolution regimes, sovereigns will be constrained to intervene and provide support to domestic banks in distress. Press releases, official guidelines and official disclosures with regard to the developments in the implementation of the BRRD seem to have already

[17] The decision-making process has to be made in a very short-time (for example, a weekend). The planning, based on ex-ante strategy proposed by the bank, has to be validated by resolution authorities (the Board together with the Commission and the European Council) within 24 hours.

[18] The FSB also proposed a series of rule called Principles and Standards for Sound Compensation Practices, with the aim of reducing excessive risk taking incentives for large financial institutions. Almost all FSB jurisdictions adopted these rules.

a significant impact on credit rating evaluations and implicitly, on market participants' anticipations.

We take the example of Germany who has already transposed the BRRD into national jurisdiction and has moved ahead by fully implementing the law one year before the European deadline. The full bail-in tools, which have been adjusted in order to better respond to specificities of the domestic system (important proportion of banks under public ownership, treatment of "grandfathered debt"[19] issued by public institutions before 2005), have been operational since January 2015. Recent ratings' reviews due to regulatory changes are explicitly accounted for by rating agencies[20]. Moody's has "lowered its expectations about the degree of support that the government might provide to a bank in Germany. The main trigger for this reassessment was the introduction of the BRRD Moody's Investors Service (2015a). In turn, covered bond benefited the most from the adoption of the BRRI (the equivalent of BRRD in Germany) since they are from now on, less exposed to default and losses[21].

For countries where the implementation of the resolution mechanism is still ongoing, the certainty that the directive will be adopted in the very near future leads to banks' credit ratings updates. Banks from several countries, especially those with sizeable proportions of senior debt, experienced ratings revaluations[22]. For French, Italian and Dutch banks' the downside revision of governments' likelihood to intervene within the context of the expected implementation of the Bank Recovery and Resolution Directive (BRRD) affected all-in ratings ratings[23].

For Austrian banks, the reduction in the expectation of public support is justified by the government's decision in the case of Hypo Alpe-Adria-Bank International AG's nationalisation, and namely they chose to protect taxpayers' interests and to penalise subordinated and senior creditors which had already benefited from a public sector guarantee in the past. This action had consequences on the perception of the willingness of Austrian government to support banks in general[24]. Erste Group Bank AG, Raiffeisen Bank International AG, Hypo Tirol Bank AG, and Vorarlberger Landes- und Hypothekenbank AG are among banks for which the expectation of public guarantee has been reduced.

[19] The term of "grandfathered debt" is used to describe state-guaranteed debt instruments borrowed at favourable funding terms by German Landesbanken. Most of these instruments will come to maturity by the end of 2015.

[20] For consistency reasons, we analyse and present Moody's ratings developments. Nevertheless, Fitch and Standard and Poor's also take into account changes in European regulatory frameworks.

[21] Covered bonds are "exempted from being written down following a bail-in intervention of the national authorities, and provides that the assets of the cover pool must remain segregated and well-funded", Article 44 of the directive. German covered bonds' ratings have been upgraded in average of 1.2 notches due to the BRRD implementation.

[22] It refers mainly to stand-alone ratings. According to Moody's Investor Service, 8th December 2014: "New EU-wide regulation has enforced higher capital levels, which, through de-risking and better asset-liability matching will improve bank performance, longer term" $https://www.moodys.com/researchdocumentcontentpage.aspx?docid = PBC\_177831$

[23] Moody's Investors Service, Press release from 22 and 23 June 2015.

[24] Moody's Investors Service, Press release from 20 June 2015.

For these banks, further negative revisions due to the implementation of the BRRD and SRM should not be excluded.

The slight reduction in the value of implicit guarantees that was noticed after 2011, came as a natural consequence of the reform agenda. However, in the present economic environment, these measures can appear as incomplete and not completely consistent with internationally developed financial activities. Nevertheless, national implementation can of course contribute to overall effects of strengthening the resilience of financial institutions. In our study, we analyse empirically the impact of these national reforms since, in several countries, they are more advanced than the international framework.

The effects of TLAC

As for the TLAC framework, it is still early to estimate its total impact. Nevertheless, the BIS and the FSB conducted an impact assessment study that has been published in November 2015 evaluating the macroeconomic net impact of the implementation of the framework. Findings suggest that TLAC reduces the fiscal costs of dealing with crises when they do occur and that benefits are significantly higher than the costs. The overall annual benefits in terms of GDP are evaluated in the range of 45-60 bps.

The main concern with regard to the negative effects of the post-crisis reforms is related to lending. The strengthening of banks' balance sheets had no major negative consequence on lending and economic activity so far (no credit rationing, although lending growth has been very weak during the subprime and the sovereign debt crises). In turn, the higher standards imposed within the TLAC are likely to increase funding costs, which can lead to increases in lending spreads. The estimates were made for the sample of 30 G-SIBs in November 2014 and results suggest that the implementation of the TLAC will lead to an increase in lending (interest) rates of 5 to 15 bps, when the assumption of constant rates of returns on equity is used.

On the other side, funding rates are generally at a low level due to very accommodative monetary policies and this should reduce the negative impact dragged by higher capital requirements. Meantime, market-based funding increased in the post crisis period driving a greater diversification in funding sources.

The extent to which resolution regimes and practices at national level contribute to ending the too-big-to-fail remains an empirical question. The question that emerges from this section is which is the magnitude of the impact of resolution regimes and practices on the expectation of future public bailout? The next section explains the motivation for our empirical work.

4.2 Motivation

The progress that has been made until now with regard to the determinants and the value of the implicit guarantees is strongly related to the systemic importance of banks. Specifically, in 2012 a list of banks considered as too big and too important to fail, whose bankruptcy could have a considerable impact at global level, were designated by the Financial Stability Board as global systemically important banks (G-SIBs). Each year, the list of banks is revised in accordance with the structural evolution of banks. The supervisory frameworks for these G-SIBs experienced important improvements and supervisory colleges were established for almost all G-SIBs. Although all G-SIBs have recovery plans and cross-border crisis management groups, there are real challenges in making operational their resolution strategies and plans.

Nonetheless, more progress is needed. Firstly, more work is needed in order to strengthen the cross-border supervisory cooperation. The regulatory agenda of European authorities proposes the implementation of a Single Supervisory Mechanism (SSM) that should be closely connected to the Single Resolution Mechanism (SRM) and to the main authority in charge of the regulation and resolution, the European Central Bank. However, less progress has been made so far for the international harmonization of supervisory and resolution measures despite the international and complex activities of large banks worldwide. We should remind that few jurisdictions have a bank resolution regime that is broadly in line with the FSB Key Attributes of Effective Resolution Regimes. We also wish to draw attention on the importance of establishing and implementing transparent and clear regulatory and supervisory strategies and priorities, as they could allow for a more operational cross-border implementation of resolution regimes on one hand, and strengthening considerably the effectiveness of the regulation as a whole, on the other hand.

The questions that rise from the very recent literature and our previous discussion would be: To which extent the progress made so far allowed to reduce the distortions in banking activities and which measures made the greatest contribution to this reduction?

In what follows we analyse the extent to which the progress made in implementing the regulatory framework is reflected in the data. We consider the impact of different resolution regimes that have been adopted at a national level on one hand, and at European level, on the other hand. Since the effectiveness of these measures could be observed in explicit cases of resolution, we propose an analysis of these cases when banks have been subject to a resolution during which debt holders of subordinated or even senior unsecured debt holders incurred losses. Finally, we are going to test for the impact of both measures and also for the changes in both resolution regimes and practices.

Although it might be still early to reach a conclusion on the full impact of reforms, one can analyse the progress made so far and examine the extent to which the impact is explained by the data. To do this, we first analyse the impact of national resolution tools and secondly, the impact of BRRD and SRM adopted at European level. Since the TLAC is not yet in force, we will not treat it in our empirical analysis but it will be considered in future work.

4.3 Methodology and data

Figure 4.1 summarizes the measures that have been taken until now in terms of resolution regimes and practices for the European countries included in our sample. The representations are made on the basis of detailed information presented in Appendix A and B. Information on the two main aspects connected to the notion of resolution in European countries can be identified in the next table:

- the introduction of resolution regimes providing rules that have to be applied by national public authorities in the case of banks' bankruptcies,
- the situations of explicit resolution practices where debt holders incurred losses, and
- finally, the cases where a resolution regime was in place and a resolution practice has been experienced by at least one bank in the country are distinguished.

In addition, we report information about the total number of banks and the G-SIBs from each national banking system.

Figure 4.1: Total number of banks by country and changes in resolution regimes and practices

Country	Number of banks	2007	2008	2009	2010	2011	2012	2013	2014
Austria	7								
Belgium	4								
Denmark	6								
Finland	3								
France	9 incl 4 G-SIBs								
Germany	19 incl 1 G-SIB								
Greece	4								
Ireland	5								
Italy	13 incl 1 G-SIB								
Luxembourg	2								
Netherlands	9 incl 1 G-SIB								
Norway	9								
Portugal	6								
Spain	10 incl 1 G-SIB								
Sweden	6 incl 1 G-SIB								
Switzerland	8 incl 2 G-SIBs								
United Kingdom	15 incl 4 G-SIBs								

Legend: New resolution regime Debtholders losses Both

Notes: We report the total number of banks from each country, included in our sample. Resolution practices represent situations when debt holders of subordinated debt incurred losses. Based on information presented in Appendix B.

In addition to national resolution regimes, a resolution mechanism has been proposed by the central European authorities in 2013.

Data

Compared to the previous chapter, consolidated data is considered for the empirical analysis. It relates to domestic bank failure resolution costs while taking into account cross-border activities. That said, the domestic contingent liability would include losses that might arise from the banks' overseas operations and the use of unconsolidated data would underestimate bank failure resolution costs.

For comparison reasons, we use the same dataset as in Chapter 3 and we add variables to describe the resolution mechanisms and practices. We can characterize the variables in our dataset as follows:

- Dependent variable: The estimated value of the implicit guarantee given by the credit rating uplift. This variable is calculated as banks' all-in credit rating (AICR) minus its stand-alone credit rating (SACR). The SACR is given by Moody's Baseline Credit Assessment while the AICR is described by the long-term issuer rating/senior unsecured rating/long-term foreign deposit rating. For the robustness (check) analysis, we use the more recent measure for the stand-alone rating, namely the adjusted-BCA[25].

- Independent variables: The value of implicit guarantees is explained by the bank intrinsic strength (SACR), the strength of sovereign (SCR), the size of bank (annual data on assets on consolidated basis from *Bankscope*), and the dummy variable describing the G-SIB status. Compared to variables employed in the empirical analysis in Chapter 3, we introduce dummy variables accounting for changes in domestic resolution regimes and practices.

Three different measures are used:

- a dummy for resolution regimes - *New resolution regime (NRR)* - indicating if a resolution framework has already been proposed or adopted in the domestic country of the bank. The introduction of this variable is motivated by the observed evolution of credit ratings as a consequence of the adoption of various national resolution mechanisms.

- a dummy for resolution practices - *Debtholders losses (DL)* - indicating if the domestic country experienced resolution policies where holders of either subordinated or

[25] Please see Chapter 3 for detailed information on this variable.

even senior unsecured debt instruments incurred losses. As in the Portuguese case, banks can support negative effects when a bank from the domestic system enters into resolution.

- a dummy that combines both measures described before - $NRR \times DL$. It states for the strongest framework of resolution.

In addition to these variables describing different aspects relied to resolution mechanisms, we will also use an alternative variable (dummy) to account for developments in European resolution schemes.

Methodology

The variables are exploited within an OLS model applied to a panel of 135 European banks. Although more appropriate models for panel data have been tested (fixed and random effects), for parsimony reasons we choose to present the results of the OLS model. Our choice is supported by two arguments. First, the choice of the model has been made after running the F-test for the significance of the fixed effects intercepts. The results - indicating that the null hypothesis that all of the fixed effect intercepts are zero is not consistent - lead us to use OLS estimates. Second, the quality of estimates and both the R^2 and the adjusted-R^2 are only marginally different from specific effect models; we finally choose the simpler OLS model for presentation. Moreover, estimates are more stable within OLS regressions over the sample interval. Fixed effects have already been tested in the article resulted from this chapter. The sample used in the empirical analysis is the same as in Chapter 3[26].

In the next section, we empirically analyse the extent to which resolution regimes and practices adopted in national jurisdictions or at European level affected the value of the implicit guarantee. We test for different variables describing resolution mechanisms in separate sub-sections.

4.4 Impact of resolution regimes and practices on the value of implicit guarantees

Previous analysis showed that the value of implicit public guarantees has two main drivers: the intrinsic strength of the bank and the financial capacity of support of sovereigns. The recent drop in the value of the implicit guarantee can effectively be explained by the disruptions in public indebtedness and the downgrades of sovereign ratings that inevitably came up. Additionally, Schich and Kim (2012) highlight that the observed decline in the

[26] Please see section 3.2.2 in Chapter 3 for further details on the composition of the sample and data selection.

value of implicit guarantees could be consistent with the very recent project of resolution regimes.

The series of policies to be implemented in case of a bank's failure has been the unavoidable consequence of massive public interventions during the episodes of high distress and further fiscal developments and sovereign borrowing needs. Moreover, market participants were sensitive to proposals and implementation of such policies and their reaction could be quantified using the rating-based model. The assumption that will be at the base of our empirical study is that the reduction of the implicit government guarantees, recorded since the sovereign crisis, goes beyond the sovereign ratings downgrades, and highlights the potential negative impact of the current efforts of resolution mechanisms adopted in European countries. Investors' anticipations on lower (and limited) public interventions driven by a more stringent legislation affected the estimated value of implicit guarantees.

Our contribution to the literature is concretized by the analysis of different variables explaining the implementation and the consequences of the resolution mechanisms. Different econometric specifications are proposed in order to test for the robustness of results: level and first-difference specifications.

First, we run separate specifications for each of the initial measures, the NRR and the DL. Second, we introduce simultaneously the two variables in a regression since, after all, they describe different facets of banks' resolution. Then, for robustness check reasons, we use the dummy variable that combines the two measures and finally, we account only for the changes in both resolution regimes and practices ($NRR \times DL$). These variables describing resolution policies are country specific.

In a next section of this chapter we also test for the impact of regulatory measures taken at European level while considering the developments made in identifying and treating G-SIBs. We complete our study with a difference in difference analysis that will test for the extent to which recent measures with the aim of ending the TBTF distortion affected the evolution of the value of implicit guarantees for different groups of banks.

4.4.1 Level specifications

The reduction in the value of implicit guarantees observed since 2011 is partly due to the weakening of sovereigns' strength dragged by the global deterioration of public finances. Moreover, changes in prudential regulation and more precisely, the earlier than scheduled implementation of the reform, contribute to enhancing the safety of banks and seem to affect significantly the value of implicit guarantees. Following a similar approach to the one in Chapter 3, we proceed here with an empirical analysis that explains the extent to which the value of implicit subsidies has been affected by developments and changes

in resolution schemes whose ultimate aim is the ending of the TBTF paradigm and stabilizing the financial activity.

First, national authorities set out the core elements for effective resolution regimes for domestic banks. These rules have been conceived for national use, hence they integrate structural specificities of the national banking system. The impact of the adoption of resolution tools in national laws is tested within a first specification by using the variable *NRR*. Second, sovereigns' willingness to support banks in distress could be observed more explicitly through cases of resolution policies where holders of unsecured debt bonds incurred losses. The pre-specified priority suggests that shareholders should be the first to incur losses, then subordinated creditors and only after, senior unsecured creditors. Nevertheless, fewer are the cases when public authorities decide to liquidate the bank. A more commonly used practice is the sale of assets to third parties or the transfer of activity to bridge entities. Appendix B details all cases of resolution practices from 15 European countries in our sample since the beginning of the financial crisis. We provide information on stakeholders' loss-bearing by distinguishing between shareholders, subordinated and senior unsecured debt holders. One should notice that cases when unsecured debt holders incurred losses are fewer than the ones recording losses for holders of subordinated instruments. If expectations on public support through lender of last resort interventions are still high, then unsecured creditors have no incentives to monitor banks' risk-taking behaviour or to avoid risky investments and market discipline is not efficient. This assumption is at the basis of our second specification. The implementation of resolution tools and the effective resolution practices can reduce the willingness of sovereigns to bailout banks in distress. By testing the impact of these two instruments on the value of implicit guarantees, separately and simultaneously, we want to evaluate the magnitude of their effectiveness. The joint effect of the two forms of resolution tools will be tested in an alternative specification. Finally, by testing for the changes of behaviour in both regimes and practices (i.e. simultaneous change in both variables), we examine the credibility of these policy measures at a national level.

Furthermore, we employ an econometric model that explains the value of implicit guarantees using the main drivers identified in the previous chapter and the resolution variables describe above:

$$IG_{it} = \alpha_1 + \alpha_2 SACR_{it} + \alpha_3 SCR_{it} + \alpha_4 Size_{it} + \alpha_5 Resolution_{it} + \varepsilon_{it} \tag{4.1}$$

Specifications include several control variables whose importance in explaining the evolution of the value of implicit guarantees has been proved in previous empirical studies: the intrinsic strength of the banks (*SACR*) on one hand, and the capacity of support of sovereigns (*SCR*), on the other hand. The size of banks is included as well in regressions

in order to test for the TBTF advantage as perceived by investors in the pre-crisis period. ε_{it} is the error term.

Results are reported in Table 4.1. Undoubtedly, banks' efforts to fulfil prudential requirements drive towards higher and better quality capital, which is a necessary condition for a safer banking system, and this reduces the expectation of public guarantees[27]. As a result of these developments, the expectation of sovereign support is lower and the negative and significant coefficient of the *SACR* confirms these assumptions. A second element can be added to the list of factors that have reduced the implicit guarantees since 2011. The weakening of sovereigns' strength, corresponding to the deterioration of public finances dragged by a global deterioration of banks' strength during the subprime crisis, also contributed to the reduction of implicit guarantees. Although not desirable, the lower capacity of support of governments affected investors' expectations of public implicit guarantees. The coefficients associated with the size of the bank are strongly significant and have the expected effect[28]. Results are therefore in line with the findings from Chapter 3. It should be noticed that the value of coefficients is changing only marginally for the strength of the bank in specifications where resolution variables are considered, as opposed to results in Chapter 3. In turn, the introduction of resolution measures seems to improve the quality of the model as indicated by the R^2 and R^2-adjusted coefficients (3% higher than similar regressions in Chapter 3).

Turing now to the variables that we are most interested in this chapter, we find that all recent progress made by national authorities in establishing effective resolution regimes affected negatively and significantly the value of implicit guarantees. Results are consistent with our assumptions and statistically significant. In what follows, we explain the estimates.

The results in column 1 suggest that the introduction of resolution regimes in national jurisdictions had a significant impact in reducing the expectations of public interventions. Estimates indicate that in countries where such regimes exist, the value of implicit guarantees (*IG*) has been reduced in average by 0.7 notches. The effect, that has been active since 2011, could be explained by the juridical restrictions for sovereigns that aim at reducing public bailouts. Almost all national resolution regimes, fully or partially implemented, set up resolution authorities and provide resolution tools to be used in case of a bank failure. Beyond deposit insurance schemes, national jurisdictions also foresee bail-in tools in order to avoid losses to be imposed to "creditors from outside the liquidation" Moody's Investors Service (2011) and even more to taxpayers. Nevertheless,

[27] There is statistical evidence with regard to the impact that changes in prudential regulation and more precisely, the earlier than scheduled implementation of the reform, contribute to enhancing the safety of banks (Chapter 3). It is important to notice the improvements made since 2011 to increase the proportion of core capital and the continuous decrease in the use of wholesale funding.

[28] We do not focus on the interpretation of this variable since it has also been discussed in Chapter 3.

having national resolution regimes in place is not yet a sufficient instrument for minimising implicit guarantees. Even if national jurisdictions provide these tools on paper, the implementation of resolution powers describing the real actions of sovereigns (transfer assets and liabilities to third parties, create bridge entities, convert debt through bail-in procedures, restructure activities etc) may account as well (or even more) in evaluating the perception of public implicit support.

For these reasons, we further test for an alternative definition of resolution tools and specifically, the resolution practices. In other terms, we test to which extent the resolution practices driven by sovereigns affected the perception of implicit support for the institutions in the domestic banking system. Namely, we take into account situations where sovereigns imposed losses to holders of subordinated or even senior unsecured instruments of banks in default. Countries like Denmark, Ireland, Portugal, and United Kingdom count more than one case where senior unsecured debt holders incurred losses[29]. This could easily be observed in the evolution of senior unsecured ratings. Nevertheless, cases where senior unsecured creditors incurred losses are more rarely than the ones when subordinated debt holders participated to burden sharing in cases of bank failure[30].

We find that the signal send to markets through these resolution practices contributed in reducing the average values of implicit guarantees of 1.2 notches. The effect is stronger than the one for the adoption of new resolution regimes and proves that the resolution practices, measured by the losses imposed to debtholders, are more credible than the agreements set up on the paper (i.e. the resolution tools as mentioned in the national legislation).

[29] In Denmark, even depositors with deposits exceeding the deposit insurance ceiling participated to burning losses process in resolutions experienced after the introduction of Bank Package III in 2010. Schich and Kim (2012) discuss the case of Danske bank.

[30] In countries whose sovereign rating has not been downgraded due to the sovereign crisis (for example Denmark and Netherlands), the reduction in the value of implicit guarantees for domestic banks is due only to improvements in the intrinsic strength of the banks and even more, to regulatory constraints concretised in lower willingness of governments to support banks and losses for unsecured creditors. In turn, in countries where the sovereign rating was downgraded, the reduction of implicit guarantees comes also from the lower capacity of support of sovereigns.

Table 4.1: Impact of resolution regimes and practices on the value of implicit guarantees (IG). Level-specification (annual data from 2007-14)

	(1)	(2)	(3)	(4)
VARIABLES	IG	IG	IG	IG
Strength of bank (SACR)	-0.419***	-0.404***	-0.420***	-0.409***
	(-19.06)	(-19.42)	(-20.01)	(-19.81)
Strength of sovereign (SCR)	0.344***	0.386***	0.374***	0.383***
	(21.50)	(25.46)	(25.38)	(25.65)
Size of bank (SIZE)	0.430***	0.433***	0.442***	0.434***
	(14.28)	(14.65)	(15.09)	(14.76)
NRR	-0.747***		-0.414***	
	(-7.384)		(-4.089)	
DL		-1.246***	-1.106***	
		(-11.16)	(-9.553)	
NRR x DL				-1.386***
				(-11.43)
Constant	-2.875***	-3.940***	-3.460***	-3.891***
	(-7.016)	(-9.919)	(-8.401)	(-9.895)
Observations	1,002	1,002	1,002	1,002
R^2	0.450	0.491	0.498	0.493
R^2 adj	0.448	0.489	0.496	0.491
F	187.3	224.7	195.9	230.0

Notes: The dependent variable is the implicit guarantee calculated as the rating uplift. $NRR \times DL$ is capturing changes in BOTH practices and regimes. Robust t-statistics in parentheses. Adjusted-R^2 is a modified version of R^2 that has been adjusted for the number of predictors in the model. Significance at 1%, 5%, 10% identified by ***, **, and *, respectively.

The alternative specification in column 4 includes the interaction variable capturing the strongest resolution framework where the national legislation includes resolution tools and the public authorities implemented these rules in practise by imposing losses to debtholders ($NRR \times DL$). Indeed, the result suggests that it has a greater impact on reducing the value of implicit support than the two variables considered separately (NRR in column 1 and DL in column 2). The regimes aim to provide appropriate tools to public authorities that face banks in default, while the resolution practices evaluate concrete measures undertaken to resolve the problem of insolvent banks. Therefore, these two aspects of resolution tools, *de jure* and *de facto*, provide a more complex estimation of the impact of resolution mechanisms in place on the value of implicit guarantees.

Our assumption that the observed decline in the value of implicit guarantees is due to the regulatory efforts of implementing resolution tools is validated by the results of the level-specifications illustrated in Table 4.1. Therefore, it appears that the willingness of sovereigns to support banks and avoid their failure is a significant determinant of the value of implicit guarantees and can be considered as an indispensable tool in ending the distortions related to TBTF banks. If partial implementation of resolution regimes and

practices at national level had a considerable role in reducing the probability of government support since 2011 and until now, then one could expect that further international harmonization of frameworks and additional measures for globally systemic important banks may help in reaching the policymakers' goal to end the TBTF paradigm or make TBTF advantages more explicit.

In countries where resolution regimes are in place and real measures like imposing losses to subordinated debtholders have been undertaken to accomplish banks' resolution, an important decline in the value of implicit guarantees is observed. This finding is relevant for our sample since the majority of European countries have already made efforts of implementing resolution regimes and transposing supra-national tools into national legislation (especially the Key Attributes defined by the FSB).

4.4.2 First-difference specifications

In this section, we run first-difference regressions in order to evaluate the punctual impact of changes in either regimes or practices on changes in the value of implicit guarantees. By considering the difference between two points in time, we obtain the annual change in the value of variables. And so, we take into account the dynamic process while removing for unobserved effects. Using a suitable econometric model (4.2) we run similar OLS regressions as in the previous section:

$$\Delta IG_{it} = \alpha_1 + \alpha_2 \Delta SACR_{it} + \alpha_3 \Delta SCR_{it} + \alpha_4 \Delta Size_{it} + \alpha_5 \Delta Resolution_{it} + \varepsilon_{it} \quad (4.2)$$

The results of regressions - reported in Table 4.2 - provide average changes in variables, there where changes have been recorded. The first difference rules out time-constant explanatory variables and deals with the collinearity issue among the time-varying variable. Using this alternative model, additional evidence on the determinants of the value of implicit guarantees is highlighted.

First, we notice that several variables are no longer statistically significant in this approach. More precisely, we notice the robustness of the results from level specifications only for the dummy resolution regimes while the other dummies lose in significance. The change in the size of the bank does not explain significantly the changes in the value of the implicit guarantees. This finding is explained by a low variability in time of the variable *Size*.

The estimates emphasize that the factor that drive the largest change in the value of implicit support is the adoption of new resolution regimes. We quantify this effect that allows us to conclude that a change in *NRR* (in our case, the implementation of a new resolution frameworks at national level) triggers in average a negative change in the value of implicit guarantees of 0.18 notches.

Several arguments could be put forward to explain the non-significance of changes in resolution practices. Firstly, the willingness of sovereigns to let unsecured debt-holders incur losses did not had a signal effect since it did not influenced significantly the variation of implicit guarantees. It had rather a long-term effect and this hypothesis has been emphasized in previous section within level-specifications.

Moreover, the data indicates that the banks that have been subject to resolution practises and for which losses have been imposed to debtholders are generally small banks. Since their resolution did not significantly affect the global financial activity but was limited to the national banking system, their influence on the expectation of implicit guarantees was not of major importance. Finally, even if domestic resolution ended up in losses for subordinated and unsecured debt holders, the global improvement in banks' resilience to shocks as a result of prudential rules and incentives of stress test exercises might outclass the concerns related to effective resolution practices.

Table 4.2: Impact of resolution regimes and practices on the value of implicit guarantees. First-difference specification (annual changes, 2007-14)

	(1)	(2)	(3)	(4)
VARIABLES	ΔIG	ΔIG	ΔIG	ΔIG
ΔStrength of bank (SACR)	-0.524***	-0.526***	-0.524***	-0.526***
	(-14.33)	(-14.26)	(-14.32)	(-14.05)
ΔStrength of sovereign (SCR)	0.184***	0.187***	0.184***	0.186***
	(4.242)	(4.273)	(4.218)	(4.257)
ΔSize of bank (SIZE)	0.127	0.168	0.127	0.169
	(0.747)	(0.938)	(0.746)	(0.935)
ΔNRR	-0.184***		-0.185***	
	(-2.952)		(-2.871)	
ΔDL		-0.0446	0.00386	
		(-0.604)	(0.0507)	
Changes in NRR × DL				0.0398
				(0.208)
Constant	-0.182***	-0.279***	-0.182***	-0.294***
	(-4.606)	(-7.428)	(-4.401)	(-8.992)
Observations	866	866	866	866
R^2	0.471	0.466	0.471	0.466
R^2 adj	0.468	0.464	0.468	0.464
F	54.45	51.40	43.52	51.61

Notes: Dependent variable is the implicit guarantee calculated as the changes in rating uplift Data for 135 banks. The aim of first-difference regressions is to model changes in outcomes as a consequence of changes in independent variables. Adjusted-R^2 is a modified version of R^2 that has been adjusted for the number of predictors in the model. Robust t-statistics in parentheses. Significance at 1%, 5%, 10% identified by ***, **, and *, respectively.

It is important to mention that the impact of imposing losses to debtholders in countries where new resolution regimes are in place is no longer statistically significant within

first-difference specifications. Again, the signal effect for markets and credit agencies has not been strong enough to induce immediate and large variations of the implicit support.

It is important to notice that differences in national resolution regimes may lead to regulatory arbitrages for internationally active banks. Therefore, the harmonization of prudential frameworks and supervision and resolution tools could undoubtedly help in reducing distortions in global banking activity.

The next section examines the extent to which cross-border regulation helps to reduce investors' perception of implicit guarantees. We focus on globally systemic important banks since they benefit in general for larger implicit support than other banks and the effects of resolution policies may be greater for them than for smaller banks. We conduct this analysis within a difference-in-difference model.

4.4.3 A difference-in-difference approach

We exploit time-varying data reflecting changes in resolution policies and panel data on banking activity distortions and we rely on difference-in-difference estimation for our identification strategy. Our aim is to analyse the extent to which policy-makers decisions affected markets' perception on public implicit guarantees by comparing the treatment and the control group before and after the decision taking.

The DID methodology, specific for event studies, is based on two assumptions. First, it is assumed that the treatment to which certain banks are exposed is exogenous. In our case, the designation of banks belonging to the treatment group comes from outside the model. Second, the evolution (the trend) of the value of implicit guarantees for the two groups of banks is similar before the application of the treatment. This assumption implies that, in the absence of the treatment (i.e. adoption of resolution tools or policies), the two groups' implicit guarantees would have evolved in a similar way.

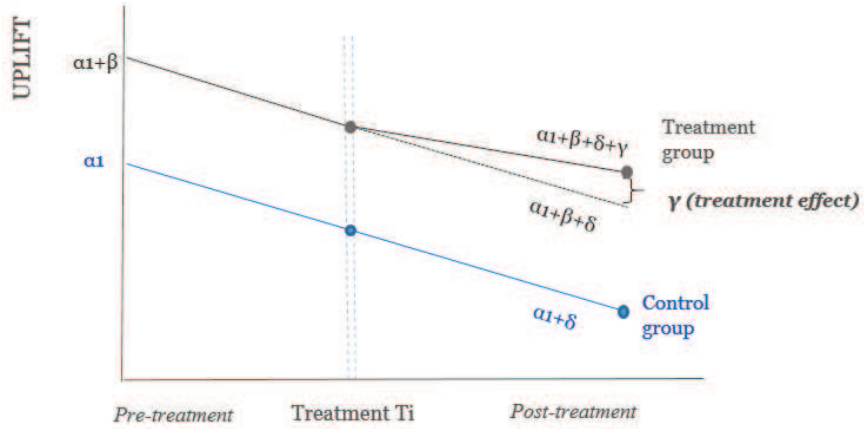
The changes in regulatory and resolution policies taken so far and that we analyse in this framework aim to reduce the too-big-to-fail distortion. Within a general case, the difference-in-difference model describes the causal effect induced by the difference between the treatment and the control groups on the one hand, and the change in time (that is the treatment), on the other hand. The equation for the basic difference-in-difference model could be written as follows:

$$IG_{it} = \alpha_1 + \beta Treatgroup_{it} + \delta T_t + \sigma(Treatgroup_{it} * T_t) + \varepsilon_{it} \tag{4.3}$$

The binary variable *Treatgroup* is equal to 1 for the treatment group and it allows identifying the banks that "live" in countries in which resolution regimes or practices have changed. The value 0 for the *Treatgroup* identifies the control group. T describes the moment when the treatment is applied to the sample of banks and equals 1 for the

post-period of the introduction of resolution regimes and practices and 0 for the pre-period[31]. The dummy switch to 1 could occur at different times, which is the case for change in resolution regimes and practices. Figure 4.2 provides a graphical representation of the model.

Figure 4.2: Interpreting difference-in-difference model



One can identify two separate effects. First, the effect of being in the treatment group in the pre-period is given by β[32], while the effect of the treatment (the post-period) is described through the value of the coefficient δ. Therefore, the treatment applied to the group of G-SIBs is measured by $\alpha_1 + \beta + \delta + \gamma$ and the difference in the effect of the treatment between the control and the treatment group is given by the factor γ.

The DID approach allows differentiating between entities of our sample according to certain characteristics and addressing the issue of omitted variables. The model, based on the assumption that there is no systematic difference in pre-treatment variables[33], compares the mean of the model for the two subgroups, the control and the treatment groups. The DID estimator is given by the OLS estimate of γ and measures the interaction effect between belonging to the treatment group and the adoption of a special treatment (i.e. policy measure for ending the TBTF paradigm).

In addition to the simpler version of the DID model described in (4.3), the econometric model that will be tested is more complex. This choice is motivated by the reduction of unobserved variables bias. Therefore, the model to estimate is the following:

$$IG_{it} = \alpha_1 + \beta Treatgroup_{it} + \delta T_t + \sigma(Treatgroup_{it} * T_t) + \alpha_2 X_{it} + \varepsilon_{it} \tag{4.4}$$

[31] The validity of the difference-in-difference model is based on the assumption that the structural differences between the treatment and the control group are unchanged in time in absence of the treatment.

[32] α_1 is the effect for a non G-SIB in the pre-period.

[33] The model assumes that the trend in the values of implicit subsidies is the sample for the treatment and the control group.

The *Treatgroup* designs the group of banks to which the treatment has been applied. The dummy variable T represents the period when the treatment is applied and X is a vector of control variables (the strength of the bank, the strength of the sovereign, the size and the systemic importance of the bank). ε_{it} is the error term.

In what follows, several types of treatment will be empirical analysed within DID models. The treatment group will be defined in accordance with the type of treatment that is applied and will change across specifications treated in separate sub-sections.

Three main events can be identified as significant events: Firstly, the adoption of resolution regimes and practices at national level. Secondly, the introduction of G-SIB status for institutions corresponding to a systemically important banks in November 2012. Finally, the announcement of the European directive defining recovery and resolution policies to deal with banks' insolvencies which came as a natural consequence of the sovereign crisis. Different DID specifications will be tested, one for each milestone event described previously. They differ through the definition of the treatment group and the variable T, the treatment to which the entities have been submitted.

4.4.3.1 National resolution regimes

In this section, we apply the methodology of difference in difference model to examine the extent to which the resolution regimes and practices had an impact on the value of implicit guarantees for the banks in the countries that adopted these mechanisms compared to banks from other countries.

We define the treatment by the adoption of new resolution regimes and/or practices at national level on the basis of information provided in Figure 4.1. Therefore, the group of banks submitted to the treatment (i.e. called the treatment group) will consist in banks from the countries that have adopted new resolution measures. The main aim of defining the control group according to this criterion is to test the effectiveness of resolution regimes, confirmed by the presence of resolution practices, and their contribution to the reduction of implicit guarantees for the banks submitted to these resolution mechanisms compared to banks from other countries.

Using the econometric model described in (3.3), we run two different specifications. First, beyond the main explanatory variables, we include several controls: the strength of the bank and the strength of the sovereign allowing us to assess the impact of the intrinsic resilience of the banks and the capacity of support of sovereigns. In addition we control for the size of the bank (column 1) and for the systemic importance (column 2)[34]. The results reported in Table 4.3 reinforce previous results and bring additional

[34] We analyse the two features of banks separately because of their strong correlation that could bias the estimations.

evidence on the determinants of implicit guarantees for the two sub-groups of banks (i.e. treatment and control groups).

We learn that there is no structural difference between the two subgroups since the coefficient for the *Treatment group* is not statistically significant. However, the implementation of resolution policy measures had a strong and negative effect on the value of implicit guarantees compared to banks from other countries. The results underline that the introduction of resolution mechanisms induced a structural change in the value of implicit guarantees that does not coincide with other events that have been experienced by banks in the sample.

Table 4.3: Impact of national resolution regimes and practices on the value of IG. DID specification (2007-14)

VARIABLES	(1) IG	(2) IG
Treatment group (*Treatgroup*)	-0.153	-0.147
	(-0.954)	(-0.930)
T	-0.316**	0.0279
	(-2.181)	(0.187)
Treatgroup x T	-0.612***	-0.772***
	(-2.846)	(-3.567)
Strength of bank (SACR)	-0.420***	-0.372***
	(-18.51)	(-15.97)
Strength of sovereign (SCR)	0.342***	0.319***
	(19.81)	(17.57)
Size of bank (SIZE)	0.440***	
	(14.25)	
G-SIB		0.277***
		(2.904)
Constant	-2.883***	1.709***
	(-7.037)	(6.532)
Observations	1 036	1 036
R^2	0.472	0.370
R^2 adj	0.469	0.367
F	146.4	100.9

Notes: Dependent variable is the implicit guarantee calculated as the rating uplift. Data for 135 banks. Robust t-statistics in parentheses. Adjusted-R^2 is a modified version of R^2 that has been adjusted for the number of predictors in the model. Significance at 1%, 5%, 10% identified by ***, **, and *, respectively.

It is important to notice that the impact of the variable T loses in significance when we control for the systemic importance of banks. We could deduct that the impact of resolution regimes and practices differs across banks in accordance to their systemic importance. This hypothesis could be explained through the special status of banks considered as too big and too interconnected to fail given their key role for the economy.

This analysis leads us to an alternative model that examines the extent to which the G-SIB status influenced the evolution of the value of implicit guarantees. Two different approaches will be employed. They are differentiate by the definition of the treatment: in the first approach, the treatment will be the introduction of the G-SIB status as the

first major regulatory change made by public authorities, and in the second one, the treatment will be defined in accordance with the resolution policy developments made so far in Europe.

4.4.3.2 G-SIBs status - an "implicit" gift

Since 2012, large and interconnected banks of a strong importance for the system have been designed as globally systemic important[35]. With this status, entities received an official recognition of their importance for the global financial system although the idea of TBTF was already anticipated by investors and regulators since the "G-SIB" status is very similar to pre-crisis concept of TBTF which is based mainly on the size of banks. The first given fact was that this new status confirms the existence of implicit guarantees for the beneficiary banks, although its implementation was made for regulatory purposes. More precisely, it allows authorities to divide entities into buckets in order to further impose specific capital buffers in accordance with the value of the systemic importance. The G-SIB status has therefore a regulatory purpose. Moreover, all following regulatory measures are based on this tool, the G-SIB status.

We employ a difference-in-difference model to test for the assumption that the additional treatment proposed by the FSB for large banks, and concretised in a very early stage through the introduction of the G-SIB status, is justified and it contributes to the reduction of the distortions in the European banking system(s).

In order to address this issue, we focus on a smaller sample of banks counting 49 institutions[36], including 16 G-SIBs. Based on a size selection criteria[37], we identify 33 banks that are at least as big as the smallest G-SIB (Nordea) in terms of size of the balance sheet and that are not considered as systemically important according to the FSB's classification made in November 2014. Therefore, our aim is to quantify the effect driven by the publication of the G-SIB list, joint with the methodology that has been at the basis of the classification. More precisely, we search to quantify the impact of this regulatory tool (the introduction of the G-SIB status) on the value of our interest variable, the implicit guarantee.

The main contribution of the DID model is that it allows us to distinguish between the individual effect of being a large and systemically important institution de facto (i.e.

[35] The first official list designating the G-SIBs was published in November 2012. However, on the basis of the methodology published by the BCBS in November 2011, "unofficial" lists identifying potential G-SIBs circulate. The Association for Financial Markets in Europe (AFME) published in their report BN-12-01 in March 2012 (so, before the official BCBS release), a list of 29 banks: 17 from Europe, eight from the US, and four from Asia. The first BCBS list of G-SIBs was slightly different. It did not included Lloyds (UK), Dexia (BE) and Commerzbank (DE) as the AFME classification, but considered BBVA (ES) and Standard Chartered (UK) as systemically important. The FSB classified 16 European banks as G-SIBs in November 2012.

[36] We count 16 G-SIBs and 33 large banks for size at least as large as the smallest G-SIB. In total, the regressions are run for a sample of 49 banks.

[37] We consider the average value of size for the period 2007 to 2014.

eligible to G-SIB status), and being officially recognized as a systemically important institution for the global financial system[38]. Compared to the DID specifications presented in the previous sub-section, two differences appear. First, the treatment is applied to all banks at the same period (in 2012). Second, the treatment group is identified according to bank-specific patterns (i.e. their systemic importance). The aim of reducing the size of the sample from 135 banks to 49 is to eliminate the selection bias related to differences in the structure of banks from the treatment group and the control group.

Therefore, the binary variable *Treatgroup* is equal to 1 for the group of G-SIBs (16 European banks designated in November 2014 as systemically important at global level) and 0 for the control group (large non G-SIBs). T_1 defines the treatment to which the banks of the sample have been submitted, the introduction of the methodology of assessing the G-SIB status, and equals 1 for the post-period (2012-2014) and 0 for the pre-period.

Results are reported in Table 4.4 below:

[38] The designation of institutions as globally systemic important is a policy decision, which is not against the initial assumption of the DID model. In order words, the introduction of the G-SIB status is not a function of the anticipations of government support in case of distress but it is rather linked to the evolution of regulatory decisions and frameworks.

Table 4.4: Impact of G-SIB status on the value of IG. DID specification (2007-14)

VARIABLES	(1) IG	(2) IG	(3) IG	(4) IG	(5) IG	(6) IG
Treatment group (*Treatgroup*)	-0.515***	-0.473***	-0.515***	-0.491***	-0.505***	-0.547***
	(-3.721)	(-3.410)	(-3.807)	(-3.560)	(-3.651)	(-3.466)
T	-1.459***	-1.173***	-1.378***	-1.225***	-1.336***	-1.464***
	(-10.85)	(-7.309)	(-10.27)	(-7.265)	(-9.755)	(-10.46)
Treatgroup x T	0.666***	0.621***	0.683***	0.654***	0.691***	0.706***
	(3.542)	(3.375)	(3.820)	(3.629)	(3.852)	(3.495)
Strength of bank (SACR)	-0.555***	-0.561***	-0.548***	-0.553***	-0.550***	-0.559***
	(-29.24)	(-29.17)	(-29.03)	(-29.06)	(-29.67)	(-27.42)
Strength of sovereign (SCR)	0.422***	0.429***	0.420***	0.424***	0.416***	0.422***
	(21.83)	(22.77)	(24.21)	(24.08)	(23.73)	(20.98)
NRR		-0.453***		-0.263*		
		(-3.456)		(-1.940)		
DL			-0.529***	-0.441***		
			(-4.509)	(-3.757)		
NRR x DL					-0.621***	
					(-4.415)	
Changes in NRR or DL						-0.118
						(-0.435)
Constant	3.207***	3.214***	3.249***	3.246***	3.320***	3.256***
	(7.246)	(7.227)	(7.871)	(7.658)	(8.085)	(7.028)
Observations	379	379	379	379	379	333
R^2	0.783	0.791	0.797	0.799	0.799	0.792
R^2 adj	0.780	0.787	0.794	0.795	0.795	0.788
F	281.8	244.0	256.7	225.9	268.0	220.1

Notes: The dependent variable is the implicit guarantee calculated as the rating uplift. Data for 135 banks. *NRR × DL* is captures the strongest resolution framework and *Changes in NRR or DL* captures changes either in practices or regimes. Size of banks is not included in regressions according to findings in Chapter 3 on strong correlation between G-SIB and size. The number of observations for the regression in column 6 is smaller since we consider the variation of one explanatory variable (the *Changes in NRR or DL*). Robust t-statistics in parentheses. Adjusted-R^2 is a modified version of R^2 that has been adjusted for the number of predictors in the model. Significance at 1%, 5%, 10% identified by ***, **, and *, respectively.

First, the results indicate that the institutions designated as G-SIBs have lower values of implicit guarantees than the non G-SIBs with similar size (coefficient β is negative and statistically significant). Second, the negative and strongly significant coefficient δ indicates that, in the post-treatment period, there are significantly lower expectations of public support for all banks in the sample. The average reduction in the estimated value of implicit subsidies in the period 2012 to 2014 has been evaluate in the range of 1.1 to 1.4 notches.

In turn, the attribution of the G-SIBs status confirming the systemic importance of banks for the global financial system, generates higher implicit guarantees for the G-SIBs than for other similar banks. Since all banks were initially G-SIB-eligible given their

size, the official attribution of the G-SIB status recognising the complexity of the balance sheet activities and the interconnections with the rest of the system, brings evidence on the implicit "protection" that they could enjoy in case of default. We estimate the implicit advantage to a 0.6 notches gain for the G-SIBs compared to large non-GSIBs, as suggested by the estimate γ being positive and statistically significant (red frame). This result, although not expected from a regulatory point of view, brings evidence on markets' perceptions on the riskiness of the banks showing that regulatory measures are giving place to other adverse effects.

The results are estimated while controlling for the evolution of banks' intrinsic strength and sovereign capacity to support. They appear as significant determinants independently of the additional controls taken into account in this alternative model.

With regard to the resolution variables, their estimated impact is confirmed within these DID regressions. Both resolution regimes and practices undertaken at national level have a lower impact on large banks compared to the average effect for the whole sample (evaluated in Table 4.1). The aspect resolution practices, and namely the perception of sovereign willingness to allow for unsecured creditors to incur losses, prevail over the existence of resolution regimes adopted at national level. Therefore, the efforts of regulatory authorities to employ resolution tools (even if not fully implemented) seem to be efficiently incorporated by domestic banks and investors in evaluating the expectation of future public support to avoid bankruptcies.

Even though we learn that there is a considerable impact of the designation of G-SIBs on investors' expectation of public support for the banks eligible to this status compared to other similar banks in terms of size, it represents only the first "episode" in the reform agenda. Moreover, we find that these measures had for instant the opposite effect than expected. In what follows, we take our analysis one step further and examine the extent to which the agreements on cross-border resolution tools contributed to the reduction of implicit advantages for large financial institutions.

4.4.3.3 Getting to bail-in in Europe

The post-crisis period has been rich in challenges for public authorities and policy makers. The inappropriate prudential rules, the lack of resolution tools and cross-border fiscal instruments, have been pointed out by the crisis and ask for solutions. In a very short-period after the crisis, regulators came up with proposals for additional rules that should address the weaknesses revealed by the latest financial shock, that "should not happen again". It is obvious that each important financial shock experienced by financial systems leads to significant changes in the regulatory framework and an acceleration of the reform agenda. This is how prudential rules have been thought under Basel I, Basel II and more

recently, under Basel III. In addition to the prudential framework, European authorities conceived a more complete reform agenda that should allow the transition to a banking union.

The project has been sped up by the numerous events experienced by the European financial system driven by banks' excessive risk-taking and strong interconnections between financial institutions on the one hand, and between financial institutions and public authorities, on the other hand. We cite here the Danish Amagerbanken which had a significant impact on the whole Danish financial system (Schich and Aydin, 2014), the Dutch bank SNS Reaal nationalization with junior creditors' participation, the famous Cyprus case and the more recent Portugal's Espirito Santo. Among these cases, the bail-in procedures applied in 2013 in Cyprus were without any doubt the most surprising and debated, even if bail-in procedures were just announced, not even totally defined. Nevertheless, the signal sent by the national governments and Euro area public authorities was of major importance for internationally active actors and worldwide financial markets. "For the first time, we agreed on a significant bail-in to shield taxpayers, to break the vicious circle of sovereigns and banks, and to induce banks to behave more responsibly," affirmed Jeroen Dijsselbloem, the chairman of the Eurogroup of finance ministers. The decision that unsecured debt holders and depositors with retail holdings above 100 000 €will incur losses[39], made of Cyprus a wide basis shock whose effects are still visible nowadays. The great impact of bailout procedures and especially the Cyprus bail-in (and bailout) shock, revealed considerable weaknesses in the European project. The adoption of additional tools became mandatory in order to reduce the sovereign-bank loop[40] and reinforce the architecture of the European structure. This is what the adoption of the BRRD and the Single Resolution Regime in 2013 were aimed at. They should reduce the arbitrages dragged by differences in national resolution regimes and provide useful tools to European authorities to address banks' failures.

We do have reasons to believe that 2013 was a year to remember not only for financial institutions but for all market participants. The agreements and debates on unique European supervisory and resolution mechanisms on the one hand, and the changes in public authorities practices to address banks' failures, on the other hand, may have changed investors' expectations on government interventions to avoid banks' failures. Our intuition is supported by previous findings showing that smaller efforts made by national authorities did have a significant impact on investors' perception of risk. Hence, we search to examine the regulatory driven changes in investors' perception of public guarantees for the banks in our sample.

[39] The Cypriot bail-in also shocked by the decision to expose depositors to losses. A 6.75 percent haircut on smaller deposits has been decided by public authorities.

[40] By the sovereign-bank loop, we define the mechanism through which weak banks can compromise the safety of sovereigns.

The aim is to evaluate the extent to which the change in cross-borders resolution regimes and practices contributed to the reduction of the TBTF phenomenon. In accordance with this objective, we will analyse the sample of 49 large banks defined in the previous section, including 16 G-SIBs and 33 large non G-SIBs of similar size. Within the DID model, we focus on the events that followed the change in resolution practices highlighted by the Cypriot bail-in and the Banking Communication on EU finance ministers' agreement with regard to the adoption of the Directive on Recovery and Resolution of Credit Institutions (BRRD)[41] that took place during 2013. Both events describe the official commitment on the implementation of burden-sharing procedures through bail-in on one hand, and on ending TBTF distortions[42,43] on the other hand.

We use an empirical model inspired from (4.3). Our identification is compatible to DID regressions, although the specification is slightly adjusted:

$$IG_{it} = \alpha_1 + \beta Treatgroup_i + \delta T_{2,t} + \gamma(Treatgroup_i * T_{2,t}) + \alpha_2 X_{it} + \varepsilon_{it} \tag{4.5}$$

The treatment is defined by the changes in resolution procedures taken at European level in 2013 and is defined through the dummy variable T_2 (1 for the period 2013-2014 and 0 otherwise). Just like in the previous section, the treatment group is given by the group of G-SIBs since the stake for globally systemic banks is (even) greater. The control group is composed of large non G-SIBs with similar size of the balance sheet. The coefficient of the interaction term $Treatgroup_i * T_{2,t}$ should quantify the difference in impact between G-SIBs and other banks. Furthermore, since previous results indicate that the publication of the FSB's list designating G-SIBs in 2012 has an important effect on the value of implicit guarantees, we control for this structural change in the value of IG through the time dummy T_1. The vector X includes other bank-specific control variables.

The results of the regressions are reported in Table 4.5 and indicate that:

- the G-SIBs have in average lower implicit guarantees than larger non G-SIBs of similar size,
- the treatment - the efforts made in 2013 (change in resolution practices and the agreement on BRRD) had a negative impact on the expectation on implicit guarantees although not statistically significant for the whole sample, and

[41] Please see IP/12/570 and MEMO/13/601 for more information on the agreement on the BRRD.

[42] August 2013 represents the date when the official agreement took place, but the BRRD was finalised and published in the Official Journal of the EU one year later, in June 2014. Therefore, we consider that the shock (the treatment) was the announcement of the official agreement since it might have a greater impact than the publication of the final text itself. We assume that the signal sent to markets was stronger in 2013. In any case, we could not use as treatment the date when the framework should have taken effect (at the end of 2014) since several countries had not implemented it at that time and because the fully implementation is still not effective at end-2015.

[43] Since our data is at annual frequency, considering as moment of significant change the year 2013 could not be considered as a limit.

- the resolution procedures taken at European level affected differently the two subgroups of banks.

At first view, the results indicate that the resolution agreements in 2013 had (in average) no significant effect on European banks. Nevertheless, the G-SIB still keep their advantage in terms of implicit guarantees compared to large non G-SIBs.

Comparing the coefficients in the red frame from Tables 4.4 and 4.5, we learn that these additional measures had an ambiguous effect on the value of implicit guarantees for G-SIBs. The coefficient γ is positive, which suggests that the policy makers' measures did not contributed efficiently to the reduction of the distortions in banks' activities but they had rather increased them.

Table 4.5: Impact of cross-border resolution tools on the value of implicit guarantees. Difference-in-difference specification (2007-14)

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	IG	IG	IG	IG	IG	IG
Treatment group (*Treatgroup*)	-0.292**	-0.279**	-0.296***	-0.286***	-0.284**	-0.244*
	(-2.528)	(-2.495)	(-2.694)	(-2.616)	(-2.557)	(-1.929)
T2	-0.141	-0.0733	-0.121	-0.0801	-0.116	-0.130
	(-0.801)	(-0.432)	(-0.767)	(-0.507)	(-0.741)	(-0.725)
Treatgroup × T2	0.461**	0.501**	0.509**	0.525***	0.505**	0.434**
	(2.191)	(2.405)	(2.567)	(2.635)	(2.548)	(1.997)
Strength of bank (SACR)	-0.552***	-0.561***	-0.545***	-0.553***	-0.546***	-0.565***
	(-27.81)	(-28.58)	(-27.57)	(-28.42)	(-27.85)	(-26.71)
Strength of sovereign (SCR)	0.425***	0.434***	0.423***	0.429***	0.420***	0.427***
	(19.85)	(21.20)	(22.38)	(22.71)	(22.30)	(19.35)
T1	-1.210***	-0.932***	-1.148***	-0.975***	-1.090***	-1.184***
	(-7.745)	(-5.505)	(-7.915)	(-5.853)	(-7.340)	(-7.465)
NRR		-0.567***		-0.384***		
		(-4.057)		(-2.799)		
DL			-0.562***	-0.430***		
			(-4.597)	(-3.630)		
NRR × DL					-0.625***	
					(-4.138)	
Changes in NRR or DL						0.0527
						(0.184)
Constant	2.857***	2.944***	2.929***	2.971***	2.963***	2.911***
	(5.871)	(6.141)	(6.688)	(6.596)	(6.835)	(5.724)
Observations	379	379	379	379	379	333
R^2	0.770	0.783	0.786	0.791	0.786	0.780
R^2 adj	0.766	0.779	0.782	0.787	0.782	0.775
F	203.2	199.8	184.8	184.2	190.0	167.4

Notes: The dependent variable is the implicit guarantee calculated as the rating uplift. Data for 135 banks. Size of banks is not included in regressions according to findings in Chapter 3 on strong correlation between G-SIB and size. Robust t-statistics in parentheses. Adjusted-R^2 is a modified version of R^2 that has been adjusted for the number of predictors in the model. Significance at 1%, 5%, 10% identified by ***, **, and *, respectively.

Another important evidence highlighted by the results in Table 4.5 is that the measures undertaken at national level have a more significant impact on ending the TBTF process than cross-border measures. The efficiency of the set of policies established at national level and their efficiency evaluated in case of resolution of a failed institution has a strong and negative impact on markets' perception of implicit support for large banks, independently of all cross border prudential and resolution measures adopted so far.

Furthermore, if market discipline can be improved by reducing the value of implicit guarantee, the effect could be even more important if national authorities in charge of the resolution apply the policy tools at their disposal. In this manner, the aim to insulate taxpayers from financing future bank failures could be reached[44]. Our findings emphasize the key role of the national procedures in applying the internationally decided policies and thus, in reaching the objective of ending TBTF distortions.

The aim of this supra-national regulatory reform is to reduce the risks emerging from banks' interconnections through assets portfolios and funding structures (i.e. the systemic risk) and above all, to minimize taxpayers' contribution to support financial institutions in distress. However, fixing as objective to eliminate the risk of failure of banks is unrealistic (and impossible) since failures are part of the functioning of financial activity.

After all, European authorities have "abandoned" Cypriot depositors and made prove of willingness to implement bail-in procedures. European authorities go one step further in reducing the distortions of banking system, as they are likely to let unsecured debt holders to incur losses in the future and markets seem to integrate this reality in their anticipations. Nevertheless, the structure of reforms and the way they have been defined so far are likely to lead to further distortions and arbitrages. First, the number of regulatory instruments proposed by supra-national institutions and the definition of different tools may be difficult to implement at national level given structural heterogeneity of banking systems. If the coordination lacks (of) consistency, the implementation of regulatory tools may be postponed and make room for further arbitrages (for example, activity offshoring). Second, at this stage of the reform agenda, even if the final text of BRRD and SRM have already been published and fully or partially transcribed in national jurisdictions, the lack of precision could as well be a source of regulatory arbitrages. One of the most evident shortage is relied to the implementation of resolution framework and several aspects should be called into question. The optimal time for the intervention is not clearly defined and is given to resolution authorities to decide when to intervene. They have been empowered to take early intervention measures when there are signals that institutions are "failing or likely to fail". In these situations, recovery plans proposed by institutions ex-ante should be applied by the resolution authority in

[44] This finding is supported by rating agencies' periodical publications suggesting that downward revisions are due to countries efforts to implement the BRRD.

charge. If the recovery plans are not efficient, then bail-in tools should be activated and resolution procedures, the sale of the institution entered in resolution (the transfer of assets to a bridge-entity and/or the transfer of assets to a resolution entity) should be launched. It is somehow understood that the whole recovery and resolution framework is based on the assumption of international efficient coordination of supervisors. Goodhart (2011) highlights the importance of enforcing standards and sanctions, at an international level. EBA's efforts to reinforce the supervision at European level passes thought the implementation of transparent and realistic stress test exercises, but also through the post-stress test measures undertaken by banks that failed the exercise. Even if significant efforts have been made at this level[45], there is still a way to go for international supervision to be efficient and coordinated with national supervisory powers. Opacity of banking activities and risk-assessment methodologies is an important issue that should be addressed. Finally, another question raised by the implementation of bail-in procedures concerns the changes in banks' business models. Namely, we raise doubts about the negative incentives that the resolution framework may induce to banks that may be encouraged to favour short-term debt since it is not bail-in eligible. Nonetheless, it is still early to conclude on such questions. More concrete effects of the resolution framework should be noticed after its' full implementation taking place starting with January 2016.

4.5 Conclusion

In the pre-crisis literature, the idea that the failure of an isolated bank cannot lead to a financial crisis prevailed. Nevertheless, recent experiences proved the opposite. The failure of an institution, and even more of a large bank, can have considerable consequences if the rest of the system is already in distress. Therefore, the improvement in banks' strength on one hand, and in policy and regulatory frameworks at national level and their harmonization at international level on the other hand, is likely to significantly reduce the distortions in the banking system, reduce the probability of failure and improve market discipline. Moreover, recent recovery and reform agenda in European countries should ensure a fair playing field for banks with cross-borders activities. These points represent the aim of this chapter.

After identifying and quantifying the determinants of the evolution of implicit guarantees on the behalf of banks and sovereigns, we take the analysis one step further and examine the impact of recent reforms aimed to reduce the too-big-to-fail distortion and the negative spillovers on public finances and taxpayers. We first evaluate the extent to which the measures undertaken at national level in terms of resolution regimes affected the expectations of public bailout. We find that the efforts of national policy makers

[45] Please see discussion in Chapter VI on the effectiveness of 2014 stress test.

contributed significantly to the reduction of distortions in their national banking system. Among the EU member countries, certain had already faced at least one case of bank resolution. The changes in resolution practices employed by national public authorities seem to affect significantly investors' perception on sovereign willingness to support banks in distress. Specifically, we find that the reduction of implicit subsidies was driven by changes in resolution regimes and practices, and the effect is stronger than the one driven by reduction in the capacity of support of sovereigns. Consequently, we can conclude on the efficiency of resolution policies undertaken at national level in reducing the TBTF paradigm.

In the last part of our empirical analysis we employ difference-in-difference models to assess the impact of resolution policies on several categories of banks. This issue is crucial for large banks whose failure could affect the global financial activity and for this reason, our analysis focuses primarily on the group of banks designed as globally systemically important.

First, we bring important empirical evidence with respect to the impact of various measures undertaken by international policy makers to reduce the expectations of public support in case of banks' failures. The evaluation of banks' importance for the global financial system through the attribution of the G-SIB status contributed to the decline in the value of implicit guarantees generally speaking but it also generated some adverse effects (since like all other regulatory measure it left room for bad incentives). More precisely, the recognition of certain banks as globally systemic lead to upward revaluations of expectancies of public support for G-SIB banks compared to other similar banks. Although it might be for a very short period, this tool had the opposite effect than regulators could expect.

Furthermore, the more recent cross border resolution procedures - mainly focused on large and interconnected institutions, reduced marginally the funding advantage generated by the probability that governments will bailout banks to avoid their default. Nevertheless, at the end of our study period (end 2014), this distortion still persists. The implementation of resolution tools at supra-national level should be more efficient starting with January 2016 when the bail-in tool (within the BRRD) should be fully implemented by all Euro area members.

The extension of common resolution frameworks is a key move towards a true Banking Union in the Euro area. The existence of a common prudential framework, a unique supervisor and a harmonized resolution regime to be addressed in case of banks' failure, should considerably improve the long-term stability. Nevertheless, there are certain aspects that could be called into question. The coordination across national authorities to reduce negative incentives, the design of cross-borders tools and intervention mechanisms,

are just some of the concerns that could be raised after analysing the existent regulatory frameworks.

Better impact assessments could be driven starting with the end of 2016, once the bail-in tool will be fully implemented at European level. This will undoubtedly be part of our future research projects.

4.6 Appendix

A.Overview of resolution regimes in European countries

Country	Year	Legislation	Administrative Authority Responsible for Restructuring	Comments
Austria	2012	Supervisory Guidelines		Consultative document reports proposals to strengthen resolution powers. It focuses on large, internationally active banks.
Belgium	2010	Financial Crisis Law		New resolution tools, such as transfer of part or all of the bank's rights and obligations, introduced.
Denmark	2008	Danish Financial Stability Act		A government-owned winding-up company was established to acquire failed banks. Full guarantee to unsecured creditors and depositors.
	2011	Amendment		Denmark was the first country to apply a haircut to senior creditors. Above-mentioned guarantee withdrawn. Separate fund called 'Winding Up Fund' established to fund resolution.
France		Financial and Monetary Code	Autorité de Contrôle Prudentiel et de Résolution	Power to operate a bank in resolution exercised through administrator appointed by ACPR, which may exercise all powers of management.
	2013	Ring-fencing and Resolution Law	ACPR	Separation of certain speculative trading and investment activities for own account of SIFIs into dedicated subsidiaries. New resolution regime for credit institutions
Germany	2011	Bank Restructuring Act, 2010 (entered into force on January 1, 2011)	Federal Financial Supervisory Authority (BaFin) and Financial Market Stabilisation Authority (FMSA)	Two new procedures were introduced for distressed institutions: a restructuring procedure and a reorganization procedure. BaFin's preventative prudential instruments were strengthened and extended. For example, BaFin was given the power to appoint a special representative to an institution during the early stages of a crisis. The assets and liabilities of a failed bank can be transferred to a bridge bank by the supervisor if voluntary restructuring and reorganization not expected to be successful.
Greece	2011	Amendment of the Banking Act	Banque of Greece (BoG)	Comprehensive resolution tools such as bridge bank and purchase and assumption introduced. Resolution fund established within the Deposit and Insurance Guarantee Fund for funding resolution. In urgent cases, the procedure for submitting offers, the determination of the remuneration to be paid to the transferee credit institution and the transfer will be based on a temporary assessment by the BoG.
Ireland	2010	Credit Institutions (Stabilization) Act		Various new resolution tools for Ministry of Finance with regard to banks receiving government support. Contract terms on subordinated bonds can be modified by Ministry of Finance.
	2011	Central Bank and Credit Institutions (Resolution) Act. Amendment, 2013.		Resolution powers transferred from Ministry of Finance to the Central Bank. Credit institutions' resolution fund to be introduced.

Italy		Consolidated Banking Law BL	Bank of Italy	Regime based on special administration and compulsory administrative liquidation through appointment and supervision by the BoI of special administrator or liquidator. Shareholders can only be overridden under compulsory administrative liquidation.
Netherlands	2012	Act on Special Measures for Financial Institutions	Dutch Central Bank (DNB) and Dutch Ministry of Finance (MoF)	The Dutch resolution framework was broadened to address the risks posed by systemically relevant banks. The resolution powers of the DNB are limited to licensed banks and do not apply to foreign branches of European Economic Area banks. The Dutch Intervention Act for Financial Institutions authorizes the DNB to adopt a Transfer Plan for the transfer of bank deposits, (other) assets and liabilities of a bank when the bank faces difficulties relating to solvency, liquidity or compliance with regulatory 'technical provisions' that cannot be reversed in a timely manner. However, the scope of application is not limited by an institution's size or systemic importance. Nevertheless, the systemic relevance is considered when selecting resolution options.
Portugal	2012	Amendments to the resolution regime for credit and financial institutions		Resolution mechanisms for the orderly winding-down of banks, including early intervention and comprehensive tools, introduced, including total or partial sale of business and the setting up of a bridge bank. Resolution fund within the Banco de Portugal established, to be funded by the industry.
Spain	2009	Law on Bank Restructuring and Credit Institution Equity Reinforcement.		Fund for Orderly Bank Restructuring (FROB) established in June 2009 to facilitate bank restructuring. It is able to provide temporary financial support for the restructuring and resolution of banks in difficulties including partial transfer of assets of failed banks to a bridge bank.
	2012	Royal Decree-law 24/2012	Bank of Spain and Bank Resolution Authority (FROB)	A new legal framework for bank resolution entered into force on August 31, 2012. The framework aims to improve the regime that had been in force since 2009, and takes into account the EU legislative proposal on the recovery and resolution of banks and investment firms. Support during the restructuring period may take the form of guarantees, loans, subordinated debt, or acquisition of assets or capital injections.
United Kingdom	2009	Banking Act	BoE and HMT	Special Resolution Regime introduced in 2009. Comprehensive resolution tools such as temporary public ownership transfer to bridge bank, and insolvency procedure provided to the authorities. The Financial Services Act from 2010 asks banks to provide recovery and resolution plans. Under the Banking Act, the Financial Services Authority, in consultation with the BoE and the Treasury, makes the decision to put a bank into the SRR. The Treasury decides whether to put a bank into temporary public ownership, and the BoE, in consultation with the other authorities, decides which of the tools to use and implements the resolution.
Europe	2013	Bank Recovery and Resolution Directive	European Central Bank	In June 2012, the European Commission published a draft Directive on recovery and resolution of credit institutions and investment firms. Within the EU, the recovery and resolution framework prioritizes resolution at group level under the leadership of a group resolution authority with strong coordination in the resolution college. Implementation of a Single Resolution Mechanism (SRM) at the European level.

Sources: FSB-"*Resolution of Systemically Important Financial Institutions –Progress Report", 2012;* FSB-"Thematic Review on Resolution Regimes", 2013; Schich and Kim (2012); European Council (2013); ECB (2011); EBA (2013); public information from central bank websites.

B.Resolution practices in European countries

Country	Banks	Date of failure (or recapitalization)	Holders' loss-bearing		
			Shareholders	Subordinated bondholders	Senior unsecured bondholders
Austria	KommunalKredit	11/2008	•	O	O
	Hypo Alpe Adria	03/2015	•	•	(•)
	Oesterreichische Volksbanken	02/2012	◎	O	O
Belgium	Fortis Bank	09/2008	◎	O	O
	KBC Bank	10/2008	◎	O	O
	Dexia Belgium	09/2008-11/2011	◎	O	O
Denmark	Roskilde Bank	08/2008	•	•	O
	EBH Bank	11/2008	•	•	O
	Løkken Sparebank	03/2009	•	•	O
	Gudme Raaschou Bank	04/2009	•	•	O
	Fionia Bank	05/2009	•	•	O
	Capinordic Bank	02/2010	•	•	O
	Eik Banki P/F and Eik Bank Denmark	09/2010	•	•	O
	Amagerbanken	02/2011	•	•	(•)
	Fjordbank Mors	06/2011	•	•	(•)
	Max Bank	10/2011	•	•	O
	Sparekassen østjylland	04/2012	•	•	O
	Spar Salling Sparekasse	04/2012	•	•	O
France	Dexia Crédit Local	09/2008-11/2011	◎	O	O
Germany	Weser Bank	04/2008	•	n.a	n.a
	Hypo Real Estate	05/2009	•	O	O
	IKB	07/2009	◎	O	O
	Commerzbank	11/2008	◎	O	O
	BayernLB	05/2009	◎	O	O
	WestLB	11/2009-06/2012	◎	O	O
	HSH Nordbank	03/2009	◎	O	O
Greece	Proton Bank	10/2011	•	•	n.a
	T Bank	12/2011	•	•	n.a
	Cooperative Bank of Lesvou-Limnou	03/2012	•	n.a	n.a
	Cooperative Bank of Lamia	03/2012	•	n.a	n.a
	Achaiki Cooperative Bank	03/2012	•	n.a	n.a
	Agricultural Bank of Greece	07/2012	•	•	n.a
Ireland	AIB	12/2010	◎	(•)	O
	Anglo Irish Bank	01/2009	•	(•)	O
	Anglo Irish Bank	11/2010	•	•	(•)
	Bank of Ireland	07/2011	•	•	(•)
	EBS Building Society	12/2009	n.a	(•)	O
	IL& P	07/2011	◎	(•)	O
	Allied Irish Banks PLC	06/2011	•	•	(•)
	Irish Life (future Permanent tsb)	07/2011	•	•	(•)
	INBS	12/2009	n.a	(•)	O
Luxembourg	Fortis Banque Luxembourg	12/2008	◎	O	O
Netherlands	ABN AMRO	12/2008	◎	O	O
	DSB Bank	10/2009	•	•	(•)
	SNS Bank N.V.	02/2013	•	•	O
Portugal	Banco Portugues de Negocios	11/2008	•	O	O
	Banco Privado Portugues	04/2010	•	•	(•)
	Banco Espirito Santo	06/2014	•	•	(•)
Spain	Cajasur	05/2010	•	O	O

	Banco CAM	06/2011	•	O	O
	Nova Caixa Galicia	09/2011	◎	O	O
	Catalunya Caixa	09/2011	◎	O	O
	Unnim	09/2011	•	O	O
	Banco de Valencia	11/2011	◎	O	O
	BFA-Bankia	05/2012	◎	O	O
	BFA-Bankia	04/2013	•	•	(•)
Sweden	Carnegie Investment Bank	11/2008	•	O	O
	HQ Bank	08/2010	◎	O	O
Switzerland	UBS	10/2008	◎	O	O
United Kingdom	Northern Rock	02/2008	•	(•)	O
	Northern Rock	12/2011	•	•	(•)
	Bradford& Bingley	09/2009	•	(•)	(•)
	Heritable Bank	10/2008	•	•	(•)
	Kaupthing Singer & Friedlander	10/2008	•	•	(•)
	London Scottish Bank	11/2008	•	n.a	(•)
	Dunfermline Building Society	03/2009	•	(•)	O
	Southsea Mortgage Investment	06/2011	•	n.a	(•)
	RBS	10/2008	◎	O	O
	Lloyd	10/2008	◎	O	O

Note: The meaning of the symbols are the followings: • full loss (either 100% haircut for bondholders or wiping-out of common shareholders), (•) partial loss, ◎ dilution or share price depreciation as a result of recapitalization by the government, O no loss and n.a. for not applicable. The dummy resolution practices, country specific, is computed on the basis of this dataset. It takes the value 1 if there is at least one case of resolution (even if the bank is not in our sample) and 0 otherwise.

Sources: IMF (2012), Schich and Kim (2012), JP Morgan (2013)

Part III

"Widespread failures in financial regulation and supervision proved devastating to the stability of the nation's financial markets. The sentries were not at their posts, in no small part due to the widely accepted faith in the self-correcting nature of the markets and the ability of financial institutions to effectively police themselves."

Financial Crisis Inquiry Commission

Chapter 5

The contribution of recent prudential requirements to strengthen the resilience of banks

The last financial crisis turned out to be highly unusual given its causes and above all, the contagion mechanisms that amplified the initial shock and lead to a systemic event. It revealed considerable anomalies of bank regulation and pointed out huge structural vulnerabilities of credit institutions. In Europe, it revealed the deep fragility of banking structures and their continuous reliance on short-term market based activities.

The traditional theory on the fundamental role of solvency in preventing banks' failure dismissed. Liquidity management captured audience's attention and policy makers focused attention on fixing the problems by tightening up the existent regulation and improving financial stability. As one could expect, the amplitude of the crisis, obliged to unprecedented regulatory measures. Basel Committee proposed in 2009 fundamental changes to be made to the existent regulatory framework.

The revision of capital requirements, imposing a "security" ratio as complement to the risk-weighted capital ratio, would not be enough. A complete liquidity management framework has been introduced to set up good incentives and ensure the strengthening of banks' resilience. The new regulatory standards should reduce the moral hazard and the built-up of leverage in banking systems, while controlling the risk appetite of banks.

Although the capital and liquidity frameworks have been defined independently, the interdependencies between different standards is likely to allow for a simultaneous achievement of requirements. A growing body of the literature focuses on importance of solvency and liquidity indicators, taken separately. In this chapter, we propose a slightly different approach that evaluates the contribution of solvency and liquidity ratios to reducing the risk of failure.

To achieve the goal, we consider two different measures of the risk of failure: the probability of default (PD) and the systemic risk (SRISK). While the former emerges

from structural imbalances, the latter is generated by systemic events and measures the sensitivity of the bank to unexpected shocks. We analyse the determinants of these risks, by taking into account the different patterns of banks according to their size and business model. This question is particularly interesting for European banking system since the subprimes crisis had severe consequences on its functioning.

The estimations emphasize important benefits of tighter requirements of Basel III, in terms of both solvency and liquidity standards. A differentiated impact according to banks' profile and size is highlighted by our results.

The remainder of this chapter is organized as follows. Section 5.1 provides a literature review related to the topic. Section 5.2 discusses the interactions between solvency and liquidity and the interest in regulating the risks associated to the main functions of credit institutions. Section 5.3 describes the dataset used in the empirical study, presented in the forth section. The final section concludes.

5.1 Literature review

Even if financial risks have been widely analysed in the literature and theoretical and empirical proofs have been brought with regard to the drivers of banks' bankruptcies, this research area still needs to be explored, since financial institutions are in continuous innovation process and change. Recent literature offers various theoretical and empirical studies, covering wide-ranging subjects (causes and consequences of financial shocks, impact of new policy measures, financial stability).

The topic addressed in this chapter is situated at the crossroads of multiple areas of research. For this reason, we provide, in what follows, a short overview of the main findings that motivated and contributed to the development of our framework.

Solvency is prominently analysed in both theoretical and empirical research that emphasise the contribution of higher levels of core capital in reducing the risk of failure (Gambacorta and Mistrulli, 2004; Wheelock and Wilson, 2000; Demirgüç-Kunt and Huizinga, 2010; Berger et al., 2010; Miles et al., 2013). Blundell-Wignall and Roulet (2013) highlight the importance of balance sheet structures and especially, the dependence on market activities, in assessing the riskiness of banks. The crucial role of wholesale funding in the propagation of shocks has been highlighted in numerous studies (Huang and Ratnovski, 2011; Shin, 2009; Le Leslé, 2012). Nevertheless, it is important to notice that risk comes from a bad use of these resources (for example, for financing long-maturity assets) rather than from their intrinsic risk since, after all, these funds are exposed only for a short period of time. The increasingly growing gap between liabilities and assets maturities becomes extremely dangerous for the institutions in times of market distress.

Le Leslé (2012) provides a more accurate examination of funding models and concludes on a greater fragility of European banks compared to their international peers. The Liikanen report published in 2012 complements this literature with a useful summary on the implication of funding structures in crisis propagation mechanisms and banks' profitability.

This takes us to the discussion on the complementarity between solvency and liquidity in preventing the risk of failure. During episodes of lack of confidence and of markets' coordination, the strong reliance on short-term wholesale funding became a weakness of financial institutions. Within a theoretical framework, König (2015) shows that if creditors perceive a higher insolvency risk, they will have incentive to withdraw their funds. These findings are reinforced by Pierret (2015) suggesting that banks' capital, beyond the loss-absorbing capacity, also contribute in ensuring the confidence of creditors to provide funding to banks even in times of crisis. In other terms, the dependence on short-term funding can lead to the failure of financial institutions if there are any concerns about their insolvency.

The question of the failure of a single financial institution has been more extensively addressed in the literature (Gorton, 1988; Calomiris and Gorton, 1991; Shleifer and Vishny, 1992; Bhattacharya and Thakor, 1993; Jackson et al., 2002), while the issue of systemic risk has been downplayed prior the financial crisis. However, this question becomes vital after Lehman Brothers failure when the systemic risk is revealed as a major facilitator for the development of banking crisis Diamond and Rajan (2012). In this sense, the financial crisis represented a wonderful laboratory to analyse the complexity of financial systems and the real risks of individual banks. Going beyond the traditional liquidity risk described by Diamond and Dybvig (1983), the systemic risk describes banks' interconnections and liquidity shortages that lead to strong propagation of distress from one institution to another. Early research of Bandt and Hartmann (2000) and Allen and Gale (2000) focused on contagion effects in describing the systemic risk, although there was a reminder with regard to the importance spillovers effects. The adverse effect of negative externalities (fire-sales, for example) on financial activity was pointed out since Stiglitz (1982) and Geanakoplos and Polemarchakis (1986), but it has not been seriously considered as a threat for global financial stability before 2008. In the post-crisis literature, systemic risk and negative externalities are strongly related to large banks' activities. Also discussed in Chapter 3, the so-called too-big-to-fail (TBTF) or too-interconnected-to-fail institutions - had a major contribution to the last global financial crisis (Drehmann and Tarashev, 2011; Huang et al., 2012; Haldane, 2012a; Haldane and Madouros, 2013; Admati and Hellwig, 2013). Moreover, Blundell-Wignall et al. (2014b) and ESRB (2014b) point out the strong and positive contribution of universal and investment-oriented banks

to financial instability. Martel et al. (2012) and Gambacorta and Rixtel (2013) bring additional proves on a better resilience of retail-oriented banks during the 2007-2009 crisis compared with more diversified banks.

Another strand of literature concerns the impact of the new prudential rules introduced within Basel III and CRD IV frameworks that try to line up with financial activity innovation and banking systems' complexity. New measures have been proposed for assessing the systemic risk generated by banks' activities in order to determine the capital buffers that should be imposed to the large financial institutions (Acharya et al., 2010; Acharya et al., 2012; Brownlees and Engle, 2010; Adrian and Brunnermeier, 2011). Nevertheless, these measures can also be used as indicators of banks' riskiness.

To summarize, the existent literature indicates that liquidity (both market liquidity and maturity transformation) could interact and affect the solvency of banks and furthermore, their risk of failure. With our analysis, we search to fill the gap in the empirical literature by examining the extent to which the improvements in liquidity and solvency patterns (as described by Basel regulation) contribute to the reduction of failure risks.

5.2 Solvency and liquidity: theoretical insights in predicting banks' failure

The lack of attention paid by the Basel Committee with regard to the liquidity management framework before the autumn of 2008 is particularly due to the strong belief that capital is "the king" and banks with stable capital structures could always raise additional funds on wholesale markets (Brunnermeier and Pedersen, 2009). But the Lehman-Brothers episode illustrated that financial stability should involve both resilient market liquidity and large loss-absorbing capacity.

While in the case of capital requirements, the Basel Committee was able to identify the shortcomings of the framework and to propose more appropriate measures, the definition of liquidity requirements was more challenging. Two levels of regulation have been considered. The standards imposed within the microprudential approach deal with the failure of financial institutions taken individually, while the macroprudential framework, which did not exist before the financial crisis, addresses the issue of externalities generated by interconnections between financial institutions.

5.2.1 Preview on solvency and liquidity risks before the crisis

Before the last financial crisis, we used to believe that liquidity is about bank's capacity to meet its financial commitments and the stability of its balance-sheet. But solvency was the main concern of regulators while discussions on liquidity management were usually

left behind. In their rapports, regulators' often argued their lack of advancement on the conception of a liquidity management framework by the complexity of the concept and the scepticism across committee members on the implementation of such a framework at an international level (Goodhart, 2011).

Therefore, the Basel Committee focused on the solvency risk and developed a capital regulation based on multiple pillars. Only the risks to which depositors are exposed were addressed. The existence of deposit insurance schemes and of the "lender of last resort" aim to reduce the risk of deposit runs generated by concerns on the solvency of credit institutions. The regulatory aspects related to (il)liquidity risks generated by market-based activities and their impact on solvency have been neglected. In turn, the risk-weighted ratios introduced with the first revision of Basel Agreements, and concertized in Basel II framework, were considered as a "magic formula" - able to deal with both solvency and liquidity concerns. Liquidity was hence treated as a solvency problem during Basel I and Basel II, when the functioning of the system was imagined close to the following framework: agents and institutions efficiently allocated their resources, markets distributed the liquidity according to liquidity needs of agents, and finally, central banks provided the amount of liquidity to balance demand and supply. Thus, each type of liquidity and agents depend one on another, and liquidity - broadly speaking - (was) is dependent of the capital base. Hence, a solvent bank could raise funds at a fairly price according to its intrinsic risk; this latter determines its counterparty risk. This principle provides an illustration of the principle that prevailed before the autumn 2008 concerning the role of solvency and liquidity in examining bank's resilience.

5.2.2 Why we need to regulate both capital and liquidity?

The need of a liquidity framework came along as an implicit consequence of financial developments. In the past fifteen years, financial innovation has changed meaningfully the architecture of financial systems. Credit institutions have been reshaped as well and become increasingly linked to financial markets (the emergence of "originate-to-distribute" models). In some extent, this evolution illustrates the short-term perspective of investors, which helped trigger the subprime crisis.

Indeed, the last financial crisis did not emerged from capital deficiencies but rather from a liquidity shortage. Furthermore, it has been fueled by the concerns on the quality of assets and the tight interconnections between banks' portfolios. It has been furthermore concretized into general panic and markets freeze (Flannery, 1996; Freixas and Gabillon, 1999; Cifuentes et al., 2005; Brunnermeier and Pedersen, 2009). Contagion did not act through classical channels, but rather through asset commonality (Allen et al., 2012). The effects have been observed mainly on assets prices that experienced historical

downward revaluations. Nevertheless, this new form of contagion could not be foreseen using traditional tools (Value-at-Risk, VaR; Expected Default Frequency, EDF) since they were not appropriate to evaluate accurately the real risk of financial institutions or the externalities generated by their activities.

Therefore, even the banks that were solvent (i.e. banks that fulfill regulatory capital requirements) become vulnerable to short-term market shortcomings, given the structure and the nature of their activities. The lack of confidence in counterparties led to vicious cycles bringing in the forefront the spillovers between solvency and liquidity.

"Liquidity and solvency are the heavenly twins of banking, frequently indistinguishable"
Goodhart (2008)

The lack of appropriate instruments, able to distinguish between insolvent and illiquid banks, was critic for certain policy makers and had a considerable impact on public finances. Governments and central banks have been compelled to intervene to stop the panic and to avoid bankruptcy of financial institutions. Although central banks "should be ready to lend without limits to any solvent bank"[1] against good collateral, the "lender-of-last-resort" (LOLR) raises moral hazard problem. However, the role of central banks is not to take over excessive risks of banks and, even less, to behave as "market-maker" of last resort. Especially since "liquidity alone cannot indefinitely stop an unsound bank from failing" (BCBS, 1985)[2]. Otherwise, prudential rules will no longer be justified and all additional regulatory and fiscal policies will no longer find their place in controlling for the bad incentives and risk taking behaviour.

Higher responsibility rests on regulators and public authorities to conceive a more appropriate regulatory framework. The macroprudential tools come in addition to microprudential ones in order to ensure a better coverage of losses in case of crisis and to reduce adverse effects on taxpayers (Hanson et al., 2010).

Nevertheless, the architecture of the new regulatory framework could be open to critics, especially with regard to the manner it has been defined: as a response to the crisis, and thus, addressing the risks revealed by the 2008 shock. Moreover, the elusive definition of the concept of liquidity also leaves room to interpretation and designating the optimal level of liquidity ratios, an almost impossible exercise, can be easily criticized as well. With such a complex framework, it is imperative to improve supervision and transparency in banking activity, in order to reinforce confidence in banking activity and improve

[1] Bagehot (1873)
[2] Committee on Banking Regulations and Supervisory Practices, report to Governors, "The liquidity of International Banks", BS/85/38

market discipline. Basel III already took steps in this direction, especially with regard to supervision mechanisms.

5.3 Data and Methodology

No doubt, like any other regulation, Basel III will engender costs. The main concern appears to be, at least for practitioners, the distribution of profits. Nevertheless, a reduction of the rates of return in banking sector, excessively high in the run-up to this crisis, will end up being unavoidable in order to achieve the primary objective of financial stability.

In order to evaluate the benefits of the new prudential regulation, we examine the extent to which the strengthened prudential standards will reduce the amplitude of financial risks.

Our study covers the period from 2003 to 2013 and applies to an unbalanced panel composed of 62 large listed banks from 21 EU countries. The final dataset is obtained after several selection filters. First, we consider banks from EU countries that are under ECB's supervision[3]. Then, we specifically choose listed banks since failure risks are measured using stock prices. We consider consolidated data on balance sheets and income statements[4] that allow to evaluate the group's overall solvency and liquidity ratios.

We explain the next sub-section the methodology used to evaluate the failure risks of banks and we describe the main independent variables used in our empirical analysis.

5.3.1 Presentation of the data

The aim of our empirical analysis is to examine the contribution of improvement in solvency and liquidity of regulated banks in reducing their risk of failure. We focus on two dimensions of banking risk. Firstly, the individual risk described by the probability of default (PD) and secondly, the systemic risk measured by the SRISK of Acharya et al. (2012). This latter should be understand as the sensitivity of banks to systemic crisis.

5.3.1.1 Interest variables

In what follows, we present the methodologies for assessing the two measures of risk of failure.

[3] We consider as starting point the sample of banks that have been subject to the 2014 AQR exercise driven by ECB and EBA. The list of banks is available on: *https://www.bankingsupervision.europa.eu/banking/comprehensive/2014/html/index.en.html*

[4] The definition and the source of all explanatory and control variables employed in the econometric analysis are provided in Appendix B of this chapter.

The probability of default (PD)

In our study, the probability of default (PD) is used to describe the individual dimension of the risk of failure. The calculation of the PD is based mainly on the Distance-to-Default (DTD) - a broadly used measure in the literature in assessing the riskiness of banks (Blundell-Wignall and Roulet, 2013; Blundell-Wignall et al., 2014a; Blundell-Wignall and Roulet, 2014).

The structural model based on the option pricing theory of Merton (1974) and Black and Scholes (1973) assumes that an institution is in default when the market value of assets falls below the book value of liabilities. This represents the default point. The DTD is therefore measured as the number of standard deviations away from the default point. The formula that estimates the distance-to-default (DTD) is given in the equation:

$$DTD_{it} = \frac{log(\frac{A_{it}}{D_{it}}) + (R_f + \frac{\sigma^2_{A,it}}{2})T}{\sigma_{it}\sqrt{T}} \tag{5.1}$$

Where A_{it} is the market value of total assets of the bank i at time t, D_{it} represents the book value of liabilities, R_f is the risk free rate[5], σ_{it} the volatility of bank's assets at time t and T the maturity of debt. In other terms, the DTD represents the difference between the current market value of assets and the default point, scaled by the volatility of the asset value.

The value and the volatility of assets (A_t and $\sigma_{A,it}$,respectively) are determined starting from the observed stock prices and their volatility within a Black and Scholes model. Giving its formula, when the DTD decreases, the bank becomes more likely to default.

In our study, we chose to use in probability of default (PD) in order to facilitate the interpretation and the comparison of the risk of failure across institutions and across banks from different countries[6]. The equation that allows for the conversion of the DTD in PD is the following:

$$PD_t = Pr[A_t < D_t] = N(-DTD) \tag{5.2}$$

Given the calculation methodology, the PD is a random variable depending on the value of assets.

The detailed methodology for the calculation of the DTD and the PD as well as technical aspects relied to the implementation of this measure for our sample of banks are presented in Appendix A of this chapter.

[5] The initial model uses an expected return on assets. Vassalou and Xing (2004) estimate this value using daily data on assets. However, several studies in the literature replace this variable with the risk free rate R_f (Hillegeist et al., 2004; Blundell-Wignall et al., 2014b).

[6] The probability of default is used by Moody's KMV and is also known as the Expected Default Frequency.

Concerning the inputs of our model, we use the following parameters:

- The value of the shares is publicly available and it is directly extracted from IODS database.
- Data on debt is extracted from Bankscope. Daily data is obtained by quadratic interpolation between the two closing dates.
- The risk free rate is given by the Euribor 12-months interbank rate.

The PD is a market-based measure of the risk of failure that is time-variant and reflects changes in credit quality as it is perceived by investors/markets. It is assumed that the PD is a forward-looking measure of risk in the extent that it is based on share prices and contains expectations of market participants. Moreover, Crosbie and Bohn (2003) sustains that the PD incorporates many of the countries and business characteristics through market prices and their volatility[7]. The pre-crisis literature argues that the DTD (and implicitly the PD) is a suitable and all-encompassing measure of the riskiness of individual banks (Gropp et al., 2006; Gropp and Moerman, 2004). Nevertheless, it proved to underestimate the real risk during the subprime crisis and showed a better risk profile of institutions since it does not take into consideration the systemic risk.

For this reason, we consider a second indicator for the risk of failure which is more appropriate to measure banks' exposure to systemic events.

The SRISK

The subprime crisis put a spotlight on the concept of systemic risk. In more general terms, it could be described as the externalities of some institutions' distress towards other institutions and the whole financial system (Bernanke, 2009; De Nicoló et al., 2012). The more one seeks to define the systemic risk, the more we learn about the complexity of this concept.

In the period after Lehman failure, both practitioners and academics made efforts in determining measures for the systemic importance of financial institutions and their contribution to the global risk. The literature proposes several metrics: some approaches based on accounting data describing size, indebtedness, complexity and interconnectedness (FSB, 2012; BCBS, 2013a) and other ones using publicly available market data. Issued from this recent literature, three main measures for systemic risk have met global success:

- *Marginal Expected Shortfall (MES)* implemented by Acharya et al., 2010 measures the average return of a bank on days when the market return is in its tail.

[7] "The DTD captures most of the relevant inter-country differences in default risk". Crosbie and Bohn (2003)

- *Systemic Risk Measure (SRISK)* of Acharya et al. (2012) and Brownlees and Engle (2010) is constructed based on the MES, the leverage and the size of banks. It gives the amount of capital shortfall in times of financial crisis.
- *Delta Conditional Value-at-Risk (CoVaR)* of Adrian and Brunnermeier (2011) - measuring the financial sector's losses through the Value at Risk (VaR) conditional to a certain threshold of loss of a financial institution[8].

We are interested in SRISK, which is a top-down measures which "starts with the risk of the system and allocates it to individual institutions" (Drehmann and Tarashev, 2011). According to the results of comparison analysis made by Bandt et al. (2013) and Benoit et al. (2016), we further focus on the SRISK. Our choice is based on several reasons. First, it is the most appropriate measure for our study since it aims at determining the sensitivity of banks to distress on global financial markets. Second, it is based only on publicly available data. Finally, it takes into account both market features and institutions leverage and size which have already been identified as main determinants of the TBTF/TITF status (see Chapters 3 and 4).

This measure is in reality an extension of the MES[9]. The primary assumption behind this measure is that a bank's distress is considered as a more important externality for the financial system if other banks are in distress as well. It is assumed that the contagion risk is endogenous for the global risk of the system, having serious implication for interbank market and funding cost of banks. Equation (5.3) provides the calculation formula for the MES of a bank i at time t over one year horizon:

$$MES_{i,t+h|t}(C) = -E_t(R_{i,t+h|t}|R_{m,t+h|t} < C) \tag{5.3}$$

We consider C, the drop in market prices equal to 2% as in Acharya et al. (2012). The market return $R_m$is given by the European stock market index Euro Stoxx that is the main index for European markets' capitalization.

In a second step, we compute the SRISK using the MES and structural features like the amount of liabilities D_{it} and the size of institutions as in equation (5.4).

$$SRISK_{it} = kD_{it} - (1-k)E_{it}(1 - MES_{i,t+h|t}(C_{t+h}) \tag{5.4}$$

where E_{it} the market value of equity of bank i at time t and k the prudential capital ratio. In our model, k is equal to 5.5% which corresponds to minimal capital requirements for European banks.

[8] CoVaR determines the contribution of a financial institution to a systemic crisis through the amount of potential loss that the bank will pass on the financial system. This measure gives a market perspective which does not meet the objective of our analysis.

[9] The Marginal Expected Shortfall (MES) is supported by ECB studies (ECB WP no 1546 / May 2013): "MES would have been able to predict the cross section of losses incurred by US financial firms during the 2007-2009 crisis".

Thus, the SRISK describes the amount of capital shortfall that a bank may incur in time of crisis. Greater values of SRISK imply largest capital shortfall and are generally associated to systemically important banks whose bankruptcy will have a higher impact on the system in case of a financial shock. Initially designed as a macroprudential tool in defining capital buffers, we will rather use the SRISK to assess banks' sensitivity to systemic events (i.e. systemic liquidity crisis).

Although strongly defended by Engle et al. (2015), other academics have been more critical with respect to the use of the SRISK as a supervisory tool for several reasons (Tavolaro and Visnovsky, 2014). Firstly, the use of market data implies that the sample of banks will be reduced to listed institutions. Secondly, the definition of the crisis using a market index can be criticized since the choice of the index directly impact the value of the SRISK. Moreover, causality issues between banks' market price and the value of market index could be raised as well.

These two additional measures of risk, the PD and the SRISK, could be considered as complementary since the first one describes the idiosyncratic weaknesses and the second one evaluates the sensitivity of banks to systemic risk. However, they are employed in this study since they are used as regulatory or supervisory tools.

5.3.1.2 Main explanatory variables

We use two main classes of explanatory variables, solvency ratios and liquidity indicators, which are in accordance with the most recent Basel prudential framework. The motivation for the introduction of these variables in our econometric model emerges from post-crisis debates that pointed out frequently the costs of the new prudential rules. By evaluating the impact of Basel III solvency and liquidity ratios, we aim to bring empirical proof on their positive impact in reinforcing the stability of the financial system by reducing the risk of failure of individual institutions.

Solvency

Basel III provides two measures of solvency: the risk-weighted ratio calculated as the amount of Tier 1 capital divided by the amount of risk-weighted assets (RWA) that has been revised compared to the previous framework, and the leverage ratio - introduced within Basel III - that is computed as the Tier 1 capital to the total amount of assets[10]. While the Tier 1 capital ratio describes the capital adequacy capacity, the leverage is a "security" ratio and aims in constraining the building up of leverage in the banking sector. This latter acts as a simple instrument that complements the risk-sensitive measure.

[10] One should notice that we use in this study the leverage measured as the amount of total assets to Tier 1 capital. And not the Leverage ratio (Tier 1 capital divided by the bank's total assets).

The Tier 1 capital ratio, issued from banks' risk models, can be subject to strong critics due to the lack of appropriate and transparent assessment methodologies. As for the leverage, it has the advantage of being simple, transparent and easy to calculate. Recent literature on financial crises points out the outperformance of the simple leverage ratio on the T1 ratio (Blundell-Wignall and Roulet, 2013; Laeven et al., 2014a) in evaluating the insolvency risk during the financial crisis.

Therefore, we seek to evaluate the contribution of each of these measures to reducing the risk of failure. We expect that higher levels of leverage lead to higher instability and higher risk of failure, while the effect for the Tier 1 ratio should be the opposite.

Liquidity

In accordance with the discussion in Chapter 2, we distinguish two dimensions of the concept of liquidity.

Firstly, we evaluate banks' capacity to *transform maturities* since this is a critical function of banks and it represents their main source of (il)liquidity. It is described in our framework by the Net Stable Funding Ratio (NSFR) that brings a more complex and appropriate measure of the liquidity risk emerged from maturity mismatches than other measures widely used in the literature (for example, loan-to deposits ratio)[11]. By including the NSFR as explanatory variable in the econometric model explaining the risk of failure, we try to examine the extent to which the reduction in maturity mismatches could improve the resilience of banks. We expect that banks that improvements in the value of the NSFR (i.e. lower maturity mismatches) will reduce the exposure to default.

Then, since we are not able to compute the LCR for lack of data reasons, we use a substitute measure. The sensitivity to market liquidity risk is assessed using the ratio of liquid assets to short-term borrowings, henceforth called the short-term liquidity ratio - *ST Liq ratio.* Banks with higher levels of *ST Liq ratio* are holding enough high-quality liquid assets (HQLA) to surpass a 30-days stress scenario. Therefore, we expect a negative relationship between *ST Liq ratio* and failure risks.

Besides, in alternative specifications we seek to evaluate the impact of each term of the *ST Liq ratio* for a further analysis of the sources of risk. For this purpose, we introduce the following variables in the empirical model:

- *Wholesale funding*[12] *(WF)* contains short-term borrowing from other banks and financial institutions, money market mutual funds and pension funds and it is used

[11] We calculate a generalized form of the NSFR as in Gobat et al. (2014) using factors' calibration as in BCBS (2014a). Detailed methodology is presented in Chapter 2 of this thesis.

[12] Wholesale funding contains short-term market borrowings, repos, federal funds purchased, commercial paper, overdrafts and supplement retail deposits (Feldman and Schmidt, 2001).

in addition to core deposits and other short-term market debt.

- *Liquid assets*[13] *(LA)* are assets that can be easily converted to cash in order to respond to immediate liquidity needs. We use the definition of liquid assets from Bankscope and we express it as proportion of total assets.

Control variables

We use two structural control variables that have been revealed in previous chapters as associated to the level of maturity transformation: the business model and the size of the balance sheet.

Business model (BM) is defined using as a score factor[14] and is based on average assets portfolio's characteristics: derivatives, trading activity and interbank lending, as to total assets[15]. *BM* takes values between -1.24 and 3.63 with higher values corresponding to greater holdings of market based activities. Since the assets in trading portfolio are more volatile, we expect that an increase in the value of this factor variable will lead to an increase in banks' risks. Detailed methodology for the computation of *BM* is provided in Appendix B[16].

Size is defined as the logarithm of total assets. From previous analysis, we learn that the NSFR is different across different categories of banks according to their size. For this reason, we consider necessary to introduce this variable in the econometric model in order to control for size effects in the level of dependent and explanatory variables.

5.3.2 Statistical analysis

Before taking the analysis one step further to the empirical study, we seek to examine the extent to which simple descriptive statistics support our hypothesis. We first present the evolution for the two measures of risk, the probability of default and the SRISK, and afterwards, we analyse in details the evolution of explanatory variables describing banks' structural patterns.

A first self-evidence is the strongly correlated evolution of the probability of default and stock markets (Figure 5.1). We identify a low increase between 2000 and 2002 that corresponds to the stressed period of Internet bubble. It follows a period of relative stability and starting with 2007, the expectations on the default of financial institutions start to climb and reach historical peaks in the autumn of 2008. Another period of

[13] Among liquid assets, we distinguish cash, interbank assets, treasury bills, government securities and other trading securities.

[14] We use the principal-component factor (PCF) method to analyse the correlation matrix.

[15] For more relevance of the indicator of business model, we base the calculation of the BM on average values over the period 2003 to 2013, expressed in proportion of total assets.

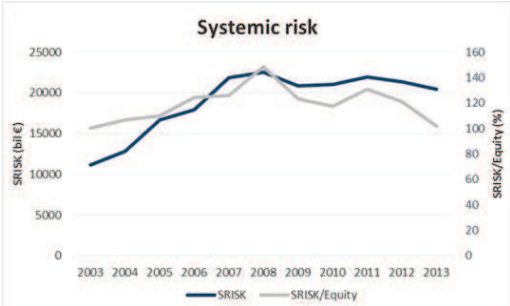
[16] For robustness check reasons, we have also tested for the impact of *Retail ratio*, the business model indicator used in Chapters 1 and 2.

financial distress is observed in 2011. This episode captures the economic turmoil on sovereign bond markets experienced at that time in Europe.

Figure 5.2 illustrates two alternative values of systemic risk: the level of the SRISK describing the amount of capital shortfall in case of a crisis (left axis), and the value of the SRISK scaled to the amount of equity (right axis). This latter describes the capital shortfall relative to the capacity of the bank to absorb losses and it allows for a more relevant comparison of the sensitivity of banks to systemic events[17]. In average, higher values of SRISK are recorded from 2007 to 2009 which corresponds to periods of strong liquidity shortfalls in worldwide financial activity. Since 2009, the average value of SRISK is relatively stable, suggesting that the exposure to systemic events is not yet reaching pre-crisis levels. The trend of the SRISK/Equity is more stable than the evolution of the level of SRISK and proves that the increased amounts of SRISK are somehow following the evolution of capital structures. Moreover, it emphasize better the period of strong distress on financial markets recorded between 2007 and 2009. It is important to notice the downward trend of this variable at the end of the period. Regulatory driven changes in funding structures improve banks' loss-absorbing capacity and reduce banks' sensitivity to systemic events.

Figure 5.1: The evolution of PD (2003-13)

Figure 5.2: The evolution of SRISK (2003-13)



Notes: For the left figure, the values for SRISK are plotted on left axis and the values for SRISK/Equity on the right axis.
Source: public data on stock prices, Bankscope, author's calculations

Although both measures of risk are strongly relied to stock market fluctuations, they are also drawing attention on assets portfolio performance. For example, the non-performing asset ratio employed in the literature to examine the financial health of a bank Agarwal and Taffler (2008) has experienced a sharp increase since 2008. Compared with the *PD* which returned to normal during 2010 and 2011, the proportion of non-performing loans as to the total amount of loans has continued climbing during the last years. This trend illustrates, in more general terms, the cumulated losses incurred by banks on their lending portfolio. Beside the accounting-based indicators, market-based

[17] The evolution of SRISK/Equity plotted in Figure 5.2 confirms the existent literature (Haldane, 2012a, Admati and Hellwig, 2013) which brings evidence on the increased size of banks' balance sheets during the last decade.

indicators like stock prices, risk premiums or credit ratings are also revealing banks' weaknesses (Ito and Harada, 2005). We chose to illustrate the volatility index VSTOXX, also called "the European VIX".

Figure 5.3: NPL/Gross loans (%)

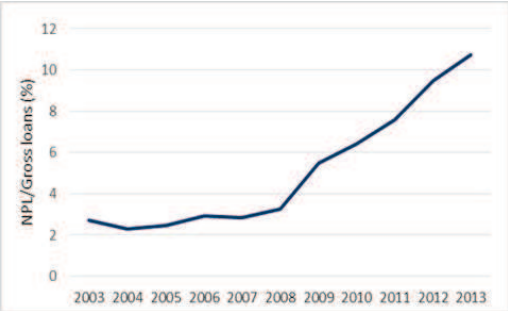


Figure 5.4: Volatility index, VSTOXX

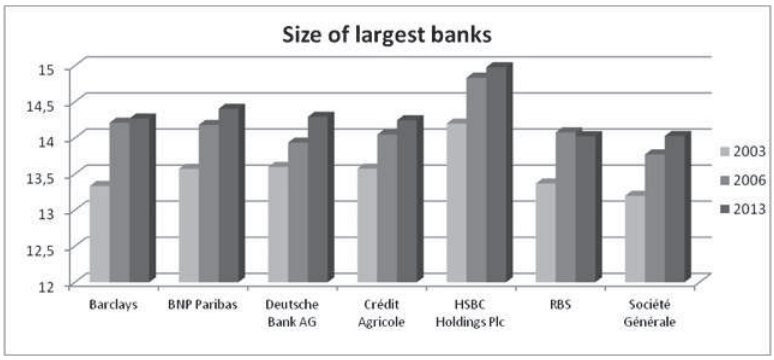
Notes: The left figure reports the annual average of the ratio of non-performing loans (NPL) to gross loans (%). The right figure plots daily values for the VSTOXX. It reflects market expectations of near-term up to long-term volatility and its computation is based on EURO STOXX 50 real time options prices.
Source: Bankscope, www.stoxx.com, author's calculations.

The figures show that the risk of default of individual institutions is very correlate to the volatility of stock markets, this later representing an important source of vulnerabilities for banks. These relationships emphasize the importance of market component in the calculation of the probability of default.

Although the two measures of risk (the PD and the SRISK) are very correlate with the evolution of stock markets, they should be influenced by the evolution of balance sheets since they are calculated on the basis on accounting data as well. Firstly, it is important to notice the considerable increase in the size of banks and especially of the largest banking groups. By plotting pre- and post-crisis values, we compare the evolution of *Size* for the largest banks in our sample (Figure 5.5). For these largest banks, we observe an important shift in size between 2003 and 2006. However, one should bear in mind that this increased trend started well before our study period[18].

[18] Laeven et al. (2014b) illustrate for a sample of worldwide banks that the increase in size started even before 1999. This argument is also by Haldane and Madouros (2013) and Admati and Hellwig (2013).

Figure 5.5: Changes in the size of largest banks in the sample

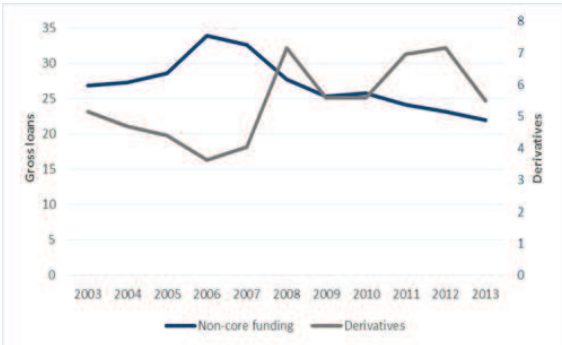


Notes: We plot the evolution of size for the largest banks in our sample with available accounting data for the whole period. The ranking is made according to the average value of size for the period 2003-2013 where size is calculated as the log of total assets.
Sources: Bankscope, Author's calculations.

Nevertheless, the variations in the size of banks recorded during the last decade are associated with changes in the structure of assets portfolios and funding patterns, mainly driven by deregulation and financial innovation developments.

These changes are clearly emphasized through the structure of assets portfolios that become increasingly dependent on high-yield trading assets in the wake of the financial crisis while lending activity recorded very small fluctuations (0.5-1 percentage point as of total assets). The structural evolution of banks can be observed as well through the liability structure. In the period up to the crisis, banks' reliance on non-core funding[19] has increased significantly. Compared with their international peers, European banks are extremely dependent on wholesale funding and this explain their strong exposure to capital market fluctuations during financial turmoil (Le Leslé, 2012). Figure 5.6 illustrates the temporal evolution of market based activities for both sides of the balance sheet (i.e. derivatives in asset portfolio and non-core funding in liabilities structure).

Figure 5.6: Structural patterns (2003-13)



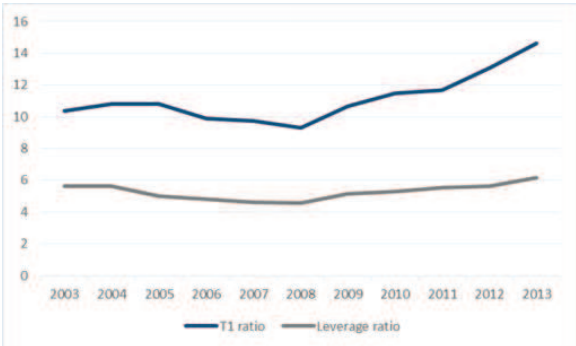
Notes: The variables are reported as proportions of total assets.
Source: Bankscope, author's calculations

[19] Non-core liabilities include debt maturing less than 1-year, repos, debt securities, certificates of deposit, other inter-bank liabilities. In turn, core funding includes deposits and long-term debt.

We should highlight that the evolution of SRISK is more likely to capture these changes in banks' structures. Specifically, the increase dependence on derivatives seems to correspond to an increase in the exposure to systemic events captured by the SRISK (and even better by the ratio SRISK/Equity). Nevertheless, we could assume that the exposure to default is more relied to the global level of indebtedness than to the structure of liabilities according to their maturity. Further analysis of solvency ratios could bring more evidence on this issue.

We plot annual averages for the risk-weighted capital ratio (blue) and the simple leverage ratio (grey). The evolution of the Tier 1 to RWA ratio reveals a decline in loss-absorbing capacity of banks relative to the amount of risk-weighted assets between 2005 and 2008 (Figure 5.7). Since meanwhile the proportion of equity did not decrease, we assume that the changes in the value of solvency ratio are due to higher exposures in assets portfolio. To a certain extent, this is in line with the evolution of the SRISK. Our assumption is strengthen by the evolution of leverage ratio suggesting that the amount of equity relative to total assets did not change considerably in the wake of the financial crisis.

Figure 5.7: The evolution of the funding structure



Notes: We illustrate the temporal evolution of the risk-weighted capital ratio (Tier 1 capital to RWA) and simple leverage ratio (Tier 1 capital to total assets). Both ratios are expressed in percentages.
Source: Bankscope, author's calculations.

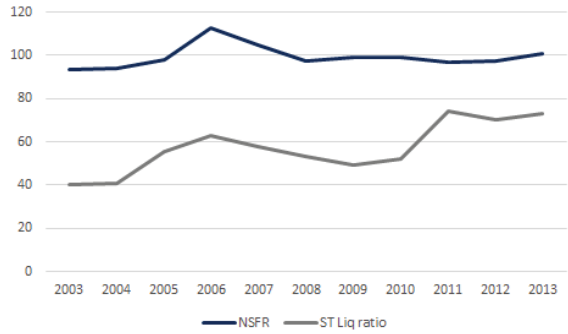
Therefore, the strong increase in the probability of default of European banks between 2006 and 2009 could be explained by the decline in the solvency ratios although this component of the *PD* is not as strong as the market based factor (i.e. volatility of assets induced by fluctuations in stock markets).

Furthermore, since the aim of study is to examine the extent to which the prudential rules contribute to the reduction in the risk of failure of regulated banks, we take a closer look to the evolution of liquidity ratios to evaluate if there is any correlation between the risk of failure and the liquidity of banks.

From Figure 5.8, we notice that (in average) the value of the NSFR did not variate considerably during the study period. In turn, the short-term liquidity ratio (liquid assets

to short-term borrowings) experienced several stages: a significant increase in the pre-crisis period generated by a higher reliance on trading activities, then a decline during the crisis, and a considerable improvement stating with 2010 since the prudential rules have been publicly announced. The temporal evolution of liquidity ratios[20] is illustrated in Figure 5.8.

Figure 5.8: Evolution of liquidity ratios



Notes: The NSFR is computed using BCBS (2014a) methodology. The short-term liquidity ratio is used as a proxy for Basel Liquidity Coverage Ratio - LCR defined by BCBS (2010d), BCBS (2013c). It is computed as the amount of liquid assets to the amount of short-term borrowings.
Source: Bankscope, author's calculations

The level of both ratios is, in average, significantly lower in the pre-crisis period and describe the weaker interest of banks in preserving liquidity. High levels of wholesale funding and derivatives proved to be a weakness in times of crisis by increasing the exposure to stops in funding markets. The holdings of liquid assets[21] are undoubtedly useful to address funding shortcomings. However, certain assets turned out to be a source of vulnerabilities in times of distress since there were concerns about their intrinsic quality but also due to asset commonality (Allen et al., 2012) and fire sales spillovers. This phenomenon engendered important losses for banks with significant holdings of similar liquid assets. The maturity gaps between liabilities and assets (i.e. NSFR lower than 100%) illustrate the unsoundness of European funding structures relative to the structure of asset portfolios.

Taken together, the evolution of balance sheet structures induced changes in solvency and liquidity of worldwide institutions, and affected banks' resilience to stocks. Although it is very likely that these interconnections differ across banks according to their business model and structural features of domestic financial markets. Since the sensitivity of banks to stock market fluctuations passes through their dependence on market based activities, we search to integrate these differences in banks' business strategies in our empirical model when explaining the riskiness of banks.

[20] The liquidity ratios defined according to BCBS (2010d), BCBS (2013c) and BCBS (2014a)
[21] Liquid assets are mainly government bonds, cash, money market instruments, and trading securities.

The structural patterns illustrated above are reinforced with the study of correlations reported in Table 5.1. The first self-evidence on the determinants of the two alternative measures of SRISK reveals that the level of SRISK is heavily related to the leverage while the scaled SRISK (i.e. SRISK/Equity) is closely associated to the Tier 1 capital ratio. Differences appear as well between these two measures and the PD.

Although the risk measures are assessed using market data, the risk measures are not significantly correlated with (our proxy of) the short-term liquidity ratio. The denominator of the ratio, the proportion of short-term borrowings, is associated with the risk measures. The NSFR ratio in turn, is significantly correlated only all interest variables. Therefore, the long-term liquidity ratio is more likely to explain banks' vulnerability to failure.

Finally, high levels of SRISK can be identified for large banks since we find a strong correlation between these two variables. For this reasons, we will also analyse empirically the scaled value of the SRISK, namely the SRISK/Equity, which should dismiss the size effect in regressions. Moreover, it allows for a more relevant comparison between banks. In addition, controlling for the business strategy of banks seems to be mandatory since the variable *BM* is strongly correlated with structural indicators but also with risk measures.

Table 5.1: Correlation matrix

	SRISK	SRISK/ Equity	PD	T1 ratio	Leverage ratio	NSFR	ST Liq ratio	LA	Wholesale funding	Size	BM
SRISK	1.0000										
SRISK/Equity	0.0434	1.0000									
PD	0.0443	0.1236*	1.0000								
T1 ratio	0.0132	0.0951*	-0.1000*	1.0000							
Leverage ratio	-0.3822*	0.0418	-0.1554*	0.5152*	1.0000						
NSFR	-0.4309*	-0.0332**	-0.1705*	-0.0476	0.4784*	1.0000					
ST Liq ratio	-0.0750	-0.0035	-0.0337	0.1138*	0.2451*	0.0943	1.0000				
Liquid assets	0.3646*	0.0968	-0.0541	0.1191*	-0.2427*	-0.5326*	0.5013*	1.0000			
Wholesale funding	-0.2611*	-0.0414	0.1957*	-0.2911*	-0.0641	0.2320*	-0.1661*	-0.1282**	1.0000		
Size	0.7823*	0.0170	0.0521	-0.0416	-0.5838*	-0.5447*	-0.2414*	0.3507*	-0.1011	1.0000	
BM	-0.4250*	-0.0447	-0.1362*	-0.1256*	0.4101*	0.8207*	0.1608*	-0.6542*	-0.0225	-0.5819*	1.0000

Notes: The statistics reported in the table illustrate Pearson correlation coefficients calculated using panel data over the period 2003-2013. * and ** denote 1% respectively 5% confidence level.

5.4 To which extent solvency and liquidity requirements prevent banks' failure?

The question that we raise in this chapter relates to the relevance of liquidity regulation, beyond the capital framework, in preventing the failure of banks. In other terms, we empirically analyse the extent to which the risk of failure could be reduced by improving the level of capitalization, on the one hand, and the liquidity of the balance sheet, on the other hand.

In a first stage, we seek to examine the impact of the regulatory measures imposed under Basel III: solvency ratios (risk-sensitive capital ratio and leverage ratio) and liquidity ratios (NSFR and the short-term liquidity ratio - proxy for the LCR). Although not fully implemented yet, the predictive power of these measures is quantified for the whole study period, from 2003 to 2013. Our aim is to evaluate the impact of banks' structural features on the risk of failure by looking on historical data, rather than the impact of these ratios in an actual and wider framework. Our choice is mainly due to the fact that we are not able to take into account the spillovers and business model changes imposed by the regulation, either the regulatory and macroeconomic environment.

Furthermore, in line with our objective of identifying the impact of different indicators of solvency and liquidity on the risk of failure, we drive an empirical study applied to an unbalanced panel of 62 large European banks, with a dataset that covers the period from 2003 to 2013. We test for the complementary of solvency and liquidity ratios by analysing each liquidity measure (*NSFR* and *ST Liq ratio*) separately and then, simultaneously in order to evaluate the synergies between the two measures.

5.4.1 Impact of excessive maturity transformation on banks' failure

Banks are at the heart of economic activity due to their capacity of liquidity creation through maturity transformation. Nevertheless, the lack of appropriate guidance for this function of banks, during the last decades, left room to adverse incentives to switch to extreme maturity transformation. Emphasized by the recent financial crisis, this shortcoming of banking regulation has been addressed using the Net Stable Funding Ratio proposed by Basel III. Its aim is to reduce bad transformation and encourage the reliance on stable and long-maturities resources.

In this section, we propose an assessment of the impact of the NSFR, evaluating the maturity mismatches between assets and liabilities, on financial risks. We expect that higher NSFR will contribute effectively to the reduction if banks' risks of failure. Nevertheless, there are chances that interdependencies between liquidity and capital requirements in reducing these risks. For this reason, we introduce in our empirical model both solvency and liquidity variables. In addition, we control for the size of banks in order to correct for size bias.

$$Defaultrisk_{it} = \beta_i + \beta_1 Solvency_{it} + \beta_2 NSFR_{it} + \beta_3 X_{it} + \varepsilon_{it} \tag{5.5}$$

where t is the period (2003-2013) and i the bank. *Solvency* measures of the level of capitalization and can be defined by two variables: the risk-weighted ratio (Tier 1 capital to RWAs) and the leverage ratio (Tier 1 capital to total assets). The liquidity indicator is introduced in the model as a complement to solvency ratio, and is described by the

NSFR[22]. X is a vector of control variables. The residual term includes β_i the unobserved time-invariant individual effect and the error term ε_{it}.

The model presented in (5.5) allows us to examine the extent to which solvency and liquidity indicators imposed by Basel III explain banks' risks. Since we dispose of two different measures, the probability of default and the SRISK, we run different specification for each indicator. Estimates are obtained for both measures of solvency: *Tier 1 ratio* (columns 1 to 3) and *Leverage ratio* (columns 4 to 6). Different specifications are tested in order to evaluate for the individual impact of the NSFR and then, for the complementarity of liquidity and solvency requirements.

The results of panel-estimations for the specifications described previously are reported in Table 5.2.

A first self-evidence is the very strong results on the impact of the NSFR on the risk of failure. It appears that the *NSFR* has a negative and stable effect in explaining both individual and systemic risks. The coefficient suggests that excessive transformation activity adds individual risk in the measure that it can increase the risk of failure if there are concerns about the bank's ability to meet its financial commitments over long-term horizon (i.e. one year). From a different point of view, the banks with lower levels of *NSFR* are more exposed to failure due to risks that can emerge from the mismatches between the maturities assets and liabilities. Funding the long-term maturity assets (i.e. credits) by short-term borrowings make banks more vulnerable to shocks on interbank markets and therefore, more exposed to default. Of course, the ability of banks to fund themselves depends as well of market conditions and especially on yield curve. In actual conditions of almost flat term structure, the cost of improving the stability of the funding structure should not have important effects on the profitability and furthermore, on banks risk of default due to unprofitability.

The significance of NSFR is confirmed across different specifications. The estimates suggest that an increase in the NSFR of one percentage point could reduce the probability of default of 0.17-0.19 percentage points. The SRISK expressed in million euros, could be reduced of 546.3 to 708.8 units for every additional unit of NSFR. Since, the amount of capital shortfall in case of strong distress is difficult to compare across banks, we introduce an alternative measure that evaluate the capital shortfall relative to the effective amount of core capital of banks. This measure eliminates the balance sheet size effect. An increase in NSFR could reduce significantly the expected capital shortfall as of total equity in case of systemic risk and the impact is evaluate in the range of 1.49-1.57 for one unit increase in the NSFR.

[22]Within an alternative specification, we use the short-term liquidity ratio - as an indicator of banks' sensitivity to market liquidity crisis - to define liquidity.

The ratio that matches assets and liabilities' maturities over a one year horizon is dominant over our study period while the opposite theory was put forward in the pre-crisis period. The solvency is important (in certain cases) but banks' capacity to match maturities and implicitly, to reduce the dependence on wholesale funding, prevails in reducing the exposure to default.

Table 5.2: Solvency and NSFR complementarity in explaining the risks of failure

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	PD	SRISK	SRISK/Equity	PD	SRISK	SRISK/Equity
	T1 ratio			*Leverage ratio*		
Solvency	-1.019***	-450.4	-6.370	-0.478	-3,226***	-1.492
	(-2.824)	(-1.469)	(-1.359)	(-1.262)	(-5.988)	(-0.282)
NSFR	-0.191***	-708.6***	-1.576**	-0.175***	-546.3***	-1.354***
	(-4.064)	(-9.852)	(-2.472)	(-3.236)	(-7.124)	(-2.589)
Constant	21.46***	65,157***	270.9***	13.92***	73,371***	192.9***
	(4.706)	(8.638)	(6.937)	(4.215)	(9.914)	(3.451)
Observations	483	483	483	483	483	483
R^2	0.167	0.198	0.031	0.146	0.236	0.026
R^2 adj	0.148	0.179	0.00829	0.125	0.217	0.00229
F	8.342	9.391	3.345	8.404	12.67	3.277
Bank FE	yes	yes	yes	yes	yes	yes
Time FE	yes	yes	yes	yes	yes	yes

Notes: We run OLS regressions and we correct for the heteroskedasticity of errors. We use one-period lagged variables. In regressions 1 to 3 solvency is defined by the Tier 1 capital ratio, while in regressions 4 to 6 it is replaced by the leverage ratio. Robust t-statistics in parentheses *** p<0.01, ** p<0.05, * p<0.1.

The results confirm our assumption that the excessive maturity transformation increases the risk of failure. From another point of view, an improvement in liquidity management reduces the risk emerged from maturity mismatches. One the one hand, the Tier 1 ratio and the NSFR are complementary when explaining the probability of default, while the leverage ratio and the NSFR appear as complementary tools in reducing the exposure to systemic crisis (i.e. SRISK).

The role of solvency in explaining the risk of failure is not neglected. It is in turn revised when solvency ratios are taken into account. Therefore, another important result highlighted in Table 5.2 concerns the solvency ratios and their impact on the riskiness of banks[23]. Namely, the Tier 1 capital ratio has a significant impact on the probability of default of banks while the leverage ratio seem to affect considerably the SRISK. The value of coefficients should nevertheless be interpreted with caution since the two measures of risk have different units of measures. Specifically, the coefficient indicates that for every additional percentage point increase in the risk-weighted capital ratio we expect

[23] The solvency ratios have significant impact on the alternative measures of risk employed in this study within univariate regressions. The specifications tested in this section take into account the NSFR which seems to influence the impact of solvency ratios in explaining the risk of failure.

probability of default to decrease by an average of 1.019 points of percentage. The logic behind this result is explained by the reduction in banks' risk taking behaviour and its implications on the improvement of the loss-absorbing capacity. In turn, the coefficient β_1 in column 5 indicates that an additional one percentage point in the leverage ratio will lead (in average) to a reduction of 3,226 million euros in the amount of capital shortfall in case of a systemic crisis (i.e. the SRISK). Therefore, the leverage ratio which is intended to avoid the build-up of excessive leverage in the banking sector, has a significant impact on banks' exposure to systemic risk while it does not affect significantly the probability of default. Of course, these results are valid for the sample of European banks and estimations are based on data over the period 2003 to 2013.

We could therefore interpret these results through the complementarity of these two ratios, which otherwise is emphasized in the most recent version of Basel regulation. While improvements in the loss-absorbency capacity reduces significantly the probability of the bank to be in default (i.e. the value of assets become lower than the value of liabilities), the increase in the leverage ratio (i.e. the proportion of capital as of total assets) allows to reduce the exposure to systemic events. This latter comes to reinforce the risk-based requirements and reduce the exposure to distress generated by systemic crisis. Therefore, it could be considered "supplementary" to the risk-based capital ratio in reducing the overall exposure to default of banks.

With respect to the alternative measure of systemic risk (SRISK to equity), the NSFR has a strong and negative impact while solvency is never significant. Hence, the NSFR dominates solvency ratios and proves to better explain the evolution of the systemic risk of banks.

5.4.2 Implications of banks' size in implementing prudential standards

One could imagine that the impact of both solvency and liquidity ratios are different according to the size of banks. At least for the systemic dimension of banks' risk, this theory could be justified by the fact that the banks considered as globally systemic important are among the largest in the world. The size of banks is also a key determinant in explaining governments' interest in supporting them in order to avoid bankruptcy[24]. However, there is no reason to believe that all small banks are less exposed to failure, at least when the risk is measured by the probability of default.

In order to examine the validity of these assumptions, we test two alternative approaches. Firstly, we introduce the size of banks in the econometrical model (vector X), and secondly, we test the relationship for two categories of banks (i.e. small and large banks) while taking into account the level of capitalization.

[24] This hypothesis has been demonstrated in Chapter 3 of this thesis.

The results are presented in Table 5.14 in Appendix C and all regressions include bank and time fixed effects. The estimates reveal that banks' size itself does not affect the relationship between the NSFR and the risk of default. We also notice that the NSFR is the main determinant of the risks of default, for both individual and systemic values even when the size is accounted for. However, it is important to notice that the value of coefficients for the NSFR is changing only marginally when explaining the PD and the SRISK/Equity while it incurs considerable variations in the case of the SRISK. These finding emphasize the strong correlation between size and the absolute amount of capital shortfall as measured by the SRISK[25]. Moreover, it appears that, when we consider for the size, solvency ratios have the opposite effect than expected on the SRISK.

The estimates for the variable *Size* should be more closely explained since they reveal important evidence. The results from columns 2 and 5 bring clear evidence with respect to the strong and positive relationship between size and SRISK and confirm the assumptions that large banks are more exposed to systemic risk and are likely to record higher capital shortfall in case of a systemic crisis. Nevertheless, this result should be interpreted with caution since it could simply reveal a size effect revealing that large banks have in general higher amount of capital than smaller banks. By analogy, large banks should record higher levels of capital shortfall in case of crisis.

The results in columns 3 and 6 bring a different point of view by analysing the SRISK relative to the amount of equity that banks have at their disposal. The estimates indicate that large banks would incur in average lower capital shortfall relative to their capitalization than smaller banks (negative and strongly significant coefficient of *Size*) if a systemic crisis hits the financial system again. The logic behind this finding is based on the fact that, even if the total amount of capital shortfall is higher for large banks, they have also more important amounts of core capital than smaller banks.

It is also important to notice the negative impact of *Size* on the probability of default suggesting that large banks are less exposed to default. This results should not surprise since large banks have in general access to market funding more easily than smaller ones and this privilege could help them to overpass periods of distress with important losses. On the other hand, small banks have more limited sources of funding and their weaker capacity to roll over debt in times of distress could considerably affect their exposure to default.

For these reasons, we will furthermore test if the effect of the NSFR in reducing banks' riskiness is different according the size of institutions. We examine the relationship between the risk of failure and solvency and liquidity for extreme values (very small and

[25] The strong impact of size on the amount of SRISK is also emphasized through the value of R^2 which improved significantly when size is accounted for compared with the first series of regressions (presented in Table 5.2). The value of both R^2 and R^2 adjusted triples.

very large banks). The results reported in Table 5.3 bring additional empirical proof. We learn that an improvement in the NSFR has significantly different effect on the risk of failure for large and small banks. The large banks would significantly reduce their exposure to the risk of failure (PD) by reducing the maturity mismatches between assets and liabilities. Moreover, their exposure to systemic risk could decline significantly as well by reinforcing their funding structure. What is the most important in our opinion is the result on the SRISK/Equity:

- for large banks, it appears that an increase in the NSFR will reduce even more the exposure to systemic risk (compared to the average),
- for small banks, an increase in the NSFR could have the opposite effect than desired.

NSFR could have an adverse effect on the exposure to systemic risk for small banks for funding cost reasons. Particularly, funding sources are limited for smaller banks for reasons of their size and business strategy[26]. Moreover, in times of crisis (as it is assumed in the calculation of the SRISK), an improvement in the funding structure in relation to the degree of asset illiquidity could be more costly for small banks than for large banks for the reasons reminded above. Efforts to increase the NSFR could therefore lead to higher SRISK and SRISK/Equity for small banks.

[26] We make reference to long-term liabilities since the other sources of stable funding (deposits for example) are a limited resource that depends more on the structure of banking systems rather than on banks' counterparty risk and ability to attract additional core funding.

Table 5.3: Solvency and NSFR impact on the risk of failure, by category of size

VARIABLES	(1) PD	(2) SRISK	(3) SRISK/Equity	(4) PD	(5) SRISK	(6) SRISK/Equity
	T1 ratio			*Leverage ratio*		
Solvency	-1.078***	-105.9	-0.0461	-0.908**	-1,301***	0.247**
	(-3.003)	(-0.389)	(-1.100)	(-2.344)	(-2.870)	(1.990)
NSFR	-0.212***	-527.1***	-0.0348***	-0.182***	-475.0***	-0.0434***
	(-3.804)	(-7.639)	(-2.918)	(-3.063)	(-6.934)	(-2.814)
Small × NSFR	-0.0206	1.234	0.0220**	-0.0175	14.65	0.0155**
	(-0.653)	(0.0646)	(2.356)	(-0.557)	(0.757)	(2.213)
Big × NSFR	-0.108***	558.9***	-0.0110***	-0.129***	534.8***	-0.00615**
	(-3.689)	(10.73)	(-3.011)	(-4.076)	(9.612)	(-2.128)
Constant	25.97***	37,542***	8.295***	20.87***	42,264***	6.722***
	(4.733)	(5.534)	(7.597)	(4.419)	(5.756)	(9.773)
Observations	483	483	483	438	483	483
R^2	0.184	0.390	0.057	0.167	0.394	0.068
R^2 adj	0.161	0.373	0.0305	0.143	0.376	0.0404
F	7.053	20.45	1.223	6.993	21.45	1.165
Bank FE	yes	yes	yes	yes	yes	yes
Time FE	yes	yes	yes	yes	yes	yes

Notes:We run regressions using bank and time fixed effects and we correct for the heteroskedasticity of errors. We use one period lagged variables. The two subgroups are established according to the average size of banks. *Big* is 1 for the 25% largest banks and 0 otherwise while *Small* is 1 for the smallest 25% banks in the sample and 0 otherwise. Robust t-statistics in parentheses *** p<0.01, ** p<0.05, * p<0.1.

The results emphasized in this section allows us to draw some important conclusions with respect to the impact of net stable funding ratio on different types of risks, while the solvency of banks is considered for.

First, by setting an appropriate balance between the liquidity of the assets and the stability of the funding, banks could considerably reduce their exposure to default. It is proved that an improvement in the NSFR reduce both the probability of default and the sensitivity to systemic risk.

Second, the effect of liquidity patterns as measured by the NSFR dominates the effect of solvency in explaining the risks of banks. In the context of our study, including periods of strong financial distress, the illiquidity of the bank could be stronger than the solvency patterns and drive banks to default. From a different point of view, an improvement in long-term liquidity ratio imposed by the Basel Committee strengthens bank's resilience and reduces the risk of failure.

Third, the contribution of solvency and liquidity to prevent risks arising from bank-level imbalances or systemic events is different for small and large banks. Our findings emphasize a more significant impact of liquidity requirement for large banks leading us to the conclusion that the improvement of the net stable funding ratio could reduce

considerably the risk of large banks whose failure represent a threat for the financial system and the whole economic activity.

These results have important policy implications for the prudential framework (still in working progress for liquidity ratios for aspects relied to liquidity requirements) and future structural reforms. Although we find that the impact of liquidity and capital requirements differ according to banks' size there is no evidence that the regulatory requirements in terms of liquidity and capital should be different for banks. In our opinion, it should be more a matter of business model.

In what follows, we take the analysis one step further and examine if the business model of banks has a significant influence on the risk of failure. We address the question of the impact of solvency and liquidity requirements in a similar approach as the one driven in this section.

5.4.3 Implications of banks' business models in implementing prudential standards

As regard the business model, we have reasons to believe that it could influence significantly the risk of failure. A first reason is provided by the findings in previous chapters of this thesis indicating that the effect of capital and liquidity requirements on the cost of funding differ according to the business models of banks. Moreover, the crisis emphasized several structural patterns of banks that make them more vulnerabilities to shocks.

The aim of the additional analysis is to examine the extent to which banks' structures could explain their probability pf default and their sensitivity to systemic risk. Based on the econometric model described in (5.5), we evaluate the additional effect of liquidity requirements (over the average effect) on the risk of failure for three types of business models.

After defining the business model on the basis of asset portfolio structure using principal-component factor analysis, we identify three categories of banks: commercial banks oriented on traditional activities (lending is predominant), universal banks and investment-oriented banks[27]. The results of panel-regressions are reported in Table 5.4. All specifications include time fixed effects.

The average effect of solvency liquidity ratios on the risk of failure are described by the coefficients of Solvency and NSFR, respectively. We are going to find similar results as in previous analysis with the liquidity requirements that dominate solvency in explaining the risks of default. Solvency has a significant impact on the probability of default and

[27] Compared with the definition of business model employed in previous chapters which is based on an indicator of retail activity on both sides of the balance sheet, the definition of business model used in this chapter uses a principal component analysis. Three dimensions of assets portfolio are considered: the interbank lending, derivatives and trading securities, all expressed in percentage of total assets. We chose to use a definition of business model based only on asset portfolio features (and precisely, on market-based activities) mainly because the funding structure is analysed separately using solvency variables. Detailed methodology is presented in Appendix B.

the amount of SRISK but no effect on SRISK/Equity. The estimates for the coefficient β_2 come to reinforce previous results on the (average) impact of NSFR on the risks of default.

The categories of business model are introduced in the model using bank-specific dummy variables *Commercial*, *Universal* and *Investment* that equal 1 for low, medium, and respectively high values of the variable *BM*, and 0 otherwise[28]. The aim of interacting these variables with NSFR s to evaluate the additional effect of an increase in liquidity requirements for each category of business model.

Although if globally the results are not very significant they bring important evidence with respect to the impact of capital and liquidity requirements:

- for commercial banks, improving the liquidity ratio could increase the capital shortfall as of available core capital (SRISK/Equity). The result is conditioned to the measure of solvency that is employed and namely to leverage ratio. It is consistent with previous finding since commercial banks are in general small banks;
- for universal banks, improving the balance between available stable funding and assets illiquidity could significantly reduce more the probability of default. However, it could request that the loss absorbing capacity be at sufficient high level (above the minimum regulatory standards);
- for investment-oriented banks the NSFR has a more considerable impact than for other banks. Results indicate that the increase of liquidity ratio could reduce the probability of default of investment-oriented banks but also their sensitivity to systemic crisis. Therefore, the reduction of maturity mismatches could strengthen considerably the resilience of investment banks to shocks.

[28] Low values of the variable BM correspond to low proportions of market-based activities (derivatives, interbank lending and trading securities) while high values are more for banks focused on lending.

Table 5.4: Solvency and NSFR impact on the risk of failure, by category of BM

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	PD	SRISK	SRISK/Equity	PD	SRISK	SRISK/Equity
	T1 ratio			*Leverage ratio*		
Solvency	-0.982***	-642.4*	-0.0231	-0.713*	-3,073***	-8.050
	(-2.738)	(-1.941)	(-0.567)	(-1.725)	(-5.086)	(-1.442)
NSFR	-0.269***	-603.3***	-0.0287**	-0.373***	-182.7	-0.113**
	(-4.017)	(-4.624)	(-2.308)	(-2.802)	(-1.022)	(-2.373)
Commercial × NSFR	0.0296	22.01	0.00644	0.139*	-244.1**	0.0713**
	(0.880)	(0.225)	(0.840)	(1.685)	(-2.006)	(2.106)
Universal × NSFR	-0.0859**	176.5*	-0.00952	0.0167	-99.18	0.0571*
	(-2.405)	(1.742)	(-1.397)	(0.207)	(-0.777)	(1.910)
Investment × NSFR	-0.220***	526.8***	-0.0248**	-0.151*	259.5*	0.0384
	(-3.789)	(3.977)	(-2.386)	(-1.780)	(1.796)	(1.548)
Constant	31.22***	45,808***	7.722***	25.22***	50,559***	6.736***
	(5.812)	(6.519)	(8.261)	(5.437)	(7.230)	(10.16)
Observations	483	483	483	483	483	483
R^2	0.208	0.264	0.040	0.194	0.294	0.073
R^2 adj	0.185	0.242	0.0113	0.169	0.272	0.0438
F	7.331	14.50	1.491	7.202	16.35	1.186
Bank FE	yes	yes	yes	yes	yes	yes
Time FE	yes	yes	yes	yes	yes	yes

Notes: We run OLS regressions and we correct for the heteroskedasticity of errors. We use one-period lagged variables. The three categories of BM are the result of cluster analysis based on the continuous variable Business model (BM). Robust t-statistics in parentheses *** p<0.01, ** p<0.05, * p<0.1.

The main contribution of this analysis consists in emphasising the differences in the impact of liquidity and capital requirements to predict the risks of default (probability of default and the systemic risk). Our findings could suggest the need to differentiate the stable funding requirements by type of business model since there is evidence that an improvement in the net stable funding ratio would have a greater effect for investment-oriented banks than for other banks.

Important evidence has been brought in this section with respect to the impact of long-term liquidity requirements, considered here as a complement to capital requirements, on the risk of failure of banks. However, from a liquidity point of view, the NSFR alone could not avoid banks to become illiquid. In periods of severe tensions on financial markets, banks should be able to respond to funding markets withdrawals using their high quality assets. The Liquidity Coverage Ratio introduced within Basel III framework should ensure a minimum liquidity buffer to respond to severe market liquidity crisis over one month horizon. Furthermore, we examine the impact of (a proxy of) the LCR on the risk of failure.

5.4.4 Contribution of resilient market liquidity on banks' risk of failure

For European banks, the 2008 crisis has been felt as a liquidity crisis with important consequences on their functioning and the whole financial and economic activity. The Basel III's short-term liquidity ratio has been introduced with the aim of ensuring that banks preserve sufficient liquid assets to tackle capital outflows in a stress scenario during one month. The liquidity framework comes thus as a complement to the solvency requirements (risk-weighted and leverage ratios) and as a supplement to the NSFR.

Therefore, the question that raises in this section is to what extent this additional measure will help in reducing the risk of failure of banks? Since the calculation of the Liquidity Coverage Ratio (LCR) is not possible for lack of appropriate dataset, we use a proxy - the *ST Liq ratio* - that takes into account the liquid assets available to cover the incapacity to rollover short-term debt during one month of distress; still, it dismiss the maturity of both assets and liabilities.

In a first step we run similar regressions as in previous section, and we test for the impact of the liquidity ratio using the *ST Liq ratio*. The results indicate that, compared to the NSFR, it has a lower significance in explaining the risk of failure. However, it is important to notice that it has a different effect on the two indicators of risk. While it has no significant effect on the individual risk of default (*PD*), it is a relevant determinant of the sensitivity to systemic crisis (SRISK/Equity). Hence, it could be seen as a substitute of solvency requirements in reducing the systemic risk. The results are reported in Table 5.12 in Appendix C.

Furthermore, we take a greater interest in analysing jointly the two measures of liquidity given their complementarity since the short-term liquidity ratio alone misses important aspects of banks' resilience. Of course, they are reinforced by solvency ratios. Based on 5.5, we define an econometric model that allows to examine the impact of both liquidity ratios (*NSFR* and *ST Liq ratio*) on different indicators of risk of failure:

$$Defaultrisk_{it} = \beta_i + \beta_1 Solvency_{it} + \beta_2 NSFR_{it} + \beta_3 STLiqratio_{it} + \beta_4 X_{it} + \varepsilon_{it} \quad (5.6)$$

All like previous estimations, solvency will be defined by the Tier 1 capital ratio or the leverage ratio. This effect of the *NSFR* and *ST Liq ratio* will be assessed through the coefficients β_2 and β_3 respectively. All regressions include bank and time fixed effects in order to account for banks' specificities and time evolution of variables, respectively.

The results of panel regressions are reported in Table 5.5 and emphasize the impact of solvency and liquidity requirements on the risks of failure. First and foremost, we emphasize that the introduction of a stable funding requirement relative to assets' illiquidity is an essential tool to reduce the exposures to default either from individual imbalances or systemic crisis. Its robustness across different specifications reinforce the results. This

is empirically demonstrated through the negative and highly statistically significant coefficient β_2.

In addition, the results highlight the complementarity of the two liquidity ratios and support recent EBA's recommendations on the necessity of a simultaneous implementation of these two measures and solvency requirements to ensure an effective improvement of financial stability. The results could be summarize in four points:

- Solvency requirements could significantly reduce both the individual risk of default as described by the probability of default, and the sensitivity to systemic crisis by reducing the amount a capital shortfall (as measured by the SRISK). Both the risk-sensitive ratio and the leverage ratio are statistically significant;
- Liquidity requirements complete the capital prudential framework and contribute significantly to the reduction of the default in banking system;
- Ensuring a balance between funding structure and assets liquidity is essential to reduce riskiness and avoid default. The reduction of maturity mismatches between assets and liabilities' contributes to the reduction of the *PD* and the *SRISK*, whether is the absolute amount of capital shortfall or relative to the amount of available capital.
- The improvement of the short-term liquidity ratio (equivalent for Basel's LCR) seems to increase the amount of SRISK although when we report the amount of eventual capital shortfall to the capacity of the bank to absorb losses (available core capital) it appears that the sensitivity to systemic risk could be considerably reduced. In turn, it has no important effect on the *PD*.

Table 5.5: Solvency and liquidity complementarity in explaining the risks of failure

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	PD	SRISK	SRISK/Equity	PD	SRISK	SRISK/Equity
	T1 ratio			*Leverage ratio*		
Solvency	-0.836**	-637.4**	-0.0169	-0.684**	-3,201***	0.325**
	(-2.571)	(-2.063)	(-0.408)	(-1.975)	(-6.220)	(2.230)
NSFR	-0.201***	-767.3***	-0.0147***	-0.174***	-610.6***	-0.0318***
	(-3.632)	(-10.23)	(-2.735)	(-2.764)	(-7.587)	(-2.836)
ST Liq ratio	-0.00203	19.53***	-0.000957*	-0.00214	19.00***	-0.000917*
	(-0.498)	(2.800)	(-1.915)	(-0.540)	(2.733)	(-1.817)
Constant	20.46***	64,483***	6.675***	18.26***	75,091***	5.480***
	(4.431)	(9.022)	(9.836)	(3.658)	(10.04)	(12.74)
Observations	483	483	483	483	483	483
R^2	0.236	0.229	0.023	0.224	0.269	0.056
R^2 adj	0.217	0.209	0.00274	0.203	0.249	0.0310
F	7.063	9.163	1.756	7.004	12.73	1.387
Bank FE	yes	yes	yes	yes	yes	yes
Time FE	yes	yes	yes	yes	yes	yes

Notes: We run OLS regressions and we correct for the heteroskedasticity of errors. We use one period lag for explanatory variables except the short-term liquidity ratio whose impact should be felt at very short-horizon. Robust t-statistics in parentheses *** p<0.01, ** p<0.05, * p<0.1.

By ensuring sufficient stable funding to balance the eventual illiquidity of assets and in the meantime, sufficient unencumbered liquid assets to survive one month of strong distress in funding markets, banks could reduce their exposure to systemic risk independently of solvency requirements. For robustness check reasons, we run additional regressions to evaluate the impact of the two components of the short-term liquidity ratio on the risk of failure. The results reported in Table 5.16 in Appendix C suggest that the source of additional risk comes from an increased dependence on wholesale funding as illustrated by the proportion of short-term borrowings as of total assets. If the 2008 crisis had such severe consequences on European banks, this could be explained by their excessive reliance on short-term borrowings compared to their international peers, on the one hand, and to bad incentives generated by maturity transformation. European banks are extremely vulnerable to stops in interbank markets that could degenerate into systemic crisis. For these reasons, during the last financial crisis ECB's and national authorities' support was inevitable. They provided "cheap" liquidity and their support improved wholesale funding conditions and reduced deposit rates allowed to European banks a return to more normal conditions[29]. It is shown that the dependence on short-term funding (proportion

[29] Le Leslé (2012) brings explicit arguments on the extreme dependence on wholesale funding of European banks compared with their international peers which determined the ample interventions of European authorities during the periods of market liquidity withdrawals.

of wholesale funding as of total assets) can become a vulnerability when banks face systemic financial shocks. It is no longer validated (at least not for the *PD* and the *SRISK*) when the dependence of short-term borrowings is analysed jointly with the structure of assets, from maturity and quality perspectives.

In turn, increasing the holdings of liquid assets could reduce the exposure to default by allowing to cover losses generated by negative shocks on funding markets[30].

To be consistent with past analysis, we run regressions for categories of size and categories of business model. Using the same categories of banks according to their size and their business strategy, our aim is to evaluate if the short-term liquidity ratio has any additional effect (above the average) for the groups of banks described previously.

We chose to present the tables of results in Appendix C (Tables 5.14 and 5.15).

Independently of the approach, solvency ratios are an essential determinant of the level of the exposure to default (excepting the alternative measure of SRISK/Equity). The stable funding requirements are effective in strengthening the resilience of banks to systemic shocks and reducing the exposure to default. The results for the impact of the NSFR are robust across specifications and models.

The results with respect to the impact of the short-term liquidity ratio are less significant from a statistical point of view, but not unsatisfactory.

Results in Table 5.14 indicate that the ST Liq ratio has an important impact on the exposure to default of large banks. Improving the quantity of high quality liquid assets enough to cover losses generated by capital outflows over one month of stress scenario reduces the share of capital shortfall relative to its available capital. Additionally, it becomes more resilient and its probability to default declines considerably. Nevertheless, this is not the case for small banks for which we find that there is no significantly different effect relative to the average.

Even though the results for different categories of banks relative to their size are relevant, we furthermore seek to examine the extent to which business strategies affect the impact of liquidity requirements on the risk of failure. The results in Table 5.15 confirm our assumptions and bring empirical proof that, just like the NSFR, the ST Liq ratio has also different effect according to the business model of banks.

Higher holdings of liquid assets relative to the short-term liabilities could have the opposite effect than expected for the commercial banks. The logic behind this results find its roots in the cost shifts that could be incurred due to higher holding of liquid assets which are lower yielded than long-maturity assets. For commercial banks, the positive effect of liquidity requirements on mitigating the risk of liquidity seems to be

[30] We still identify an opposite effect of Liquid assets on SRISK than expected. This could be interpreted as a size effect and could indicate a limit of the measure SRISK. Again, the use of the SRISK reported to the amount of core capital seems to be a more relevant measure of systemic risk.

overpassed by the negative effect of holding higher proportions of liquid assets on the cost of functioning. This results brings empirical proof to theoretical argument advanced by König (2015).

Higher liquidity requirements according to LCR standards will have a very important contribution in reduction the risk of failure of investment-oriented banks. Their vulnerabilities generated by strong dependence on wholesale funding and important imbalances between assets' liquidity and liabilities' stability lead to failure (for certain institutions) and massive and inefficient public interventions during the crisis. The short-term liquidity requirements could significantly reduce the exposure of investment-oriented banks to default, whether it is generated by inappropriate management or systemic events[31]. No significantly different effect relative to the average is recorded for universal banks.

The results of different analysis driven in this section allow us to draw conclusions with regard to the contribution of solvency and liquidity requirements in preventing the risk of failure of banks.

The risk issued from maturity mismatches could be a real threaten for banks' stability, it is therefore essential to effectively implement the liquidity measures imposed by Basel III. The results indicate that the NSFR is obviously dominating the short-term liquidity ratio in explain the risks of default for our sample of large European banks. Nevertheless, the importance of the short-term liquidity ratio in preventing the systemic risk should not be underestimated, especially for large and complex banking structures.

5.4.5 Conclusion

The weaknesses of banking structures pointed out by the financial crisis have been addressed in the most recent regulatory framework imposed by the Basel Committee for both qualitative and quantitative aspects. The revision of risk-weighted capital ratio and the leverage ratio should reduce banks' risk taking behaviour and the accumulation of leverage in the banking systems, respectively. The liquidity framework, introducing two liquidity measures, comes to supplement the capital requirements to reach the final objective consisting in improving funding stability and reducing banking crisis. Since the announcement of these new rules, the reluctance of practitioners has slowed down the implementation process for reasons of higher funding costs and adverse effects on funding activities.

Although the cost of stable resources is undoubtedly higher than for wholesale funding, that otherwise banks used to use excessively to increase their profitability, the prudential rules should have a net benefit in medium and long-term through the reduction of the exposure to default and implicitly, the improvement of financial stability. This debate

[31] We do not focus on the interpretation of results on the absolute amount of SRISK since they prove to be less relevant and stable across specifications.

motivated our study whose primary aim is to evaluate the effectiveness of new prudential rules in reducing the risk of failure of regulated institutions. Specifically, the analysis driven in this chapter provides empirical proof with regard to the contribution of solvency and liquidity requirements in reducing the exposure of default generated by imbalances in balance sheet and systemic risk.

The empirical analysis applied to a sample of 62 large European banks emphasize the importance of the adoption of the liquidity requirements as a complement to solvency framework. The liquidity requirements introduced under Basel III help in preventing default and reducing the sensitivity to systemic risk.

By examining the impact of the net stable funding ratio, we find that an increase in stable funding relative to assets' illiquidity reduces the probability of default and also the expected capital shortfall in case of systemic crisis, independently of the business strategy or the size of banks. The NSFR appears as a robust and efficient prudential tool that could reinforce banks' stability. With regard to the probability of default, the NSFR comes to complement the solvency requirements while for the amount of capital shortfall reported to the available core capital (i.e. SRISK to equity) the NSFR tends to dominate the effect of solvency requirements. Solvency requirements alone could definitely not avoid default even if higher minimum capital requirements are imposed.

Furthermore, the implementation of a short-term liquidity ratio, meant to ensure on the capacity of banks to survive from important capital outflows over a one-month stressed scenario, could reduce the sensitivity to systemic crisis. In turn, we find no empirical proof that the short-term liquidity ratio would affect the probability of default of banks. However, these results point out the importance of increasing the proportions of high quality liquid assets for reducing the exposure to systemic risk. Nevertheless, the results should be interpreted with caution since our measure of short-term liquidity ratio is a proxy of Basel's LCR that dismiss the information on maturities for reasons of lack of data.

The contribution to the literature on this topic is made through a more detailed evaluation of the impact of liquidity ratios on banking risks, for different categories of banks according to their size and business model. The results highlight a greater contribution of liquidity and solvency ratios for universal and investment-oriented banks, while the results for commercial-oriented banks are mitigated. We find that an additional unit of NSFR could improve significantly the resilience of investment-oriented banks and reduce their probability of default as well as their sensitivity to systemic crisis. A similar analysis applied to largest banks in the sample reinforce our findings: liquidity requirements, implemented as a complement to solvency requirements, reduce the riskiness of banks on average, and more for large and complex institutions.

An effective implementation of solvency and liquidity requirements should therefore take into account the complexity of banks' structural patterns for achieving the objective of financial stability. Moreover, the difference in the amplitude of the impact according to different categories of banks that have been analysed could be a reason for further differences in the level of requirements according to the size or structural patterns. These results bring support to additional regulatory measures as capital buffers for large banks and additional liquidity standards for globally systemic important banks (TLAC) that are to be adopted in the future.

Meanwhile, an effective implementation of the two elements of the liquidity framework as a complement to capital standards, could simultaneously reduce moral hazard and improve monitoring and market discipline. Concrete historical evidence on liquidity and solvency standards could improve the capacity to distinguish between illiquid and insolvent banks not only in case of exceptional interventions (lender of last resort for example) but also in normal times for usual policy decisions.

The revision of regulatory framework adopted within Basel III is undoubtedly helpful. Nevertheless, despite the fact that it addresses the shortcomings revealed by the last financial crisis it may not entirely solve the problem. An additional measure should be the improvement of financial activities' monitoring that will furthermore allow to better identify the weaknesses and provide efficient remedies.

5.5 Appendix

A. Methodology for calculating the DTD and the PD

In our study, the probability of default (PD) is employed as a measure of the risk of default of individual banks. The methodology used to calculate the PD is based on another measure of risk widely use in the literature, the Distance-to-Default (DTD), and combines a dataset on firms' liabilities, shares prices and volatility of assets Crosbie and Bohn (2003).

Specifically, there are several steps to follow in order to determine the PD of a bank:

- assess assets' value and volatility by exploiting the option nature of equity to evaluate the market value and volatility of assets,
- calculate the DTD as the number of standard deviations between the market value of a firm's assets and its relevant liabilities, and
- calculate the PD.

The very first step is the assessment of the default point characterized as the moment when the value of assets equals the book value of debt ($At = Dt$). Since the market value of assets is not directly observed, it will be calculated by exploiting the option nature of equity[32] knowing that the value of equity is the difference between the market value of assets A_+ and the book value of liabilities D_t. [33] Therefore, the value of equity when the debt reaches maturity T[34] is calculated using the formula:

$$Max(A_{i,t+1} - D_{i,t+1}, 0) \tag{5.7}$$

In a first time, we determine the market value of assets from the market value of equity[35]. We use the observed market value of equity (E_{it})and the book value of liabilities (D_{it}) to further solve the equation that determines the value of assets (A_{it}):

$$A_{it} = \frac{E_{it} + D_{it}e^{-R_f T}N(d_2)}{N(d_1)} \tag{5.8}$$

Second, we calculate the asset volatility of the bank using the market value and the volatility of equity (E_{it}) and respectively $\sigma_{E,t}$) and the value of assets (A_{it}):

[32] According to the models of Black and Scholes (1973) and Merton (1974), equity can be modeled as an option. It is assumed that a bank becomes insolvent if the value of assets is lower than the values of liabilities. In this case, shareholders can lose their initial investment or they can decide to pay off the debt and take over the assets of the bank in order to avoid bankruptcy. Hence, treating equity as a call option on the bank's assets is justified.

[33] The value of total assets can also be written as the sum of equity and liabilities: $A_{it} = E_{it} + D_{it}$.

[34] We assume that T equal to one year which is perfectly in line with the existent literature (Blundell-Wignall and Roulet, 2013)

[35] This is the reverse of the initial objective of the model which proposes to determine the future value of equity from assets value. This approach supposes that the return on assets follows a random distribution.

$$\sigma_{A,it} = \frac{E_{it}}{A_{it}} \frac{\sigma_{E,t}}{N(d_1)} \tag{5.9}$$

The volatility of the equity is calculated by the historical equity return data.

Some important assumptions are made in order to estimate the assets' market value and volatility:

- The time path of the asset value is stochastic and the value of the bank (i.e. total assets) follows the process:

$$dA_t = \mu A_t dt + \sigma_A A_t dz \tag{5.10}$$

  With μ the firm's assets value drift rate, σ_A assets volatility and dz the Wiener process.

- The market value of equity is relied to the assets value by the relationship:

$$E_{it} = A_{it} N(d_1) - e^{-R_f T} N(d_2) \tag{5.11}$$

Where E_{it} is the market value of equity and R_f is the risk free rate. d_1 and d_2 are described by the following equations:

$$d_1 = \frac{\ln(\frac{A_t}{D_t} + (R_f + \frac{\sigma^2}{2})T}{\sigma\sqrt{T}} \tag{5.12}$$

$$d_2 = d_1 - \sigma\sqrt{T} \tag{5.13}$$

After solving the two equations (5.8) and (5.9) that estimate the market value of assets and the volatility of the bank i at each period t, we can finally apply the formula that estimates the distance-to-default (DTD):

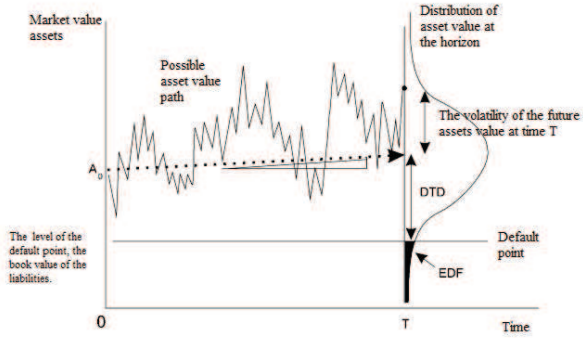
$$DTD_{it} = \frac{log(\frac{A_{it}}{D_{it}}) + (R_f + \frac{\sigma^2_{A,it}}{2})T}{\sigma_{it}\sqrt{T}} \tag{5.14}$$

Where A_{it} is the market value of total assets of the bank i at time t, D_{it} represents the book value of liabilities, R_f is the risk free rate, σ_{it} the volatility of bank's assets at time t and T the maturity of debt. Since we cannot gain the access to the details of the maturity time for complex liability structure, we assume the firm's liabilities will be matured in the time horizon of one year[36].

The formula described in equation (5.14) defines the DTD as the gap between expected value of assets and the default point divided to the standard deviation of assets. Figure 5.9 below illustrates the concept:

[36] We consider that T-t=1

Figure 5.9: The distance-to-default (DTD)



Source: Crosbie and Bohn (2003)

Nevertheless, estimating the model as it has been presented so far may lead to biased estimations due to highly volatile values for market leverage. The asset volatility will be overestimated if market leverage is decreasing sharply and significantly and so will be the risk of the bank. Therefore, marginal biases may interfere in the calculation of the DTD.

In order to avoid these misconceptions, in the next step, instead of using instantaneous relationships to calculate the DTD we use a system of two nonlinear equations through an iterative procedure[37]. We first estimate the market value of assets where the initial value is given by the ratio assets to market value of equity multiplied by the volatility of shares σ_E. This latter and the volatility of assets are calculated using an iterative process.

Furthermore, we transform the DTD in probability of default (PD) in order to facilitate the interpretation and the comparison of results across institutions and across banks from different countries. The equation that allows for the conversion of DTD in PD is the following:

$$\begin{aligned} PD_t &= Pr[A(T) < D] \\ &= Pr[A(t)exp\{(R_f - \frac{\sigma_A^2}{2})(T-t) + \sigma_A W_{T-t}\} < D \\ &= Pr[W_{T-t} < fracln((D/A(t)) - R_f - \sigma_A^2/2)(T-t)\sigma_A \\ &= Pr[Z < fracln(A(t)/D) - (R_f - \sigma_A^2/2)(T-t)\sigma_A\sqrt{T-t} \\ &= Pr[Z < DTD] = N(-DTD) \end{aligned} \tag{5.15}$$

Where dW is a standard Weiner process and $W_t \sim N(0,t)$. Z is a random variable than follows a standard normal distribution, $Z \sim N(0,1)$ and the

$$DTD = \frac{ln(A(t)/D) + (R_f - \sigma_A^2 2)(T-t)}{\sigma_A\sqrt{T-t}} \tag{5.16}$$

[37]One of the main contributions of using this iterative procedure is the fact that it allows the default point to be a random variable.

Limits of the model

Despite all appreciations and utilities of this measure, one cannot lose sight of its limits. In a first time, the methodology is criticized for the use of the normal distribution to model variables that are supposed to have a random distribution (for example, revenues which are different from one bank to another and moreover from one business model to another).

In a second time, the model does not distinguish between different types of debt. Moreover, the model is static in the way that once the debt is in place it is not changed. Therefore, the leveraging behaviour of banks is not taken into account by the model.

In a third time, our approach consisting in averaging daily PD over one year horizon may mask certain signals that are included in market prices. Nevertheless, this is imposed by the annual frequency of balance-sheet data and the frequency matching that has to be made for our empirical analysis.

Finally, the default probability estimated using the methodology described previously may not correspond exactly to the point when the value of assets falls below the value of liabilities since several asymmetries which are specific to banking system are reflected in market prices. Specifically, the implicit public guarantees can have an impact on the value of debt pricing which can further affect the estimation of default. Overall, in consideration of the nature of financial activity itself, the model may be less robust for financial institutions than for other firms in reason of higher opacity of their activity.

B. Presentation of variables employed in the econometric model

Table 5.6: Definition of variables

Variables		**Definition**
Solvency	*Leverage ratio*	Tier 1 capital to Total assets (source: Bankscope; author's calculations)
	T1ratio	The solvency ratio as defined within Basel III. It is computed as the amount of Tier 1 capital divided by the total amount of risk-weighted assets, T1/RWA (source: Bankscope)
Structural liquidity	*NSFR*	Net Stable Funding Ratio (source: Bankscope, Author's calculations). Detailed methodology in Chapter 2.
Market liquidity	*ST Liq ratio*	Liquid assets divided to the amount of short-term borrowings (source: Bankscope). We use the ST Liq ratio as an equivalent of Basel Liquidity Coverage Ratio (LCR) which is impossible to calculate using publicly available data that we have at our disposal.
Market liquidity	Wholesale funding (WF)	Short-term borrowings divided to the amount of total assets (source: Bankscope)
	Liquid assets (LA)	The amount of liquid assets as provided by Bankscope divided to the amount of total assets (source: Bankscope)
Other control variables	*Size*	Logarithm of total assets (source: Bankscope).
	Business model (BM)	Scoring factor obtained through a principal component analysis and based on asset portfolio structure: derivatives, trading securities and interbank lending as to total assets (average for the period 2003-2013). Source: Bankscope, author's calculations

Table 5.7: Descriptive statistics

Variables	**No obs**	**Mean**	**Std.dev.**	**Min**	**Max**
Dependent variables					
Risk of failure					
Default probability (%)	483	12.31	22.80	1.03	99.92
SRISK (Meur)	483	21617.35	33308.86	105.17	170994
SRISK/Equity	483	117.68	83.1	27.61	680.26
Explanatory variables					
Solvency					
T1 capital ratio (%)	483	10.24	3.2	1.00	30.88
Leverage ratio	483	5.23	2.16	-4.20	17.17
Maturity transformation					
NSFR (%)	483	92.62	23.86	26.04	187.90
Short-term liquidity ratio					
ST Liq ratio (%)	483	36.16	28.26	3.67	170.78
Market liquidity					
Liquid assets - LA (%)	483	19.64	12.33	2.92	63.49
Wholesale funding - WF (%)	483	22.7	11.85	0.11	58.89
Control variables					
Size	483	11.6	1.75	7.66	15.01
Business model (BM)	483	0.17	1.05	-1.21	3.07

Notes: Extreme values for the probability of default are mainly due to sharp shifts in the value of stock prices used to compute the PD. These extreme values correspond to Dexia (BE) in 2011, Piraeus (GR) in 2011 and Hypo Real Estate Holding (DE) in 2009.

Business model of banks

The business model of banks is defined using factor analysis/correlation. The principal-component factor analysis is applied to data describing the structure of the asset portfolio in 2013. The variables that are considered as main indicators of business model are considered in proportion of total assets.

Table 5.8: BM - Results of PCA analysis

Factor	Eigenvalue	Difference	Proportion	Cumulative
Factor1	1.397	0.465	0.466	0.466
Factor2	0.932	0.261	0.310	0.776
Factor3	0.671	.	0.224	1.0000

Notes: LR test: independent vs. saturated: $\chi^2(3) = 163.27$ Prob> $\chi^2 = 0.0000$

Table 5.9: PCA analysis - the pattern matrix

Variable	Factor 1	Uniqueness
Trading securities	0.791	0.375
Interbank lending	0.500	0.750
Derivatives	0.722	0.479

Notes: The pattern matrix reports rotated factor loadings and unique variances. LR test: independent vs. Saturated: $\chi^2(3) = 134.16$ Prob> $\chi^2 = 0.000$

Table 5.10: BM - details of PCA analysis

Factor	Variance	Difference	Proportion	Cumulative
Factor1	1.397	.	0.466	0.466

Notes: Results after rotation using orthogonal varimax (Kaiser off). LR test: independent vs. saturated: $\chi^2(3) = 163.57$ Prob> $\chi^2 = 0.0000$

Table 5.11: BM - Scoring coefficients based on varimax rotated factors

Variable	Factor1
Trading securities	0.566
Interbank lending	0.358
Derivatives	0.517

Figure 5.10: The components of the BM

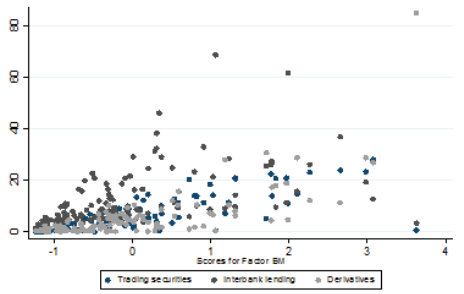
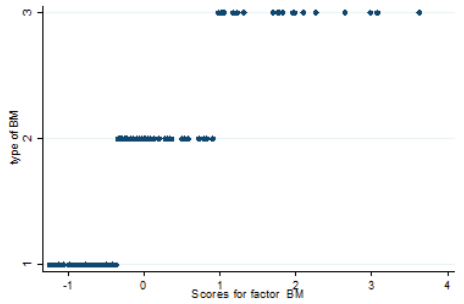


Figure 5.11: Classes of BM



Notes: All variables used to compute the BM are expressed in proportion of total assets and average values by bank over the period 2003-2013 are the inputs. The graph illustrates averages by bank for each category of assets.
Source: Bankscope, Author's calculations.

C. Results of robustness check regressions

Table 5.12: The impact of solvency and NSFR on the risk of failure, when size is accounted for

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	PD	SRISK	SRISK/Equity	PD	SRISK	SRISK/Equity
		T1 ratio			*Leverage ratio*	
Solvency	-1.148***	548.0**	-7.228	-1.314***	1,856***	-5.658
	(-3.060)	(2.237)	(-1.441)	(-2.990)	(3.623)	(-1.004)
NSFR	-0.285***	-38.43	-2.173***	-0.249***	-103.5**	-1.718***
	(-4.375)	(-0.709)	(-3.865)	(-3.846)	(-2.000)	(-3.123)
Size	-2.176***	15,524***	-13.81**	-2.692***	16,033***	-13.16**
	(-2.844)	(15.46)	(-2.156)	(-3.175)	(14.20)	(-2.398)
Constant	55.57***	-167,547***	477.7***	54.81***	-174,330***	396.3***
	(4.016)	(-11.41)	(4.110)	(3.828)	(-10.54)	(3.847)
Observations	483	483	483	483	483	483
R^2	0.187	0.629	0.034	0.172	0.630	0.028
R^2 adj	0.167	0.619	0.00906	0.150	0.620	0.00228
F	7.657	29.89	3.161	7.464	33.05	3.046
Bank FE	yes	yes	yes	yes	yes	yes
Time FE	yes	yes	yes	yes	yes	yes

Notes: We run regressions using bank and time fixed effects and we correct for the heteroskedasticity of errors. We use one period lagged variables. Robust t-statistics in parentheses *** p<0.01, ** p<0.05, * p<0.1.

Table 5.13: The impact of solvency and ST Liq ratio on the risk of failure

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	PD	SRISK	SRISK/Equity	PD	SRISK	SRISK/Equity
		T1 ratio			*Leverage ratio*	
Solvency	-0.972***	-264.7	-0.0232	-1.181***	-5,586***	0.182*
	(-2.678)	(-0.789)	(-0.584)	(-3.323)	(-8.122)	(1.797)
ST Liq ratio	-0.00215	2.311	-0.000575**	-0.00221	3.327	-0.000625**
	(-1.234)	(0.708)	(-2.200)	(-1.242)	(1.006)	(-2.172)
Constant	9.573***	19,448***	5.833***	7.700***	47,850***	4.211***
	(2.814)	(3.544)	(13.85)	(3.423)	(8.379)	(6.906)
						3
Observations	483	483	483	483	483	483
R^2	0.137	0.010	0.011	0.128	0.151	0.025
R^2 adj	0.117	0.0134	0.0118	0.107	0.130	0.00156
F	8.598	0.808	0.936	8.241	6.201	0.702
Bank FE	yes	yes	yes	yes	yes	yes
Time FE	yes	yes	yes	yes	yes	yes

Notes: We run regressions using bank and time fixed effects and we correct for the heteroskedasticity of errors. We use one lag for solvency ratio while the short-term liquidity ratio is considered for the same period as the interest variable since its effects is likely to be observed in very short horizons. Robust t-statistics in parentheses *** p<0.01, ** p<0.05, * p<0.1.

Table 5.14: The impact ST liquidity ratio on the risk of failure, by category of size

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	PD	SRISK	SRISK/Equity	PD	SRISK	SRISK/Equity
	T1 ratio			*Leverage ratio*		
Solvency	-0.819**	-572.1***	-0.0165	-0.967**	-958.5***	0.295**
	(-2.517)	(-3.223)	(-0.401)	(-2.545)	(-3.053)	(2.114)
NSFR	-0.265***	-193.2***	-0.0259***	-0.240***	-152.6***	-0.0383***
	(-3.775)	(-3.468)	(-2.887)	(-3.201)	(-2.949)	(-2.871)
ST Liq ratio	-0.00192	3.748	-0.000780*	-0.00158	3.650	-0.000839
	(-0.430)	(1.399)	(-1.720)	(-0.379)	(1.375)	(-1.625)
Small × ST Liq ratio	0.00181	-1.568	0.000162	0.00187	-1.471	0.000157
	(1.025)	(-1.334)	(1.088)	(1.087)	(-1.312)	(1.108)
Big × ST Liq ratio	-0.0155*	158.9***	-0.00294***	-0.0200**	155.2***	-0.00200**
	(-1.687)	(9.610)	(-2.744)	(-1.997)	(9.016)	(-2.433)
Constant	24.81***	23,633***	7.531***	22.35***	22,235***	6.216***
	(4.404)	(4.569)	(8.413)	(4.225)	(3.756)	(10.61)
Observations	483	483	483	483	483	483
R^2	0.244	0.654	0.037	0.237	0.652	0.063
R^2 adj	0.221	0.643	0.00758	0.213	0.641	0.0334
F	5.931	26.00	1.511	5.755	33.84	1.334
Bank FE	yes	yes	yes	yes	yes	yes
Time FE	yes	yes	yes	yes	yes	yes

Notes: We run regressions using bank and time fixed effects and we correct for the heteroskedasticity of errors. We use one lag for solvency ratio while the short-term liquidity ratio is considered for the same period as the interest variable since its effects is likely to be observed in very short horizons. *Small* contains banks with an average size over the period 2003-2013 below the values of the quantile 25%, while *Big* contains the largest 25% banks according to the average size over the period. Both variables equal 1 if banks below to the group and 0 otherwise. Robust t-statistics in parentheses *** p<0.01, ** p<0.05, * p<0.1.

Table 5.15: The impact ST liquidity ratio on the risk of default, by category of BM

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	PD	SRISK	SRISK/Equity	PD	SRISK	SRISK/Equity
	T1 ratio			*Leverage ratio*		
Solvency	-0.796**	-748.1***	-0.0144	-0.852**	-2,478***	0.311**
	(-2.493)	(-2.941)	(-0.353)	(-2.352)	(-6.040)	(2.190)
NSFR	-0.307***	-307.0***	-0.0255***	-0.286***	-216.9***	-0.0393***
	(-3.841)	(-4.037)	(-2.589)	(-3.397)	(-2.723)	(-2.724)
ST Liq ratio	-0.00598	20.77***	-0.00103**	-0.00516	20.50***	-0.00106*
	(-1.313)	(2.651)	(-2.035)	(-1.163)	(2.681)	(-1.829)
Commercial × ST Liq ratio	0.00861***	-17.75***	0.000499*	0.00788***	-16.72***	0.000470
	(2.993)	(-2.736)	(1.841)	(2.835)	(-2.987)	(1.584)
Universal × ST Liq ratio	-0.00170	3.195	-0.000240	-0.00182	3.197	-0.000153
	(-0.765)	(0.568)	(-0.924)	(-0.791)	(0.558)	(-0.622)
Investment × ST Liq ratio	-0.0245***	100.1***	-0.00233**	-0.0227*	92.92***	-0.00163*
	(-2.933)	(6.545)	(-2.048)	(-1.673)	(6.233)	(-1.676)
Constant	27.28***	37,410***	7.413***	24.33***	38,860***	5.972***
	(4.628)	(5.438)	(8.054)	(4.365)	(6.053)	(10.16)
Observations	483	483	483	483	483	483
R^2	0.253	0.375	0.031	0.244	0.394	0.061
R^2 adj	0.229	0.355	0.000558	0.218	0.374	0.0294
F	6.034	14.67	1.310	5.861	18.13	1.053
Bank FE	yes	yes	yes	yes	yes	yes
Time FE	yes	yes	yes	yes	yes	yes

Notes: We run regressions using bank and time fixed effects and we correct for the heteroskedasticity of errors. We use one lag for solvency ratio while the short-term liquidity ratio is considered for the same period as the interest variable since its effects is likely to be observed in very short horizons. Groups of business model are defined using cluster analysis based on the variable Business model. Commercial, Universal and Investment are dummy variables with values 1 if the bank below to the group and 0 otherwise. Robust t-statistics in parentheses *** p<0.01, ** p<0.05, * p<0.1.

Table 5.16: Components of ST liquidity ratio and risk of failure

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	PD	SRISK	SRISK/Equity	PD	SRISK	SRISK/Equity
	T1 ratio			*Leverage ratio*		
Solvency	-0.685**	-1,136***	0.0175	-0.717**	-2,846***	0.256**
	(-2.135)	(-3.399)	(0.374)	(-1.974)	(-6.180)	(2.200)
NSFR	-0.150**	-764.3***	0.00302	-0.120	-614.5***	-0.0142**
	(-2.220)	(-8.048)	(0.462)	(-1.533)	(-5.908)	(-2.043)
Liquid assets	-0.313***	683.9***	-0.0405**	-0.352***	645.2***	-0.0422**
	(-2.913)	(5.538)	(-2.345)	(-3.238)	(5.165)	(-2.235)
Wholesale funding	0.538***	-1,059***	0.128***	0.550***	-913.0***	0.110***
	(4.783)	(-7.291)	(2.789)	(4.658)	(-6.229)	(2.687)
Constant	8.593	86,319***	2.970**	6.331	79,098***	2.898**
	(1.313)	(7.454)	(2.268)	(0.902)	(7.365)	(2.385)
Observations	483	483	483	483	483	483
R^2	0.247	0.331	0.146	0.240	0.350	0.156
R^2 adj	0.227	0.313	0.123	0.218	0.331	0.131
F	8.088	12.27	1.220	7.877	15.43	1.072
Bank FE	yes	yes	yes	yes	yes	yes
Time FE	yes	yes	yes	yes	yes	yes

Notes: We run regressions using bank and time fixed effects and we correct for the heteroskedasticity of errors. The amount of liquid assets is provided by Bankscope. Wholesale funding is defined here by the amount of short-term borrowings. The two variables accounting for the two components of the *ST Liq ratio* are expressed as proportion of total assets. Robust t-statistics in parentheses *** p<0.01, ** p<0.05, * p<0.1.

Chapter 6

An assessment of banks' strength during stressed scenarios

Faced with the worst financial crisis in a century, the architecture of the European banking system has been revealed as weak and important shortcomings in funding structures have been pointed out. At the same time, the lack of appropriate prudential and resolution policies has amplified the initial shock and lead to greater distress in European banking systems. The response of policy makers, at the height of the crisis, aim to improve the robustness of financial institutions through strengthened internationally harmonized rules and additional monitoring and resolution procedures.

The stress tests supplements the existent measures of risk management and provides important information to supervisors and market participants regarding the expected losses that banks could incur during the periods of strong financial distress. Using a unique methodology and harmonized implementation rules for all participating banks from both EU and non-EU countries, the credibility of these stress tests driven at European level has been improved. The European Banking Authority (EBA) in collaboration with the European Central Bank (ECB), the European Systemic Risk Board (ESRB) and national authorities set up a genuinely improved framework for the 2014 exercise compared to the 2011-version: a revised methodology and more complex implementation procedures that relate the stress test to the Assets Quality Review (AQR). The outcomes of the exercise, covering a significant share of the European banking system, claim to be more accurate due to the revisions of several technical aspects.

Our interest is therefore in exploiting the information provided in these outcomes and compute a measure of risk that will further be explained within an empirical analysis by banks' fundamentals[1]. Then, we proceed to an additional study to compare this measure (the capital ratio shortfall) with two more traditional ones, the SRISK and the probability

[1] So far, the dataset on banks' ability to withstand global economic shocks provided by the stress test has been exploited to analyze the severity and the robustness of the stress tests (Arnould and Dehmej, 2015; Steffen, 2014) and to assess the vulnerabilities of banks according to their size (Mody and Wolff, 2015).

of default. We are therefore filling the gap in the literature by examining whether banks' weaknesses revealed by the 2014-EU stress test are mitigated by the implementation of solvency and liquidity requirements, and then, we seek to identify common determinants of different measures of the risk.

The rest of this chapter is structured as follows. We first provide a short overview of the comprehensive assessment by pointing out the main elements of the adverse scenario for the stress test exercise. Then, we discuss how the various shocks are likely to influence the outcomes, as well as the lack of the stressed scenario to replicate a severe shock such as the 2008 crisis. For a better understanding of outcomes, we proceed to a detailed statistical analysis in section 6.2.2 that explain the evolution of banks' statements during the 3-year horizon of crisis. In Section 6.3 we propose an empirical study that seeks to respond to our questions related to the determinants of the shortfall in solvency level and the incidence of business strategies undertaken by banks. Our findings provide empirical proof on the importance of liquidity requirements in improving the resilience of banks to global shocks. The final part of the chapter provides a comparative analysis of the existent risk measures using a more homogenous sample of banks than the one submitted to EBA's stress test exercise.

6.1 Description of stress test methodology

The ECB applied the comprehensive assessment (CA henceforth) to a sample of 130 financial institutions covering 81.6% of the banking activity from the 19 SSM Member states. Sample selection was based on the size of banks and their importance for the domestic banking system. According to these criteria, banks with total assets exceeding €30 billion and a ratio of total assets to domestic GDP higher than 20% were subject to the CA. The final sample contains 130 financial institutions considered at the highest level of consolidation in participating Member states. One should be aware that the samples for AQR and stress test are slightly different. While the AQR is applied only to banks from SSM Member States - in total 130 institutions - the stress test is conducted for a sample of 123 institutions from EU and Norway. The complete list of participating banks in the CA is illustrated in Appendix A.

The complete comprehensive assessment having two pillars, the Assets Quality Review (AQR) and the stress test, has the main objective to evaluate the resilience of European banks to adverse economic developments (EBA, 2014a).

After examining the assets portfolio[2] and evaluating the provisions that need to be made for potential losses on exposures to risky assets, EBA's exercise runs a stress test in the perspective of assessing banks' strength to different macroeconomic scenarios. Using

[2]The revaluation of asset portfolio is based on data as of 31 December 2013.

"clean" data from AQR results, the stress test results provide previsions for adjusted-capital ratios under both normal and stressed scenarios. Given this framework, the results of the stress test have the advantage of providing a meaningful comparison of banks since a harmonized methodology has been used by the ECB and the EBA.

Beyond this main objective of analysing banks' weaknesses in different economic conditions, the comprehensive assessment is important for supervisory activity. It provides important information with regard to the quality of data disclosure, transparency on banking activity and efficiency of the implementation of future redressing and resolution measures. In the next sub-sections we provide more detailed information about the two pillars of the CA, with a greater focus on the stress test exercise.

6.1.1 Assets Quality Review (AQR)

In this sub-section, we aim to briefly present some methodological aspects of the AQR coming ahead of the stress test[3]. The AQR was conducted to improve the quality and the implementation of stress test but at the same time, to prepare ECB mission as supervisor of EU banks.

The national competent authorities (NCA) used an ECB-imposed uniform methodology for all participating banks in order to evaluate their credit portfolios and calculate appropriate provisions for their different risk exposures[4]. The ECB played a key role in monitoring and coordinating the NCA work and ultimately, in centralizing results on the Assets Quality Review.

The main steps in the AQR were first, to analyse and to provision the non-performing activities and second, to assess the impact of fair value exposure review. Within the first step, NCA teams dealt with a meticulous credit file analysis by verifying on an exposure-by-exposure basis first, that each credit risk exposure is classified according to the ECB methodological framework and second, that provisions for each of these exposures are correctly calculated[5]. Then banks' assets portfolios[6] were revised through a qualitative review of trading securities and derivative pricing models. The final result of AQR is the calculation of an adjusted-capital ratio that will further be used in the stress test.

[3] This exercise was driven by the ECB prior to its nomination as supervisor of EU banks which became effective in November 2014. According to Article 33(4) of the Council of Regulation (EU) No 1024/2013, the ECB received supervisory responsibilities as part of the Single Supervisory Mechanism (SSM).

[4] National competitive authorities (NCA) were in direct dialogue with participating banks which provided data required for running AQR and stress test. NCA were responsible for project management activities at national level. NCA teams were appointed by external advisers and auditors.

[5] Credit reviewed exposures include loans, advances, financial leases and other off-balance sheet items like shipping and project finance (ECB, 2014b).

[6] Specifically, the revision concerned level 3 exposures which are assets holding in banking or trading book considered as illiquid and difficult to evaluate.

6.1.2 Stress test exercise

The stress test following the AQR assesses the resilience of European financial institutions under different economic conditions. Based on previous exercises, the October 2014 stress test provides a prudential forward-looking framework[7] for a sample of 123 banking groups from 22 countries (EU and Norway).

The stress test considers two macroeconomic scenarios, a baseline and an adverse scenario, over a three year horizon running from 2014 to 2016[8]. In this context, the stress test is applied at a micro level (on individual banks' portfolios) in order to assess the weaknesses of their balance sheet structure. In addition, both scenarios include a macroeconomic dimension that allows to consider for the stability of the financial system as a whole. Therefore, EBA's stress test aims to assess both individual and systemic vulnerabilities of financial institutions.

Beyond the already mentioned cleaning up effect of the AQR, several enhancements were made for 2014 stress test compared to the previous one. First, increasing the number of banks in the sample (from 90 to 123) led to greater implication of national authorities and other European institutions than EBA as it was the case in 2011. Second, the common methodology defined and centralized by the EBA allows for a greater degree of standardization but also for comparable results relative to 2011 exercise. Third, the study period increased from 2 years in the 2011 stress test (8 quarters, 2011 and 2012) to 3 years for the 2014 exercise (12 quarters, from beginning-2014 to end-2016). This latest version keeps up with prudential regulatory agenda and imposes a threshold of 8% of CET1 ratio under the baseline scenarios and 5.5% for the adverse scenario compared to only 5% in 2011. More information about each of the two scenarios will be provided in next paragraphs.

6.1.2.1 The baseline scenario

The framework for the baseline scenario was defined by the EC according to their winter 2014 forecasts which were extended for a period of 2 years (2015 and 2016). The objective was to map out a period of relative stability which should be in accordance with the EC forecasts clearly indicating a "continuation of the economic recovery in the EU as a whole" (European Commission, 2014a). Moreover, the methodology for this scenario implies that the economic development is sustained by the implementation of regulatory measures and by improved confidence in financial conditions. Improvements in terms of unemployment, house prices and inflation are integrated in the projection modelling for

[7] The stress test is not only an accounting exercise but rather a prudential one. It assesses the resilience of banking groups under severe economic conditions. Some methodological restrictions reinforce the prudential character of this test. For example, the hypothesis of static balance sheet limits institutions' adverse reactions like deleveraging.

[8] All definitions employed in the comprehensive assessment are in accordance with the CRR/CRD IV framework.

3 years concerned by the exercise. In a more general way, banks' financial structure is improving progressively under the baseline scenario as the evolution of regulatory ratios suggests (ECB, 2014a).

Under the baseline scenario which is supposed to describe periods of relative stability, the amount of core capital[9] is projected with a positive trend. According to EC previsions on financial and economic activity, banks should continue to improve the stability of their funding structure by increasing the amount of core capital.

As a matter of fact, the projections indicate that the baseline scenario could be considered as too optimistic to reflect the actual macroeconomic developments. One main reason, which was also brought as justification by EC president Victor Constancio, could be the timing of forecasts and stress test execution. Using winter forecasts, the baseline scenario appears as too optimistic to be consistent with the actual risks the euro zone is facing.

This assumption gives us reasons to further focus on the adverse scenario since it describes better the economic environment in the period that followed the publication of stress test results and is more in compliance with the topic of our chapter, we will focus henceforth on the stressed scenario. We further describe this scenario by pointing out the impact of different risk factors on the development of banks' activities.

6.1.2.2 The adverse scenario

The adverse scenario framework designed jointly by the EBA and the ESRB brings a substantial improvement compared to the 2011 exercise. Improvements have been made in terms of severity and complexity of this scenario compared to previous exercises [10] even if critics can still be addressed to this latest version.

The shocks that have been imposed reflect different dimensions of risk (which will be afterwards described) and take into account the main threats for the EU countries. More precisely, it considers a mix of shocks that affects directly different positions in both banking and trading books. Globally, the adverse macroeconomic scenario - that follows the concrete and traditional economic patterns (deviation in terms of GDP growth, increase in the unemployment rate, increase in interest rates and stock prices[11]), has a

[9] The definition of CET1 capital in accordance with CRR/CRD IV Directive No 575/2013, Article 467.2 subparagraph 2 and 3 measures the regulatory CET1 capital as the sum of all capital instruments eligible as CET1 capital. In addition, the amount of eligible CET1 capital is subject to a set of adjustments and deductions. We present the methodology and measure for the CET1 capital in Appendix C. Henceforth, CET1 capital is used to design the amount of CET1 capital net of deductions and after transitional adjustments conforming to CRR/CRD IV Directive.

[10] The 2014 adverse scenario is considered more severe and more complex since it imposes greater macroeconomic impact in terms of GDP, greater losses in equity and house prices (illustrated in Figures 6.1 and 6.2) but also greater consideration with regard to sovereign risk exposures. For this last category, haircuts were applied to both trading and banking book compared to the 2011 exercise when only sovereign exposures in trading book were treated. The interest rate shock imposing an increase in spreads for all bonds rejected any flight-to-quality effect which was not the case in 2011 when German bonds were exempted from this shock.

[11] Otherwise, the severity of the adverse scenario could be measured if necessarily by the deviations relative to the baseline scenario projected by the EC.

direct impact on banks' balance sheet through their profit and loss statements and the amount of risk-weighted assets (RWAs).

While for some types of risk, which are directly linked to banks' holdings, the impact could be easily translated through assets' revaluations, other macroeconomic shocks like GDP growth or unemployment variations cannot directly be assessed in terms of balance sheet impact. For this reason, banks employ a methodology that allows them to translate the shocks designed within the adverse scenario into risk factors. For example, complex institutions using IRB models have the possibility to estimate by themselves credit risk factors themselves through default and LGD rates while STA banks use rather a set of predetermined factors defined by EBA[12,13]. ESRB (2014a) details the values of stressed factors used to model the adverse scenario. In what follows, we describe the main shocks applied in the adverse scenario while the detailed information on the risk parameters are reported in Appendix B.

Shocks to bond yields

One of the most important threats to the stability of financial institution is the increase in global bond yields. Generated by an increased aversion to long-term fixed income securities and assets' prices spillovers (ESRB, 2014a), the starting point is given by the substantial increase in in US long-term bond yields[14] (Figure 6.1). This shock has a significant effect on worldwide economies. Hence, the variation of EU bond yields is estimated as a result of tensions on US bond market.

The shock on long-term bond yields represents a key element of the 2014 stress test having an important effect on economic developments during the 3 years of exercise. Moreover, it is conceived to affect country specific sovereign bond spreads that magnify the effect of the initial shock.

[12]Internal Rating Based models (IRB) and Standardized Approach (STA). LGD - Loss Given Default.

[13] However, this methodology allowing banks to estimate themselves risk factors can be subject to critics. We will address this issue in the section describing the limits of the stress test.

[14] It is assumed that increased risk aversion has an impact on US long-term yields which will further trigger a global increase in bond spreads. The spillover effects are modeled using data on past dependencies (2012-2013).

Figure 6.1: Stressed government bond yields

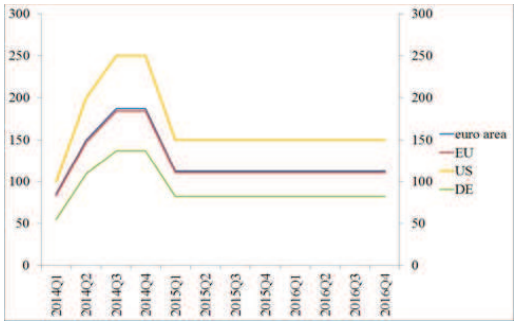
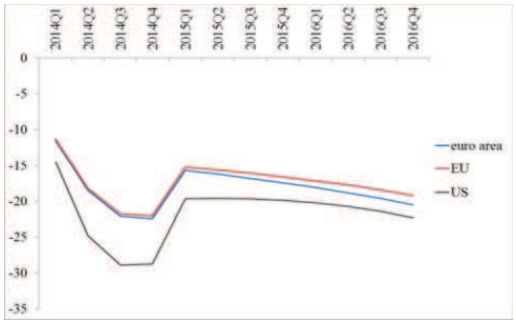


Figure 6.2: Equity prices in adverse scenario



Notes: Yields expressed in basis points compared to the baseline.
Source: ESRB (2014).

Indirect effects are felt worldwide, with stronger impact on emerging market economies (EMEs) where demand shocks, currency depreciations and funding disturbances reflect differentiated fiscal patterns and market perceptions. The shocks in Eastern European economies as a consequence of long-term interest rates variation[15] are taken into account in the risk parameters defined within the macroeconomic shock. The main reasons are the deterioration of capital outflows and internal demand for EMEs that negatively impact the EU exportations and furthermore, their GDP growth.

Increase in risk exposures

The global financial shock engenders other additional shocks. For example, in countries with weak demand and unstable banking sectors, it had repercussion on country-specific housing prices leading to a greater deterioration in credit quality[16]. This shock had a positive impact on credit risk exposures.

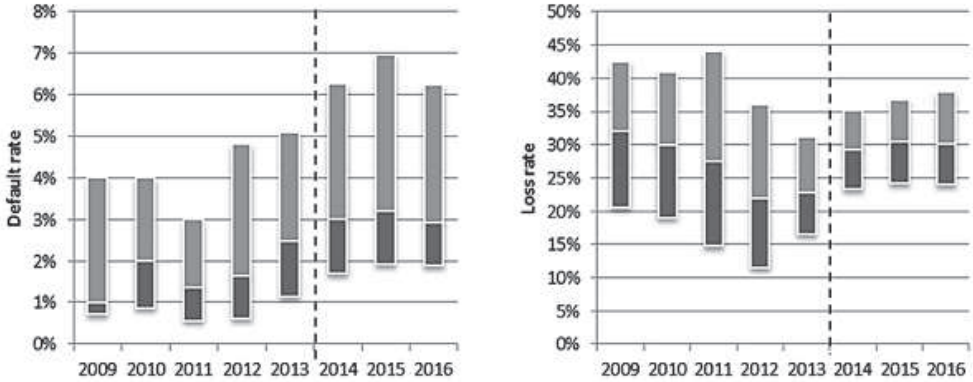
Exposures from both banking and trading books were modelled by taking into account the nature of risk (credit, market, sovereign and securitization) and the type of counterparty[17]. The methodologies imposed an exposure-by-exposure calculation of risk exposures using LGD and probability of default calculations. These two parameters are projected in accordance with historical values between 2011 and 2013 as shown in the Figure 6.3 below:

[15] The scenario takes into account currencies depreciations against the euro (15% for Czech Republic, Croatia, Poland and Romania and 25% for Hungary) and their repercussions on their public debt (if indebted in foreign currencies), behavior of borrowers and trade. For more information see ESRB (2014a).

[16] Annual values for house prices' variations by country are presented in Appendix B.

[17] Risk parameters were estimated by banks and then submitted for validation to the EBA which during 2014 published several notes on the consistency of RWA evaluated by banks (EBA, 2014c).

Figure 6.3: Distribution of both default and loss rates



Source: (EBA, 2014a)

The impact of the global financial shock on positions held-for-trading, available-for-sale (AFS) and positions designed at fair-value (FV) in the trading book is modelled through the framework for market risk. The amount of impairments for these positions is calculated in accordance with VaR, SVaR parameters estimated by banks through the IRB approach or provided by the ECB/ESRB. The market risk is due to increased interest rates, exchange rates and volatilities of major currencies, changes in credit spreads for debt instruments and increased correlations in trading portfolios (EBA, 2014a; ESRB, 2014a). The impact of market risk on the balance sheet is distributed over the 3 years with 50% of losses entering into the accounts in 2014, 30% in 2015 and 20% in 2016 and is principally materialized through the impact on the net trading income.

Shock to funding costs

The shifts in long-term interest rates create tensions in money markets and affect borrowing costs for financial institutions, firms and households. The short-term interbank rates are affected in the first instance[18], while the long-term funding costs are strongly correlated with bond yields variations. The variations in EU interbank interest rates are supposed to describe past underestimated risks and unstable banking funding structures and have a direct impact on the funding cost of banks.

Additionally, the country-specific shocks related to funding vulnerabilities[19] affect the productivity of each domestic market and furthermore, corporate bond spreads[20] and the cost of borrowing for households. Therefore, the global financial shock imagined under

[18] The methodology does not provide any detailed information about the variation of short-term interbank rates across countries. It is communicated that the macroeconomic adverse scenario leads to a permanent increase of 80 bp in interbank rates (ESRB, 2014a).

[19] Funding vulnerabilities are modeled within a DSGE model and shocks linked to this issue are calibrated to the cost of capital and households nominal wealth. (ESRB, 2014a).

[20] Supply shocks are calibrated according to historical values while the effect of the increase in corporate bond yields is quantified using rating downgrades buckets.

the adverse scenario has a considerable negative impact on the real economy, of a greater magnitude in countries with weak fundamentals.

6.1.3 Main outcomes of the adverse scenario of EBA's 2014 stress test

The disclosure of the results of the 2014-stress test focuses on the impact of macroeconomic scenarios on the AQR-adjusted Common Equity Tier 1 ratio (CET1 ratio). The latter is measured on the basis of the amount of core capital net of deductions and after applying transitional adjustments[21] and the AQR-revised amount of risk-weighted assets.

The results reported by EBA transcribe the incidence of the global financial shock in terms of deviations in GDP growth, unemployment and inflation relative to baseline levels in 2013. These deviations can be quantified on average as:

- Cumulative deviation of GDP: -2.2% in 2014; -5.6% in 2015; -7% in 2016;
- EU unemployment: 0.6 percentage points (pp) in 2014; 1.9pp in 2015; 2.9pp in 2016;
- Inflation below the baseline level and implied adverse inflation rates: 0.1pp/rate of 1% in 2014; 0.6pp /rate of 0.6% in 2015; 1.3pp/rate of 0.3% in 2016.

EBA (2014b) indicate that, for a threshold of the CET1 ratio of 5.5%, 24 banks experienced a shortfall under the adverse scenario counting for an aggregate shortfall of €24.2bn.

We will not dwell in explaining the magnitude of stress test results. We will rather use these outcomes and define our own framework, whose objective will be to examine the extent to which the variation of the CET1 ratio in stressed conditions, employed as a risk measure, can be explained by solvency and liquidity ratios of banks.

Before taking our analysis one step further, we shall briefly discuss the limits of the CA and their eventual impact on the outcomes.

6.1.4 Limits of the 2014-EU stress test

Inevitably, the stress test methodology and the outcomes of its execution are subject to several critics.

First, the assessment's technical framework can be criticized since it considers the risk-sensitive capital ratio as the main instrument of the stress test. This ratio, which serves in assessing the capital shortfall, has proved so far a quite weak capacity in predicting banks' weaknesses. This judgment is mainly due to the denominator of the ratio and more precisely to the use of internal models in calculating the amount of RWAs since

[21] The nominator of the CET1 ratio, the CET1 capital, is defined according to the European regulation in place, the CRR/CRD IV and accounts for transitional adjustments regulatory deductions as imposed by the regulator as of 1 January 2014. Appendix C details the definition and the formula for the CET1 ratio.

they lack transparency - and cannot be easily compared across banks. Overall, the use of internal models could contest the credibility of the stress test through the use of AQR outcome. The inefficiency of RWAs to predict default has also been discussed in the literature by Hoenig (2013) and ESRB (2014b). Financial Times economist Martin Wolf brings concrete proof based on 2014 data on the gap between RWAs and leverage in describing banks' solvency[22]. Since the stress tests conducted so far are mainly based on solvency ratios, Acharya et al. (2014) explain the extent to which results can easily be anticipated by analysing the RWAs and he points out the inefficiency of 2011 stress test. While the use of RWAs and core capital are required in order to better assess assets' risk and the loss-absorbing capacity respectively, the analysis of leverage could provide important additional information on banks' soundness[23] (Arnould and Dehmej, 2015). All the more, the numerator of the capital ratio may also be subject to debates because of the calculation methodology. Phasing-in arrangements for CRD IV are still decided at a national level[24].

Second, and one of the main limits of the CA, is the lack of modelling for the systemic risk through a market liquidity shock. The adverse scenario is not taking into account either the interlinkages between banks (or between banks and other financial institutions) or feedback effects due to the initial macroeconomic shock (fire sales for example). The assumption of static balance-sheets initially meant to simplify the methodological framework and its execution is in our opinion very restrictive since it imposes that banks do not react to any macroeconomic or financial shock during the 3 years of adverse scenario. According to this hypothesis, the substitution of maturing positions on both assets and liabilities sides will have an impact in terms of returns on the concerned positions but not in terms of volumes. Taking into account the interconnections between banks should definitely be considered for future macroprudential stress tests in order to better assess real risks[25].

Finally, less significant critics was made to the adverse scenario like the inflation scenario which is quite optimistic since it fails to cover the possibility of deflation. At a European level, it assumes an inflation rate of 1.1% in 2014 while in reality it was 0.3%, 0.6% in 2015 and 0.3% in 2016. Generally, the stressed parameters do not reflect a

[22]The use of risk-weighted ratio can favor large French, German, and Dutch banks since they have higher leverage and high risk-weighted ratios due to weak amount of risk-weighted assets compared to the total assets.

[23] The Federal Reserve in the United States already employed a leverage ratio in their 2012 stress test. Ratnovski and Huang (2009) explain the resilience of Canadian banks during the last financial crisis by the existence of an assets-to-capital multiple (inverse of leverage ratio).

[24] ECB (2014a): "discretions with respect to phase-in rules applied at the national level currently constitute a country-specific driver of the magnitude of the transitional adjustments"

[25]However, we should mention that even if the systemic risk is not explicitly modeled, it is possible that country-common shocks on interbank markets and further through funding costs capture in some extent the systemic dimension of risk Steffen (2014).

severe crisis of the magnitude of the one experienced in 2008 and hence, the assessment of banks' resilience to stressed scenarios could be questioned.

Overall, in regard to the methodology, there is clear evidence that EBA's stress test focuses on the impact of stressed parameters on bank's solvency. This is very strong limit of the stress exercise since it does not reflect the real threats that banks and financial systems are exposed to. Therefore, it would be right to think that certain structures will be revealed as more vulnerable than others given the scenario patterns. In the next section, we seek to explain the extent to which the banks, according to their structural features, have reacted to the stressed scenario.

6.2 Stress test outcomes

A key element in stress test outcome is the assessment of the amount of capital shortfall incurred by banks in case of a stressed scenario when a minimum threshold of 5.5% capital ratio is imposed by the regulator. In this study, we go one step further and evaluate the shortfall in capital ratio. Additionally, we seek to analyse how structural patterns of banks in terms of solvency and liquidity explain their evolution during periods of distress.

6.2.1 Methodology

The composition of ECB and EBA samples differ in terms of number of participating banks since the AQR exercise driven by the ECB was applied only to the banks presented in Euro area being under the supervision of the SSM, while the stress test driven by the EBA also took into consideration, the banks from EU countries non-SSM members (Denmark, Norway, Sweden and UK) which are under its direct supervision. Meanwhile, one should notice that not all banks in the AQR sample are in-scope for the stress test[26].

Our sample includes banks from both samples since our objective is not incompatible with the supervisory objective. Therefore, by combining the two samples and further applying additional selection criterion imposed by balance sheet data availability, we obtain a final sample that counts 135 banks from EU Member states and Norway. In the empirical analysis, we match balance sheet data provided by Bankscope according to the ownership of institutions. The study covers the period 2013 to 2016[27].

[26] The Appendix 9 in the Aggregate Report on the Comprehensive Assessment published by ECB in October 2014 explains different criterion for banks' selection.

[27] One should bear in mind that our framework could be subject to technical limits relied to the dataset. Specifically, we dispose of balance sheet data for 2013 which we transpose for the 3 years of stress test. Therefore, the balance sheet structure will be constant during the 3 years of adverse scenario and only the data issued by the stress test is subject to variations.

6.2.1.1 Interest variable

The main variable of our model is the capital ratio shortfall (CET1 ratio shortfall). It is computed as the variation of the CET1 capital ratio compared to its value in 2013, which represents the starting point for the stress test (Eq. 6.1).

$$CET1ratioshortfall_{it} = CET1ratio_{i,2013} - CET1ratio_{it} \tag{6.1}$$

where t takes the values 2014, 2015 or 2016 in order to compute a value of shortfall for each year of the stress test. The choice of this methodology is mainly based on the fact that it allows us to compute a measure that increases with the riskiness of banks since the losses increase in time[28]. The two factors that drive this tendency are: (i) the increased risk-exposures due to macroeconomic conditions and (ii) the reduction in banks' loss-absorbing capacity due to greater impairments on assets' portfolio and hurdle funding access.

For further and more detailed analysis, we compute alternative indicators of banks' weaknesses based on data issued from the stress test results.

Firstly, we calculate the capital shortfall according to the methodology used to compute the CET1 ratio shortfall . The *CET1 capital shortfall* measures the variation of the amount of CET1 capital defined in accordance with CRR/CRD IV directive (i.e. capital net of deduction and after applying transitional adjustments) relative to 2013. We use the same formula as in Eq. 6.1.

Secondly, we compute the variation of RWA, for the total amount and for each category of risk exposure (i.e. credit, market and operational). Therefore, Δ RWA represents the variation of the amount of RWA and is measured by the spread between the value in each year of the crisis and the initial value (in 2013). It is calculated for each year of the stress test (k takes the values 1, 2 or 3 for 2014, 2015 and 2016, respectively) and each bank i. Thus, greater values of this variable correspond to higher risk.

$$\Delta RWA_{it} = RWA_{i,2013} - RWA_{i,2013+k} \tag{6.2}$$

These two additional risk-indicators will allow us to better understand the sources of the decline in capital ratio and to further proceed to robustness check tests.

[28] Our definition of the shortfall is a quantitative variable being different from the definition of EBA's shortfall which is rather a qualitative indicator. EBA defines by the shortfall as the amount of capital required to banks that record levels of capital ratio under the regulatory minima of 5.5% during the 3 years of adverse scenario.

6.2.1.2 Explanatory variables

In addition to the set of variables issued from the stress test results, the empirical analysis uses a set of predictor variables describing relevant characteristics of banks' balance sheets. We define these variables below:

We use two alternative solvency indicators, as defined under Basel III framework. The *Tier 1 capital ratio*, the risk-weighted ratio calculated as the amount of Tier 1 capital divided by the amount of risk-weighted assets (RWA) and the *leverage ratio*, the Tier 1 capital to the total amount of assets. While the Tier 1 capital ratio describes the capital adequacy capacity, the leverage is rather a "security" ratio and aims in constraining the building up of leverage in the banking sector. These two requirements are therefore complementary.

Maturity transformation activity is measured by the Net Stable Funding Ratio (NSFR) (see measure and discussion in Chapters 2 and 5).

Short-term liquidity ratio (ST Liq ratio) is the ratio of liquid assets to short-term liabilities. We use this variable as a proxy for the short-term liquidity ratio introduced within CRR/CRD IV - Liquidity Coverage Ratio (LCR).

Liquid assets (LA) is the amount of high-quality assets that can be easily exchanged even under stress conditions and at a fair price. We use the Bankscope measure of liquid assets as in Huang and Ratnovski (2011)[29]. The ratio of liquid assets to total assets measures banks' sensitivity to market liquidity shocks.

Wholesale funding (WF) defines the proportion of wholesale funding held in the banks' balance sheet in order to supplement retail deposits, as to total assets. The crisis revealed that stronger dependence on these type of funds leads to collective withdrawals and financial disruptions (IMF, 2013; Huang and Ratnovski, 2011; Brunnermeier and Oehmke, 2013). Hence, we use this variable to assess banks' sensitivity to market liquidity shocks.

6.2.1.3 Control variables

We calculate an indicator of the business model of banks since we search to explore whether the are any asymmetries in banks' reaction to stress test according to their structural patterns. The variable *Business model (BM)* defines the business strategy of banks in terms of asset allocation. Contrary to Roengpitya et al. (2014) and Ayadi and De Groen (2014) who define business models using indicators for both assets and liabilities structures, we consider that the business model is defined by the assets' structure through the proportion of market based activities. Specifically, we define our variable *Business*

[29] The amount of liquid assets includes cash, government bonds, interbank lending and securities hold in the trading portfolio. The advantage of this indicator provided by Bankscope is that it is calculated using a harmonized methodology for all different jurisdictions. The inconvenience is that the detailed methodology used for its calculation is not publicly available.

model as a composite factor using the proportions of derivatives, trading securities and interbank lending as to total assets. Higher values correspond to a higher dependence on investment activities.

6.2.2 Descriptive statistics

The disclosure of stress test results provide detailed information on the risks that are generated through different activities of banks. According to the existent literature which recognizes the differences in the nature of risks according to the complexity of structures Haldane (2012b), we therefore seek to explore the results of the stress test by categories of business model. Please see Appendix D for more detailed information on the construction of the variable BM.

Turning now to our interest variable, it appears that, according to the architecture of the crisis scenario itself and the assessment methodology for our risk measure, the shortfall increases progressively between 2014 and 2016 (Fig. 4). This evolution shows the net losses incurred by banks in each year of the study period and transcribes the projections of the cumulative impact on both credit and market portfolios[30].

Viewed from another perspective, the amplitude of the shortfall seems to depend on the business model of banks[31]. More precisely, it appears that, in average, the shortfall records lower values for commercial banks compared to banks oriented on investment activities. These developments only transcribe the impact of the scenario's assumptions (i.e. distribution of losses by type of activity and in time) in evaluating the amount of losses for each type of activity.

Turning now to our interest variable, we notice that the *CET1 ratio shortfall* increases progressively between 2014 and 2016 (Figure 6.4). This evolution transcribes the increased net losses incurred by banks during the 3 years of stress test[32]. The analysis of the distribution according to the business model points out that commercial banks incur, on average, lower capital ratio shortfalls than banks with more diversified balance sheets. Among these last ones, banks with a business model oriented on investment activities

[30] We also calculate the variation of the CET1 ratio from year-to-year (for example the annual shortfall corresponding to 2014 is the difference between the value of the ratio in 2013 and the value in 2014). The trend of the annual shortfall is just the opposite of the cumulative shortfall. The annual shortfall records the highest values in 2014 which decrease progressively until 2016.

[31] The variable business model (BM) is calculated using a principal-component factor (PCF) method. The score factor is obtained using assets portfolio's characteristics: derivatives and, trading securities, as to total assets. *BM* takes values between -1.2 and 2.6 with higher values corresponding to greater holdings of market based activities. See details in Appendix B

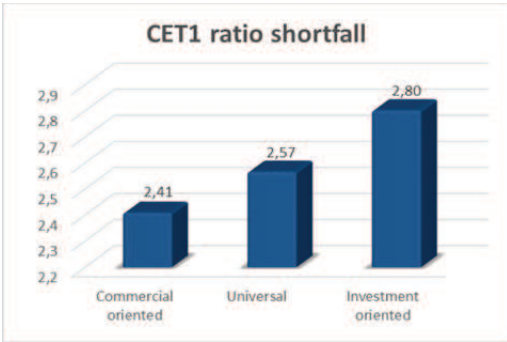
[32] We also calculate the variation of the CET1 ratio from year-to-year (for example the annual shortfall corresponding to 2014 is the difference between the value of the ratio in 2013 and the value in 2014). The trend of the annual shortfall is just the opposite of the cumulative shortfall. The annual shortfall records the highest values in 2014 which decrease progressively until 2016. We present graphics for the annual shortfall in Appendix E. The difference between the distributions of the 2 shortfalls - year-to-year and cumulative - is explained mainly through technical aspects of the adverse scenario.

seem to incur greater shortfalls starting with the first year of the stress test. This transcribes, to a certain extent, the impact of scenario's assumptions with regard to losses incurred on trading portfolio.

Additionally, one should notice that the distributions of cumulative shortfall changes according to the type of business model (Figure 6.5).

Figure 6.4: CET1 ratio shortfall, by year

Figure 6.5: CET1 ratio shortfall, by type of BM



Notes: We plot values for the variation of the CET1 ratio relative to 2013 (called CET1 shortfall). We count 80 commercial banks, 39 universal banks and 16 investment banks.
Source: Author's calculations

As mentioned previously, the evolution of the CET1 ratio shortfall illustrated above is the results of the joint evolution of its two components.

Firstly, the amount of risk exposures (RWAs) is likely to increase under the adverse scenario in order to transcribe the increased effects of the global financial shock as shown in Figure 6.6 below. The revaluation of RWAs is based on stressed default and loss rates for credit risk exposures - representing the majority of RWA (Figure 6.7), and on VaR and SVaR parameters for market activities[33].

Figure 6.6: Annual changes in RWAs (2014-16)

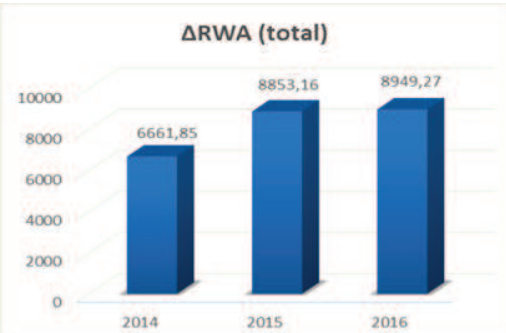
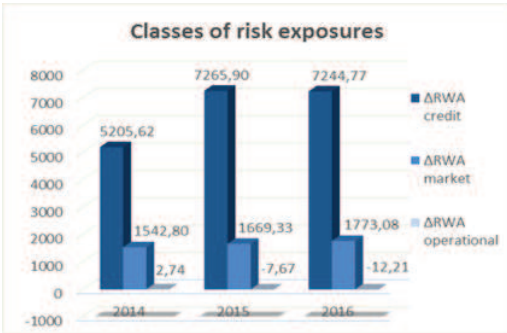


Figure 6.7: Annual changes, by categories of RWAs



Notes: We plot in the left figure the variation of the risk-weighted assets corresponding to the total amount of risk exposures. The right figure plots the variation of RWA by type of activity. Within ΔRWA for credit exposures, risk exposures for securitization activities represent in average 25% in 2014 and 33% in 2016. The rest correspond to risk exposures for other credits. The variation of RWA under the adverse scenario is calculated according to equation (6.2).
Source: Author's calculations

[33]The variations of exposures for market risk are calculated in accordance with VaR, SVaR parameters for banks using internal models. For banks not using internal models, the parameters for evaluating risk exposures are provided by ECB/ESRB and the amount of risk-exposures stays unchanged to stress test assumptions.

Commercial banks are generally less exposed to losses and the analysis of the variation of total exposures from year-to-year by class of business model indicates that the variation of the total amount of exposures is still less significant than for other categories of banks (Figure 6.8). Moreover, when we scale the variation of RWAs to the value of total assets in order to make comparison easier and more relevant across banks (and additionally, to remove all concerns about biased results related to the size effect), we notice that the tendency is still maintained across business models (Figure 6.9).

Figure 6.8: RWAs, by type of BM

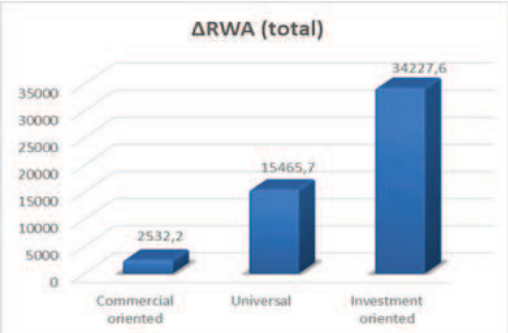
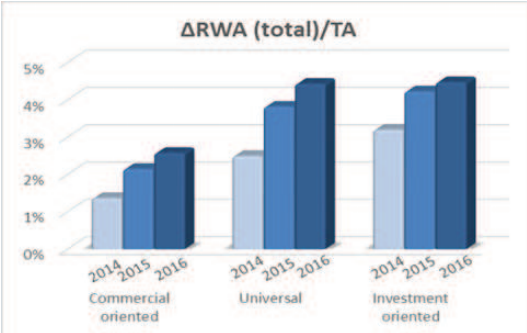


Figure 6.9: Scaled RWAs, by type of BM



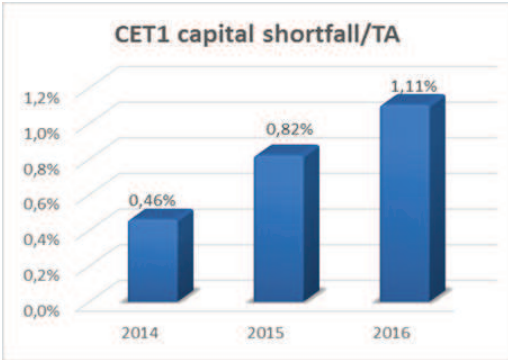
Notes: We plot values for the absolute variation of risk exposures relative to 2013 (Figure 6.10) and the variation as of total assets (Figure 6.11). The sample counts 80 commercial banks, 39 universal banks and 16 investment banks.
Source: Author's calculations

There are similar trends in the variation of RWAs and the CET1 ratio shortfall across business models and in time as well.

Secondly, **the CET1 capital** evolution during the 3 years of adverse scenario has also a significant impact on the capital ratio shortfall. As illustrated in Figures 6.10 and 6.11, important shifts are recorded in terms of core capital. The absolute amount of capital shortfall as well as the shortfall relative to the size of the balance sheet increase in time.

Figure 6.10: CET1 capital shortfall (2014-16)

Figure 6.11: CET1 capital shortfall/Total assets



Notes: We consider the amount of CET1 capital net of deductions and after adjustments in accordance with CRR/CRD IV directive.
Source: Author's calculations

Compared to the$\Delta RWA/TA$, the decline in the amount of core capital as of total assets is distributed differently across business models (Figure 6.12). Statistics emphasize a greater capital shortfall for commercial banks than for more diversified banks. Moreover, the annual evolution indicates that the spread between the 3 classes is generated by accumulated losses and is identified through considerable shortfall in 2016 (Figure 6.13). Again, this could be the consequence of the initial assumptions of the stressed scenario on increasing losses on credit portfolio during the stressed period.

Figure 6.12: CET1 capital shortfall/TA, by BM

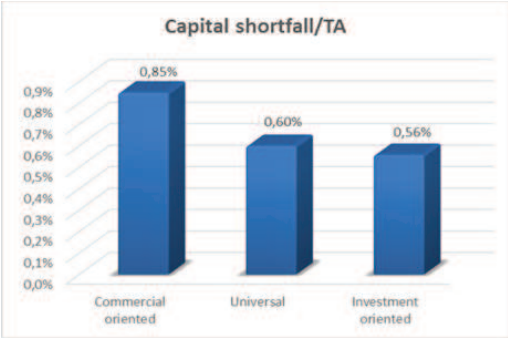
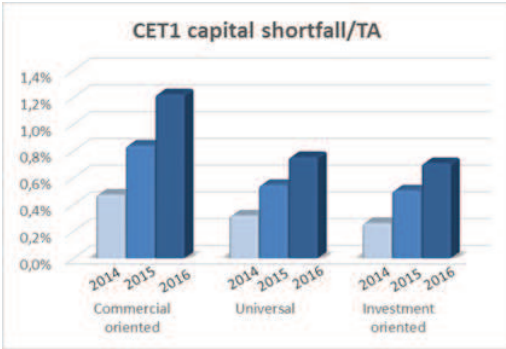


Figure 6.13: Annual CET1 capital shortfall/TA, by BM



Notes: We consider the amount of CET1 capital net of deductions and after adjustments in accordance with CRR/CRD IV directive. Source: Author's calculations

Up to this point, the distribution of the shortfall in capital across classes of BM[34] seems to be explained by the methodological aspects of the stressed scenario. In order to better understand the differences in the capital shortfall for the 3 classes of banks, we chose to take a closer look at the evolution of different components of regulatory capital during the stress period.

Components of the CET1 capital (shortfall)

In what follows, we seek to explain how evolution of different elements of the core capital generated the differences in the CET1 capital (shortfall) across banks, and especially across types of business models.

First, we notice considerable differences in the treatment of losses generated by various activities held in banks' portfolio, and especially between trading and banking book activities. The net interest income is decreasing in time and this effect could be explained mainly through the increased losses recorded on interest earning assets (as imposed by the scenario). Hence, the capital shortfall is greater due to a lower profit on lending and other earning assets. This observation brings a first explanation to the high capital shortfall incurred by commercial banks, whose main activity is lending, compared to other banks.

[34] The main drivers of the shortfall according to ECB and EBA are presented in ECB (2014a), pp 106.

Figure 6.14: The evolution of net income, by type of activity (2014-16)

Notes: The calculation formula of net income is based on the amounts of outcome from the banking and trading books. The total income is reduced by the amount of expenses and taxes. Net trading income is available starting with 2014.
Source: Author's calculations

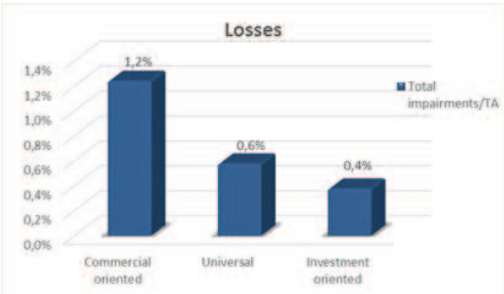
While the outcome on activities in the banking book is decreasing gradually during the stress test period (Figure 6.16 below, left plot), the net trading income is completely withdrawn in 2014 and recovers during 2015 and 2016. The contribution of the net trading income is still positive during the adverse scenario but significantly smaller to the global net income compared to the contribution of the net interest income.

Second, the adverse scenario predicts greater risks that are concretized into greater values of stressed parameters. Since the revaluation of credit risk is the main driver for the amount of losses incurred by banks, the amount of losses for banks with large proportion of traditional activities is very likely to be higher. However, one should bear in mind the significant impact of market shock in 2014 being materialized through the amount of impairments on assets designated at fair-value through profit and losses statements (P&L).

Additionally, Figure 6.15 illustrates the distribution of incomes from both credit and trading portfolios and indicates that commercial activities generate significant revenues (relative to their size). The net profits of commercial-oriented banks are high and so is the amount of losses as of total assets (Figure 6.16).

Figure 6.15: The distribution of income, by BM

Figure 6.16: The distribution of losses, by BM



Notes: We report scaled values of incomes and losses since their levels present a strong size effect indicating significantly higher values for universal than for commercial banks.
Source: Author's calculations

Third, the amount of core capital is also subject to deductions and adjustments which are imposed for prudential purposes within the CRR/CRD IV Directive. Generally, the amount of these instruments varies significantly across banks according to the structure of their balance sheet. Moreover, the average amount of total adjustments is not linear in time.

Even if the impact of these elements is smaller than the impact of the two previous components[35], their magnitude of deductions illustrated in Figure 6.22 in Appendix E brings additional explanations with regard to the higher capital shortfall for commercial-oriented banks (DTAs/CET1 capital). Among the adjustments that impact significantly the amount of CET1 capital we remind the intangible assets and the goodwill, the transitional adjustments and the deferred tax assets[36].

Given the impact of all the elements discussed above, the amount of capital shortfall as of total assets increases over the 3 years of stress test. The amount of risk exposure (Figure 6.8) is increasing as well, although with a different intensity than the capital shortfall. Thus, the evolution of CET1 ratio shortfall is not linear since its two components are not always correlated[37].

The CET1 ratio shortfall may also depend on other balance sheet characteristics. In line with our results, we notice that leverage and liquidity ratios are strongly correlated with *Business model* and *Size*. This can bring additional evidence on the results of stress test according to the size and the business strategy employed by each bank. For this reason, in what follows we report the correlation coefficients between the capital ratio shortfall and balance sheet structural features (Table 6.1). The results highlight the strong relationship between the capital ratio shortfall and the stable funding liquidity ratio. The negative coefficient suggests that banks with lower maturity mismatches are less vulnerable to shortcomings during periods of crisis. *CET1 ratio shortfall* is also negatively correlated with the leverage ratio meaning that solvency requirements with respect to the leverage level could be a good predictor of banks' resilience in times of crisis. The vulnerabilities could in turn raise from an excessive dependence on short-term funding. This feature of banks has been emphasized in previous chapters using historical measures of risk.

[35] Comparison between figures should be made with caution since the income and losses are expressed in terms of total assets while the figures on capital deductions are relative to the amount of capital.

[36] We define each of these adjustments and present their impact on the CET1 capital in Appendix E.

[37] The correlation coefficient between ΔRWA and CET1 capital shortfall is equal to 0.0649 and it is not statistically significant.

Table 6.1: Correlation matrix shortfall and balance sheet indicators

	CET1 ratio shortfall	Leverage ratio	T1 ratio	NSFR	ST Liq ratio	LA	WF	BM	Size
CET1 ratio shortfall	1.0000								
Leverage ratio	-0.1489*	1.0000							
T1 ratio	-0.2398	0.4374*	1.0000						
NSFR	-0.1496*	0.5299*	0.0466	1.0000					
ST Liq ratio	-0.0847	0.0329	0.1574	0.1787*	1.0000				
Liquid assets	-0.0617	-0.1562*	0.2007*	-0.3512*	0.0753	1.0000			
WF	0.1706*	-0.2909*	0.0889	-0.1533*	-0.1347	0.0055	1.0000		
BM	-0.0618	-0.2862*	-0.0088	-0.4752*	-0.0955	0.3873*	-0.0928	1.0000	
Size	0.0496	-0.5913*	-0.1122	-0.4907*	-0.2320*	0.0066	0.1642*	0.4663*	1.0000

Notes: The statistics reported in the table represent Pearson correlation coefficients calculated using panel data over the period 2014-2016. *indicates a 1% confidence level.

The additional descriptive statistics show some trends in that relationship between business models and both solvency and liquidity features (Table 6.2). Beyond the self-evidence on the value of leverage ratio, more interesting results are revealed with respect to liquidity ratios.

- Investment-oriented banks have the lowest values for the NSFR and the short-term liquidity ratio. The figures are explained mainly through a strong dependence on short-term funding.
- Commercial banks hold larger proportions of equity and are closer to fulfil liquidity requirements. Funding structures based mainly on equity, long-term liabilities and deposits help in attaining higher values of NSFR. On the other side, these banks give priority to lending and this explains the low proportion of liquid assets in their balance sheet.

Table 6.2: The distribution of structural variables by type of BM

	Commercial	*Universal*	*Investment*
T1 ratio	13.8	14.6	14.3
Leverage ratio	6.8	5.7	3.9
NSFR (%)	75.5	65.0	31.9
ST Liq ratio (%)	27.9	37.7	75.9
LA (%)	14.5	22.1	36.9
WF (%)	16.2	24.4	21.4

Notes: We report average values calculated for the sample of 135 stress test banks using values in 2013 since balance sheet data is available only for the period up to 2013. The sample counts 80 commercial-oriented banks, 39 universal banks and 16 investment-oriented banks.

The distribution of wholesale funding by class of business model is more mitigated and is explained by the asset portfolio structure based definition of business models.

The outcomes of our statistical analysis encourage to further examination of the relationship between balance sheet structure and the resistance to shocks. They justify

our motivation of testing the extent to which solvency and liquidity ratios explain the evolution of the *CET1 ratio* during stressed period.

6.3 Determinants of the capital ratio shortfall

In a first part of this section, we analyse the impact of solvency and liquidity ratios for participating banks to CA exercise. Then, we run robustness check for sub-samples that we will define according to the type of business model employed by banks.

6.3.1 How solvency and liquidity requirements could prevent losses within a long-term adverse scenario?

To answer this question, we examine the extent to which solvency and liquidity requirements contribute in preventing the capital ratio shortfall as evaluated in EBA's last stress test exercise. The following equation that will be estimated for our panel of European banks:

$$CET1capitalshortfall_{it} = \beta_1 Solvency_{it} + \beta_2 NSFR_{it} + \beta_3 STLiqratio_{it} + \varepsilon_{it} \quad (6.3)$$

Solvency in introduced in the model to evaluate the impact of banks' solvency and can be measured either by the risk-sensitive capital ratio (T1 ratio) or the leverage ratio. *NSFR* is an indicator of the stability of funding structures and measures the maturity mismatches between assets[38] and liabilities while the *ST Liq ratio* counts for banks' sensitivity to market liquidity shocks. ϵ_{it} is the error term.

Different specifications of the econometric model defined in Eq. 3 are successively tested using OLS regressions. Two series of regressions are executed, one for each measure of solvency: regressions 1-4 use the risk-weighted capital ratio (T1 ratio) while in regressions 5-8 it is replaced with the leverage ratio. We first run "basic" specifications testing for the complementarity of solvency and liquidity requirements in explaining the capital ratio shortfall during stressed scenario. Based on previous studies, we consider the net stable funding ratio (NSFR) as the main tool of liquidity requirements. Further, we consider simultaneously the two liquidity ratios: the *NSFR* as an indicator of long-term stability and the short-term liquidity ratio (*ST Liq ratio*) describing the capacity of banks to survive to highly stressed periods. Then, in the last two specifications we replace successively the *ST Liq ratio* with the two indicators for banks' sensitivity to market shocks (i.e. the components of the *ST Liq ratio*): the amount of liquid assets (*LA*) and wholesale funding (*WF*), both being measured in proportion of total assets.

[38] Aimed to address the risk of maturity mismatch, the NSFR is measured by the ratio of available stable funding (ASF) to required stable funding (RSF). Banks are required to meet at minimum a regulatory ratio of 100 percent beginning 2018 (BCBS, 2010c). For more details about the construction and the role of this variable, please see Chapters 2 and 5.

The results are reported in Table 6.3. There is clear evidence on the predictive power of the NSFR in explaining the shortfall in capital ratio that could be incurred in times of strong financial distress. The coefficient of the NSFR being negative and statistically significant suggest that higher stable funding requirements - meant to reduce the maturity mismatches between assets and liabilities - are very likely to reduce banks' capital shortfall in times of crisis. The importance of these results is twofold. First, it proves the importance of ensuring stable funding requirement with respect to assets' illiquidity to immunize banking structures to future distress. Second, it confirms the robustness of this measure and completes our previous results on the complementary role of liquidity and capital requirements in preventing losses and the failure of banks.

Moreover, the NSFR impact is robust across specification and especially, to the introduction of the market liquidity indicators in the regressions. It is important to notice that it has a stronger effect over the risk-weighted capital ratio than over the leverage ratio. While the estimates for the NSFR are robust, the solvency ratios do not have a statistically significant impact on the capital ratio shortfall.

Table 6.3: Capital ratio shortfall explained by solvency and liquidity. Results of panel-estimations

VARIABLES	(1) CET1 ratio shortfall	(2) CET1 ratio shortfall	(3) CET1 ratio shortfall	(4) CET1 ratio shortfall	(5) CET1 ratio shortfall	(6) CET1 ratio shortfall	(7) CET1 ratio shortfall	(8) CET1 ratio shortfall
		T1 ratio				Leverage ratio		
Solvency ratio	0.000908	-0.0765	-0.0137	0.0168	-0.0978	-0.163*	-0.0452	-0.0834
	(0.0208)	(-1.456)	(-0.270)	(0.345)	(-1.607)	(-1.891)	(-0.610)	(-1.267)
NSFR	-0.0185***	-0.0143*	-0.0200***	-0.0241***	-0.0145*	-0.00991	-0.0192***	-0.0215*
	(-3.597)	(-1.809)	(-4.165)	(-3.391)	(-1.928)	(-1.049)	(-2.877)	(-1.867)
ST Liq ratio		-0.000541				0.000697		
		(-0.390)				(0.379)		
Wholesale funding			0.0157***				0.0119	
			(2.592)				(1.502)	
Liquid assets				-0.0165				-0.0195
				(-1.361)				(-1.234)
Constant	3.846***	4.611***	3.676***	4.386***	4.254***	4.360***	3.871***	5.042***
	(7.056)	(5.394)	(5.355)	(7.384)	(10.27)	(8.055)	(8.189)	(5.701)
Observations	405	405	405	405	405	405	405	405
R^2	0.022	0.032	0.041	0.033	0.033	0.039	0.041	0.041
R^2 adj	0.0175	0.0189	0.0334	0.0255	0.0276	0.0259	0.0318	0.0323
F	6.963	2.740	7.020	4.961	8.738	3.903	5.863	5.918

Notes: Regressions are run for a balanced panel of 135 banks for the period of 2014 to 2016 using annual data. We run ordinary least squares (OLS) regressions and we correct for heteroscedasticity of errors. Robust t-statistics in parentheses *** p<0.01, ** p<0.05, * p<0.1.

However, in general the estimations confirm our hypothesis emerged from the preliminary statistical analysis. The findings comply with the existent literature pointing out the vulnerabilities emerging from inappropriate funding based on an excessive leverage

(IMF, 2013b; Admati and Hellwig, 2013) and from maturity mismatches between assets and liabilities (Huang and Ratnovski, 2011).

Second, in the context of stressed period as described by the stress test scenario, the question of liquidity contribution in explaining banks' deterioration of the solvency position is of particular interest to us. Beyond the *NSFR* whose interest has been discussed on several occasions, the short-term liquidity requirements have been revealed as essential during the 2008 liquidity crisis. Nevertheless, the *ST Liq ratio* is not supported by the data in the context of this study, with the estimates that are not statistically significant. The main explanation for this finding can be found in the assumptions of the stresses scenario which does not take into account explicitly a market liquidity shock. It was although essential to evaluate banks' vulnerabilities to cessation in short-term interbank markets and their ability to rollover debt (Brunnermeier, 2009). This finding points out a major limit of the 2014 stress test exercise, which turns out to be quite accommodating for banks. Nevertheless, one could also question the relevance of the measure, a proxy for the Liquidity Coverage Ratio - LCR[39], since it does not take into account either the maturity or the creditworthiness of counterparties for wholesale borrowings.

Furthermore, we test for the impact of the two components of the short-term liquidity ratio that should capture bank's sensitivity to market shocks. The extreme dependence on wholesale funding, also discussed in Le Leslé (2012), becomes a vulnerability in times of distress and drive to greater losses, while the contribution of liquid assets[40] in reducing the exposure to losses is not supported for the data describing European banks' financial statements.

Furthermore, some more subtle questions emerge from these first empirical findings. For example, we examine the robustness of the findings for different categories of business model since there are reasons to believe that there is a different distribution according to the business strategy employed by banks.

6.3.2 Results of regressions by type of business model

The aim of this additional analysis is to take a closer look at the relationship between the shortfall in terms of capital ratio incurred within a stressed scenario and the solvency and liquidity features of banks, according to their business model. For statistical driven reasons, we make the assumption that the relationship is different across business models and so is banks' resilience to macroeconomic financial shocks.

[39]The Liquidity Coverage Ratio - LCR - is requiring banks to increase the amount of high quality liquid assets (HQLA) in order to overcome a liquidity stress over 30 days.

[40] The amount of liquid assets is the nominator of the ST Liq ratio.

For this purpose, we run regressions for each subpanel of banks defined on the basis of the variable *Business model* using the model described in (6.3). The results reported in Table 6.4 emphasize several facts although they are mixed.

We find that, in line with the business model, the impact of explanatory variables on the *CET1 ratio shortfall* is generally coherent. The main result of this analysis concerns the net stable funding requirements whose effect is associated to a lower shortfall in capital ratio due to stressed macroeconomic conditions. We should notice the difference in the amplitude of the impact across classes of business model: it is strongly significant for universal banks, lower for commercially-oriented structures and unimportant for investment-oriented banks. For universal banks, the negative coefficient suggests that an increase of one percent of the NSFR will reduce (on average) the capital ratio shortfall of 5.9-6.3%, while for commercial-oriented banks the effect of the NSFR is evaluated in the range 2.2-3%. Therefore, for these two sub-samples, the resilience of banks could be significantly improved by reducing the maturities mismatches between assets and liabilities, and implicitly the bad maturity transformation. In turn, for investment–oriented banks, the lack of significant effect could be due to the very low levels of *NSFR* (average of 32%) but also to a lower representativeness of these banks in the sample defined by the EBA for running the stress test.

Then, the effect of the *ST Liq ratio* is mitigated and does not provide relevant information with regard to the impact of short-term liquidity requirements on the resilience to shocks. As reminded previously, these results could transcribe the lack of modelling of this risk in the adverse scenario of the stress test that affects directly the magnitude of the impact on banks' capital ratio shortfall.

Solvency ratios, *T1 ratio* as well as the *Leverage ratio*, have a negative coefficient but their impact is still insignificant. It is somehow counter-intuitive since there is clear evidence that the methodology of the stress test is focused on the impact of shock in terms of solvency level.

Table 6.4: Results of regressions for each type of BM

VARIABLES	(1) CET1 ratio shortfall	(2) CET1 ratio shortfall	(3) CET1 ratio shortfall	(4) CET1 ratio shortfall	(5) CET1 ratio shortfall	(6) CET1 ratio shortfall
	Commercial	*Universal*	*Investment*	*Commercial*	*Universal*	*Investment*
		T1 ratio			*Leverage ratio*	
Solvency	-0.00312	-0.0640	-0.153	-0.0948	-0.0910	-0.151
	(-0.0378)	(-1.539)	(-1.514)	(-1.267)	(-1.352)	(-0.299)
NSFR	-0.0302**	-0.0592***	-0.0109	-0.0222*	-0.0637***	-0.0473
	(-2.077)	(-3.309)	(-0.423)	(-1.760)	(-2.837)	(-0.885)
ST Liq ratio	-0.000418	-0.0287	0.0284**	-0.00635*	0.00721*	-0.0476
	(-0.180)	(-1.664)	(2.081)	(-1.809)	(1.915)	(-0.0629)
Constant	4.744***	8.406***	2.879	4.806***	6.651***	5.041***
	(6.644)	(4.748)	(1.470)	(5.810)	(5.055)	(5.217)
Observations	240	117	48	240	117	48
R^2	0.031	0.240	0.273	0.042	0.397	0.199
R^2 adj	0.0161	0.209	0.211	0.0271	0.359	0.116
F	4.423	5.132	4.834	7.521	15.06	2.624

Notes: We run OLS regressions with correction for the heteroscedasticity of errors for the period 2014 to 2016 for 3 sub-samples corresponding to each type of business model. We count 67 commercial banks, 46 UB and 30 UB-oriented investment. Robust t-statistics in parentheses ***p<0.01,**p<0.05,*p<0.1.

Although the statistical analysis indicate considerable differences in the evolution of the amounts of risk-exposures and core capital and also in terms of solvency ratio, the empirical results are less relevant on this issue. Expecting the impact of the NSFR, the other main structural indicators do not provide significant explanations on the variation of the capital ratio under the stressed scenario of the stress test.

Even when the question is addressed from a different point of view, the one of the annual variation of the capital ratio shortfall, there is no relevant information that stands out[41].

Overall, the analysis driven in this section brings evidence on the structure of banks according to their business model. However, the results of estimations could be partly explained through some technical aspects of the adverse macroeconomic scenario. Firstly, the lack of modelling for market liquidity risk can favour banks which are oriented to investment activities (i.e. banks holding large proportions of market based activities). The insensitivity of stress test outcomes to solvency and liquidity levels for investment-oriented banks could therefore be explained by the lack of modelling of the risks specific to these institutions. Secondly, the most severe shock is affecting especially P&L statements through losses incurred on credit portfolio. Commercial banks, which are stable than

[41]The objective of regressions for each period of the sample (i.e. 2014, 2015, and 2016) was to evaluate the temporal dynamic of the variables that we though as important as the effect of inter-banks structural differences. Nevertheless, the results are generally not significant. For these reasons, we do not report these results.

others in respect to the NSFR criteria, appears more resilient. Their high level of stable funding resources relative to the structure of assets, broadly speaking, lead to a lower impact for these credit oriented institutions in terms of solvency ratio shortfall.

The conclusions that could be drawn with respect to the relationship between solvency and liquidity ratios on the one hand, and the capital ratio shortfall, on the other hand, are following:

- The high level of stable funding requirements relative to assets illiquidity can improve significantly the resilience of banks to adverse shock, and a stronger effect is recorded for commercial-oriented and universal banks.
- Banks with more complex balance sheet structures, with important proportions of market based activities, were somehow "protected" by the methodological framework and seem to be more insensitive to the shocks anticipated by the adverse scenario.

The study provides empirical proof on the resilience of banks to financial shocks and completes the analytical framework on the contribution of solvency and liquidity requirements in preventing losses and ultimately, their failure.

Nevertheless, we could not easily compare the magnitude of results for the different measures of risk since the structure of the samples is considerably different.

For these reasons, we are going to furthermore drive a comparative analysis of the three measures of risk studied in the last part of this thesis in order to determine the extent to which they are explained by the same determinants. This exercise implies a reduction in the sample size used in this chapter, and the grouping of banks according to one main criterion: the availability of all three measures of risk (probability of default, systemic risk and capital shortfall as described by the stress test outcomes). Section 6.4 details the comparative analysis.

6.4 Comparison of different measures of financial risks

The aim of this section is to summarize and compare the findings from the last two chapters of this thesis in order to draw conclusions on the elements that improve banks' resilience to financial shocks. We compare the 3 measures of risk that were separately analysed in previous sections: the probability of default (PD) as indicator of balance sheet imbalances, the SRISK measuring the sensitivity of banks to systemic risk and finally, the shortfall in solvency level as described by the 2014-EU wide stress test outcomes.

6.4.1 Required assumptions for the comparison framework

Although all risk measures are computed using publicly available data, it is necessary to point out an important methodological difference that will help in the interpretation

of the results. According to the method of calculation, we dispose of historical data for the first two indicators, the *PD* and the *SRISK*. In turn, for the third measure (i.e. the shortfall in solvency level) we dispose only of punctual data for 2013 and projections over a 3-year horizon (from 2014 to 2016). Therefore, the limitation of the study period intervenes as a natural consequence and it covers the years from 2013 to 2016[42]. Another implication of the use of the stress test dataset is the assumption that the PD and the SRISK are constant for the years following 2013. Although it could be considered as a limit of the study, this hypothesis is in line with the methodological framework of stress test which considers balance sheet data in 2013 to make projections for the three following years. In order to study the rich outcomes provided by the stress test exercise, these assumptions are unavoidable.

The interest in comparing this additional measure of risk and namely the shortfall incurred in case of a stressed scenario, finds its roots in the very detailed dataset on exposures and funding structures that is not available within classical databases[43]. Analysing this indicator simultaneously with the more commonly used measures (PD and SRISK) allows to assess the robustness of the widely used measures, the PD and the SRISK, at a specific point in time.

Another technical issue about the setting up of the comparison is the size of the sample. The analysis provided in Chapter 5 uses a dataset of 58 large listed European banks from 21 countries over the period of 2003 to 2013. The main selection criterion is data availability and more precisely, historical stock prices that are necessary in computing the probability of default and the SRISK. In turn, the sample of participating banks to the 2014 EU stress test counts 13 institutions from 24 countries (Euro and non-Euro zone). Therefore, for the ease of comparison between the measures of risk, we will reduce the size of the sample to the institutions disposing of all 3 measures of risk. The final sample counts 58 banks having in common the fact that they are all listed institutions.

6.4.2 Description of the sample and presentation of the dataset

The sample used for the comparative analysis is in general very similar to the one from Chapter 5 but considerably different from the one used in this chapter[44]. Certain differences appear in terms of descriptive statistics given the study period, and more precisely the use of 2013 balance sheet data.

[42]Common data for the 3 measures is available only for 2013. However, considering only 2013 as a study period will not allow us to consider for the shortfall incurred during the adverse macroeconomic scenarios of stress test exercise.

[43]We should remind that data provided by Bankscope is used in previous studies.

[44] The sample used in Chapter 6 is composed of banks submitted to comprehensive assessment exercise driven by EBA and ECB.

Furthermore, in order to test for the relevance of the sub-sample of banks used for the comparative analysis relative to the larger sample of banks used previously in this chapter, we proceed to a simple statistical analysis. Several facts should be highlighted:

- Liquidity ratios, both *NSFR* and the *ST Liq ratio*, have on average similar values for the two samples compared.
- More significant differences are noticed in terms of solvency ratios with banks from the sub-sample revealing lower solvency levels both in terms of leverage ratio and risk-weighted ratio. Nevertheless, it is important to notice that average values are well above the minimum regulatory standards.
- In terms of size, the banks from the smaller sample are slightly larger.

Detailed descriptive statistics are presented in Table 6.5 below. Globally, the small sample could definitively be considered as representative for the sample of banks submitted to the stress test exercise.

Table 6.5: Descriptive statistics for balance sheet features

Sample of 135 banks						**Sample for comparison analysis**					
	Obs	**Mean**	**Std. Dev.**	**Min**	**Max**		**Obs**	**Mean**	**Std. Dev.**	**Min**	**Max**
Leverage ratio	135	6.27	3.29	2.12	20.70	Leverage ratio	58	5.63	2.10	2.12	11.48
T1 ratio	135	14.63	6.43	1.00	49.40	T1 ratio	58	12.80	3.49	1.00	21.40
ST Liq ratio	135	33.91	26.55	2.55	120.84	ST Liq ratio	58	31.96	26.30	3.70	105.53
NSFR	135	67.96	23.58	3.86	133.63	NSFR	58	66.25	23.16	14.94	112.87
Size	135	11.08	1.64	6.35	14.98	Size	58	11.63	1.81	8.15	14.98

Notes: The table on left present descriptive statistics for the sample used in section 6.3, while the ones on right side are for the smaller sample used for the comparison analysis (58 banks). All statistics are computed on the basis of 2013 data.

In more concrete terms, the small sample regroups banks with more similar characteristics and leaves out banks with more distinct structures (small cooperative and savings banks, small retail banks or even small wholesale banks).

Finally, slight differences are noticed in terms of the magnitude of the shortfall in solvency level which seems to be determined by both components of the ratio. Table 6.6 below brings more evidence about the distribution of the shortfall and its two components for each sample.

Table 6.6: Descriptive statistics for stress test outcomes

Sample of 135 banks						**Sample for comparison analysis**					
	Obs	**Mean**	**Std.Dev.**	**Min**	**Max**		**Obs**	**Mean**	**Std.Dev.**	**Min**	**Max**
CET1 ratio shortfall	450	3.70	11.84	-15.50	142.64	CET1 ratio shortfall	174	2.71	2.18	0.12	14.23
CET1 capital shortfall/TA	450	2.73	3.05	-10.16	16.66	CET1 capital shortfall/TA	174	2.98	2.74	-3.04	13.90
ΔRWA/TA	450	0.78	3.58	-28.38	30.52	ΔRWA/TA	174	0.96	1.17	-0.46	7.05

Notes: The levels of CET1 ratio, CET1 capital and RWA are available for the period of 2013 to 2016. The shortfall is calculated compared to 2013; therefore the data on shortfalls corresponds to the 3 years of stress test (2014-2016)

Although they have higher amounts of risk exposures relative to their size and incurred greater losses in capital (as of total assets), banks from the smaller sample have recorded on average a lower shortfall in solvency level compared to banks from the big sample (left side of Table 6.6).

The distribution of the shortfall in capital and the variation of risk exposures reinforce our assumption which states that the evolution of solvency level in times of adverse scenario depends not only on the initial values of solvency ratios (reported in Table 6.5) but also on other features of the balance sheet.

Before taking the analysis one step further, we proceed to a final check and namely to the correlation analysis between our measures of risk. The coefficients reported in Table 6.7 suggest that the 3 measures are correlated at a 1% confidence level and therefore, the figures encourage to a further empirical analysis.

Table 6.7: Risk indicators - correlation matrix

	PD	SRISK	SRISK/ Equity	CET1 ratio shortfall	ΔRWA/ TA	CET1 capital shortfall/Equity
PD	1.0000					
SRISK	-0.1181	1.0000				
SRISK/Equity	0.3204*	0.1961*	1.0000			
CET1 ratio shortfall	0.3861*	-0.0835	0.2309*	1.0000		
ΔRWA/TA	-0.1207	0.1995*	0.0048	0.0972	1.0000	
CET1 capital shortfall/Equity	0.2971*	-0.0416	0.1406	0.6899*	-0.0399	1.0000

Notes: All correlations are estimated for the period 2014-2016. For the SRISK and the PD we consider values in 2013. We also evaluated the correlation coefficient between the amount of SRISK and the amount of capital shortfall from stress test results and they prove to be strongly correlated (0.2456∗). Nevertheless, we do not focus on these measures because they are more difficult to compare across banks. *indicates a 1% confidence level.

In what follows, we empirically examine the extent to which these 3 different measures of risk have similar determinants.

6.4.3 The results of the empirical study

The econometric model employed to perform the comparison is similar to the one described in section 6.3. The dependent variable, called *Risk*, will be successively described

by the PD, the SRISK and the capital ratio shortfall. We run OLS regressions on the basis of the following model:

$$Risk_{it} = \beta_1 Solvency_{it} + \beta_2 NSFR_{it} + \beta_3 ML_{it} + \varepsilon_{it} \tag{6.4}$$

The model is applied to the sample of 58 banks. Although several specifications have been initially tested, we report results only for regressions including solvency and both liquidity ratios[45]. We also provide results for both alternative measures of SRISK, in absolute amount and relative to the size of the balance sheet.

The results reported in Table 6.8 show that the reduction of the sample is not affecting the results.

The results in Table 3 show that the structural liquidity ratio is a key determinant of risk measures employed by the model. It appears that the NSFR has the most significant impact on both the amount of SRISK and the level of SRISK relative to the total assets of the bank. This result is critically important since it reveals that the NSFR reduces the amount of capital which should be covered by shareholders in times of distress, relative to the size of the bank. The NSFR appears as a key tool that will allow to reduce the sensitivity of banks to systemic events by ensuring an appropriate level of maturity transformation[46]. By level of significance of the NSFR, then we find the CET1 ratio shortfall. Although its impact losses in significance compared to previous analysis applied to a larger sample, it remains a major determinant of this risk measure. Finally, the results show a lack of consistency in the relationship between the PD and the NSFR. This finding could be explained through several technical assumptions and namely, the weak information content on the fundamental features of banks in market prices used for the assessment of the PD and the hypothesis of no time variation of these accounting-based variables. One could therefore conclude on the contribution of NSFR in reducing the vulnerabilities to which banks are exposed and particularly to those associated to systemic events.

Then, in general, solvency ratios are not statistically significant in explaining the three different measures of risk. Only the leverage ratio is pointed out as a significant determinant of the level of SRISK, confirming the findings in the literature on their very close relation Acharya et al. (2014). Moreover, a very interesting and relevant result is provided in columns 3 and 7 where the model explains an alternative measure of systemic risk, the SRISK relative to the total assets of the bank. Deleveraging should undoubtedly be pursued in order to improve the loss-absorbing capacity of banks and hence, to reduce their exposure to financial shocks.

[45] Additional results will be provided in Appendix F.
[46] Also called "good transformation" according to Davanne (2015)

Table 6.8: Comparison of the 3 risk indicators. Results of panel-regressions

VARIABLES	(1) PD	(2) SRISK	(3) SRISK/ Equity	(4) CET1 ratio shortfall	(5) PD	(6) SRISK	(7) SRISK/ Equity	(8) CET1 ratio shortfall
	T1 ratio				*Leverage ratio*			
Solvency	0.559	-1,059	0.773	-0.128**	1.655	-2,647*	-5.655	-0.0499
	(0.716)	(-1.278)	(0.401)	(-2.241)	(0.950)	(-1.817)	(-0.834)	(-0.905)
NSFR	-0.172	-669.6***	-1.400***	-0.0157**	-0.282	-587.0***	-1.234**	-0.0103
	(-1.390)	(-3.321)	(-4.440)	(-2.370)	(-1.376)	(-2.714)	(-2.660)	(-1.381)
ST Liq ratio	0.225	-34.63	0.253	-0.00163	0.259	-37.43	0.139	0.00419
	(1.345)	(-0.261)	(0.887)	(-0.117)	(1.405)	(-0.301)	(0.488)	(0.263)
Constant	8.521	79,639***	184.3***	5.349***	13.57	76,272***	216.4***	2.574***
	(1.043)	(3.941)	(6.200)	(5.721)	(1.430)	(4.328)	(8.520)	(4.913)
Observations	58	58	58	58	58	58	58	58
R^2	0.055	0.213	0.344	0.076	0.074	0.248	0.408	0.067
R^2 adj	0.00139	0.167	0.306	0.0596	0.0198	0.203	0.373	0.0137
F	1.014	5.940	7.760	3.478	0.948	6.492	10.68	1.460

Notes: PS, SRISK/Equity and CET1 ratio shortfall are expressed in percentage points while SRISK is measured in millions of euros. We use a balanced panel of 58 banks for the period of 2014 to 2016 using annual data. We run ordinary least squares (OLS) regressions and we correct for heteroscedasticity of errors. Robust t-statistics in parentheses *** p<0.01, ** p<0.05, * p<0.1.

From a technical point of view, the empirical results on the NSFR are robust independently of the specification and the solvency measure taken into consideration. In terms of efficiency of the econometric model, we find that the models explaining the two alternative measures of systemic risk (SRISK and SRISK adjusted to total assets) have the higher coefficients of determination. At the opposite, the model does not explain very well the variance of the two other measures of risk, the shortfall and the PD. These later might be due to the lack of time dimension of the model.

Globally, this empirical analysis allow us to draw important conclusions on the policy implications of our findings.

There is a self-evidence on the importance of ensuring enough stable funding requirement with respect to assets' illiquidity that is necessary to immunize banking structures to financial shocks. Although there are critics with regard to its adverse impact on the real economy (decline of long-term lending, risk shifting), recent studies show that the setting up of the NSFR had no significant impact on lending, either in terms of cost or volume Banerjee and Mio (2015). Then, the dominant effect of the NSFR over both solvency indicators could leave room to further discussion on the definition and the measurement of different regulatory requirements, on the one hand, and their complementarity, on the other hand.

With regard to the comparison of the risk measures, our analysis fails in finding similarities between the three different indicators. Based on the empirical findings, we can deduct that the relevance of the CET1 ratio shortfall in assessing global risks of financial institutions is located between the measure of systemic risk, the SRISK, and the indicator of intrinsic risk, the PD. Several facts could explain this finding:

- First, the lack of intensity and of magnitude of the financial shock under the adverse scenario of the stress test and the lack of spillover effects between credit and market activities restrict the capacity of the outcomes to capture the real threats (contagion effects through asset holdings, dependence on wholesale funding) for large listed financial institutions, such as those in our sample for the comparative study.
- Then, the SRISK is still debated in the literature and still being judged as insufficient in evaluating the systemic risk. It is rather associated to the traditional market beta, describing the sensitivity of financial institutions to systemic events[47]. The alternative version reporting the amount of SRISK to the amount of total assets seems to be a more relevant indicator that facilitates the comparison across banks.
- The PD appears as insufficient compared to other indicators since it captures only the riskiness of banks emerged from balance sheet imbalances (high level of indebtedness) and market prices volatility, without considering the degree of interconnection between institutions and the complexity of their activities.

Although the results do not allow to conclude on the similarity of the three risk measures, they emphasize the importance of the implementation of structural liquidity requirements. The NSFR, by evaluating more appropriately the required and the available funding items using risk-weights, allows to raise awareness on the capacity to cover risks on each type of activity, in both banking and trading books. The fulfill of minimum requirements could therefore reduce the global risks in financial systems.

6.5 Conclusion

The aim of the study driven in this last chapter is twofold. Firstly, it explores the stress test outcomes and examines the extent to which the shortfall in CET1 capital ratio recorded because of adverse macroeconomic conditions is influenced by initial structural features in terms of liquidity and solvency. Secondly, it examines the similarities between this new measure of risk issued from stress test results and more traditional risk indicators, the probability of default and the SRISK.

[47] In this context, "systemic events" makes reference to high volatility on stock markets.

The results provide strong empirical proof on the meaningful contribution of the structural liquidity ratio (NSFR) in reducing the banks' exposure to losses. This conclusion is triggered from different econometric specifications applied to the risk measure emerged from stress test outcomes (CET1 ratio shortfall) and is reinforced by the results of a study comparing it with two more traditional measures, the SRISK and the probability of default. Within a framework where the temporal dimension is dismissed, it appears that the NSFR has a greater contribution than solvency ratios in reducing (i) the level of shortfall during periods of crisis (CET1 ratio shortfall) and (i) the SRISK, whether it concerns the absolute amount or the level of SRISK relative to total assets.

Although important progress have been made in terms of strengthening prudential standards, the efficiency of their implementation is strongly associated to a reinforced supervision. While much has been accomplished to enhance the stress tests exercises, there are still some areas that should be improved. Modeling the market liquidity risk and the contagion effects between credit and market activities, on one hand, and between strongly interconnected institutions on the other hand (i.e. the systemic risk), will provide a deeper awareness of the real threats for financial institutions and financial systems. It seems that the 2016-EU wide bank stress tests, covering three years starting from the first quarter of 2016, are already redressing some of the shortcomings of the 2014 exercise. Specifically, the adverse scenario proposes a more careful evaluation of the threats to the stability of European financial system, and improves the modeling of systemic risks by considering a more abrupt reversal of compressed risk premias and fragile secondary market liquidity, amplified by an increased stress in shadow banking sector (ESRB, 2016).

In the meantime, even if certain measures of risk have been defined, it is essential to further develop the assessment of more appropriate measures, able to reflect the real exposures of banks to systemic risk. With regard to the SRISK, while not denying the usefulness of the absolute amount, we suggest that the measure relative to the size of the balance sheet (SRISK/total assets) might be more relevant for further analysis and comparisons between banks.

6.6 Appendix

A. Sample

The samples for AQR and stress test are slightly different. AQR is applied to banks from SSM Member States - in total 130 institutions, while the sample for the stress test exercise is run for a sample of 123 institutions from EU and Norway.

The stress test sample counts 103 banks from SSM and 20 from non SSM countries covering more than 70% of total European banking assets. At a national level, selected institutions represent more than 50% of the banking activity. In table below, we combine both samples and, after applying all selection criteria based on data availability, we obtain a final sample of 135 banks.

Table 6.9: List of participating banks in the comprehensive assessment

Country	Bank	Country	Bank
AT	BAWAG P.S.K.	**GR**	**Eurobank Ergasias**
AT	**Erste Group Bank AG**	**GR**	**National Bank of Greece**
AT	Österreichische Volksbanken	**GR**	**Piraeus Bank**
AT	Raiffeisen Zentralbank Österreich AG	**IE**	**Allied Irish Banks plc**
AT	Raiffeisenlandesbank Niederösterreich-Wien AG	IE	Merrill Lynch International Bank Limited*
AT	Raiffeisenlandesbank Oberösterreich AG	**IE**	**Permanent tsb plc.**
BE	AXA Bank Europe SA	**IE**	**The Governor and Company of the Bank of Ireland**
BE	**Dexia***	IE	Ulster Bank Ireland Limited*
BE	**KBC Group**	**IT**	**Banca Carige S.P.A.**
BE	The Bank of New York Mellon SA*	**IT**	**Banca Monte dei Paschi di Siena S.p.A.**
CY	Bank of Cyprus Public Company Ltd	**IT**	**Banca Piccolo Credito Valtellinese**
CY	Co-operative Central Bank Ltd	**IT**	**Banca Popolare Dell'Emilia Romagna**
CY	**Hellenic Bank Public Company Ltd**	**IT**	**Banca Popolare Di Milano**
DE	**Aareal Bank AG**	**IT**	**Banca Popolare di Sondrio**
DE	Bayerische Landesbank	IT	Banca Popolare di Vicenza - Società Coop. per Azioni
DE	**Commerzbank AG**	IT	Banco Popolare - Società Cooperativa
DE	DekaBank Deutsche Girozentrale	**IT**	**Credito Emiliano S.p.A.**
DE	Deutsche Apotheker- und Ärztebank eG	IT	Iccrea Holding S.p.A
DE	**Deutsche Bank AG**	**IT**	**Intesa Sanpaolo S.p.A.**
DE	DZ Bank AG	**IT**	**Mediobanca - Banca di Credito Finanziario S.p.A.**
DE	HSH Nordbank AG	**IT**	**UniCredit S.p.A.**
DE	Hypo Real Estate Holding AG	**IT**	**Unione Di Banche Italiane Società Coop. Per Azioni**
DE	**IKB Deutsche Industriebank AG**	IT	Veneto Banca S.C.P.A.
DE	KfW IPEX-Bank GmbH	**LT**	**DNB bankas (LT)**
DE	Landesbank Baden-Württemberg	LT	AB SEB bankas*
DE	Landesbank Berlin Holding AG	LT	Swedbank AB*
DE	Landesbank Hessen-Thüringen Girozentrale	LU	Banque et Caisse d'Epargne de l'Etat
DE	Landeskreditbank Baden-Württemberg-Förderbank	LU	Clearstream Banking S.A.*
DE	Landwirtschaftliche Rentenbank	LU	Precision Capital S.A.*
DE	Münchener Hypothekenbank eG	LU	RBC Investor Services Bank S.A.*
DE	Norddeutsche Landesbank-Girozentrale	LU	State Street Bank Luxembourg S.A.*
DE	NRW.Bank	LU	UBS (Luxembourg) S.A.*
DE	SEB AG*	LV	ABLV Bank
DE	Volkswagen Financial Services AG	LV	AS SEB banka*
DE	WGZ Bank AG	LV	Swedbank AS*
DE	Wüstenrot Bank AG Pfandbriefbank	**MT**	**Bank of Valletta plc***
DE	WÃijstenrot Bausparkasse AG	**MT**	**HSBC Holdings plc**
DK	**Danske Bank**	NL	ABN AMRO Bank N.V.
DK	**Jyske Bank**	NL	Bank Nederlandse Gemeenten N.V.
DK	Nykredit	NL	Coöperatieve Centrale Raiffeisen-Boerenleenbank B.A.
DK	**Sydbank**	**NL**	**ING Bank N.V.**
EE	AS DNB Pank*	**NL**	**SNS Bank N.V.**
EE	Swedbank AS*	**NL**	**The Royal Bank of Scotland N.V.***
ES	**Banco Bilbao Vizcaya Argentaria**	NO	DNB Bank Group
ES	**Banco de Sabadell**	PL	Alior Bank SA
ES	Banco Financiero y de Ahorros	**PL**	**Bank BPH SA**
ES	Banco Popular Espanol	**PL**	**Bank Handlowy W Warszawie SA**
ES	**Banco Santander**	**PL**	**Bank Ochrony Srodowiska SA**
ES	**Bankinter**	**PL**	**Getin Noble Bank SA**
ES	Caja de Ahorros y M.P. de Zaragoza	PL	Powszechna Kasa Oszczednosci Bank Polski S.A.
ES	**Caja de Ahorros y Pensiones de Barcelona**	PT	Banco BPI
ES	Cajas Rurales Unidas	PT	Banco Comercial Portugues
ES	Catalunya Banc	PT	Caixa Geral de Depósitos
ES	Kutxabank	**SE**	**Nordea Bank AB (publ)**
ES	Liberbank	**SE**	**Skandinaviska Enskilda Banken AB (SEB)**
ES	NCG Banco	**SE**	**Svenska Handelsbanken AB**
FI	**Nordea Bank Finland Abp***	**SE**	**Swedbank AB (publ)**
FI	**OP-Pohjola Group**	SI	Nova Kreditna Banka Maribor d.d.
FR	Banque PSA Finance	SI	Nova Ljubljanska banka d. d.
FR	**BNP Paribas**	SI	SID - Slovenska izvozna in razvojna banka
FR	BPI France	SK	Slovenská sporitelňa, a.s.*
FR	**Groupe BPCE**	SK	Tatra banka, a.s.*
FR	**Groupe Crédit Agricole**	SK	Všeobecná úverová banka, a.s.*
FR	**HSBC France***	**UK**	**Barclays plc**
FR	La Banque Postale	**UK**	**HSBC Holdings plc**
FR	RCI Banque	**UK**	**Lloyds Banking Group plc**
FR	**Société Générale**	**UK**	**Royal Bank of Scotland Group plc**
GR	Alpha Bank		

Notes: Banks subject to national supervision not included in EBA sample. Banks in bold are in the sample for the comparison analysis driven in Section 6.4 (58 banks).
Source: ECB, 2014b, EBA, 2014a

B. Details of the parameters defined for the adverse scenario

Table 6.10: Country-specific parameters for the macroeconomic adverse scenario

	EBA 2011 (2011/2012)	Worst Value 2011-2013	EBA 2014 Adverse (2014/2015/2016)
GDP EU	-0.4%/0.0%	-0.40%	-0.7%/-1.4%/0%
GDP Germany	-0.9%/0.5%	0.40%	-0.9%/-2.0%/1.4%
GDP Greece	-4.0%/-1.2%	-7.10%	-1.6%/-0.6%/1.2%
GDP Ireland	-1.6%/0.3%	-0.30%	-1.3%/-0.7%/0.5%
GDP Italy	-0.1%/-1.0%	-2.40%	-0.9%/-1.6%/-0.7%
GDP Portugal	-3.0%/-2.7%	-3.20%	-0.8%/-2.3%/-1.1%
GDP Spain	-1.1%/-0.7%	-1.60%	-0.3%/-1.0%/0.1%
Unemployment EU	10%/10.5%	10.80%	11.3%/12.3%/13.0%
Unemployment Germany	6.8%/6.9%	5.90%	5.4%/6.0%/7.0%
Unemployment Greece	15.2%/16.3%	27.30%	26.5%/25.3%/21.6%
Unemployment Ireland	14.9%/15.8%	14.70%	12.4%/12.9%/14.0%
Unemployment Italy	8.6%/9.2%	12.20%	12.9%/13.7%/14.4%
Unemployment Portugal	11.6%/13.0%	16.50%	17.2%/18.2%/17.3%
Unemployment Spain	21.3%/22.4%	26.40%	26.3%/26.8%/27.1%
HICP Inflation EU	1.5%/0.5%		1.1%/0.6%/0.0%
HICP Inflation Germany	1.6%/1.5%		1.4%/0.9%/0.4%
HICP Inflation Greece	2.2%/-0.1%		-1.0%/-0.9%/-0.7%
HICP Inflation Ireland	0.1%/0.6%		0.7%/0.4%/0.3%
HICP Inflation Italy	1.3%/0.8%		0.9%/1.0%/0.6%
HICP Inflation Portugal	1.2%/-0.3%		0.7%/0.1%/-0.7%
HICP Inflation Spain	0.9%/-0.2%		0.3%/0.4%/0.8%
Gvt Yields EU	3.3%/3.5%	4.30%	4.4%/4.3%/4.4%
Gvt Yields Germany		2.60%	2.9%/2.9%/3.0%
Gvt Yields Greece		22.50%	11.2%/10.6%/10.7%
Gvt Yields Ireland		9.60%	4.9%/4.8%/4.9%
Gvt Yields Italy		5.50%	5.9%/5.6%/5.8%
Gvt Yields Portugal		10.60%	7.4%/7.1%/7.2%
Gvt Yields Spain		5.90%	5.7%/5.5%/5.6%
House Prices EU	(-3.8%/-11.6%)	-1.60%	-7.9%/-6.2%/-2.1%
House Prices Germany		1.40%	-4.5%/-1.8%/2.3%
House Prices Greece		-12.50%	-11.1%/-9.9%/-7.9%
House Prices Ireland		-15.40%	-3.5%/-0.9%/1.4%
House Prices Italy		-7.00%	-7.9%/-4.7%/-3.3%
House Prices Portugal		-8.40%	-9.3%/-7.5%/-4.6%
House Prices Spain		-16.90%	-7.4%/-3.0%/0.9%

Source: ESRB, 2014a, Steffen, 2014

C. Stress test outcomes - CET1 ratio, CET1 capital and RWA

Within Basel III the definition of capital was reviewed since several capital instruments proved to have an insufficient loss-absorbing capacity. *Common Equity Tier 1 ratio* (*CET1 ratio*) is the main solvency indicator employed in the CA. The phase-in of CET1 ratio states that the minimum level has to be raised by 4.5% of risk-weighted assets, after deductions. The CRR/CRD IV directive imposes the minimum Tier 1 capital to reach 8% of RWA in 2019.

(A) *Common Equity Tier 1 capital (CET1 capital)* represents the core capital of banks and it sums the amount of common shares, stock surplus given by share premiums recorded at new issuances of shares, retained earnings and minority interest in consolidated subsidiaries of the bank.

According to the CRR/CRD IV Directive No 575/2013, the regulatory CET1 capital will be measured based on the amount of instruments eligible as CET1 capital to which a set of deductions and adjustments will be applied. This rule is part of the capital adequacy framework whose aim is to improve the quality, the consistency and the transparency of regulatory capital. Specifically, the deductions and adjustments that are applied to the amount of core capital are related to unrealized gains/losses on AFS portfolio, participations in other financial sector entities, intangibles assets, goodwill, deferred tax assets (DTAs), shortfalls due to IRB measures of RWA, phase-out prudential filters and others. Beyond the supervisory objective of this rule, there is also a prudential objective that consists in reducing the artificial volatility of regulatory capital. We detail in what follows the calculation formula for the CET1 capital as in CRR/CRD IV:

Table 6.11: Composition of CET1 capital

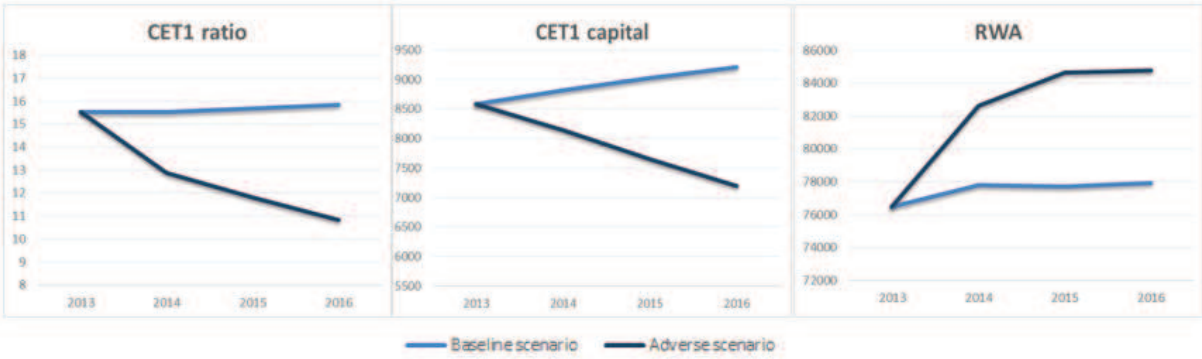
COMMON EQUITY TIER 1 CAPITAL (net of deductions and after applying transitional adjustments)
= Capital instruments eligible as CET1 Capital (including share premium and net own Capital instruments)
(+) Retained earnings
(+) Accumulated other comprehensive income
(+) Other Reserves
(+) Funds for general banking risk
(+) Minority interest given recognition in CET1 capital
(+) Adjustments to CET1 due to prudential filters
(-) Intangible assets (including Goodwill)
(-) DTAs that rely on future profitability
(-) IRB shortfall of credit risk adjustments to expected losses
(-) Defined benefit pension fund assets
(-) Reciprocal cross holdings in CET1 Capital
(-) Excess deduction from Additional Tier 1 items over AT1 Capital
(-) Deductions related to assets which can alternatively be subject to a 1.250% risk weight
(-) Holdings of CET1 capital instruments of financial sector entities
(-) Amount exceeding the 17.65% threshold
(+) Transitional adjustments

Notes: CRR/CRD IV Directive 2013/36/UE

Retained earnings represent the percentage of net earnings not paid out as dividends but retained by the company to be reinvested in its core business or to pay debt.
Comprehensive income includes revenue, finance costs, tax expenses, discontinued operations, profit share and profit/loss.

Adjustments due to prudential filters are made for instruments that are no longer eligible under the new prudential framework.
Intangible assets and goodwill represent the valuation of investments in the capital of banks. These items have to be fully deducted in the calculation of CET1 capital for reasons of their weak loss absorbing capacity in times of distress. The amounts of intangible assets and goodwill are reported according to IFRS definition.
Deferred-Tax assets (DTAs) are claim or receivable tax assets and rely to future profitability of banks. The corresponding amount is deducted in the calculation of CET1 capital since it cannot be recognized for core capital purposes.
Transitional adjustments concern the implementation of new prudential standards and states for capital instruments that are eligible for inclusion in CET1 capital. They may be due to grandfathered CET1 Capital instruments or to additional minority interests[48].
Shortfall of Provisions to Expected Losses have applied by banks using an IRB approach. Any shortfall of provisions to expected losses has to be deducted from CET1 capital.
(B) *RWAs* sum all risk-weighted assets generated through credit, market and operational activities. The amount of RWA can be calculated using either the STA or IRB approaches. We use AQR - adjusted risk exposures[49].

Figure 6.17: The evolution of CET1 ratio and of its components (2013-2016)



Notes: Average values for the sample of 135 banks.

D. Business model of banks

The business model of banks is defined using factor analysis/correlation. The principal-component factor analysis is applied to data describing the structure of the asset portfolio in 2013. Then, clusters of banks are composed according to their business model[50] by

[48] If the instruments are not included in the regulatory capital of the financial entity then it is not required to be deducted from the capital of the bank which holds the participations.
[49] The RWA for credit exposures distinguishes between RWA for securitization and RWA counterparty credit risk. The latter is reported in EBA/ECB data as risk exposures for other credit risk. Comparing the value of RWA announced by banks before AQR with the revised one, we find that the two values are still strongly correlated. The correlation coefficient between the two variables (RWA before AQR and RWA after AQR adjustments) is equal to 0.9018 and it is statistically significant for a 1% confidence level.
[50] The definition of the variable Business model is the same as in Chapter 5. The main difference relative to the variable used in Chapter 5 is that here BM is defined based only on 2013 accounting data.

using Euclidean distances to measure the similarity of BM's values[51]. The tables below provide more insight on the methodology for assessing the variable BM.

Table 6.12: BM - Results of PCA analysis

Factor	Eigenvalue	Difference	Proportion	Cumulative
Factor1	1.39199	0.51400	0.4640	0.4640
Factor2	0.87799	0.14798	0.2927	0.7567
Factor3	0.73002	.	0.2433	1.0000

Notes: LR test: independent vs. Saturated: $\chi^2(3) = 134.16$ Prob> $\chi^2 = 0.000$

Table 6.13: PCA analysis - the pattern matrix

Variable	Factor1	Uniqueness
Trading securities	0.6091	0.6290
Interbank lending	0.6759	0.5431
Derivatives	0.7511	0.4359

Notes: The pattern matrix reports rotated factor loadings and unique variances. LR test: independent vs. Saturated: $\chi^2(3) = 134.16$ Prob> $\chi^2 = 0.000$

Table 6.14: BM - details of PCA analysis (1)

Factor	Variance	Difference	Proportion	Cumulative
Factor1	1.39199	.	0.4640	0.4640

Notes: After rotation using orthogonal varimax (Kaiser off). LR test: independent vs. saturated: $\chi^2(3) = 134.16$ Prob> $\chi^2 = 0.0000$

Table 6.15: BM - details of PCA analysis (2)

Variable	Factor1	Uniqueness
Trading securities	0.6091	0.6290
Interbank lending	0.6759	0.5431
Derivatives	0.7511	0.4359

Notes: We display rotated factor loadings (pattern matrix) and unique variances

Table 6.16: BM - Scoring coefficients based on varimax rotated factors

Variable	Factor1
Trading securities	0.43757
Interbank lending	0.48558
Derivatives	0.53957

We are therefore able to define 3 types of business models:

- *Commercial-oriented banks* focused on retail activities,

[51] We choose the cluster analysis to define groups of business models since this methodology fits better the framework of our analysis. We also experienced quantiles analysis which forms groups using quantitative tools. Results are not consistent using quantiles categories since the groups defined using this methodology are not homogenous.

- *Universal banks (UB)* characterized by more complex and diversified balance sheet structures, and
- *Investment-oriented banks* having a significant proportion of market based activities in their asset portfolio.

The cluster for retail-oriented banks is the one composed by banks with the lowest values of BM while the cluster for investment-oriented banks is consistent with highest valued of BM which correspond to higher proportions of market based activities (Figures 6.18 and 6.19).

Figure 6.18: Factor-components of the *BM*

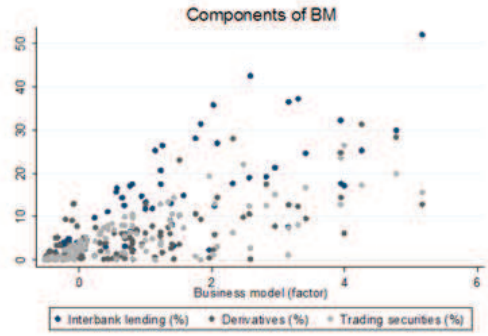
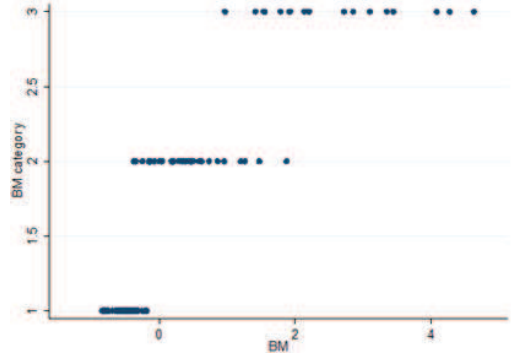


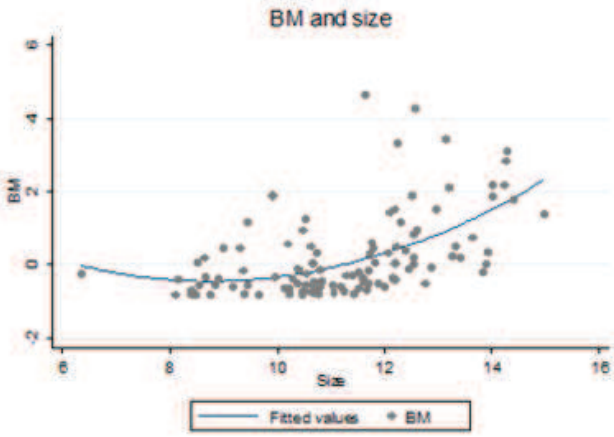
Figure 6.19: Categories of BM



Notes: We define a qualitative variable, BM cluster, which worth 1 for commercial banks oriented on retail activities (80 banks), 2 for universal banks (39 banks) and 3 for universal banks-oriented investment (16 banks). Clusters are defined based on BM values in 2013.

Figure 6.20 below shows that commercial banks are generally among the smallest while investment-oriented banks are among the largest in our sample. The size effect for the variables RWAs and CET1 capital could suggest that the larger banks hold higher amounts of capital and are also more exposed to risks since the size of their asset portfolio is considerably larger. This is consistent with findings in previous chapter.

Figure 6.20: BM and size



Notes: Data is fitted according a quadratic regression of BM on size and size^2

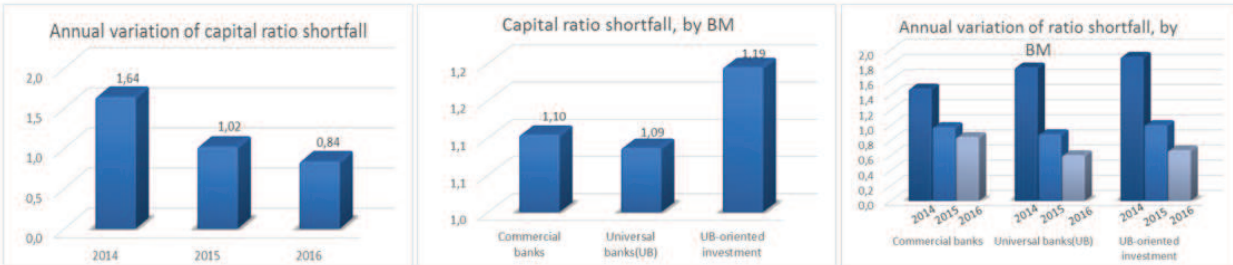
E. Alternative measure of shortfall

For robustness concerns, we compute the annual variation of the CET1 ratio according to the formula:

$$annualCET1ratioshortfall_{t+1} = CET1ratio_t - CET1ratio_{t+1} \tag{6.5}$$

Where t takes the values 2013, 2014 and 2015. Figure 6.21 plots the evolution of the annual CET1 ratio shortfall for each period, by type of business model and combined - by type of business model and by year.

Figure 6.21: Evolution of annual CET1 ratio shortfall

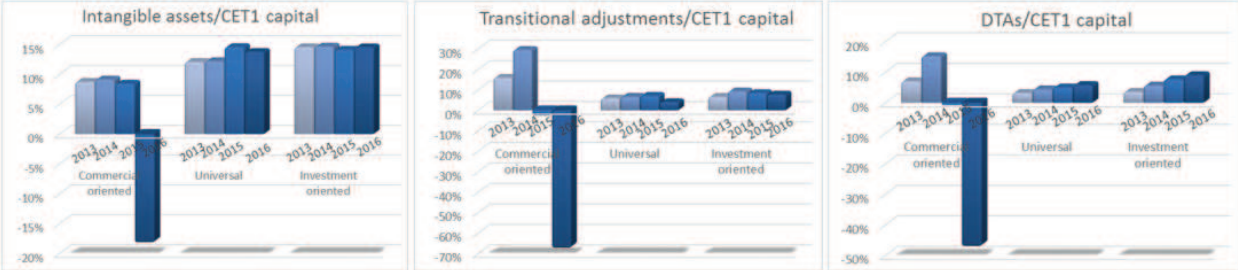


Notes: The sample counts 80 commercial-oriented banks, 39 universal banks and 16 investment-oriented banks.
Source: Author's calculations

The upper left illustrates a decreasing trend for the shortfall defined as a year-to-year variation. This result comes of the consequence of the evolution of stress factors assumed within the adverse scenario. The evolution of the main stress factors is plotted in Figure 6.1 in Section 6.1.2 and indicate lower values for 2014 and a recovery for the two last years. This translated into a greater impact in 2014 than in 2015 and 2016. Moreover, the distribution of the shortfall by type of business model can be easily explained through methodological aspects relied to risk cover. Commercial banks incur in average higher shortfall than universal banks since retail activities which are the principal component of their balance sheet are hit stronger than other activities. In turn, universal banks and moreover, universal banks oriented on investment activities record important losses in 2014 due to the market shocks whose impact is distributed over the 3 years with 50% of losses entering into the accounts in 2014, 30% in 2015 and 20% in 2016.

Given this strong dependence of the annual shortfall on the structure stressed factors imposed within the adverse scenario, it will not be used further in our empirical analysis as an interest variable. We will rather consider the definition of shortfall that accounts for cumulative impact since it is more in line with the topic of our chapter.

Figure 6.22: Capital adjustments, by business model and by year



Notes: We scale the amounts of adjustments to the period corresponding level of CET1 capital. Intangible assets include the goodwill. DTAs correspond to the amount of deferred-tax assets. For more details on these different adjustments, please see ECB (2014a). Intangible assets and DTAs have a negative impact while transitional adjustments have a positive impact on the CET1 capital. The negative values in 2016 for commercial banks correspond to banks which record a negative amount of CET1, and namely Eurobank Ergasias (GR), National Bank of Greece (GR), Co-operative Central Bank Ltd (CY), Hellenic Bank Public Company Ltd (CY), Banca Monte dei Paschi di Siena (IT).
Source: Author's calculation

F. Robustness check analysis

Table 6.17: Components of the capital ratio. Robustness check panel-regressions

	(1)	(2)	(3)	(4)
VARIABLES	Capital shortfall/TA	RWA/TA	Capital shortfall/TA	RWA/TA
	T1 ratio		*Leverage*	
Solvency ratio	-0.0918	0.000305	-1.714	-0.000724
	(-0.157)	(1.117)	(-1.634)	(-0.895)
NSFR	-0.175*	-0.000346***	-0.0691	-0.000198***
	(-1.965)	(-4.454)	(-0.695)	(-2.765)
ST Liq ratio	-0.0505*	4.22e-05**	-0.0536**	4.08e-05**
	(-1.805)	(2.009)	(-2.144)	(2.415)
Constant	29.93**	0.0453***	31.45***	0.0438***
	(2.488)	(6.687)	(4.134)	(8.068)
Observations	405	405	405	405
R^2	0.009	0.080	0.019	0.056
R^2 adj	-0.000600	0.0715	0.0102	0.0474
F	2.485	14.49	2.835	9.097

Notes: The dependent variables are the two components of the capital ratio. Solvency ratio is defined simultaneously by the risk-weighted capital ratio (T1 ratio) and the leverage ratio. Robust t-statistics in parentheses *** p<0.01, ** p<0.05, * p<0.1.

Table 6.18: Total shortfall in solvency ratio. Robustness check panel-regressions

	(1)	(2)	(3)	(4)	(5)
VARIABLES			Total capital ratio shortfall		
Solvency ratio	0.0867	0.0564	0.104	0.0866	0.153*
	(1.040)	(0.592)	(1.225)	(1.010)	(1.943)
NSFR	-0.0689***		-0.0742***	-0.0564**	-0.101***
	(-2.665)		(-2.717)	(-2.175)	(-3.007)
ST Liq ratio		0.000402	-0.00783		
		(0.0619)	(-0.701)		
Wholesale funding				0.0518	
				(1.641)	
Liquid assets					-0.105**
					(-1.992)
Constant	11.45***	7.245***	11.85***	9.301***	14.72***
	(4.894)	(4.891)	(4.750)	(4.329)	(4.522)
Observations	135	135	135	135	135
R^2	0.046	0.003	0.049	0.057	0.086
R^2 adj	0.0276	-0.0161	0.0215	0.0295	0.0595
F	4.793	0.204	3.343	3.772	4.124

Notes: The dependent variable is the total capital ratio shortfall over the 3 years of stress scenarios. It represents the sum of annual shortfall in the capital ratio. The solvency ratio is measured by the T1 ratio. Results for the leverage ratio are not reported since there are not stable and statistically significant. Robust t-statistics in parentheses *** p<0.01, ** p<0.05, * p<0.1.

Conclusion Générale

L'instabilité financière a, dans une large mesure, été engendrée par des incitations perverses (prêteur en dernier ressort, fiscalité de la dette, politiques de rémunération etc) qui ont induit une mauvaise gestion des risques des institutions, mais aussi, par une évaluation inappropriée des risques financiers par les régulateurs. Alors que l'imposition de règles rigides aurait pu réduire la fréquence des faillites bancaires, leur coût pourrait réduire l'efficience des systèmes bancaires. En effet, l'adoption d'une régulation bancaire est fondée sur un arbitrage entre la fermeté des normes et l'efficience du système de paiement et de financement. Le "dosage" choisi par le régulateur a donné lieu à des incitations adverses, ce qui a conduit au développement des structures bancaires peu résistantes aux chocs.

Après la crise des subprimes, le durcissement des normes prudentielles, bien qu'indispensable pour restaurer la stabilité des structures bancaires, a été fortement critiqué par la profession bancaire, qui a voulu convaincre de l'impact négatif sur l'activité réelle, en raison d'un coût de mise en place très onéreux.

Ainsi, l'objectif de cette thèse a été d'analyser comment le cadre réglementaire post-Lehman devrait s'efforcer de réduire les incitations perverses afin de mieux assurer la stabilité des systèmes financiers. Elle cherche à expliquer comment les incitations adverses de la régulation ont affecté la structure des bilans bancaires et leur exposition aux risques. Après avoir traité des questions liées à l'effet que ces nouvelles normes prudentielles peuvent avoir sur le coût de financement selon les business models, nous avons focalisé notre analyse sur une des principales distorsions de l'activité bancaire : les garanties implicites offertes aux banques TBTF. Enfin, nous avons évalué les bénéfices du nouveau cadre prudentiel en termes de réduction des risques financiers.

Partie 1

Lors d'une restructuration du cadre réglementaire, la question des coûts supplémentaires que les banques doivent supporter est au cœur des débats. Dans le contexte de la réforme Bâle III, nous avons analysé, dans un premier chapitre, la question de l'impact du renforcement des exigences en fonds propres sur le coût du capital, en nous appuyant sur le

théorème de la neutralité de l'endettement de Modigliani-Miller et sur le MEDAF. L'étude empirique nous a conduit à trois principales conclusions. Tout d'abord, malgré les limites évoquées quant à l'application du théorème de Modigliani-Miller au système bancaire, dues pour l'essentiel à des imperfections de marché, les résultats indiquent l'existence d'un effet partiel de compensation entre la hausse de la proportion des ressources stables, plus chères, et la réduction du risque systématique des institutions. Ainsi, la hausse du coût moyen pondéré du capital est sensiblement plus faible que celle indiquée par la profession bancaire (IIF, 2010). Ensuite, il résulte de l'analyse que les marchés accordent davantage de confiance au levier qu'au ratio de capital pondéré des risques dans le processus d'évaluation du risque. Néanmoins, l'adoption simultanée de ces deux mesures pourrait réduire davantage l'exposition aux fluctuations des marchés, bien que leur importance diffère selon le type de business model[52]. Enfin, le coût lié aux normes renforcées des fonds propres devrait être, en moyenne, peu conséquent. Pour les banques systémiques, ce coût pourrait être supérieur en raison des exigences plus sévères qui les concernent. Celui-ci serait induit par une réduction des avantages fiscaux (garanties implicites, imposition sur la dette) suite à une réduction du levier.

Quant aux inquiétudes concernant les effets adverses du renforcement des normes prudentielles, notamment sur la prise de risque supplémentaire pour assurer un niveau élevé de rentabilité, l'imposition de deux mesures complémentaires dans leurs objectifs - un ratio de solvabilité tenant compte du risque des actifs et un ratio de levier limitant le niveau d'endettement - sont censées réduire ces incitations perverses.

En outre, pour réduire l'aléa moral lié à l'existence du prêteur en dernier ressort, l'adoption d'une régulation de liquidité a été inévitable après le choc financier de 2008. Elle vient ainsi compléter le cadre prudentiel dans l'objectif d'assurer une meilleure couverture des risques émergeant de l'évolution des business models (on est passé du modèle "*originate-to-hold*" au modèle "*originate-to-distribute*"). Néanmoins, la difficulté à définir et mesurer la liquidité bancaire, qu'elle concerne l'intermédiation de bilan ou celle de marché, a alourdi l'exercice d'évaluation de l'impact des normes de liquidité. Ceci explique pourquoi notre attention s'est concentrée sur le ratio structurel de liquidité à long-terme, le NSFR (deuxième chapitre). Après avoir analysé son évolution dans le temps et selon les structures bancaires, nous avons étudié les stratégies adoptées entre 2011 et 2013 qui ont permis aux banques de s'aligner sur les standards réglementaires. Par ailleurs, des différences considérables sont constatées entre les institutions selon leur

[52] Il apparaît que pour les banques universelles orientées vers les activités d'investissement, le ratio de levier domine le ratio de capital pondéré des risques, alors que pour les banques commerciales, le ratio pondéré des risques est plus pertinent que le ratio de levier dans l'évaluation du risque de marché.

taille, leur importance systémique et leur business model, mais également entre les pays, notamment en raison des spécificités de leur système bancaire[53].

Enfin, nous nous sommes attachés à l'évaluation de l'impact sur le coût de financement et sur l'activité traditionnelle des banques. Nos résultats indiquent que l'inquiétude des autorités publiques et du régulateur, quant à la hausse des taux et à la réduction du volume de crédit, ne s'est pas concrétisée pour les banques sous revue. L'explication viendrait, dans le contexte actuel, des taux de refinancement très faibles qui ont permis une mise en place des stratégies d'amélioration de la structure de refinancement peu couteuses. De plus, l'adoption du ratio structurel de liquidité a soulevé la question de la désintermédiation. Alors que l'architecture des économies européennes a été historiquement basée sur le financement intermédié, le passage vers un financement de l'économie (notamment des entreprises) plus axé sur les marchés ne semble pas réalisable dans un futur proche.

Partie 2

L'évolution des structures financières a été influencée, depuis toujours, par des incitations visant à contourner la régulation qui leur a été imposée. Parmi celles-ci, les garanties "offertes" par l'Etat pour éviter des faillites bancaires coûteuses ont généré des niveaux d'endettement excessifs et des prises de risques considérables. Or, les aides massives des autorités publiques pendant la crise des subprimes n'ont fait qu'accroitre le caractère systémique des banques (expansion des bilans, complexité accrue des activités, diversification transfrontalière)[54]. De plus, le lien entre les dettes souveraines et celles des institutions financières s'est vu renforcé et a ainsi contribué à l'amplification de la crise des dettes publiques en Europe. Pour ces raisons, le problème du TBTF a été encore plus impactant en Europe que dans d'autres pays. Le rôle clé des banques pour l'économie européenne et leur taille surdimensionnée par rapport à l'activité économique sont bien plus importants qu'ailleurs (qu'aux Etats-Unis par exemple).

C'est pourquoi, nous avons souhaité apporter notre contribution à l'étude des garanties implicites et de leurs déterminants pour mieux comprendre leur évolution (chapitre trois). En adoptant une approche basée sur des ratings, nous avons évalué l'ampleur des garanties implicites, ce qui a mis en évidence trois principales phases. Au début des années 2000, nous retrouvons des niveaux faibles, ensuite nous constatons une très forte hausse pendant la période de crise (2007-2010), puis, elles sont revues à la baisse (2011-2014). La résilience des banques est un premier élément déterminant dans la valeur de ces garanties, cependant

[53] Nous montrons l'existence d'une relation négative entre le niveau de NSFR et la taille. Si l'importance systémique est considérée comme critère de sélection, les G-SIBs ont des NSFRs d'environ 80% alors que les autres banques sont plus près du niveau réglementaire de 100%. En général, le niveau du ratio NSFR est bien supérieur pour les banques commerciales à celui de celles orientées vers les activités de marché. L'appartenance à la zone euro semble avoir un impact également puisque les banques des pays membres ont un niveau de NSFR plus élevé que les autres banques de l'UE (spread de 5%).

[54] Haldane (2015)

la capacité de support des Etats intervient également. D'autres éléments semblent avoir impacté les attentes des marchés à propos de l'intervention des gouvernements pour sauver les banques en difficulté. Au-delà de la taille, déterminant essentiel, la forte dépendance au financement de marché de court-terme a renforcé le caractère TBTF des banques. Ainsi, les banques très interconnectées, désignées comme étant systémiques, profitent globalement d'un soutien plus appuyé que les autres banques.

Il est donc apparu essentiel d'approfondir l'analyse et d'évaluer l'impact des différentes mesures prises pour réduire l'aléa moral généré par l'existence du phénomène TBTF (désignation des institutions systémiques, des normes permettant de passer de bailout au bail-in). Dans le chapitre quatre, nous consacrons une attention toute particulière aux cadres de résolution adoptés, d'une part au niveau des systèmes bancaires nationaux, et d'autre part au niveau international. Nos résultats montrent que, dans les pays ayant mis en place des régimes de résolution, les banques ont connu une plus forte baisse de la valeur des garanties implicites que les banques d'autres pays. Ainsi, la réduction de l'ampleur de ces distorsions, à partir de 2011 peut s'expliquer par la capacité de support affaiblie des gouvernements, mais aussi par l'effet des régimes de résolution.

Nous montrons également que cette réduction est moindre pour les institutions désignées comme G-SIBs, comparée à d'autres banques de taille similaire. A ce stade, il apparaît que les initiatives des régulateurs, consistant à désigner ces banques d'importance systémique, n'ont pas eu (au moins jusqu'à présent) l'effet désiré puisqu'elles continuent de bénéficier de la protection étatique. Finalement, les normes de résolution européennes, d'une part au niveau décisionnel (avec l'accord sur la BRRD en 2013) et d'autre part au vu de l'application des politiques de résolution dans le cas chypriote, n'ont pas eu de contribution significative à la réduction de mauvaises incitations données par les garanties implicites.

Le fait que les distorsions persistent dans l'activité des grandes banques suggère qu'un suivi renforcé de l'implémentation de la nouvelle régulation bancaire est indispensable. En particulier, une meilleure coordination des mécanismes de supervision et de résolution au niveau international pourrait éliminer les externalités négatives et assurer la stabilité des systèmes qui passe, sans aucun doute, par la stabilité des grandes institutions.

Partie 3

L'objectif d'exigences prudentielles plus strictes vise principalement l'amélioration de la stabilité financière par une réduction de la fréquence des faillites bancaires et des externalités associées. C'est pourquoi la question posée dans la dernière partie de la thèse concerne la capacité des normes plus strictes de capital et de liquidité à prévenir le défaut des banques. Nous nous sommes focalisés sur deux mesures de risque financier :

la probabilité de défaut et le risque systémique, tel qu'il est défini par le SRISK (chapitre cinq). La complémentarité des mesures de solvabilité et de liquidité est testée et les résultats montrent que le ratio structurel de liquidité est le déterminant primordial des mesures de risque étudiées. Son effet est encore plus important pour les grandes banques ou pour celles orientées vers des activités de marché. Quant à l'impact du ratio de liquidité de court-terme, les résultats sont mitigés. La définition de ce ratio (un proxy du LCR) ainsi que la difficulté à capter les crises de liquidité, de courte durée, à travers des données annuelles pourraient justifier ces résultats.

Par ailleurs, pour renforcer la supervision de banques, des tests de résistance (*stress tests*) ont été mis en place. Leurs résultats représentent une source riche de données bancaires, qui nous a permis développer une nouvelle mesure de risque, le shortfall du ratio de solvabilité[55] (chapitre six). Nous avons tout d'abord mis en évidence la manière dont les aspects techniques liés à la définition du scénario adverse ont impacté les projections des pertes en ratio de solvabilité. En effet, la focalisation sur l'activité de crédit a conduit à l'estimation de pertes élevées pour les banques commerciales, alors que les banques dites d'investissement semblent avoir été "protégées" par le scénario. L'explication provient notamment de l'insuffisante prise en compte, d'une part, des interactions entre les banques et, d'autre part, au sein d'une même institution, de la négligence des interactions entre les activités de marché et les activités traditionnelles[56]. Au final, nos résultats empiriques indiquent que le NSFR domine largement les ratios de solvabilité pour expliquer l'amplitude du shortfall. Les vulnérabilités des banques semblent être générées par la dépendance au financement de marché de court-terme.

Reste alors à comparer les différentes mesures de risque analysées précédemment. Pour cela, nous avons été amenés à utiliser un échantillon un plus petit mais plus homogène, constitué de grandes banques universelles[57]. De cette analyse comparative, le résultat essentiel et le plus robuste concerne le NSFR qui est identifié comme un déterminant principal du shortfall et du SRISK. Nous n'avons pas abouti à des résultats homogènes pour les trois différents indicateurs de risque, ce qui peut s'expliquer par les méthodologies et objectifs différents: la probabilité de défaut et les SRISK - étant basés sur les prix de marché - évaluent l'évolution des banques en cas de choc sur les marchés, alors que le shortfall est basé sur les données de bilan et transcrit davantage les pertes dans les portefeuilles de crédit.

D'importantes implications découlent de ce travail empirique. Il apparaît qu'une crise n'affecte pas de la même manière les différents types de banques (selon l'activité et la

[55] Nous utilisons les résultats des stress tests mis en place par l'Autorité Bancaire Européenne (EBA) et la Banque Centrale Européenne en 2014.

[56] Tandis que le choc affecte davantage le crédit supportant des pertes cumulatives pendant les trois années d'exercice, l'activité de marché a subi un choc seulement au cours de la première année et s'est redressée par la suite sans aucune autre conséquence sur l'activité des institutions.

[57] Le re-échantillonnage s'est imposé en raison de la disponibilité simultanée des trois mesures de risque.

taille). De plus, nos résultats indiquent un effet hétérogène de l'adoption des normes prudentielles selon les différentes catégories. Par conséquent, une solution possible pourrait être l'imposition de niveaux distincts des normes prudentielles au regard des risques portés, non seulement pour les G-SIBs (comme c'est le cas avec le TLAC), mais aussi pour les autres banques.

Limites de la thèse

Bien entendu, ce travail connait des limites dont la principale provient de l'accessibilité restreinte aux données bancaires et financières. Tout d'abord, la disponibilité de données à une fréquence plus élevée aurait permis d'évaluer des indicateurs de risque (probabilité de défaut et SRISK, en particulier) de manière plus précise. Ceci aurait pu améliorer la qualité des estimations. Ils auraient donné une image plus précise sur la capacité d'adaptation des banques aux normes règlementaires imposées. Ensuite, une meilleure communication sur les maturités des structures de financement et des actifs détenus aurait pu permettre une analyse plus détaillée des vulnérabilités ainsi qu'une évaluation plus réaliste des ratios de liquidité dont la méthodologie de calcul a évolué dans le temps. Par ailleurs, l'étude détaillée des positions du bilan aurait pu servir à identifier les caractéristiques qui donnent le statut de banque systémique, au-delà de la taille, et à quantifier les avantages implicites associés. De manière plus globale, une meilleure qualité des informations financières d'intérêt réglementaire, accessible non seulement pour les grands groupes bancaires mais aussi pour les plus petites banques, pourrait faciliter et améliorer la recherche académique[58]. D'ailleurs, on peut souligner la réticence des autorités à rendre publiques les données en leur possession (ACPR, AMF, ECB, EBA, SSM), suscitant des interrogations et pouvant nuire à leur crédibilité.

Une autre limite du travail mené dans cette thèse concerne la méthodologie d'évaluation des coûts de la nouvelle réglementation. Alors que nous avons privilégié les aspects microéconomiques, la question de l'impact macroéconomique reste très importante. Une étude au niveau macroéconomique aurait fourni un cadre global d'analyse de l'impact de la nouvelle régulation prudentielle en tenant compte des interactions, d'une part, entre les banques et le reste du système financier (notamment le shadow banking et le secteur de l'assurance) et d'autre part, entre les systèmes bancaire et financier et l'économie réelle.

Enfin, l'analyse des coûts des exigences en liquidité peut paraître assez sommaire. Cependant, il existe une difficulté réelle à définir le seuil "acceptable" de risque de liquidité et implicitement, le niveau optimal de liquidité. Par ailleurs, évaluer le coût de la

[58] Le rapport du Conseil national de l'information statistique (Capelle-Blancard and Bellando, 2015) délivre une analyse détaillée de la difficulté d'accès aux données bancaires et financières. Il met en avant le cas français considéré comme dramatique en termes de communication financière dans le domaine bancaire et financier.

mise en place de la régulation de liquidité ne peut se faire qu'à travers une analyse par approximations, à partir d'hypothèses sur les stratégies à mettre en place pour atteindre les exigences réglementaires.

Vers un système bancaire plus stable ?

Au final, les études d'impact ainsi que des statistiques plus récentes de l'EBA et du BCBS[59] montrent que les institutions bancaires sont en avance pour répondre aux exigences en capital et en liquidité qui leur ont été imposées par le régulateur pour 2019. Cela s'explique en partie par la pression des marchés mais aussi par la complémentarité des mesures proposées, même si elles sont définies de façon indépendante. En effet, le coût estimé de la mise en place d'un renforcement de la règlementation se voit réduit par les interdépendances des stratégies envisageables pour atteindre les standards.

En définitive, la principale inquiétude de la profession bancaire porte sur l'affaiblissement de la rentabilité en raison de la mise en place des nouvelles normes. Il faudrait néanmoins rappeler que les niveaux de rémunération dans le secteur financier est bien supérieurs à ceux des autres secteurs. Les incitations à augmenter la rentabilité des fonds propres soit par une prise de risque excessive, soit par la distribution des dividendes[60] , illustrent la vision court-termiste des dirigeants et des actionnaires. Ces mauvaises pratiques de gouvernance, elles-mêmes à l'origine de la dernière crise financière, impactent directement le niveau de solvabilité, qui aurait pu sécuriser la résilience des institutions financières aux chocs et, ainsi, rétablir la confiance des investisseurs. C'est pourquoi, un encadrement plus strict de la politique de distribution des dividendes, accompagnant un cadre prudentiel de capital et de liquidité adéquat, pourrait être une alternative encourageante pour combattre les mauvaises incitations, qui s'accordera avec une plus grande stabilité.

Il faut toutefois admettre que l'ensemble des mesures proposées dans la période post-Lehman peut engendrer des transformations, qui sont d'ailleurs indispensables pour corriger les imperfections. En revanche, elles peuvent aussi laisser place à d'autres changements, notamment dans les modèles de financement de l'économie réelle[61]. Or, une mise en place efficiente de la régulation devrait conduire à mieux gérer les risques et à proposer

[59] EBA (2014a); ECB (2014b)

[60] Shin (2016) discute les stratégies malsaines mises en place par les banques à partir de 2014 pour augmenter la valeur du ratio cours boursier/valeur comptable (market to book ratio). Plus précisément, elles ont choisi de distribuer les profits sous forme de dividendes au lieu de les intégrer dans le capital, ce qui aurait permis d'augmenter la base de fonds propres réglementaires.

[61] Le débat sur les effets des normes réglementaires renforcées pourrait être redirigé sur la question des business models. La banque universelle, qui semble avoir mieux dépassé la crise, est aussi à la base de nombreux effets adverses (activités imbriquées qui ne sont pas nécessairement facile à concilier, plus forte concentration et développement des activités transfrontalières (Pollin, 2009)). Leur évolution peut se faire vers des structures plus robustes, ce qui pourrait impliquer des solutions plus ou moins radicales (la séparation des activités, par exemple). Néanmoins, de telles mesures permettraient une distinction plus claire des activités bancaires et une moindre transmission des fluctuations de marché à la distribution de crédit. De plus, elles pourraientt favoriser la mise en pratique des outils de résolution qui, à ce stade de développement, sont encore fortement contestés.

des tarifs appropriés. Cela devrait donc permettre de continuer à proposer des financements, même pour des horizons plus longs. Dans ces conditions, la désintermédiation ne sera pas obligatoirement plus compétitive. De plus, l'hypothèse d'un passage vers un modèle de financement à l'anglo-saxonne est encore moins probable, étant donné que les systèmes économiques européens ont historiquement été demandeurs de financements sécurisés et stables[62] et sont construits autour de relations bancaires de long-terme. La vision court-termiste des marchés serait donc incompatible avec le modèle européen.

Dans le même ordre d'idées, des inquiétudes existent sur les dangers de plus hautes exigences en fonds propres et le transfert de risques vers le shadow banking (Plantin, 2015). Ces structures de l'ombre, se situant à la limite entre le système bancaire et les marchés, peuvent servir d'instrument d'arbitrage réglementaire pour les banques[63] et contribuer ainsi à l'accroissement du risque systémique en raison des interconnexions qu'elles créent au sein du système financier. Il apparait donc indispensable de contrôler davantage l'activité des institutions financières pour s'assurer de l'adoption efficace des règles prudentielles et des bonnes pratiques de gestion des risques. Cela est d'autant plus important actuellement, étant donné la volonté des autorités publiques à encourager le crédit, ce qui, maintenu sur des horizons plus longs, pourrait avoir des conséquences indésirables sur la prise de risque des banques. C'est pourquoi, un retour vers des conditions de financement plus strictes est nécessaire pour assurer un équilibre financier et macroéconomique.

Les rôles clés de la supervision et de la discipline de marché permettront aussi une meilleure conscience des risques dans le système, qui pourra résoudre un problème de la régulation : sa capacité d'adaptation aux développements des activités bancaires et financières[64]. De manière plus globale, il ressort que l'évolution de la régulation a depuis toujours été fondée sur les faiblesses révélées durant les crises et focalisée sur le "plus jamais ça", de sorte que le système de régulation s'est construit comme une accumulation des réponses ponctuelles à des difficultés particulières. Et il se peut que ces dispositions, prises en ordre dispersé, soient contradictoires entre elles et finalement incomplètes.

[62] Le modèle social européen en est la preuve.

[63] Le FSB a proposé en 2013 des normes d'encadrement du shadow banking (FSB, 2013a). De plus, en 2015 des propositions d'évaluation de la taille de ces structures de l'ombre et un rapport de suivi de leur activité a été publié (FSB, 2015). Néanmoins, la définition du cadre réglementaire n'est pas prête à être finalisée.

[64] L'émergence de structures complexes, orientées davantage vers les marchés, devrait mieux être suivies et régulées davantage. Les structures internationales et diversifiées, nécessaires dans un contexte économique mondialisé, obligent la création d'outils capables d'assurer la résolution des établissements afin d'éviter un coût à la charge des autorités publiques ou des contribuables.

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Oana–Maria TOADER

Recherches sur les coûts et les bénéfices de la nouvelle régulation bancaire

Application au cas européen

Résumé :

L'arbitrage entre la stabilité et l'efficience des systèmes bancaires a toujours été au coeur de la définition des dispositifs de régulation bancaire. Cette thèse analyse comment cet arbitrage a été conçu et dans quelle mesure il a permis de concilier les deux types d'objectifs, c'est-à-dire les coûts et les bénéfices de la nouvelle réglementation. Nous évaluons, dans une première partie, l'impact des exigences renforcées en fonds propres et en liquidité sur le coût du capital et sur l'activité bancaire. Les résultats empiriques montrent de manière générale que les coûts des normes imposées par Bâle III sont relativement faibles et ont un impact limité sur l'activité de crédit. Nous mettons en évidence un effet différencié selon les différentes catégories de banques, selon leur taille, importance systémique ou business model. Un autre constat tiré de cette étude concerne les anomalies dans la tarification du risque, générées par l'existence des garanties implicites. C'est pourquoi, la seconde partie est consacrée à leur analyse approfondie et aux mesures mises en place pour éliminer le fameux problème de *too big to fail*. Même si des mesures ambitieuses ont été adoptées par les autorités de régulation, les distorsions liées à l'activité des banques TBTF persistent. On en vient à s'interroger, dans le cadre de la dernière partie, sur l'amélioration de la stabilité des institutions. Les résultats montrent que la mise en place des bonnes incitations, notamment grâce à des standards prudentiels adéquats, pourrait s'avérer comme une solution efficiente pour réduire les risques financiers (probabilité de défaut, sensibilité au risque systémique, perte en cas de scénario adverse). Ces différentes questions sont analysées pour les banques européennes. La démarche retenue est principalement empirique et les aspects microéconomiques ont été privilégiés.

Mots clés : solvabilité, liquidité, garanties implicites, résolution, risque financiers, stress test, coûts, bénéfices.

Essays on the costs and the benefits of the new regulatory framework

An application to European banks

Abstract:

The arbitrage between financial stability and the efficiency of banking systems has always been a key issue in defining the prudential regulation. This thesis analyses how this arbitrage is conceived and the extent to which it allows to reconcile the two objectives, namely the cost and the benefits of the new regulatory framework. We first focus on the impact of the new capital and liquidity requirements on the cost of capital and on banking activities. Our findings indicate that, globally, the cost of the recent reform is relatively low and does not have a significant impact on lending. We also emphasize a differentiated effect according to banks' size, systemic importance and business model. The existence of various distortions, affecting the pricing of risk, motivates the second part of the thesis, which is dedicated to the analysis of implicit guarantees. We also assess the impact of resolution regimes and practices in ending the *too big to fail* anomaly. Although ambitious measures have been undertaken, there is still a way to go to eliminate these distortions. In the third part, we examine the contribution of solvency and liquidity requirements to strengthen the resilience of banks. The results indicate that setting up good incentives, through adequate prudential standards, could efficiently reduce financial risks (default probability, systemic risk, capital shortfall in case of adverse scenario). The approach adopted in this thesis focuses on microeconomic aspects and is based on empirical studies applied to a sample of European banks.

Keywords: solvency, liquidity, implicit guarantees, resolution, risk of failure, stress test, cost, benefits.

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