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Michael Alfons Stemmer

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# Essays on Growth, Unemployment and Financial Development

Michael Alfons Stemmer

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Für Mama, Papa, Tobias und Oma.

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---

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# Résumé

Le traité de Lisbonne, qui est entré en vigueur le 1er Décembre 2009, après avoir été ratifié par la République Tchèque, le dernier pays membre de l'Union européenne, postule dans l'article 2 (3) *“L'Union établit un marché intérieur. Elle œuvre pour le développement durable de l'Europe fondé sur une croissance économique équilibrée et sur la stabilité des prix, une économie sociale de marché hautement compétitive, qui tend au plein emploi et au progrès social [...]”*.<sup>2</sup>

Pendant les premières décennies, les objectifs principaux de l'Union européenne, comme la prospérité économique et un renforcement continu du marché intérieur, ont été un succès. La formation de l'Union économique et monétaire de l'Union européenne en 1990, qui a été suivie par l'introduction de l'euro une décennie plus tard, a contribué à une intégration toujours plus étroite entre les pays membres de la zone Euro. La suppression des barrières de taux de change par le biais de la monnaie commune a également contribué à un renforcement puissant des relations commerciales et financières. De plus l'élargissement de l'UE, en particulier par l'entrée des pays d'Europe de l'Est, a permis l'adhésion de nouveaux marchés ouverts, ce qui a été bénéfique aux deux côtés et a conduit à accroître la prospérité parmi les anciens et les nouveaux pays membres de l'UE. Cette évolution positive a également été alimentée par un environnement économique mondial plutôt avantageux, particulièrement depuis le début des années 2000.

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<sup>2</sup>Le traité de Lisbonne est accessible par <http://eur-lex.europa.eu/legal-content/fr/TXT/?uri=CELEX%3A12007L%2FTXT>

Au cours l'année 2007, cependant, la période de croissance est arrivée à son terme avec la propagation de la crise de liquidité des États-Unis sur le continent européen, une crise d'abord domestique s'est transformée en une crise financière mondiale. De plus, les connexions inextricables entre les banques locales et le financement publique dans certains pays ont ensuite conduit à la crise de la dette européenne. Son impact négatif est encore perceptible aujourd'hui: les économies européennes connaissent une croissance économique faible et un taux de chômage élevé. Les États-Unis, à l'origine de la crise, ont eu en revanche des taux de croissance remarquables au cours des dernières années.

Pourtant, la crise n'a pas seulement exacerbé les écarts de croissance entre les États-Unis et l'Europe, mais a aussi mis en lumière une hétérogénéité considérable au sein des pays européens en termes de performance économique et de chômage, résultant souvent de carences structurelles. Les pays de l'est à la recherche de solutions pour relancer la croissance économique ont toujours le souhait d'intégrer l'UE afin de suivre le chemin des nouveaux États membres. L'adhésion européenne a été synonyme de stabilité macroéconomique et de réformes institutionnelles dans les pays en transition.

Alors que dans certains pays membres de l'UE la résistance politique à engager des réformes a engendré une crise politique, d'autres pays, les pays baltes par exemple, sont passés par un processus de réforme drastique. Selon des recherches récentes, ce programme orienté vers les réformes et la flexibilité institutionnelle a également prouvé son efficacité dans une correction plus rapide à la sortie de la crise (Gros and Alcidi (2015); Gardó and Martin (2010)).

En outre, pour les pays adhérents et candidats des Balkans occidentaux, le rapprochement de l'UE ne signifie pas seulement des réformes et de l'investissement, mais elle représente aussi une vision de paix et de prospérité économique.

Sur le bord de ce fossé économique et perceptif, cette thèse tourne autour

de l'analyse de ces questions susmentionnées. Ce faisant, cette thèse avance en élargissant d'unité d'analyse: des régions d'Européens occidentale aux pays en transition d'Europe orientale. Il examine dans le chapitre 1 la distribution du chômage régional au fil du temps et ensuite dans le chapitre 2 analyse la convergence de la croissance des pays européens et occidentaux. En outre, il semble de plus près à l'impact d'un aspect particulier de l'intégration entre l'est et l'ouest, à savoir les liens financiers. Les chapitres 3 et 4 analysent l'impact du développement financier sur l'entreprise et le niveau des pays. Alors que le chapitre 3 considère les contraintes financières sur les entreprises en Serbie, le chapitre 4 examine l'impact du développement financier sur la croissance économique dans plusieurs pays en transition.

## **Proximité Géographique et Interdépendence**

Alors que les chapitres de cette thèse de doctorat touchent à des sujets variés tels que l'hétérogénéité régionale, la convergence de la croissance ou le développement financier, l'intersection entre eux vient principalement de la proximité géographique des pays et régions qui y sont analysées. En conséquence, une forte interdépendance en termes de développement économique, par des flux commerciaux et l'intégration financière qui a été mise en place, non seulement entre les pays d'Europe occidentale mais aussi entre l'est et l'ouest. Les résultats récents de la littérature sur les effets de propagation des chocs financiers et de la demande entre la zone euro et de l'Europe de l'Est, comme le montre par exemple Fadejeva et al. (2016), confirment ces observations.

Étant donné que nous nous concentrons dans trois chapitres sur quatre sur des zones géographiques très intégrées, nous attachons une importance particulière à l'aspect spatial lors de la génération de nos résultats. Nous abordons notre analyse par un certain nombre de méthodologies appropriées. Le chapitre 1 repose sur des techniques non paramétriques afin d'évaluer la dynamique de répartition. Empruntée à la littérature de la

croissance économique suivant Quah (1993, 1997), cette méthode dite des noyaux stochastiques permet une analyse de la mobilité intra-distributive à travers le temps. De plus, elle permet d'identifier le regroupement, la polarisation ou la stratification des régions à travers l'espace (à voir par exemple Overman and Puga (2002); Magrini (2009)). Dans une deuxième étape, nous utilisons un modèle de facteur hiérarchique introduit par Doz et al. (2012) pour tenir compte des contributions européennes ou nationales aux mouvements de chômage régionaux. Dans le chapitre 2, nous employons pour nos estimations des relations de cointégration à long terme et linéaires de correction d'erreur: l'estimateur Common Correlated Mean Group selon Pesaran (2006) et l'estimateur Augmented Mean Group (Bond and Eberhardt (2009)). Les deux estimateurs sont en mesure de tenir compte des facteurs communs inobservables et sont donc en mesure d'accueillir des chocs mondiaux et régionaux en raison de la proximité culturelle ou géographique (Chudik et al. (2011)). Dans le dernier chapitre, j'emploie un cadre de causalité de Granger en panel introduit par Konya (2006), qui, fondé sur une approche système, permet de la dépendance en coupe transversale dans les estimations.

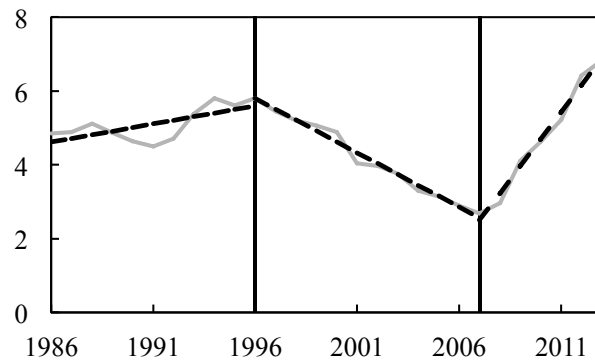
Dans ce qui suit, je présente un bref résumé des conclusions de chaque chapitre de ma thèse de doctorat, en insistant sur la façon dont ils contribuent à la littérature.

## **Polarization or Convergence**

Le premier chapitre, en coopération avec Robert Beyer, analyse la répartition des taux de chômage régionaux en Europe à partir de la mise en place de l'Union économique et monétaire de l'Union européenne. Fondé sur des travaux antérieurs par Overman and Puga (2002), il vise à étendre leur analyse en examinant la dynamique du chômage régional au cours de la période allant de 1986 à 2013, incluant les événements clés que sont l'introduction de l'euro ainsi que la crise financière mondiale et la crise



de la dette européenne. Comme l'illustre le graphique 1, nous identifions et ensuite étudions deux périodes distinctes, qui correspondent à peu près à deux occasions: une convergence 1996-2007 et une polarisation 2007-2013.



**Figure 1: Écart Type des Taux Relatifs EU avec une Tendence Segmentée Linéaire en %**

*Description:* Les données sont linéairement interpolées linéaires pour les années 1997 et 1998. Les lignes verticales noires pour les années 1996 et 2007 divisent les périodes pour la tendance segmentée.

*Source:* Estimations par les auteurs.

Bien que les changements de tendance marquent clairement les points de retournement dans le comportement global des taux de chômage régionaux sur toute la période, ils masquent une hétérogénéité considérable. Afin d'analyser la dynamique de la forme extérieure de la distribution ainsi que l'intérieur, nous nous appuyons sur l'analyse non-paramétrique des densités de noyau et des noyaux stochastiques, qui ont été empruntés à la littérature de la croissance économique suivants Quah (1993, 1997). En particulier, celle-ci permet une révélation de la polarisation et le regroupement au sein d'une distribution difficile à découvrir avec des méthodes conventionnelles. Par conséquent, nous ne trouvons pas seulement un regroupement de régions à l'intérieur de certains pays, mais aussi une persistance relativement forte des taux de chômage régionaux tout au long de notre période d'analyse.

Selon Zeilstra and Elhorst (2014), ces regroupements régionaux ne peuvent être ignorés dans l'analyse empirique. Ils affirment que la plupart

des études macroéconomiques se concentrent sur la façon dont les caractéristiques nationales affectent le chômage. De même la plupart des études régionales se concentrent sur la façon dont les caractéristiques régionales influent sur la décision ou la possibilité de travailler. Les auteurs optent pour la dynamique intégrée à la fois sur le pays et le niveau régional, parce que même dans le groupe assez homogène des pays membres de l'Union européenne, les institutions et les conditions macro-économiques diffèrent. Ainsi, une analyse se limitant à un seul niveau ne peut conduire qu'à une représentation déformée de la réalité.

Dans cet esprit, nous estimons un modèle de facteur multi-niveaux par la méthode de Doz et al. (2012) afin d'identifier la contribution des fluctuations continentales, nationales et celles spécifiques à la région. Par conséquent, notre analyse fournit des preuves pour les cycles de chômage européens et discute les tendances régionales intéressantes. De plus, nous soutenons que la convergence avant la récente crise est uniquement imputable aux facteurs nationaux, alors que la forte polarisation après peut être attribuée aux fluctuations nationales et régionaux.

Notre analyse empirique est principalement liée à la littérature analysant les disparités régionales des taux de chômage. Marston (1985) et le travail fondateur de Blanchard and Katz (1992) se concentrent sur les Etats-Unis. Considérant que, pour Marston (1985), l'existence de disparités régionales en matière de chômage peut refléter un résultat d'équilibre, qui est déterminée par la demande et de l'offre des facteurs ou des institutions, Blanchard and Katz (1992) montrent que les disparités régionales ne sont pas persistantes en raison de la main-d'œuvre et la mobilité des entreprises. Cette stabilisation des disparités régionales n'a pas confirmée pas par Decressin (1995) pour l'Europe, où l'hétérogénéité est beaucoup plus cohérente et la migration de la main-d'œuvre n'est pas courante. Au lieu de cela, l'évolution du chômage régional en tant que réponse aux chocs économiques se produit principalement par le mouvement dans le chômage. En termes d'analyse du comportement de la distribution de chômage dans l'ensemble, le travail par Overman and Puga (2002)

est précurseur. C'est pourquoi nous l'avons pris comme base pour notre analyse dans ce chapitre.

## What Does It Take to Grow Out of Recession?

Les conséquences de la persistance de la crise financière mondiale et de la crise de la dette européenne sur la croissance économique à long terme sont largement débattues. La littérature existante sur les récessions précédentes, comme Cerra and Saxena (2008), souligne la perte potentielle à long terme infligées par niveau de PIB. Ce chapitre, conjointement écrit avec Olivier Damette et Mathilde Maurel, se concentre sur les chocs économiques dans les pays européens et de transition avancés et suppose au sens de Friedman (1993) de “plucking” que plus faible que la croissance normale en période de récession est suivie d'une période de récupération avec une croissance supérieure à la normale jusqu'à ce que l'économie atteint son niveau d'avant-crise. L'objectif est d'évaluer la capacité à rebondir, la vitesse de convergence vers une trajectoire de croissance normale, ainsi que des non-linéarités potentiels. Les données trimestrielles ont été prises à partir de Kocenda et al. (2013) et, si possible, étendues.

Empiriquement, la capacité de rebond est explorée à travers une exploitation des relations de cointégration entre les variables de croissance classiques dans les régressions de croissance à long terme. L'emploi ultérieur d'une variété de modèles de correction d'erreurs de panel, qui permettent également de la dépendance en coupe transversale entre les unités de panel, donne une preuve solide pour correction d'erreur et une vitesse différente dans le processus de convergence. Nos résultats suggèrent que les économies en transition devancent les pays d'Europe occidentale. Des données récentes, par exemple, par Gros and Alcidi (2015) confirment cette tendance lorsque l'on compare le comportement de récupération de certains pays de la zone euro avec les pays baltes et la Bulgarie au cours de la récente crise.

Notre analyse est prolongée par la réalisation d'un examen des non-linéarités potentielles dans le processus de convergence. Pour tenir compte des différents régimes dans les modèles de croissance par rapport à une sélection de variables de transition, nous suivons le travail de González et al. (2005) et utilise des Panel Smooth Transition Regressions. Alors que la vitesse de convergence des principaux pays européens présente un motif non linéaire et les régimes de croissance différent selon le niveau de prix et de la flexibilité des salaires, les pays en transition restent linéaires dans leur retour à la tendance de la croissance. Nos résultats suggèrent donc que des ajustements internes demeurent les facteurs clés pour les pays européens et de transition pour se remettre des chocs économiques négatifs.

En ce qui concerne la mise au point sur la convergence et la vitesse de retour à la trajectoire de croissance normale, le travail théorique de Friedman (1993) et les preuves empiriques ultérieures pour les États-Unis, par exemple, Kim and Nelson (1999), définit la travail de base pour l'idée de ce chapitre. Un examen plus poussé de la profondeur, de la persistance des chocs ainsi que la récupération, tel que proposé par Corricelli and Maurel (2011) et Cerra et al. (2013), justifie le caractère de pour notre analyse.

À la lumière de nos constatations, la discussion précoce entre Keynes (1936) et von Hayek (1937) concernant les outils sur la façon de récupérer à partir d'un choc négatif peut être considéré comme un précédent à la situation post-crise actuelle. Compte tenu des taux de change soit fixe ou l'adoption de l'euro dans nos pays de l'échantillon, des ajustements internes semblent être une option appropriée et beaucoup moins coûteuse. Ce résultat confirme les analyses récentes par Maurel and Schnabl (2012), qui soutiennent que la croissance à long terme devrait être atteint via la flexibilité des prix et des taux de change stables.

## Firm Growth Dynamics and Financial Constraints

Le chapitre 3 analyse la situation financière des entreprises serbes pendant la période 2005-2012. En se fondant sur un ensemble de données unique de 1.558 des petites et moyennes entreprises non cotées, dans ce travail en collaboration avec Milos Markovic, nous analysons l'impact des contraintes financières internes sur la croissance des entreprises.

Les petites et moyennes entreprises (PME) constituent l'épine dorsale de l'activité économique en Europe (Banerjee (2014)). Comme le tableau 1 le montre, les PME constituent de loin la plus grande part des entreprises à travers le continent, emploient la majorité des travailleurs et de contribuent en termes de VA le plus à la production économique. L'importance du secteur des PME en Europe centrale et orientale est comparable au reste du continent. Il est donc vital pour le développement économique que ces entreprises aient accès à des fonds suffisants pour les investissements et pour leur permettre de croître.

**Table 1: Contribution Économique par les PME**

Pays	Enterprises		Emploi		Valeur Ajouté	
	2005	2011	2005	2011	2005	2011
<b>Danemark</b>	99.7	99.6	66	66	67	64
<b>Finlande</b>	99.7	99.7	56	62	52	57
<b>France</b>	99.8	99.8	61	64	54	59
<b>Allemagne</b>	99.5	99.5	60	63	53	54
<b>Italie</b>	99.9	99.9	81	80	71	68
<b>Portugal</b>	99.9	99.9	82	78	70	68
<b>Pays-Bas</b>	99.8	99.7	67	65	61	63
<b>Espagne</b>	99.9	99.9	79	76	69	66
<b>Suède</b>	99.8	99.8	63	64	56	58
<b>Royaume-Uni</b>	99.6	99.6	54	55	52	50
<b>Etats Unies</b>	99.7	99.7	50	49*	46	45*

Source: Banerjee (2014), \* données de 2010

L'importance des PME pour la croissance économique globale est, cependant, une seule partie de l'histoire. Lors de l'analyse comme dans le cas de la Serbie a les pays en transition, le niveau généralement plus faible du développement financier et des particularités de la structure du marché

financier doivent être pris en considération. Dans ce but, nous comparons donc nos résultats avec la situation en Belgique selon Hutchinson and Xavier (2006) et mettons à jour leur analyse sur une période antérieure. En outre, les PME ont été révélées être particulièrement résistantes en ce qui concerne le stress économique et révèlent des effets positifs sur l'emploi (Honjo and Harada (2006); Henrekson and Johansson (2010)). Nous analysons également les effets potentiels créés par la crise financière mondiale de 2008-2009.

Pour ce faire, nous estimons les sensibilités des flux de trésorerie de croissance de l'entreprise, suite à la spécification de panel dynamique de Guariglia et al. (2011). Pour tenir compte de la relativement grande section des entreprises, la petite taille de l'échantillon et l'endogénéité de nos régresseurs, nous employons la méthode des moments généralisés (GMM) estimateur par Blundell and Bond (1998). Après avoir contrôlé attentivement pour les opportunités d'investissement, nos résultats montrent que les entreprises serbes font face à des contraintes financières élevées et présentent généralement une forte dépendance à l'égard des bénéfices non répartis pour la croissance de l'entreprise. Nous ne trouvons pas la preuve d'un effet de crise, potentiellement dû à des fonds internes accumulés avant la crise. Les caractéristiques des entreprises classiques tels que l'âge, la taille et la performance globale déterminent la dépendance à l'égard des fonds internes pour la croissance de l'entreprise. En outre, les entreprises étrangères sont particulièrement en mesure d'échapper à l'écart de financement en appuyant sur d'autres ressources. Une comparaison avec les entreprises belges pour le même temps confirme nos résultats par rapport à une économie plus financièrement développée.

D'une part, ce chapitre est enraciné dans la littérature théorique sur le comportement de financement ou le choix des entreprises. La "pecking order theory" développée par Myers and Majluf (1984) fournit le cadre théorique lors de l'examen des contraintes financières. L'accès limité au financement extérieur peut nuire à l'investissement et donc la performance des entreprises, souvent liée à leurs propres caractéristiques ou le

développement des marchés financiers dans lesquels ils opèrent. Découlant d'asymétries d'information sur les opportunités d'investissement entre emprunteur et prêteur créer une "cale" des coût entre des fonds internes et externes pour le financement des investissements et de la croissance ainsi entreprise. En conséquence, les fonds internes moins chers et facilement disponibles sont censés être préférés par les entreprises financièrement limitées.

Cette théorie a d'abord été testée empiriquement dans le travail séminal par Fazzari et al. (1988) sur l'investissement des entreprises et par Carpenter and Petersen (2002) sur la croissance des entreprises américaines. Ils confirment que les flux de trésorerie de sensibilité à l'augmentation de la croissance des entreprises d'investissement avec des contraintes financières, ce qui est conforme à la "pecking order theory" par Myers and Majluf (1984). Dans la même veine, les travaux plus récents par Guariglia (2008) établissent des critères de sélection pour déterminer si une entreprise est financièrement contraint ou non sur un large panel d'entreprises britanniques. Nous voyons notre travail principalement lié à Hutchinson and Xavier (2006) et Guariglia et al. (2011) qui analysent les pays en transition et de se concentrent sur les critères de sélection des contraintes financières internes aussi essentielles pour nous.

## **Revisiting Finance and Growth in Transition Countries**

Dans le dernier chapitre je réévalue la question de l'impact du développement financier sur la croissance économique avec un fort accent sur les pays en transition. En particulier, je fournis de nouvelles preuves sur le lien entre finance et croissance pour 15 pays européens en transition entre 1994 et 2014 au moyen d'un cadre de causalité de Granger en panel. La littérature conventionnelle sur le sujet insiste souvent sur l'impact positif du développement financier, soit par la banque ou le marché des

intermédiaires, sur la croissance économique. Pagano (1993) et Levine (1997), par exemple, signalent notamment l'atténuation des asymétries d'information et une allocation d'actifs en fin de compte plus efficace que la principale contribution. Plusieurs études entre les pays à faible revenu et à revenu intermédiaire ont confirmé cette causalité plutôt positive du développement financier sur la croissance (King and Levine (1993a,b); Beck et al. (2000b)).

Pour les pays en transition, cependant, la question de la relation de la finance et de la croissance peut être considérée comme deux dimensions. Mis à part le sens de la causalité, la question se pose si le développement financier est globalement positif pour ces pays, étant donné qu'ils présentent une hétérogénéité considérable dans le développement de leurs économies et des secteurs financiers. La littérature récente sur la non-monotonie dans la relation finance-croissance est aussi considérée (à voir, par exemple, Arcand et al. (2015)). D'autre part, étant donné que le développement relativement récent des secteurs financiers a attiré un grand afflux de banques d'Europe occidentale, l'impact d'une forte domination étrangère dans les secteurs financiers respectifs doit être pris en compte, indépendamment de la taille du secteur financier. Ce chapitre tente de reconnaître spécifiquement cette particularité du marché par différentes variables lors de l'analyse.

Cette approche de causalité de Granger est basée sur des systèmes multivariés de *Seemingly Unrelated Regression* (SUR) développés par Konya (2006), qui comprend des tests de Wald avec des valeurs bootstrappées critiques qui sont spécifiques par pays pour tenir compte de la section transversale de dépendance et l'hétérogénéité de la pente. En se fondant sur plusieurs indicateurs de développement financier pour la taille, la profondeur et l'efficacité, je trouve que pour certains pays une causalité négative émane de la monétisation financière et du crédit intérieur à la croissance économique, ce qui est mesuré par le PIB par habitant. L'inverse est vrai pour la causalité inverse, qui soutient plutôt une hypothèse axée sur la demande pour le développement financier. Étant donné que les coefficients estimés sont plus grands et de l'importance pour le Wald teste



haute, les résultats vont plutôt dans le sens de la causalité inverse, corroborant ainsi l'hypothèse de Robinson (1952). La prévalence élevée de banques étrangères semble avoir un impact positif sur la croissance. La forte présence étrangère dans le secteur bancaire peut ainsi exercer un impact plutôt positif sur la croissance économique, sans doute tirée par une plus grande efficacité, un comportement de crédit plus prudentielle et un effet d'amortissement des chocs de prêt à l'étranger.

Le reste de cette thèse de doctorat est structurée comme suit. Dans le chapitre 1, en collaboration avec Robert Beyer, nous inspectons l'hétérogénéité régionale des taux de chômage européens, évaluons la dynamique interne et externe dans leur distribution et analysons les contributions européennes et des pays aux changements relatifs au fil du temps. Le chapitre 2, qui est un travail commun avec Olivier Damette et Mathilde Maurel, fournit une analyse empirique de la convergence de la croissance dans les pays européens et de transition de l'Ouest. L'accent a été mis sur la vitesse de retour à la voie normale de croissance, ainsi que les non-linéarités potentielles du processus. Le chapitre 3 fait un examen plus approfondi des contraintes financières internes de la croissance des entreprises en Serbie. Une collaboration avec Milos Markovic, nous montrent à quel point les entreprises serbes dépendent des flux de trésorerie pour leurs activités expansionnistes et de comparer nos résultats de sensibilité avec la Belgique, un pays avec un secteur financier avancé. Enfin, dans le chapitre 4 j'adresse la relation entre le développement financier et la croissance économique dans les pays en transition à travers une analyse en panel Granger de différents indicateurs financiers.

# Introduction

The Treaty of Lisbon, which entered into force on December 1, 2009 after it was ratified by the Czech Republic, the last European Union member country, postulates under Article 2 (3) “*The Union shall establish an internal market. It shall work for the sustainable development of Europe based on balanced economic growth and price stability, a highly competitive social market economy, aiming at full employment and social progress [...]*”.<sup>3</sup>

For quite some years, economic prosperity and a continuous strengthening of the internal market as the main goals of the European Union have been a success story. The formation of the Economic and Monetary Union in 1990, which was followed by the introduction of the Euro a decade later, have contributed to an ever-closer integration among Euro zone member countries. The abolition of exchange rate barriers through the common currency has further contributed to a reinforcement of strong trade and financial ties. Moreover, on-going EU-enlargement, particularly by countries in eastern Europe, has brought about the accession of new and open markets, which has benefitted both sides and led to increasing prosperity among the old and the new EU member countries. This positive development was further fuelled by a general rather benign global economic environment, particularly since the early 2000s.

By the end of 2007, however, the so far successful economic growth story came to a bitter end once the US liquidity crisis started to spill over onto

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<sup>3</sup>The Treaty of Lisbon can be accessed via <http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A12007L%2FTXT>

the continent, turning an initially domestic crisis into the Global Financial Crisis. Moreover, almost inextricable connections between local banks and domestic government financing in some countries ultimately triggered the European debt crisis. The negative impact is still discernible today. For almost a decade, European economies have been battered to a large extent by anemic economic growth and high unemployment. In contrast, the United States as the country of origin of the Great Recession has escaped the trough relatively quickly and has shown remarkable growth rates during the last years.

The aftermath of the crisis has not only exposed growth differentials between the US and Europe, but also considerable heterogeneity between and within European countries in terms of economic performance and unemployment, often resulting from structural deficiencies. On the hunt for solutions to kick-start economic growth with continuous political jostling about its future, countries in eastern Europe are still eager to join and to follow the path of the new member states. Future European accession has proven itself to be a reliable policy anchor for macroeconomic stability and institutional reforms in transition countries. While in some EU founding member countries political resistance to embark on reforms has paved the way for a political crisis, the Baltic countries, for instance, went through a drastic reform process. According to recent research, this reform-oriented agenda and institutional flexibility has also proven to succeed in a faster correction in the aftermath of the crisis (Gros and Alcidi (2015); Gardó and Martin (2010)). Moreover, for the acceding and candidate countries of the Western Balkans, EU approximation does not only mean reform and investment, but it represents also a vision of peace and economic prosperity.

On the brink of this economic and perceptual divide, this PhD thesis revolves around the analysis of these aforementioned issues. By doing so, this thesis spreads its analytical reach step-wise from the smaller unit of western European regions to the eastern European transition countries. At the outset it examines in chapter 1 the distribution of regional unem-

ployment over time and subsequently in chapter 2 analyses the growth convergence of western European and transition countries. Additionally, it looks closer at the impact of a particular aspect of integration between east and west, namely financial ties. Chapters 3 and 4 analyze the impact of financial development on the firm and the country level. Whereas chapters 3 considers financial constraints on firms in Serbia, chapter 4 examines the impact of financial development on economic growth across several transition countries.

## **Geographic Proximity and Interdependence**

While the chapters in this doctoral thesis touch upon varying subjects such as regional heterogeneity, growth convergence or financial development, the intersection among them consists primarily in the geographic proximity of the countries and regions analyzed therein. As a consequence, a strong interdependence in terms of economic development, trade flows and financial integration has been building up, not only among western European countries but also between east and west. Recent findings in the literature on spill over effects of financial and demand shocks between the euro area and eastern Europe, as shown for instance in Fadejeva et al. (2016), confirm these observations.

Consequently, this PhD thesis has tried to account methodologically for these spillovers as well as cross-section dependency through varying techniques. Given that we focus in three out of four chapters on very integrated geographic areas, either regions or countries, where possible we pay close attention to the spatial aspect when generating our results. We approach our analysis through a number of appropriate methodologies. Chapter 1 relies on non-parametric techniques in order to assess distributional dynamics. Borrowed from the economic growth literature following Quah (1993, 1997), so-called stochastic kernels allow for an analysis of intra-distributional mobility across time. Moreover, they enable to identify clustering, polarization or stratification of regions across space (see e.g.

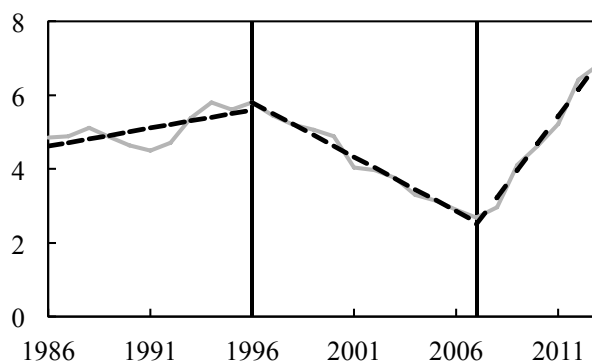
Overman and Puga (2002); Magrini (2009)). In a second step, we employ a hierarchical factor model introduced by Doz et al. (2012) to account for European or national contributions to regional unemployment movements. In chapter 2, we employ for our estimates of long-term cointegration relationships and linear error-correction the Common Correlated Effects Mean Group estimator (Pesaran (2006)) and the Augmented Mean Group estimator (Bond and Eberhardt (2009)). Both estimators are able to account for unobserved common factors and are thus able to accommodate global and regional shocks due to cultural or geographic proximity (Chudik et al. (2011)). In the last chapter 4, I employ a panel Granger causality framework by Konya (2006), which, based on a system approach, allows for cross-sectional dependence in the estimations.

In the following, I provide a short summary of the findings of each chapter of my doctoral thesis while embedding them into the key literature they aim to contribute to.

## **Polarization or Convergence?**

The first chapter, which is joint work with Robert Beyer, analyses the distribution of regional unemployment rates in Europe from the establishment of the Economic and Monetary Union onwards. Building on earlier work by Overman and Puga (2002), it sets out to extend their analysis by examining regional unemployment dynamics during the period from 1986 to 2013, including important events such as the the introduction of the Euro as well as the Global Financial Crisis and the European debt crisis. As Figure 2 shows, we identify and subsequently study two distinct periods which are roughly corresponding to both occasions: a convergence from 1996 to 2007 and a polarization from 2007 to 2013.

Although the trend changes clearly mark turning points in the overall behaviour of regional unemployment rates over the whole period, they



**Figure 2: Standard Deviation of EU Relative Rates with Segmented Linear Trend (Dashed Line) in Per Cent**

*Description:* We linearly interpolated data for 1997 and 1998. Black vertical lines at 1996 and 2007 partition the periods for the segmented linear trend and mark trend changes.

*Source:* Authors' calculations using Eurostat data.

do mask considerable heterogeneity. In order to uncover dynamics in the external shape of the distribution as well as within it, we rely on non-parametric kernel densities and stochastic kernels, which have been borrowed from the economic growth literature following Quah (1993, 1997). Particularly the latter allows for a revelation of polarization and clustering within a distribution, which conventional methods are unable to discover. Consequently we do not only find a clustering of regions within certain countries but also a relatively strong persistence of regional unemployment rates throughout our sample period.

According to Zeilstra and Elhorst (2014), such regional clusterings cannot be ignored in the empirical analysis. They claim that most macroeconomic studies focus on how national characteristics affect unemployment and similarly most regional studies focus on how regional characteristics affect the decision or possibility to work. The authors consider the dynamics as embedded on both the country and the regional level, because even among the fairly homogenous group of European Union member countries, institutions and macroeconomic conditions differ. Thus, confining an analysis to a single level only may lead to a distorted representation of reality.

In this spirit, we further estimate a multi-level factor model by Doz et al. (2012) in order to identify the contribution of continental, country and region-specific fluctuations. As a result, our analysis provides evidence for European unemployment cycles and discusses interesting regional patterns. Moreover, we argue that the convergence prior to the recent crisis is solely accounted for by country factors, whereas the strong polarization afterwards can be attributed to both country and region-specific fluctuations.

Our empirical analysis is primarily related to the literature analyzing regional disparities of unemployment rates. Marston (1985) and the seminal work by Blanchard and Katz (1992) concentrate on the US. Whereas for Marston (1985) the existence of regional disparities in unemployment may reflect an equilibrium outcome, which is determined by demand and supply factors or institutions, Blanchard and Katz (1992) show that regional disparities are not persistent due to labor and firm mobility. This levelling off of regional disparities is not found by Decressin and Fatás (1995) for Europe, where heterogeneity is much more consistent and labor migration not commonplace. Instead, changes in regional unemployment as a response to economic shocks happen primarily through moving into unemployment. In terms of analyzing the behaviour of almost the whole unemployment distribution, the work by Overman and Puga (2002) is pioneering. This explains why we have taken it as the basis for our analysis in this chapter.

## **What Does It Take to Grow Out of Recession?**

Consequences from the lingering Global Financial Crisis and the European debt crisis on long-run economic growth are widely debated. Existing literature on previous recessions, such as Cerra and Saxena (2008), emphasizes the potential long-term loss inflicted on per capita GDP levels. This chapter, which is a collaboration with Olivier Damette and Mathilde

Maurel, concentrates on economic shocks in advanced European and transition countries and assumes in a Friedman (1993) sense of “plucking” that lower than normal growth during recessions is followed by a recovery period with above normal growth until the economy reaches its pre-crisis level. The objective is to assess the capacity to rebound, the speed of convergence towards a normal growth path as well as potential nonlinearities. Quarterly data has been taken from Kocenda et al. (2013) and, where possible, extended.

Empirically, the rebound capacity is explored through an exploitation of the cointegration relationships among conventional growth variables in long-run growth regressions. The subsequent employment of a variety of panel error-correction models, which allow also for cross-sectional dependency among panel units, yields a strong evidence for error-correction and a different speed in the convergence process. Our results suggest that transition economies outpace western European countries. Recent evidence, for instance, by Gros and Alcidi (2015) confirms this tendency when comparing the recovery behaviour of selected Euro zone countries with the Baltics and Bulgaria during the recent crisis.

Our analysis is extended by carrying out an examination of potential nonlinearities in the convergence process. To account for different regimes in the growth patterns with respect to a selection of transition variables, we follow the work of González et al. (2005) and study Panel Smooth Transition regressions. Whereas the velocity of convergence for European core countries exhibits a nonlinear pattern and growth regimes differ according to the level price and wage flexibility, transition countries remain linear in their return to the growth trend. Our results thus suggest that internal adjustments remain the key factors for both European and transition countries to recover from negative economic shocks.

Regarding the focus on convergence and the speed of return to the normal growth path, the theoretical work of Friedman (1993) and the subsequent empirical evidence for the US by, for example, Kim and Nelson (1999), sets



the foundational work for the idea of this chapter. Further examination of the depth, persistence of shocks as well as recovery, as proposed by Corricelli and Maurel (2011) and Cerra et al. (2013), complement the empirical incitement for our analysis.

In light of our findings, the early discussion between Keynes (1936) and von Hayek (1937) regarding the tools on how to recover from a negative shock can be considered as a precedent to the current post-crisis situation. In view of either fixed exchange rates or the adoption of the Euro in our sample countries, internal adjustments seem to be the preferred and by far less costly option. This result confirms recent evidence by Maurel and Schnabl (2012), who argue that long-term growth should be achieved via price flexibility and stable exchange rates.

## **Firm Growth Dynamics and Financial Constraints**

Chapter 3 analyzes the financial situation of Serbian firms during the period of 2005-2012. By relying on a unique dataset of 1.558 primarily small and medium-size unlisted firms, in this joint work with Milos Markovic we analyze the impact of internal financial constraints on firm growth.

Small and medium-size enterprises (SMEs) are the backbone of economic activity in Europe (Banerjee (2014)). As Table 2 reports, SMEs constitute by far the largest share of firms across the continent, employ the majority of workers and contribute in terms of value added the most to economic output. The importance of the SME sector in central and eastern Europe is comparable to the rest of the continent. It is thus vital for economic development that these firms have access to sufficient funding for investment and ultimately growth.

The importance of SMEs for overall economic growth is, however, only one part of the story. When analyzing like in the case of Serbia a transition countries, the usually lower level of financial development and the

Table 2: Economic Contribution of SMEs

Country	Enterprises		Employment		Value Added	
	2005	2011	2005	2011	2005	2011
Denmark	99.7	99.6	66	66	67	64
Finland	99.7	99.7	56	62	52	57
France	99.8	99.8	61	64	54	59
Germany	99.5	99.5	60	63	53	54
Italy	99.9	99.9	81	80	71	68
Portugal	99.9	99.9	82	78	70	68
Netherlands	99.8	99.7	67	65	61	63
Spain	99.9	99.9	79	76	69	66
Sweden	99.8	99.8	63	64	56	58
United Kingdom	99.6	99.6	54	55	52	50
United States	99.7	99.7	50	49*	46	45*

Source: Banerjee (2014), \* data from 2010

particularities of financial market structure need to be considered. For comparative purposes we therefore contrast our findings with the firm situation in Belgium, following Hutchinson and Xavier (2006) and thereby updating their analysis on an earlier period. Moreover, SMEs have been proving to be particularly resilient when it comes to economic stress and reveal positive employment effects (Honjo and Harada (2006); Henrekson and Johansson (2010)). We also analyze potential effects created by the 2008-2009 Global Financial Crisis.

In order to do so, we estimate cash flow sensitivities of firm growth, following the dynamic panel specification of Guariglia et al. (2011). To account for the relatively large cross-section of firms, the small sample size and the endogeneity of our regressors, we employ the Generalized Method of Moments (GMM) estimator by Blundell and Bond (1998). Controlling carefully for investment opportunities, our results show that Serbian firms face considerable financial constraints and exhibit generally a strong and significant reliance on retained earnings for firm growth. We do not find evidence for a crisis effect, potentially due to internal funds accumulated prior to crisis. Conventional firm characteristics such as age, size and overall performance determine the dependency on internal funds for firm growth. Moreover, particularly foreign companies are able to escape the

financing gap by tapping other resources. A comparison with Belgian firms for the same time confirms our results with regard to a more financially developed economy.

On the one hand this chapter is rooted in the theoretical literature on the financing behaviour or choice of firms. The “pecking order” theory developed by Myers and Majluf (1984) provides the theoretical framework when examining financial constraints. Constrained access to external finance can impair investment and thus the performance of firms, often related to their own characteristics or the development of financial markets they operate in. Arising informational asymmetries about investment opportunities between borrower and lender create a cost “wedge” between external and internal funds for financing investments and thus firm growth. As a consequence, cheaper and easily available internal funds are supposed to be preferred by financially constrained firms.

This theory has initially been tested empirically in the seminal work by Fazzari et al. (1988) on firm investment and by Carpenter and Petersen (2002) on growth of US firms. They confirm that cash flow sensitivity to investment firm growth increases with financial constraints, what is in line with the “pecking order theory” by Myers and Majluf (1984). In a similar vein, the more recent work by Guariglia (2008) establishes selection criteria for determining whether a company is financially constrained or not on a large panel of UK firms. We see our work mostly related to Hutchinson and Xavier (2006) and Guariglia et al. (2011), who analyze transition countries and focus on selection criteria for internal financial constraints that are also essential to us.

## **Revisiting Finance and Growth in the Transition Economies**

In the last chapter I re-assess the question of the impact of financial development on economic growth with a strong emphasis on transition countries. In particular, I provide new evidence on this finance-growth nexus for 15 European transition countries between 1994 and 2014 by means of a panel Granger causality framework. Conventional literature on the topic often emphasizes the positive impact of financial development, either through bank or market intermediaries, on economic growth. Pagano (1993) and Levine (1997), for instance, report particular the mitigation of informational asymmetries and an ultimately more efficient asset allocation as the primary contribution. Several studies across low- and middle-income countries have confirmed this rather positive causality of financial development on growth (King and Levine (1993a,b); Beck et al. (2000b)).

For transition countries, however, the question on the finance and growth relationship can be considered to be two-dimensional. Apart from the direction of causality, the question arises if financial development is in general positive for these countries, given that they exhibit considerable heterogeneity in the development of their economies and financial sectors. The recent literature on non-monotonicity in the finance-growth relationship is therefore considered as well (see, for instance, Arcand et al. (2015)). On the other hand, given that the relatively recent development of financial sectors has attracted a large inflow of western European banks, the impact of a strong foreign dominance in the respective financial sectors needs to be taken into account, irrespectively of the size of the financial sector. This chapter attempts to specifically recognize this market particularity through different variables during the analysis.

The Granger causality approach is based on multivariate Seemingly Unrelated Regression (SUR) systems developed by Konya (2006), which

features Wald tests with country-specific bootstrap critical values to account for cross-sectional dependency and slope heterogeneity. By relying on several financial development indicators for size, depth and efficiency, I find that for some countries a negative causality runs from financial monetization and domestic credit to economic growth, what is measured as per capita GDP. The contrary holds for the opposite causality, which rather supports a demand-driven hypothesis of financial development. Given that the estimated coefficients are larger and the significance for the Wald tests is high, the overall result points rather in the direction of stronger causality from GDP per capita to financial development, thus corroborating the hypothesis of Robinson (1952). The high prevalence of foreign banks seems to have a positive impact on growth. The strong foreign presence in the banking sector may thus exert a rather positive impact on economic growth, presumably driven by higher efficiency, a more prudential lending behavior and a cushioning effect of external lending shocks.

The remainder of this doctoral thesis is structured as follows. In chapter 1, Robert Beyer and I inspect regional heterogeneity of European unemployment rates, assess external and internal dynamics in their distribution and analyze European and country contributions to relative changes over time. Chapter 2, which is joint work with Olivier Damette and Mathilde Maurel, provides an empirical analysis of growth convergence in western European and transition countries. Emphasis has been placed on the speed of return to the normal growth path as well as potential nonlinearities of the process. Chapter 3 takes a closer look at internal financial constraints of firm growth in Serbia. A collaboration with Milos Markovic, we show how much Serbian firms depend on cash flow for their expansionary activities and compare our sensitivity results with Belgium, a country with an advanced financial sector. Finally, in chapter 4, I address the relationship between financial development and economic growth in transition countries through a panel Granger analysis of different financial indicators.

# 1

## **Polarization or Convergence? An Analysis of Regional Unemployment Disparities in Europe Over Time<sup>1</sup>**

### **1.1 Introduction**

With the economic turmoil that followed the financial crisis of 2008 unemployment rates in Europe rose sharply and have remained elevated in many countries since then. The unemployment rate in the Euro Area, the weighted average of the unemployment rates in the member countries, increased from 7.5 per cent in 2007 to 11.9 per cent in 2013. The measure hides substantial heterogeneity: in 2013 the unemployment

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<sup>1</sup>Joint work with Robert C. M. Beyer (Goethe University Frankfurt; E-mail: Robert.Beyer@hof.uni-frankfurt.de). We are grateful to Paresh Narayan, two anonymous referees, Jakob de Haan, Robert Vermeulen, Jens Südekum, Nicola Fuchs-Schündeln, Bettina Brüggemann, Adjmal Sirak, and Iñaki Aldasoro. We also thank workshop participants at the Bundesbank and IAB, Université Paris 1 Panthéon Sorbonne, Paris School of Economics, the Regional Studies Early Career Conference in Sheffield, DIW, and De Nederlandsche Bank for their helpful comments. This chapter is based on the published article in *Economic Modelling*, Vol. 55(June 2016): 373-381.

rate was close to 5 per cent in Germany but was above 25 per cent in Spain. Even within countries unemployment rates can differ strongly: in Bruxelles-Capitale, for example, it is almost five times higher than in Oost-Vlaanderen, even though both regions belong to Belgium. While unemployment rates have been persistently higher than the average in some countries and regions, the recent economic turmoil has aggravated heterogeneity in European labour markets. Unemployment undermines social cohesion and is a burden for public finance, both because of increased spending on unemployment benefits and decreased tax earnings. High levels of unemployment therefore have always been a worry of policy makers and researchers alike. Reducing unemployment and heterogeneity in Europe – both at the national and regional level – is a prevailing challenge. The analysis of regional unemployment has therefore regained importance.

It started with the seminal paper of Blanchard and Katz (1992), which finds permanent differences between the unemployment rates in US states. In a related study, Decressin and Fatás (1995) provide evidence for a relatively higher heterogeneity among European regions and show that regional year-on-year changes are less correlated than in the US. Obstfeld et al. (1998) look in more detail at regional unemployment trends in existing currency unions and find similar results. Overman and Puga (2002) focus on the spatial distribution of 150 European regional unemployment rates and detect an increasing polarization between 1986 and 1996. Beyer and Smets (2015a), in a recent paper, report a fast convergence of European regional unemployment rates after the introduction of the Euro but increasing standard deviations since 2008<sup>2</sup>.

We contribute to the understanding of recent unemployment dynamics by studying the distribution of European regional unemployment over time. First, we update the analysis of Overman and Puga (2002). This is important, as regional unemployment rates have evolved considerably

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<sup>2</sup>Estrada et al. (2013) show that prior to 2008 regions in other developed countries converged as well, though less than in Europe.

in recent years; first, due to the establishment of a common currency and, second, due to the global financial crisis and the European sovereign debt crisis. We start by documenting changes of the spatial inequality of unemployment rates using different non-parametric methods.

Updating Overman and Puga (2002), however, is just one concern. In addition, we address the question whether unemployment is a country or regional phenomenon. Overman and Puga (2002) rely on stochastic kernel mappings to judge whether the regional or country dimension is dominant in determining unemployment. We extend this analysis and propose to employ a multi-level factor model, which decomposes regional and country fluctuations, to then study the contributions of country and regional factors in the distributional dynamics.

Our study is closely related to Iacus and Porro (2015), who study Gompertz stochastic unemployment processes for European regions and conduct a cluster analysis based on steady state values. Since we address different questions and use another methodology, we consider our study complementary to theirs.<sup>3</sup>

The remaining paper proceeds as follows. The next section introduces the data and provides descriptive statistics. The distributional analysis follows in Section 1.3. We then estimate a multi-level factor model of regional unemployment rates to study the role of country and regional factors in the distributional dynamics in Section 1.4. The final section summarizes and discusses the findings.

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<sup>3</sup>Iacus and Porro (2015) do not include developments since 2008 and need to make many assumptions, for example, that regional unemployment rates have a stochastic steady state and a log-normal limit distribution. We consider our approach – to use non-parametric methods for a distributional analysis of filtered actual unemployment – more suitable for our study.



## 1.2 Data and Descriptive Statistics

We update the dataset from Overman and Puga (2002) using Eurostat's regional NUTS2 database on unemployment rates. They covered the period from 1986 to 1996, which we extend to 2013.<sup>4</sup> Due to data availability we can include only 131 of the 150 regions included in the original dataset.<sup>5</sup> The regions span eleven countries, namely Belgium, Denmark, France, Germany, Great Britain, Italy, Ireland, Luxembourg, the Netherlands, Portugal, and Spain. The average regional population in 2013 was 2.3 Million. A list of all regions included in the sample as well as a map can be found in Appendix A.1.

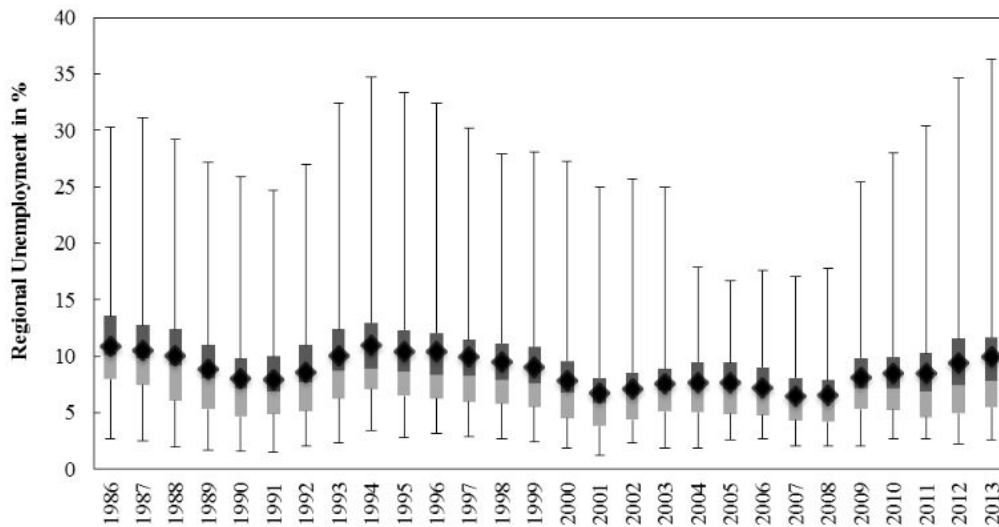
The average unemployment rate over all years and for all regions in our sample is 8.7 per cent. It was lowest in 2007 with 6.5 per cent and highest in 1994 with 10.9 per cent. In 2013 a similar height was reached with a rate again above 10 per cent. The minimum rate overall was experienced by Utrecht (NLD) with 1.2 per cent in 2001 and the maximum with 36.6 per cent by Andalucía (SPA) in 2013. Before the outbreak of the financial crisis in 2007 the highest unemployment was 17.1 per cent in Bruxelles-Capitale (BEL).

Figure 1.1 presents the main characteristics of the European regional unemployment distribution. By looking at the outmost values on both the upper and the lower end of each year's distributions, minimum values can be observed to remain relatively stable over time and roughly fluctuate around 3 per cent. Maximum values, on the other hand, exhibit high heterogeneity over time and pronounced movements. They provide a clear decreasing trend during the period from the mid-1990s until the eve of the

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<sup>4</sup>Unemployment is defined by Eurostat as a person aged between 15 and 75 and without work during the reference week, who is able to start work within the next two weeks and who has actively sought employment at some time during the last four weeks. For 1997 and 1998 data is not available for any region.

<sup>5</sup>The regions are based on Eurostat's regional classification of territorial units in 1996. A land reform in the UK in the mid-90s has in particular diminished our sample. However, other national administrative reclassifications or minor data availability issues affect nearly all our countries.



**Figure 1.1: Distribution Characteristics of European Regional Unemployment Rates**

*Description:* Exhibited distributional characteristics are the interquartile range within the boxes showing also the median as the parting line between lighter and darker grey shaded parts. The diamonds represent the mean in each year and the upper and lower whiskers respectively maximum and minimum values.

*Source:* Authors' calculations using Eurostat data.

financial crisis, falling from 34.7 per cent to 17.1 per cent. Even though the gradual decline already started in 1994, it was after the introduction of the Euro that in the early 2000s this trend intensified. Interestingly, the mean between 2001 and 2005 increased, even though maximum rates dropped strongly. The 95<sup>th</sup> percentile follows the same pattern as the maximum values and this pre-crisis development can also be detected through slightly falling interquartile ranges, including generally lower median values and means.

The fallout of the financial crisis, however, brought about a sudden and harsh reversal of previous gains in closing the gap between very high and very low regional unemployment rates. Maximum rates surged again from 2009 on to almost twice the size of 2008 and have since then experienced a continuous increase peaking at 36.6 per cent in 2013. Again we find a similar trend for the 95<sup>th</sup> percentile and for the other distributional characteristics with mean and median unemployment rates

creeping upwards and interquartile ranges widening.

### 1.3 Distributional Analysis

Regional variables are often measured relative to aggregate ones (Blanchard and Katz (1992); Obstfeld et al. (1998); Overman and Puga (2002)). We initially follow this convention and define *EU relative unemployment rate*,  $u_{i,t}^1$ , in the following way:

$$\mathbf{u}_{i,t}^1 = U_{i,t} - U_{EU,t}, \quad (1.1)$$

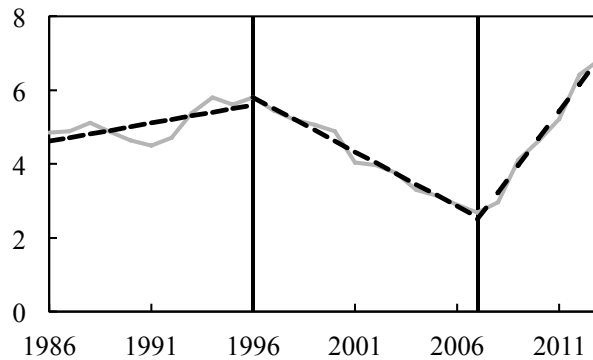
where  $U_{i,t}$  is the regional unemployment rate of region  $i$  at year  $t$  and  $U_{EU,t}$  is the European unemployment rate in year  $t$ , which is defined here as the average of all regions in the sample.

#### 1.3.1 Standard Deviation

In Figure 1.2 we plot the standard deviations of EU relative regional unemployment rates as well as a segmented linear trend. Between 1986 and 1996 the standard deviation increased slightly. With the introduction of the Euro, regional differences decreased considerably and the standard deviation dropped from 5.8 per cent in 1996 to 2.7 per cent in 2007. The convergence reversed promptly after the outbreak of the financial crisis. The standard deviation increased strongly and in 2013 was with 6.8 per cent higher than in any year before.<sup>6</sup>

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<sup>6</sup>Note that the average regional unemployment rate follows a similar trend, i.e. it remained mostly stable until 1996, decreased until 2007 and is increasing again since then. When we normalize the EU relative standard deviation by the mean, we still find the same pattern as just discussed.



**Figure 1.2: Standard Deviation of EU Relative Rates with Segmented Linear Trend (Dashed Line) in Per Cent**

*Remarks:* We linearly interpolated data for 1997 and 1998. Black vertical lines at 1996 and 2007 partition the periods for the segmented linear trend and mark trend changes.

*Source:* Authors' calculations using Eurostat data.

In the following, we focus on the distributional changes between two periods: with the first, from 1996 to 2007, we analyse the initial Euro convergence and with the second, from 2007 to 2013, we study the Great Recession divergence.<sup>7</sup> With these terms we refer to the concurrence of these events with clear trend changes in the dispersion of unemployment rates.<sup>8</sup>

### 1.3.2 Non-Parametric Analysis

Following Overman and Puga (2002), we tackle the spatial analysis of European regional unemployment with two non-parametric methods: (1) a standard density distribution analysis for the aforementioned selected year pairs and (2) estimations of so-called stochastic kernels, initially

<sup>7</sup>The first period from 1986 to 1996 has been analyzed by Overman and Puga (2002).

<sup>8</sup>Note that we are not claiming causality. Certain consequences from these events, like decreasing interest rates in Southern Europe after 1999 or the recessions in some countries during the financial and sovereign debt crises, most likely affected regional unemployment. Moreover, the convergence period after the introduction of the Euro coincided with an expansion of trade and economic growth on a global scale, what has positively affected regional growth in Europe. However, we leave formal establishment of causality for future work and discuss potential reasons for these distributional changes only briefly in Subsection 1.5.2.

proposed in the economic growth literature by Quah (1993, 1996, 1997). Our analysis thus inspects the evolution of the cross-sectional distribution of European regional unemployment rates by exposing both changes in external shape and intra-distributional dynamics. In contrast to more traditional measures, like  $\sigma$ - and  $\beta$ -convergence, this approach allows the identification of polarization, stratification or convergence clubs (Magrini (2009); Quah (1997)).<sup>9</sup> While density functions are widely known, stochastic kernels are used less.<sup>10</sup> They can be interpreted as the graphical equivalent of a transition matrix with infinitely small ranges. To avoid potential shortcomings of discretizing a continuous transition process, the stochastic kernel estimates through kernel densities a transition matrix containing a continuum of rows and columns.<sup>11</sup>

In addition to these visual methods, we report Gini coefficients and the polarization measure proposed by Esteban et al. (2007) to establish robustness of our findings.<sup>12</sup> The Gini ratio measures the degree of statistical dispersion of the overall distribution. The latter measure allows quantifying the degree of regional polarization into two groups – high and low relative unemployment.<sup>13</sup>

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<sup>9</sup> $\beta$ -convergence for Euro Area unemployment rates has, for instance, been examined by Estrada et al. (2013). While they do not find significant convergence among countries for the period from 1998 to 2011, the opposite holds for a shorter period ending in 2007.

<sup>10</sup>They are used less, but are by no means rare. For example, Magrini (1999), Ioannides and Overman (2003), Pittau and Zelli (2006), Maza et al. (2012), El-Gamal and Ryu (2013), as well as Kamihigashi and Stachurski (2014) also employ stochastic kernels. Other examples are numerous.

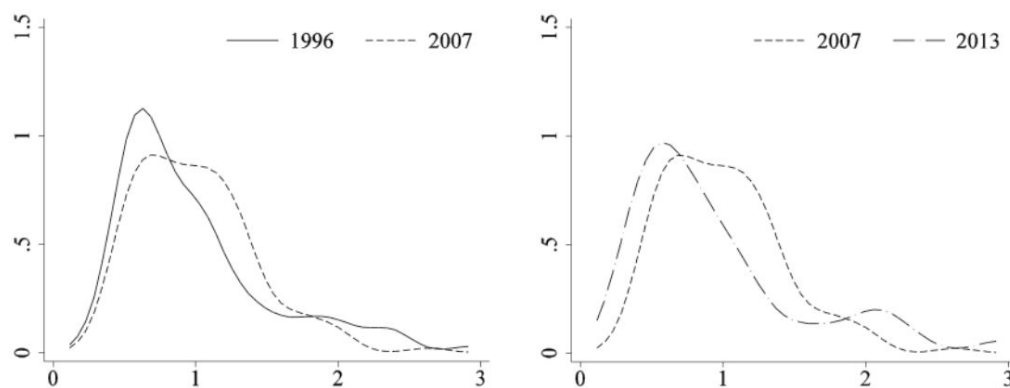
<sup>11</sup>For a more detailed description of kernel density estimation as well as mathematical preconditions see Quah (1996, 1997) and Magrini (2009).

<sup>12</sup>Both measures have been computed with the DASP Package for distribution analysis (Araar and Duclos (2007)).

<sup>13</sup>This is an extended version of the original measure by Esteban and Ray (1994) and can be applied to continuous distributions allowing for an endogenous determination of groups. In our case of two groups, either high or low unemployment, we calculate the *bipolarization* of a cumulative distribution of unemployment rates. The endogenous determination of each group is achieved by finding a cut-off point through maximizing the vertical difference between the Lorenz curve and the 45° line, what in our bipolar case becomes the mean deviation. Following Esteban et al. (2007), we set the constant of group identification and the weight of measurement error equal to one. Polarization is then measured as twice the mean deviation minus the Gini ratio of the density.

### Kernel Densities

Figure 1.3 plots kernel densities for the year pairs 1996 and 2007, as well as 2007 and 2013. These years mark the start and end points of the periods identified before. We report EU relative rates as a fraction so that regions at 1.5 have an unemployment rate that is 50 per cent above the EU average. Between 1996 and 2007, regions from both extremes converged. While the distribution remains right-skewed (very few regions have very high rates), the right tail shortened, which shows a convergence of the weakest regions. A reduction in the polarization measure by about 25 per cent, from 0.131 to 0.099, illustrates this convergence as well.



**Figure 1.3: Kernel Densities of EU Relative Rates**

*Remarks:* Kernel densities can be considered as a continuous form of histograms. They depict the shape of the overall distribution of regional EU relative unemployment and allow discerning changes from one period to another. Above and all densities are calculated non-parametrically by using a Gaussian kernel with a bandwidth set using the optimal rule described in Silverman (1986).

*Source:* Authors' calculations using Eurostat data.

As expected from looking at the evolution of the standard deviation, the distribution widened again strongly from 2007 to 2013. Regions polarized so that in 2013 many more regions had unemployment rates higher than twice the EU average but also more regions had a rate less than half of the EU average. This bipolarization of regions with very high and very low unemployment rates shows up in a 60 per cent increase in polarization

from the pre-crisis level to 2013.<sup>14</sup>

### **Spatial Dissemination**

Figure 1.4 relates the previously revealed changes in the aggregate distribution to a more detailed picture of the spatial dissemination. The heat maps show a regional breakdown of EU relative unemployment rates. In 1986, at an average unemployment rate of 10.9 per cent, primarily the South of Spain and Ireland belonged to the upper extreme of relative unemployment rates. As darker colors indicate, by 1996 more regions in the South of Europe displayed rates of twice and above the EU average, which almost remained stable at 10.4 per cent. Also in France relative unemployment rates increased, whereas some Northern regions, in particular in Ireland and the United Kingdom, now either find themselves on a par with or below the average. In line with the convergence process indicated by the densities, regional heterogeneity decreased in the following years and was much lower in 2007. This is true not only in relative terms, as the average unemployment rate decreased to 6.5 per cent. By 2013, however, this development has been reversed completely. Not only are many regions back at the high unemployment rates relative to the EU average experienced in the 1980s, but for some the situation has never been worse. Almost all Spanish and Southern Italian regions have relative rates at least twice as high as the EU average. Note that the average in 2013 was back at the pre-convergence levels of slightly above 10 per cent.

Just by looking at the maps one notices certain country effects. For example, the increase of EU relative rates from 2007 to 2013 was shared by all Spanish regions, which makes the increase a Spanish phenomenon. In other words, these regions did not all perform worse because of regional features but because of their country affiliation. In this particular case the financial and sovereign debt crises have adverse effects on all Spanish

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<sup>14</sup>The same trends are also visible when looking at the Gini index numbers. Inequality decreased by about 20 per cent during the period 1996 to 2007 and strongly increased again by 47 per cent from 2007 to 2013.

regions. Equally important, though, country effects can clearly not explain all changes. Note for example the increase of relative rates from 1986 to 1996 in Southern Italy. At the same time other Italian regions improved their relative position. We think that the question of country and regional fluctuations deserves further attention and hence return to it in Section 1.4. Before that we address the question of the inner distributional mobility of regions.

### Stochastic Kernels

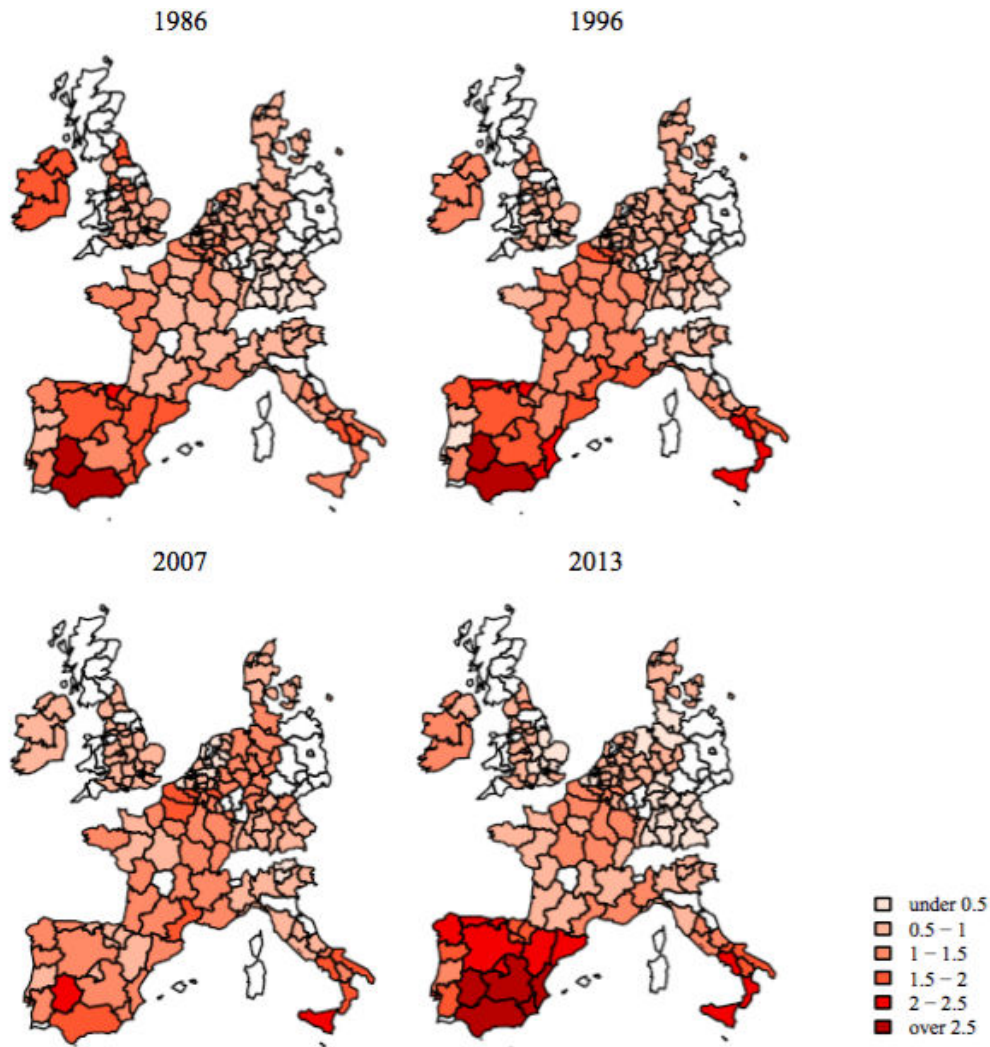
We analyse the inner distributional mobility of regions to determine whether always the same regions are at the extremes. Stochastic kernels allow for such an examination of intra-distributional dynamics across time.<sup>15</sup>

Year pairs and normalizations under scrutiny remain the same as before. The left-hand side in Figure 1.5 shows the respective three-dimensional surface graphs of the stochastic kernels whereas the right-hand side displays their contour plots. These can be read like geographical contour maps with inner lines representing higher levels of the graphs and thus more mass. A plot with mass only along the diagonal line from the lower left corner to the upper right points at a complete persistence of the distributional dynamics, i.e. regions with, for instance, an EU relative rate of two at the beginning of the time period will have the same above EU average rate at the end of the period. For graphs primarily concentrated along the inverted diagonal line the picture gets reversed and high intra-distributional mobility occurs from one period to the other. Regions with previously high relative unemployment rates now migrate to lower rate areas and vice versa. The other extreme case of unemployment rates amassing around the vertical axis implies that regional rates at period commencement contain no information about their whereabouts some years later.

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<sup>15</sup>We thank Stefano Magrini for providing a helpful *Matlab* code.



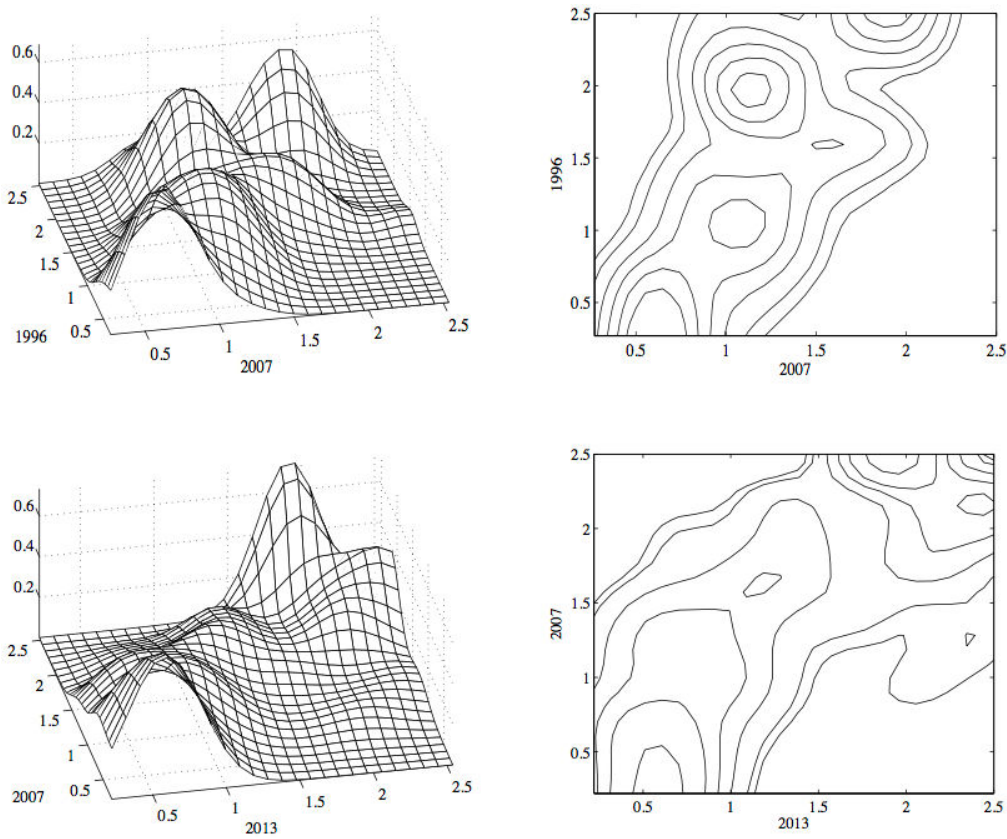


**Figure 1.4: European Relative Unemployment Rates 1986, 1996, 2007, and 2013**

*Remarks:* The heat maps above present regional unemployment rates relative to the European average in the respective year. Darker colors indicate regions with higher EU relative rates; regions left white denote missing data. The average EU unemployment rate in 1986 was 10.89 per cent, 10.42 per cent in 1996, 6.49 per cent in 2007, and 10.01 per cent in 2013.

*Source:* Authors' calculations using Eurostat data.

Regions with low unemployment rates in 1996 had low unemployment rates in 2007 as well. Regions with a high relative rate in 1996 were very likely to have a lower rate in 2007, i.e. during the convergence process particularly hitherto high relative unemployment regions migrated to lower rates. Note the multiplicity of local maxima discernible in both the surface



**Figure 1.5: Stochastic Kernels**

*Source:* Authors' calculations using Eurostat data.

shape of the kernel and the contour plot, which can be related to specific countries. During the decade from 1996 to 2007, Spanish regions experienced the largest progress overall and moved from unemployment rates of twice and beyond the European average down to rates of around equal or even below the mean. Regions with the highest inner-distributional mobility, Cantabria, Pais Vasco, and Murcia, saw their rates drop by more than once the European average. The peak in the upper right corner belongs to Italy's Southern regions including Sicilia, which moved somewhat downwards from roughly 2.5 times to around two times the European average. Campania and Calabria, with a respective decrease in their unemployment rates by 0.72 and 0.67 times the European average, also belonged to the group of regions with the highest mobility. The strong regional clustering by country suggests again that country factors are crucial to explain the

observed changes of the external shape.

For the period of 2007 to 2013, the graphs in the lower panels point at a thorough reversal of the convergence process after the financial and the sovereign debt crises. Regions with a very low unemployment rate decreased their rates further, regions with middle and high rates remained where they were or experienced increasing rates. This also refers to the aforementioned Spanish and Italian regions that converged before but today have again rates twice as high as the European average. With the exception of Andalusia, Extremadura, and Pais Vasco, Spanish regions faced an increase of above one time the European average; Southern Italian regions already had elevated levels before and experienced therefore comparatively smaller increases in unemployment rates.

Concluding, our first look at the distributional dynamics revealed a convergence of regions between 1996 and 2007, which was driven in particular by decreasing unemployment rates of regions with initially very high rates. The same regions experienced increasing rates between 2007 and 2013 and as a consequence the distribution widened again. Regions with low unemployment rates experienced little change throughout the whole period. Interestingly, the distributions in 2013 look very similar to the one in 1986.<sup>16</sup> The convergence between 1996 and 2007 has been fully undone by the current crisis. Moreover, we found interesting patterns linked to country fluctuations. Therefore, we are next studying the importance of country versus regional factors.

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<sup>16</sup>We compare them in Figure 6 in the working paper version of this paper (Beyer and Stemmer (2015)).

## 1.4 Decomposing Unemployment Fluctuations

We are interested in understanding better the origins of the described developments. For that reason, we decompose unemployment fluctuations in different level contributions.

### 1.4.1 Multi-Level Factor Model Analysis

So far we have filtered regional relative unemployment rates by subtracting the European unemployment rate. Other strategies are possible. Decressin and Fatás (1995), for example, stress that European regions are very differently correlated with the aggregate and, in order to compute region-specific variables, propose to first regress the regions on the European aggregate and then use the coefficients as weights when differencing. They hence condition the regional variables on one common factor as well, but they allow for heterogeneous reactions to aggregate fluctuations. Beyer and Smets (2015a) find that European labour market variables have more than one common factor, above all due to the presence of country effects, and propose to compute region-specific variables as residuals from a multi-level factor model accounting for country factors. The factor model is used to classify co-movements of variables as either continental or country fluctuations and minimizes the region-specific fluctuations. We follow the latter strategy and separate the regional unemployment into European, country and regional contributions. The developments described above can originate either in within-country or between-country developments and hence it is important to include country factors.

For policy makers this question is important, because it determines the appropriate level of action. For example, national factors influencing unemployment rates, e.g. labour market institutions, financial conditions, or the educational system, lie beyond the reach of regional policy. If regions diverge because of these factors, the effectiveness of regional

policies will be limited and rather national reforms are necessary. On the other hand, if countries converge because some countries with high unemployment rates experience decreasing rates, but some regions in these countries are not benefitting from the trend, then regional reforms are necessary.

We include one European factor on which all regions are allowed to load and eight country factors (Belgium, Germany, Spain, France, Italy, the Netherlands, Portugal, and Great Britain) on which all regions belonging to a particular country load.

We estimate the following model for the period from 1986 to 2013:

$$\mathbf{U}_{i,c,t} = u_{i,t}^2 + L_i^{EU} f_t^{EU} + L_i^c f_t^c, \quad (1.2)$$

where  $L_i^{EU}$  is the regional specific loading on the EU factor  $f_t^{EU}$ , and  $L_i^c$  are the regional specific loadings on the country factors  $f_t^c$ . Since we allow for a structure of the factors, the model cannot be estimated with principal components. Instead, we estimate it using the quasi-maximum likelihood approach of Doz et al. (2012).<sup>17</sup>

### 1.4.2 Explained Variance and Loadings

European fluctuations explain 41 per cent of the regional fluctuations, which provides strong evidence for the existence of European unemployment cycles. The country factors are nearly as important and explain another 38 per cent. Hence, only 22 per cent idiosyncratic variance re-

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<sup>17</sup>The QML estimator is implemented using the Kalman smoother and the EM algorithm. For initialization we use principle components. We confirmed stationarity of unemployment rates using the panel unit root test suggested by Levin et al. (2002), which rejects a unit root at the 1 per cent level. We linearly interpolate the data for 1997 and 1998.

**Table 1.1: Maximum, Minimum, and Mean Regional Factor Loadings**

Factor	EU	BEL	DEU	ESP	FRA	ITA	NLD	PRT	GBR
Mean	0.44	0.65	0.83	0.36	0.51	0.38	0.56	0.88	0.36
Max	0.92	0.83	0.93	0.70	0.86	0.91	0.65	0.96	0.91
Min	-0.63	0.43	0.69	-0.23	0.21	-0.22	0.28	0.67	-0.13

*Source:* Author's calculations using Eurostat data.

mains. Note that the explained variance is given by the squared loading on the factor. Differences between loadings inform us about the homogeneity of regional unemployment reactions to European and country movements. By looking directly on the loadings, we are able to differentiate between the sign of the correlation.

Table 1.1 shows the mean as well as the minimum and maximum regional loadings on the European factor and on each country factor. Note that regions may load with different signs on the same factor. An increase of the price of oil, for example, benefits a region producing oil but is harmful for a region producing steel. Such contrary reactions of regions are even found for the continental unemployment cycle, as regions turn out to load both positively and negatively on the European factor. In Italy and Spain, two countries clearly characterized by enormous structural differences between their regions, some regions load with different signs on the respective country factor. In most countries, however, regions react with different intensities but not different signs to the national factor. The most homogenous reactions are found in Germany, the Netherlands, and Portugal.

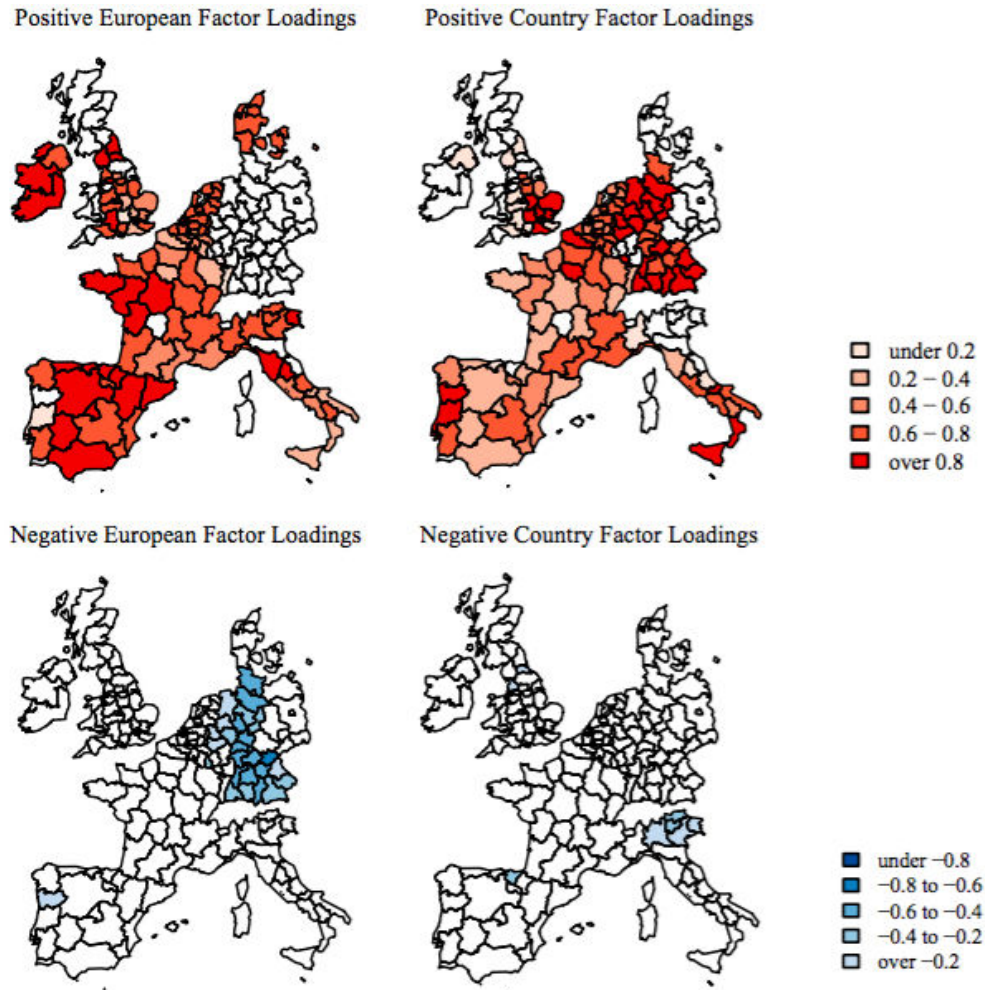
Figure 1.6 depicts the regional breakdown of the region-specific loadings on the European and the country factors. We plot the positive loadings in the first and the negative in the second row. The left panel refers to the loadings on the European factor, the right panel to the loadings on the country factor. The figure allows us to identify the regional sensitivity to European and country unemployment cycles.

While regions from all countries load differently on the European factor,

German regions clearly stand out. They load negatively on that factor meaning that they are not only detached from the European unemployment cycle, but that their unemployment rates change in the opposite direction. Interestingly, Bruxelles-Capitale (BEL) and Luxembourg also load negatively on the European factor. Portuguese regions deserve attention because they load very heterogeneously on the European factor. While three out of the four regions load positively on it, Norte loads negatively. In England, France and Italy regional loadings vary considerably as well, though to a much lesser extent.

The Southern Italian regions load heavily and positively on it, whereas Northern ones load negatively on that factor. This effect is strongest in the two autonomous regions Alto-Adige and Trentino. Surprisingly, strong heterogeneity is also found in England. While Greater London and its surrounding regions load strongly on the English factor, many other regions are only marginally moving with it. And four regions, including Greater Manchester, even load negatively on the English factor. While Spanish regions react much more homogeneously to their country factor, Pais Vasco also loads negatively on it. It is striking that regions enjoying autonomy are less (or even negatively) correlated with the unemployment cycle of the country. Major capital regions, on the other hand, such as Île-de-France (FRA), Greater London (GBR), Bruxelles-Capitale (BEL), and Lisboa e Vale do Tejo (PRT) load heavily on the country factor, often in contrast to neighbouring regions. German regions load homogeneously on their country factor. This result relates nicely to Montoya and de Haan (2008), who look at regional business cycles and find a strong border effect in Germany as well.

Belke and Heine (2006) and Barrios and de Lucio (2003) analyse the strength of business cycles over time and find that national business cycles have become more synchronized. We split our sample and run the factor model separately for the three periods identified before. While the variance share explained by regional fluctuations remains constant over time, the share explained by the country factors decreases, whereas the variance



**Figure 1.6: European and Country Factor Loadings**

*Remarks:* The heat maps above present constant but region-specific loadings on the European and the country factors. Darker colors depict regions with stronger loadings on the respective factors.

*Source:* Authors' calculations using Eurostat data.

explained by the European factor increases. European integration has thus not only synchronized business cycles, but also unemployment cycles.

To conclude, a European unemployment cycle is discernible and the vast majority of regions load positively and strongly on that factor. However, German regions are moving in the opposite direction. Moreover, we find that regional loadings on the country factor vary in particular in Italy and England.

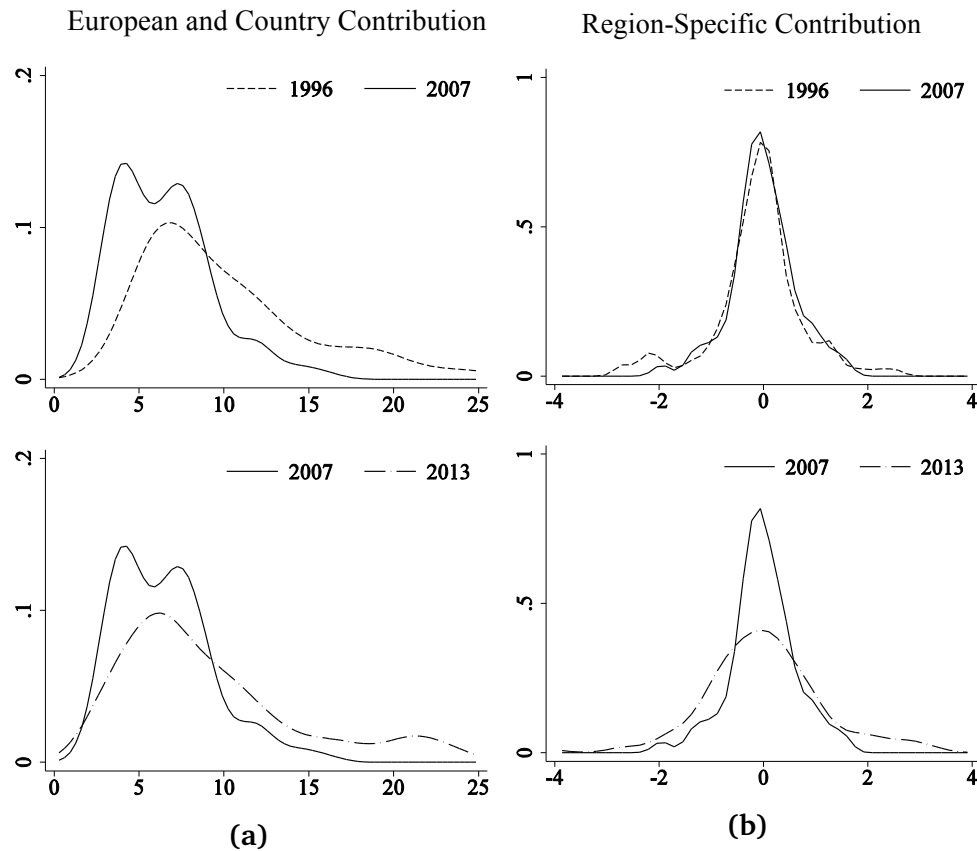


We can interpret the residual of the factor model  $u_{i,t}^2$  as another measure of regional unemployment performance. We refer to it as *region-specific unemployment rate*.

### 1.4.3 Which Level Is Responsible for Distributional Changes?

We now analyse the distributions of the different contributions over time. We sum the European and country contributions and contrast the distribution with the distribution of the region-specific unemployment rates. We estimate again kernel densities and report the distributions in 1996, 2007, and 2013. The left panel shows the unemployment rate predictions of the factor model, i.e. the European and country contribution to regional unemployment; the right panel shows the region-specific unemployment, i.e. the residual of the factor model. A region with a region-specific unemployment rate of -2 in a specific year has an unemployment rate that is 2 percentage points lower than one would expect for this region. Adding the region-specific unemployment rate to the European and country contribution gives the actual regional unemployment rate.

Note that the European and country contributions in 1996 were much wider than in 2007. In particular, there were fewer regions for which a rate above 10 per cent was predicted in 2007 than in 1996. The distribution of the region-specific contributions, on the other hand, is nearly identical in 1996 and 2007. The unemployment specific to a region, i.e. the unemployment that the factor model is unable to explain, varies between minus three and plus three percent in both years and is symmetric around 0. The convergence between EU relative unemployment rates detected before can hence be attributed to a smaller heterogeneity of European and country contributions. The contribution of region-specific factors remained the same. This finding does not surprise us. After the introduction of the Euro interest rates in the Euro Area converged and in particular weaker countries experienced booms and a decline of their unemployment rate, possibly explaining the lower European and country contribution. National



**Figure 1.7: Kernel Densities Region-Specific and Country-Specific Unemployment Rates**

*Source:* Authors' calculations using Eurostat data.

convergence has been a powerful tool to reduce regional heterogeneity measured relative to the EU average.

From 2007 to 2013 the distribution of the European and country contribution has widened again and looks very similar to the one in 1996, with numerous regions for which the factor model predicts rates above 20 per cent. In addition, also the distribution of the region-specific unemployment has widened. Hence the divergence since 2007 has been driven by an increasing heterogeneity of both European and country contributions as well as of region-specific rates.

## 1.5 Conclusion

### 1.5.1 Summary of Findings

In our analysis, we focused on two periods clearly marking trend changes in regional unemployment dispersion. While not establishing causality, we pointed to the concurrence of the trend changes with the introduction of the Euro and the financial crisis. Building on this partitioning, we were able to show the following new facts:

1. With the introduction of the Euro regional unemployment relative to the EU average converged strongly. The Gini coefficient decreased from 1996 to 2007 by 20 per cent from 0.28 to 0.23. In particular Spanish regions were able to move within the distribution.
2. With the outbreak of the financial crisis these developments reversed. Heterogeneity is strongly increasing since then and today has reached the highest level ever. Between 2007 and 2013 the Gini coefficient of EU relative rates has increased by nearly 50 per cent and the polarization measure by over 60 per cent. In addition, the same regions that converged before moved back to their previous positions resulting in a strong persistency of EU relative rates over the whole sample.
3. European fluctuations explain two fifths of the variance in regional unemployment rates, meaning that European unemployment cycles exist. Country factors are nearly as important so that only one fifth of unemployment movements are region-specific.
4. European regions react very heterogeneously to European and country fluctuations. German regions, Bruxelles-Capitale (BEL), and Luxembourg respond in the opposite direction to European movements. The response to country movements varies in particular in Italy and England.

5. We attribute the convergence between 1996 and 2007 purely to country factors but the divergence between 2007 and 2013 to both country and region-specific factors.

### 1.5.2 Discussion

Compared to the period from 1986 to 1996, which Overman and Puga (2002) studied, the development of regional unemployment has been strongly affected by country factors afterwards.<sup>18</sup> Their finding that regions polarize and country developments play only a minor role in regional heterogeneity is not an empirical regularity. In contrast, our study has shown that national developments are crucial to understand the convergence and polarization of regional unemployment.

Crescenzi et al. (2016) argue that national macroeconomic conditions affected regional reactions to the crises more generally. The importance of the country level suggests a need for new national efforts. National labour market policies are, first and foremost, pivotal to reduce national unemployment and thereby smooth regional heterogeneity resulting from between-country differences. Recent evidence has, for instance, been brought forward by the IMF, arguing that structural reforms in the Netherlands in the 1990s and Germany in the early 2000s have supported the growth trajectory of these countries and, as a result, decreased unemployment rates (Adhikari et al. (2016)). In addition, they can reduce within-country divergence as argued by Boltho et al. (2016).

On the other hand, even though country factors play a decisive role in driving regional unemployment rates up or down, their persistency over a longer time horizon is palpable. Our results confirm the findings of persistent disparities from existing country studies, for example, for Italy

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<sup>18</sup>Patrick Honohan suggested in the panel discussion that Overman and Puga (2002) downplay country effects. But clearly they became much more important afterwards.

(Cracolici et al. (2007); Boltho et al. (2016)) or Spain (López-Bazo et al. (2005)). This seems to suggest that observed changes in relative regional unemployment are rather oscillations around a long-term equilibrium where shocks such as the financial and sovereign debt crises cause only temporary deviations.<sup>19</sup> The occurrence and amplitude of such oscillations, i.e. the sensitivity with respect to shocks, however, are often determined by a region's economic structure and its more general institutional setting (Martin (2012)). In line with these findings, Zeilstra and Elhorst (2014) emphasize the joint impact of regional and national labor market factors as an explanation of regional differentials.

Consequently, besides national measures, policy makers need to focus more on regional unemployment policies aimed at improving regional performance and enhancing resilience against shocks. For example, skills in regions with the highest unemployment should be reinforced (Anderson et al. (2015)), regional wage setting should be promoted, and short distance mobility encouraged.

Moreover, as unemployment remains a challenge in most countries in the European Union, it may be useful to coordinate these policies also on the European level. They could be modelled, for example, after the Luxembourg process, which was an initiative launched in 1997 that laid out national reforms to reduce unemployment. But European Union involvement should not be limited to the country level. The European Union's structural spending, which accounts for a third of its expenditures, aims at greater regional homogeneity. While currently the main concern is income inequality, which certainly is important, regional unemployment heterogeneity should play a more important role.

In order to improve our understanding of the reasons for convergence and divergence of regional unemployment, it would be beneficial to add

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<sup>19</sup>Contrary to the theory supported by Blanchard and Katz (1992), where regional unemployment rates level off across areas due to high labor and firm mobility, these findings appear to rather follow the equilibrium theory of Marston (1985). It advocates the view that each region tends to its own equilibrium unemployment rate determined by institutions, regional supply and demand factors, or amenities.

conditional variables to a distributional analysis. While our paper and Iacus and Porro (2015) study convergence and divergence, Andersson et al. (2015) and Crescenzi et al. (2016) identify variables determining regional unemployment performance. Putting the two approaches together would allow analysing conditional and absolute convergence and even discuss the speed of convergence, very similar to the way Narayan et al. (2011) study the convergence of stock markets. We leave such an analysis for future work.

## 2

# What Does It Take to Grow Out of Recession? An Error-Correction Approach Towards Growth Convergence of European and Transition Countries <sup>1</sup>

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<sup>1</sup>Joint work with Olivier Damette (Université de Lorraine; E-mail: Olivier.Damette@univ-lorraine.fr) and Mathilde Maurel (Univ. Paris 1 Panthéon-Sorbonne and FERDI; E-mail: Mathilde.Maurel@univ-paris1.fr). We are grateful to Michael Funke, our discussants Michael Graff and Thomas McGregor, and Valerio Scalone for their helpful comments. Remarks from participants in seminars at Université Paris 1 Panthéon Sorbonne, Paris School of Economics, Université de Lorraine, the Makroökonomik und Konjunktur Workshop at the ifo Dresden, the Conference on the Imperative of Economic Growth in the Eurozone in Brno, the Annual Macroeconometric Workshop at the DIW and the 20th ICMAIF in Crete have been highly appreciated.

## 2.1 Introduction

*“[...] a key fact is that recessions are followed by rebounds. Indeed, if periods of lower-than-normal growth were not followed by periods of higher-than-normal growth, the unemployment rate would never return to normal.”*

– Council of Economic Advisors of President Obama, 2009<sup>2</sup>

The consequences of the subsiding 2008-09 financial crisis on long-run economic growth and the policy implications that can be drawn from it have become widely debated. For many, the recovery in both the United States and Europe has been unusually sluggish and has been characterized by persistently high unemployment rates. (Bordo and Haubrich (2012); Beyer and Stemmer (2016)). The 2012 conference of the Federal Reserve Bank of Boston on “Long-Term Effects of the Great Recession” was, for instance, exclusively devoted to this topic. In the accompanying conference issue, Papell and Prodan (2012) find evidence of a full recovery in the US not until late 2016 but no lasting effect on long-term potential GDP.

Yet, this has not always been the case. Covering crises earlier and elsewhere, Cerra and Saxena (2005), for instance, provide evidence that the banking crisis in Sweden in the early nineties explains why the country has incurred a permanent loss in its long term GDP per capita level. Corricelli and Maurel (2011), by focusing on transition countries which have switched from planned to market economies and experienced severe transitional recessions, show that the transitional recession is particularly deep with long term consequences, and argue that the capacity to rebound, proxied by the depth and length of the crisis, depends foremost on the quality of the financial institutions and trade liberalization.

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<sup>2</sup>The report was presented on February 28, 2009 and can be accessed through <http://www.whitehouse.gov/administration/eop/cea/Economic-Projections-and-the-Budget-Outlook/>



However, studies on financial crises cover in many respects only the extreme versions of cyclical downturns and recessions. In this work we move beyond the mere focus on economic crises and concentrate instead on typical business cycle swings, which may have a permanent effect on long-term average growth. As an assumption we follow the conventional view that lower than normal growth during a recession is followed by a recovery period with above normal growth rates. Once the economy reaches its potential output (and full employment), growth continues to follow its normal equilibrium trend. Consequently, the primary objective of this paper is first to assess whether a convergence towards this normal growth path exists and at what speed such a return is happening. Second, we further analyze potential non-linearity of this convergence process and control for factors impacting such a behavior.

In contrast to a majority of the literature, which is concentrating on the US, we focus in the following analysis on European core countries and the Eastern European transition economies. Our analysis is structured as follows: initially, we test for time series properties and estimate long-term (cointegration vector) growth models to check for long-run relationships and growth determinants of our country samples. As a next step linear error-correction models are employed to assess potential differences in adjustment velocity towards the long-run growth trend, thereby also controlling carefully for slope heterogeneity and cross-sectional dependence among countries. In order to account for potential non-linearity and different regimes in growth convergence behavior, we additionally estimate nonlinear Panel Smooth Threshold Regression-Error Correction Models, which allow for a determination of different regimes according to a selection of transition variables.

Results show that the error-correction terms from the linear models, i.e. the speed of convergence towards normal growth, are highly significant and that they are larger for transition countries. Moreover, as for non-linearity in the process found, convergence to the equilibrium varies only for EU-core countries with respect to the degree of price and wage

flexibility. Typically, the more flexible an advanced EU country is, the faster the catching-up process it will experience. Moreover, not flexible enough countries may fail to converge to their long run average output growth.

The rest of the paper is structured as follows: Section 3.2.1 presents previous literature on the topic and sets the theoretical underpinning for the analysis thereafter. Subsequently in Section 2.3, the overall estimation design is briefly outlined and thereafter data is explained. Section 2.5 focuses on the technical specificities of the linear estimations where part one covers the dynamic long-term growth models including the undertaken tests for unit roots and co-integration in the variables as well as error-correction models. The analysis of non-linearity by describing in detail estimations with the Panel Smooth Threshold Regression-Error Correction Model follows in the penultimate part. Eventually Section 4.6 concludes.

## **2.2 Related Literature and Theoretical Underpinning**

From 2008 to 2012 the Great Recession as well as the European debt crisis revealed the different adjustment strategies to a crisis. EMU membership prohibited depreciation as a quick remedy for the adjustment of unit labour costs to regain international competitiveness. The loss of independent monetary policy made price and wage adjustments necessary, which magnified the recession and provoked different policy responses. Whereas Ireland (like the Baltic countries and Bulgaria) embarked on drastic reforms in the private and public sector, in Greece political resistance delayed reforms and paved the way to the recent political crisis. This situation is reminiscent of a discussion during the world economic crisis in the 1930s. Whereas Keynes (1936) called for a depreciation to provide a short-term growth impulse, von Hayek (1937) stressed the need of price and wage adjustment. While the former emphasised the need for

a timely anti-cyclical macroeconomic impulse, the latter believed in the self-stabilizing forces of the market. In the same vein, Mundell (1961) assumes that countries need to preserve the exchange rate as an adjustment mechanism, even more if prices and wages are not flexible, while von Hayek (1937) and Schumpeter (1912) insist on declining prices and wages as the prerequisites for a robust recovery after a crisis. According to them, whatever the policy needed, there is no need to make a strong distinction between the long run and the short run growth.

In contrast to those historical insights, the more recent literature on growth dynamics after a negative economic shock focuses on the detection of depth and length of a recession or crisis as well as the associated capacity to rebound.<sup>3</sup> As documented by Kim and Nelson (1999), US recessions were usually followed by periods of high growth. High recovery periods have also been behind several other papers that find evidence of trend stationarity in GDP, such as Campbell and Mankiw (1987) or Cheung and Chinn (1999).<sup>4</sup> More recently, Cerra and Saxena (2008) examined a variety of country groups and found varying degrees of persistence of output loss following different financial and socioeconomic crises. They argue that most of the time, crisis are not neutral on long run average growth, and the return to the latter depends upon a range of institutional features.<sup>5</sup> Papell and Prodan (2012) reach a different conclusion. They analyse the length and structure of slumps, defined as a contraction and part of an expansion until the economy reaches its long-run growth rate, across a cross-section of several countries. They find that most

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<sup>3</sup>The separate emphasis on crisis on the one hand and long-run growth on the other reflects a strong tradition among macroeconomists, which consists in studying business cycles and long-term growth as two separate phenomena. For business cycle theorists, long-term growth is a fundamentally exogenous trend, while for growth theorists, short-term shocks are neutral on the long-run growth rate of the economy.

<sup>4</sup>Such high growth recoveries for the US were particularly observed before the Great Moderation and thus provide ample empirical evidence for Friedman (1993)'s theoretical "plucking" or "bounce back" model. Camacho et al. (2009), however, observe since 1984 a loss of this plucking effect with the result of recessions becoming more permanent.

<sup>5</sup>In contrast to Friedman (1993), recessions are, according to Hamilton (1989), movements in the trend of series resulting in permanently lower output. Both theories are nicely compared in Kim and Piger (2002).

recessions associated with financial crises in advanced countries do not cause permanent reductions in potential GDP. The situation is different for emerging countries where potential GDP is only restored in two out of six cases analysed. Beyond the divide developed versus emerging countries, Corricelli and Maurel (2011) demonstrate that more flexible financial institutions diminish the length and depth of crisis in transition economies. They highlight the importance of reform complementarity, particularly in financial sector reform.

Another complementary strand of research focuses on explicit policy measures and country characteristics that exert influence on a recovery and its persistence. Bicara et al. (2014), for example, focus on policy measures that influence stability periods between financial crises. Cerra et al. (2013) investigate macroeconomic policies that can influence the speed of recovery and mitigate the persistence of such shocks for different groups of industrialized and developing countries. Monetary expansion thus seems a powerful tool in industrialized countries, yet only to rebound from recession and not during regular expansion years. Expansionary fiscal policy is found to have a positive impact for recovery in both industrialized and non-Sub-Saharan countries. Floating exchange rate regimes perform best in facilitating a growth rebound from recession and are also the preferred regime for industrialized countries to support recoveries. The opposite holds for developing countries, where a fixed regime is associated with highest rates of growth over an entire expansion. During recovery years, real appreciation deteriorates growth perspectives, impacting in particular developing countries.

A clear distinction between the short and the long run was formalised in the nineties, where endogenous growth theorists show (both at the theoretical and empirical level) that there is a relation between short-term economic instability and long-run growth. According to Aghion and Saint-Paul (1993), this relation can be positive or negative, depending on whether the activity that generates growth in productivity is a complement or a substitute to production. For Aghion and Saint-Paul (1991), they

are substitutes, which implies that a larger amplitude of business cycle fluctuations has a positive effect on long run. For Stadler (1990) and Martin and Rogers (2000), they are complementary: if growth is generated via learning by doing, a negative correlation between short and long run growth will hold, particularly in developing and emerging countries. In a similar vein, Comin and Gertler (2006) examine medium-term business cycles in the US post-war period, which are found to be more variable and persistent than conventional cycles. They find that fluctuations feature significant procyclical movements in technological change with productivity swings as a central element to the persistence of cycle fluctuations. Bianchi and Kung (2014) approach the link between business cycle shocks and long-run growth through a medium-sized DSGE framework. Apart from knowledge accumulation which links business cycle shocks and long-run growth, shocks to the marginal efficiency of investment help to explain a large share in overall macroeconomic volatility. This debate finds an echo in Fatas and Mihov (2006), who argue in a slightly different policy setting that there are two forces at work: fiscal discretion, which should reduce volatility, and responsiveness of fiscal policy, which might amplify the business cycle. At the empirical level and for the sample of 48 American states, they show that a more restrictive fiscal policy leads to less volatility in output.<sup>6</sup>

The recent work by Kocenda et al. (2013) is one of the most recent empirical papers belonging to this tradition, by disentangling long-term and short-term effects of exchange rate flexibility on growth and arguing that short run growth can be painful in the long run. On a panel of 60 emerging and developing countries the authors find that exchange rate adjustments stimulate growth in the short-term, but hamper it on the long run. Confirming the results of Maurel and Schnabl (2012), long-term growth should therefore be achieved via price and wage flexibility and stable exchange rates. Moreover, monetary expansion and depreciation as a recovery strategy from a crisis may bring short-term relief, but long-term

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<sup>6</sup>If we consider fiscal policy as a driver of the business cycle, this result can be interpreted as evidence that fiscal policy is a substitute to production in the long run.

pain.

This paper aims to contribute to this debate by initially analysing convergence speeds towards the long-term growth trend via long-run growth regressions and panel error-correction models. It thus adds some profound empirical evidence to the recent theoretical attempts of Bianchi and Kung (2014) of studying economic growth and business cycles in a more unified setting within a European context. It also contributes to the more general discussion on whether recessions have exerted a more lasting effect on long-term output during recent decades. By further assessing the non-linearity of factors that drive economic growth along business cycles and demonstrating that price flexibility affects the speed of growth convergence processes, it also blends well with the recent discussion initiated by Blanchard (2014), who emphasizes the importance of accounting for nonlinearities in the growth process, particularly in light of the recent crisis period. To our knowledge of the existing literature, we are the first to analyse the non-linearity in the present context.

### 2.3 Estimation Design

Our empirical analysis begins by estimating endogenous long-term growth models in order to single out drivers of economic growth in the long run.<sup>7</sup> This behavior hails from nonstationary variables, which form, if cointegrated, long-run equilibrium relationships. Hence in this paper, we set the following basic growth model:

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<sup>7</sup>Note that the use of the term 'long run' for our purpose is considered as an econometric rather than a macroeconomic definition. The econometric definition encompasses the notion of persistency in the evolution of output – a long-run equilibrium – which may also entail firm-level productivity analysis in panels *à la*, for instance, Blundell and Bond (2000) over a couple of years. The macroeconomic literature usually attempts the same through long-run growth models and error-correction specifications as employed here. The long run thus refers to the range of years in the sample, rather than some macroeconomic principle extending over several generations.

$$y_{i,t} = \alpha_i + \beta_1 T_t + \beta_2 X'_{i,t} + Z\epsilon_{i,t}, \quad (2.1)$$

where  $y_{i,t}$  is the endogenous variable that is the growth proxy,  $T_t$  is a time trend,  $X'_{i,t}$  is the vector of all long-run growth drivers (supposedly cointegrated) variables, and the vector  $Z$  comprises all exogenous variables that are not cointegrated.

For this purpose, we employ a number of estimators, which are able to cope with non-stationarity of variables (and unobserved processes) and also potential cross-sectional correlation across panel units (countries). If these issues are not properly accounted for, spurious regressions and misspecification problems may arise. The biasedness of the standard two-way fixed-effects estimator in the presence of non-stationary variables is well known. Two homogeneous estimators we first employ, the FMOLS and DOLS, which were introduced by Pedroni (2000), are able to cope with this problem and have been used throughout the literature (e.g. Kao and Chiang (2000)).<sup>8</sup> We further introduce the CCEMG estimator developed by Pesaran (2006), which was extended to nonstationary variables in Kapetanios et al. (2011), and the alternative AMG estimator recently developed by Bond and Eberhardt (2009) and Eberhardt and Teal (2010) as a robustness check. These novel heterogeneous estimators will be further compared with the MG estimator of Pesaran and Smith (1995), which does not allow for cross-sectional correlation in the data.

We subsequently estimate linear error-correction models, in which the residuals from the previous long-run regressions serve as error-correction terms to examine convergence behavior in more detail. As recently well

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<sup>8</sup>Abbreviations for estimators hereafter: 2FE, 2-way Fixed-Effects; FMOLS, Fully Modified Ordinary Least Squares; DOLS, Dynamic Ordinary Least Squares (Kao and Chiang (2000)); MG, Mean Group estimator (Pesaran and Smith (1995)); CCEMG, Common Correlated Effects Mean Group estimator (Pesaran (2006)); AMG, Augmented Mean Group estimator (Bond and Eberhardt (2009); Eberhardt and Teal (2010)); PSTR, Panel Smooth Transition Regression model (González et al. (2005)).

explained by Eberhardt and Presbitero (2015), employing an error correction model (ECM) representation in macro panels offers three advantages over static models and restricted dynamic specifications: (i) readily distinguishing short-run from long-run behaviours; (ii) investigating the error correction term and deducing the speed of adjustment for the economy to the long-run equilibrium; and (iii) testing for cointegration in the ECM by closer investigating the statistical significance of the error term. As an additional check, we again employ the MG, CCEMG, and AMG estimators from the previous estimation step.

Moreover, we consider non-linearity in the convergence process through the estimation of PSTR models following González et al. (2005), including as before the residuals as error-correction terms from the long-run growth equation estimations. All aforementioned estimators will be briefly explained throughout the paper in order of appearance. Note that we always estimate both subsamples separately to account for a different economic structure and economic development in both country blocks.

## 2.4 Data

The selection of growth determinants is based on the theory and empirical results laid out in the relevant growth literature. Even though Durlauf et al. (2005) have identified 140 growth regressors, the number of growth determinants in our equations, however, has been kept rather limited due to several empirical reasons. A more parsimonious approach is advocated by Ciccone and Jarocinski (2010) and Moral-Benito (2012).<sup>9</sup> They find that the fewer variables are included in the regressions, the less sensitive are results. Another reason is a general limitation in data availability for the Eastern European transition countries. Moreover, Durlauf et al. (2008) find consistent significance for canonical neoclassical growth variables

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<sup>9</sup>The authors use Bayesian averaging techniques to address both model uncertainty and endogeneity issues when testing their growth equations.



independent of the underlying growth theory followed.

We include the investment to output ratio, which is a typical Solow-type determinant and has been found to have a positive effect on economic growth (see e.g. DeLong and Summers (1991); Sala-i-Martin (1997)). It represents the increasing relationship between capital accumulation, i.e. investment, and economic growth. We further employ the size of the labor force, defined here as the amount of people in employment compared to overall population (see e.g. Aghion and Howitt (1992)). In their endogenous theory growth benefits from a larger scale in the population for inventing new products and production techniques. Trade integration in terms of exports and imports as a share of GDP contributes to economic growth through increased opportunities for profitable investments (Levine and Renelt (1992)). Government consumption as a ratio to GDP represents distortional effects through taxation or government expenditure and has thus a negative impact on growth (Barro (1991); Sachs and Warner (1995)). Average inflation, constructed as the average quarterly year-on-year changes of the consumer price index, controls for (detrimental) growth effects originating in macroeconomic instability (Bruno and Easterly (1998)). We also tried other usually employed variables such as the domestic credit to GDP ratio as a measure of financial development, which, however, does not turn out to be significant.<sup>10</sup>

We use an original dataset of quarterly frequency that is partly borrowed from Kocenda et al. (2013) and has been extended to include the recent crisis. For most of the series, it covers a period from 1995Q1 to 2010Q4, thus the panel is unbalanced across countries. The sample coverage starts in 1995 because we want to exclude the beginning of the 1990s. For most of the Central, Eastern and Southeastern European countries the early nineties implied a transition pattern different from the business cycles framework in normal market economies, which is used in this paper. As this paper wants to single out different long-term drivers for economic

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<sup>10</sup>Data on human capital, typically measured as secondary school enrolment (see Barro (1991), among others), is already in annual frequency very patchy for transition countries and therefor not included.

growth and analyze convergence behavior of Eastern European and transition countries, the original dataset includes 15 European core countries (henceforth EU-core) and 15 Eastern European transition countries plus Turkey.<sup>11</sup> Eventually, due to maximizing data series length, 11 transition countries are included, dropping Albania, Bosnia-Herzegovina, Macedonia, Serbia and the outlier Turkey.

The data come from the IMF's International Financial Statistics. Missing or inconsistent data have been completed and crosschecked with national statistics, mainly at national central banks. Series used in estimations were, where necessary, seasonally adjusted.<sup>12</sup> Quarterly real GDP growth rates and inflation rates are calculated as year-over-year quarterly growth rates to filter out seasonal patterns and lower the erratic volatility of the series ( $x_{i,t} = \ln(X_{i,t}) - \ln(X_{i,t-4})$ ). The measure of quarterly de facto exchange rate flexibility and, in an analogue manner, of changes in the producer price index (PPI) as a measure for price and wage flexibility are computed as the quarterly arithmetic average of monthly percent exchange rate changes.<sup>13</sup> The exchange rate variable is calculated against the euro (the Deutsch mark before 1999) or the dollar, depending on the respective anchor currency. Once a country has entered the EMU the proxy for exchange rate flexibility is set to zero (see Kocenda et al. (2013)).

Before embarking on the results section with the estimation of the long-run relationships, we test for stationarity of the included variables via several panel unit-root tests and need to confirm whether our variables are indeed cointegrated. We further control for cross-sectional dependence among

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<sup>11</sup>EU-Core countries: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Portugal, Spain, Sweden, United Kingdom; Transition countries: Albania, Bosnia-Herzegovina, Bulgaria, Croatia, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Macedonia, Poland, Romania, Slovak Republic, Slovenia, Serbia, Turkey

<sup>12</sup>For seasonal adjustment the *X12-ARIMA* package provided by the US Census Bureau was used.

<sup>13</sup>The quarterly arithmetic average ( $\mu$ ) has been introduced by Ghosh et al. (2003) and combined with the standard deviation of quarterly percent exchange rate changes of the respective quarter ( $\sigma$ ) to form the z-score  $z = \frac{\mu}{\sqrt{\sigma^2 + \mu^2}}$ . This measure has further been employed by Schnabl (2009) and Maurel and Schnabl (2012).

Table 2.1: Panel Unit Root Tests (EU-Core Countries)

PURT	Production [1]	Labor Force [2]	Investment [3]	Trade [4]	Government Consumption [5]
Levin Lin Chu	0.341 (0.633)	-0.967 (0.167)	-1.361 (0.087)	-0.907 (0.182)	1.055 (0.854)
Im Pesaran Shin	0.882 (0.811)	1.016 (0.845)	-6.453 (0.000)	0.016 (0.507)	-0.038 (0.485)
Maddala-Wu (ADF)	30.575 (0.437)	31.614 (0.386)	125.495 (0.000)	26.366 (0.656)	33.980 (0.282)
<b>Specification</b>	Constant and Trend	Constant	Constant	Constant	Constant
CIPS	0.062 (0.525)	-1.278 (0.101)	-2.141 (0.016)	0.514 (0.696)	0.497 (0.690)
(1 to 4 lags)	0.757 (0.775)	0.268 (0.606)	0.086 (0.534)	1.069 (0.857)	1.164 (0.878)
	2.340 (0.990)	0.476 (0.683)	0.294 (0.616)	2.267 (0.988)	2.267 (0.988)
	1.837 (0.967)	1.661 (0.048)	1.131 (0.871)	1.124 (0.870)	2.645 (0.996)
Carrion-i-Silvestre	-	-	6.138 (0.000)	-	-
			5.845 (0.000)		

*Remarks:* AIC selection is used to perform first panel generation tests. The second generation CIPS test has 1 to 4 lags included. Carrion-i-Silvestre et al. (2005)'s third generational test assumes as the null hypothesis stationarity; it is performed considering a maximum of two structural breaks. *na* refers to no available statistics due to a lack of observations.

*Source:* Authors' calculations.

the countries in our subsamples.

## 2.5 Estimation Results

### 2.5.1 Cross-Sectional Dependence, Panel Unit-Root and Cointegration Tests

In order to avoid spurious regressions and to provide a robust analysis, we initially employ a battery of panel unit-root tests (PURT) on each variable, using the Levin et al. (2002) (LLC) test, the Im et al. (2003) test, and the Fisher-type ADF test (Maddala and Wu (1999)). The literature has shown that Maddala and Wu (1999) exhibit the best size properties.

Concerning the EU-core countries (Table 2.2) and the first generation tests, we do find an integration of order 1 for labor force, trade openness, government consumption, and by construction, the trend. The inflation rate is stationary and will thus be added to the set of exogenous explanatory

Table 2.2: Panel Unit Root Tests (Transition Countries)

PURT	Production [1]	Labor Force [2]	Investment [3]	Trade [4]	Government Consumption [5]
Levin Lin Chu	-2.056 (0.019)	-0.999 (0.159)	-1.298 (0.097)	-1.129 (0.192)	-3.744 (0.000)
Im Pesaran Shin	0.503 (0.692)	-0.897 (0.185)	-2.943 (0.002)	-1.030 (0.151)	-6.768 (0.000)
Maddala-Wu (ADF)	20.865 (0.831)	37.958 (0.151)	43.865 (0.008)	38.401 (0.056)	117.533 (0.000)
<b>Specification</b>	Constant	Constant	Constant	Constant	Constant
<b>CIPS</b>	na	-1.141 (0.127)	-1.867 (0.031)	-2.608 (0.005)	-1.832 (0.034)
<b>(1 to 4 lags)</b>		1.677 (0.953)	-1.426 (0.077)	-0.411 (0.341)	-1.461 (0.072)
		2.655 (0.996)	-1.917 (0.028)	na	-1.744 (0.038)
		3.950 (1.000)	-0.959 (0.169)	na	-0.225 (0.411)
<b>Carrion-i-Silvestre</b>	-	-	-	-	-

*Remarks:* AIC selection is used to perform first panel generation tests. The second generation CIPS test has 1 to 4 lags included. Carrion-i-Silvestre et al. (2005)'s third generational test assumes as the null hypothesis stationarity; it is performed considering a maximum of two structural breaks. *na* refers to no available statistics due to a lack of observations.

*Source:* Authors' calculations.

variables that are outside the cointegration vector. However, the case of investment leads to mixed results since only the LLC test shows no rejection of the null hypothesis of no unit root. As for the transition countries, the results of the first-generation PURT are in favor of the presence of a unit root in the dynamics of the series except again for investment as well as for the government expenditure variable.

Since we expect some contagion and common factor effects between the countries of each subsample – for instance, the core countries share the same monetary policy in the Euro Zone – we perform absolute values of the pairwise correlations and also the Pesaran (2004)<sup>14</sup> cross-section dependence test (CD test). As shown in Table 2.3, not surprisingly we find evidence of significant cross-section dependence between our series. We thus reinvestigate the previous unit root testing and take into account common factors by using so-called second generation PURT from Pesaran (2007) named CIPS. Indeed, when the cross section independence assumption is not verified, the first-generation tests exhibit large size distortions.

<sup>14</sup>Moscone and Tossetti (2009) evaluate other tests to assess cross-sectional dependence but none perform better than the Pesaran (2004) one.

Table 2.3: Cross-Sectional Correlation Tests

Variable	CD Test [1]	p-Value [2]	Correlation [3]	Absolute Correlation [4]
<b>EU-Core Countries</b>				
<b>Production</b>	33.98	0.00	0.487	0.553
<b>Labor Force</b>	59.15	0.00	0.843	0.843
<b>Investment</b>	32.47	0.00	0.470	0.474
<b>Trade</b>	39.60	0.00	0.566	0.591
<b>Government Consumption</b>	42.74	0.00	0.617	0.626
<b>Transition Countries</b>				
<b>Production</b>	26.94	0.00	0.815	0.815
<b>Labor Force</b>	11.21	0.00	0.352	0.510
<b>Investment</b>	17.04	0.00	0.532	0.556
<b>Trade</b>	7.21	0.00	0.232	0.367
<b>Government Consumption</b>	9.58	0.00	0.302	0.330

*Remarks:* The Pesaran (2004) CD test is distributed as a standard normal under the null hypothesis of no cross-sectional dependence and based on mean pair-wise correlation coefficients. It is valid for N and T going to infinity in any order and it is robust to possible structural breaks.

*Source:* Authors' calculations.

Finally, considering that investment series may contain structural breaks that might lead to biased unit root tests results, we also perform the so-called third generation panel unit root test from Carrion-i-Silvestre et al. (2005) that extends a panel KPSS (or Hadri) specification introducing potential structural breaks.

Results from these tests (see the two last lines in Table 2.2) suggest that investment may be also considered as a nonstationary variable in core countries. The test from Carrion-i-Silvestre et al. (2005) clearly rejects the null of stationarity and all the CIPS results (except with a one-lag specification) are in favor of the unit root hypothesis. However, results are less clear-cut in the transition countries case and the presence of a cointegration relationship needs to be cautiously concluded.

Regarding previous PURT tests, it should be reasonable to assume that all the variables exhibit  $I(1)$  or near  $I(1)$  properties, at least in the case of core countries. We thus assess in the next step the null hypothesis of a non-

cointegrating relationship against the alternative of cointegration among these variables by relying on Pedroni (1999, 2004) as well as Westerlund (2007)'s panel cointegration techniques. The Pedroni first generation cointegration tests are residual tests extending the Engle and Granger methodology in a panel context. Pedroni introduced some heterogeneity in terms of cointegration vectors and developed some pooled (or panel) tests and also some group-mean (or heterogeneous) tests. The results in Table 2.4 show that four test statistics out of seven lead to reject the null of no cointegration regarding the core countries but only three in the case of transition countries.<sup>15</sup>

Considering potential cross-section dependence in the production dynamics, we also perform the Westerlund (2007) test based on an ECM approach and on bootstrap critical values robust to the presence of cross-section dependence. Results from the Westerlund test are clearly not in favor of cointegration. However, as the correlation is weak in the case of core countries – the dependent variable (production) exhibits a correlation value inferior to 0.6 (see Hlouskova and Wagner (2006) and Table 2.3) – the cross-section dependence issue is of minor importance and we can thus follow the conclusions from Pedroni and argue in favor of a cointegration relationship in both sub-samples. Note that there were no indications of major breaks in the production dynamics over the period 1995-2010; therefore there was no need to apply cointegration tests that account for structural breaks.

### 2.5.2 Linear Long-Run Estimations

The above cointegration tests have confirmed that a long-run equilibrium relationship between the variables of interest seems to exist. Thus, although the results for the transition countries are not totally clear-cut,

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<sup>15</sup>Using a simulation study with  $T=200$  and  $N$  superior to 5, Orsal (2008) find that the panel-t test has the best size and size adjusted power properties. On the contrary, the group-p, panel-p and group-t tests have poor size-adjusted powers. Other studies show that Pedroni's parametric tests perform best in terms of power.

Table 2.4: Cointegration Tests

Dimension	Statistic [1]	Standardized Values [2]	Statistic [3]	Standardized Values [4]
		<b>EU-Core Countries</b>		<b>Transition Countries</b>
<b>Panel (Pooled)</b>	$Z_{vN,T}$	-0.281 (0.611)	$Z_{vN,T}$	-0.480 (0.685)
	$Z_{\rho N,T}$	-2.578 (0.005)	$Z_{\rho N,T}$	-0.570 (0.284)
	$Z_{tN,T}$	-3.809 (0.000)	$Z_{tN,T}$	-2.031 (0.021)
	$Z_{vtN,T}^*$	1.415 (0.921)	$Z_{tN,T}^*$	-1.978 (0.024)
<b>Group (Heterogeneous)</b>	$\tilde{Z}_{\rho N,T-1}$	-2.306 (0.011)	$\tilde{Z}_{\rho N,T-1}$	0.841 (0.780)
	$\tilde{Z}_{tN,T}$	-3.900 (0.000)	$\tilde{Z}_{tN,T}$	-1.951 (0.026)
	$\tilde{Z}_{tN,T}^*$	1.649 (0.950)	$\tilde{Z}_{tN,T}^*$	-1.082 (0.311)
<b>Westerlund ECM Test</b>	1.204	0.51	0.785	0.52
	2.128	0.56	2.408	0.84
	1.990	0.77	0.536	0.51
	2.024	0.82	1.002	0.63

*Remarks:* The seven statistics follow a  $N(0,1)$  under the null of no cointegration of the Pedroni (1999, 2004) tests. Specification with only a constant but no trend. Z-values and robust p-values with one lag are presented concerning the Westerlund (2007) test. Results with zero or two lags are similar in a qualitative manner.

*Source:* Authors' calculations.

we initially employ the Fully Modified Least Squares (FMOLS) estimator, suggested by Pedroni (2000) that allows to profit from the non-stationarity and that corrects the regular pooled OLS estimator for cointegration between the different series and for endogeneity among covariates.

Although the series length should be long enough to avoid small sample bias<sup>16</sup>, we also estimate with Dynamic Ordinary Least Squares (DOLS), which shows slightly better finite-T handling in the presence of endogenous feedback (Kao and Chiang (2000)) and outperforms the previous FMOLS estimator. The DOLS estimator uses parametric adjustment to the errors by including leads and lags of the differenced  $I(1)$  regressors. It is obtained from the following equation:

<sup>16</sup>Both EU core and transition countries have at least a sample length of 63 periods with a total of 486 panel observations.

$$y_{i,t} = \alpha_i + \beta_1 T_t + \beta_2 X'_{i,t} + \sum_{j=-q_1}^{j=q_2} c_{i,j} \Delta X_{i,t+j} + \epsilon_{i,t}, \quad (2.2)$$

where  $c_{i,j}$  is the coefficient of lead or lag values of the differenced explanatory variables  $X_{i,t}$  including Investment, Labor Force, Trade Integration and Government Consumption variables and  $T_t$  represents a time trend. Inflation enters the regression as a deterministic regressor due to not being integrated. Leads and lags are based on the AIC criterion.

Considering the results of the previous cointegration tests in the spirit of Eberhardt and Presbitero (2015), we also employ more flexible estimators, specifically the MG estimator, which accounts for slope heterogeneity, and in light of positive cross-sectional correlation findings, the CCEMG and AMG estimators that allow for both characteristics. The baseline equation (2.1) will thus be denoted in the following form:

$$y_{i,t} = \alpha_i + \beta_1 T_t + \beta_2 X'_{i,t} + \epsilon_{i,t}, \quad (2.3)$$

where cross-sectional dependence arises from a multifactor error structure

$$\epsilon_{i,t} = \alpha_{1,i} + \lambda_i f_t + u_{i,t} \quad (2.4)$$

$$X'_{i,t} = \alpha_{2,i} + \lambda_i f_t + \gamma_i g_t + \varepsilon_{i,t}. \quad (2.5)$$

Above representation assumes that both the covariates and the error term contain a finite number of unobserved common factors  $f_t$ , whose



impact may differ across countries due to heterogeneous factor loadings  $\lambda_i$ .<sup>17</sup> The factors  $f_t$  and  $g_t$  are allowed to be nonstationary and do not necessarily remain linear over time.  $u_{i,t}$  and  $\varepsilon_{i,t}$  are stochastic shocks. The estimators thus accommodate a limited number of strong factors representing global shocks, such as the recent global financial crisis, and an infinite number of weak factors, such as regional spillover effects due to cultural or geographic proximity (Chudik et al. (2011)).

The standard MG estimator by Pesaran and Smith (1995) cannot explicitly consider cross-sectional dependence and either assumes the unobservables  $\lambda_i$   $f_t$  away or tries to catch them with a linear trend.<sup>18</sup> The estimated coefficients  $\hat{\beta}_i$  are then averaged across countries in the sample.

In order to account for these unobserved common factors in the estimation process, the CCEMG estimator adds as covariates to the regression a linear combination of cross-sectional panel averages of both the dependent and the independent variables  $(\bar{y}_t, \bar{X}_t)$ .<sup>19</sup> These extra regressors, however, cannot be interpreted in a meaningful way, but help to consistently estimate the model parameters in the presence of unobserved common factors. Pesaran (2006) demonstrates that the estimator has good finite sample properties and that it is able to control for serially and spatially correlated error terms. Moreover, various simulation studies (e.g. Coakley et al. (2006); Kapetanios et al. (2011)) have shown that the CCEMG estimator also performs quite well in presence of non-stationary and cointegrated covariates, global and regional spillover and business cycle effects, as well as structural breaks (Eberhardt and Teal (2013b,a)).<sup>20</sup>

<sup>17</sup> $g_t$  is included to highlight that the observables  $X$  can also be driven by other factors than  $f_t$  (Eberhardt (2012)).

<sup>18</sup>Not explicitly controlling for cross-sectional correlation, the MG estimator can thus be considered as a fully heterogeneous estimator.

<sup>19</sup>For an accessible study of heterogeneous parameter estimators containing unobserved common factors consult, for example, Eberhardt et al. (2013).

<sup>20</sup>In the presence of common factors, Bai et al. (2009) advocate the updated and fully modified bias corrected estimators. Recent contributions by Bailey et al. (2015) and Westerlund and Urbain (2015) mark a preference for the CCEMG estimator on the basis of theoretical and computational easiness.

Regarding the AMG estimator, it provides a viable alternative to the CCEMG estimator, particularly in the context of cross-country production functions (Bond and Eberhardt (2013)). Whereas in the CCEMG estimator the unobserved common factors have been treated as nuisance, the AMG estimator introduces a “common dynamic process” in the group specific regression. This common dynamic process variable is constructed by taking the coefficients of the  $t - 1$  time dummies in a first stage OLS regression run in first differences. In the second step, the group-specific regression model is then augmented with these coefficients along with linear time trends to catch omitted idiosyncratic processes. We resort to including the common dynamic effect as an explicit variable rather than imposing it on each group member by subtracting the process from the dependent variable with a unit coefficient. Like in the MG and the CCEMG estimators, the group-specific model parameters enter the final regression as an average across panel members<sup>21</sup> (Eberhardt (2012)). Note, however, that the estimation via AMG serves as robustness check to the CCEMG only, as due to shorter time series of the transition countries, subsample estimations with AMG could only be performed for the EU core countries. Results can be found in the Appendix B.1.1.

Tables 2.5 and 2.6 below present the estimation results on the long-run economic growth relationships for the EU-core and transition subsamples computed with previously described estimators. Whereas estimates of FMOLS and DOLS in columns [1] and [2] imposing parameter homogeneity across countries, the other two models in columns [3] and [4] allow for differential relationships.

Regression output in both tables exhibits for all coefficients of the employed explanatory variables, according to theory, the expected signs and to a large extent significance.<sup>22</sup> By closer examining estimation results

<sup>21</sup>Like in the MG and the CCEMG estimators, the group-specific model parameters are averaged across the panel, i.e.  $\widehat{\beta}_{AMG} = \frac{1}{N} \sum_{i=1}^N \beta_i$ . For all MG estimators we follow standard practice in the literature and regress the group-specific coefficients on the intercepts with a weighting robust to outliers, following Hamilton (1992).

<sup>22</sup>This also holds for the AMG estimations of the EU-core subsample in Appendix 1,

Table 2.5: Long-Run Determinants of Economic Growth (EU-Core Countries)

Variables	Homogeneous Estimates		Heterogeneous Estimates	
	FMOLS [1]	DOLS [2]	MG [3]	CCEMG [4]
Investment	0.187*** [0.027]	0.249** [0.051]	0.079* [0.043]	0.014 [0.014]
Labor Force	0.812*** [0.175]	0.721*** [0.247]	0.476 [0.329]	0.240* [0.143]
Trade Integration	0.334*** [0.050]	0.365*** [0.065]	0.329*** [0.048]	0.328*** [0.077]
Government Consumption	-0.539*** [0.093]	-0.513*** [0.126]	-0.634*** [0.147]	-0.248* [0.133]
RMSE	-	-	0.038	0.021
Share Trends (No. Trends)	-	-	0.667 (10)	0.533 (8)
No. Countries	15	15	15	15
No. Observations	784	759	796	796

*Remarks:* Estimations are based on FMOLS, DOLS, MG, and CCEMG estimators. Sample: 15 EU core countries, quarterly data from 1995Q1 - 2010Q4. We report the cross-country mean of coefficients in the heterogeneous parameter models [3]-[4] according to Hamilton (1992); standard errors in brackets are non-parametrically constructed following Pesaran and Smith (1995). An intercept, a group-specific linear trend and the quarterly average of the inflation rate as an exogenous variable are included in all models, yet not reported (available upon request). RMSE is the root mean square error; Share Trends (No. Trends) reports the share (number) of group-specific trends significant at the 5% level. \*, \*\*, \*\*\* indicates significance at the 1%, 5%, or 10% level.

*Source:* Authors' calculations.

for EU core countries in Table 2.5, investment is shown to have a positive impact on long-run economic output, and is, with the exception of the CCEMG estimator, always significant. This is consistent with early results on growth determinants by Barro (1991) and Barro and Lee (1994). Along the lines of standard growth literature, the size of the labor force attracts the largest coefficients among all variables included. The positive and across all specifications pretty stable and highly significant coefficient of the trade integration variable is particularly for core members of the European Union not really surprising. The tight integration in trade of goods and services has since the early set-up of the European Economic

where the signs of coefficients also fulfil expectations. However, only trade integration and the common dynamic process remains highly significant.

Table 2.6: Long-Run Determinants of Economic Growth (Transition Countries)

Variables	Homogeneous Estimates		Heterogeneous Estimates	
	FMOLS [1]	DOLS [2]	MG [3]	CCEMG [4]
Investment	0.220*** [0.022]	392*** [0.033]	0.161*** [0.048]	0.044 [0.028]
Labor Force	0.322** [0.140]	0.233* [0.129]	0.314 [0.313]	0.190 [0.137]
Trade Integration	0.024*** [0.008]	0.012 [0.008]	0.243*** [0.048]	0.046 [0.067]
Government Consumption	-0.269*** [0.061]	-0.098 [0.081]	-0.072 [0.119]	-0.172* [0.096]
RMSE	-	-	0.044	0.031
Share Trends (No. Trends)	-	-	1.000 (11)	0.545 (6)
No. Countries	11	11	11	11
No. Observations	502	486	518	518

*Remarks:* Estimations are based on FMOLS, DOLS, MG, and CCEMG estimators. Sample: 11 transition countries, quarterly data from 1995Q1 - 2010Q4. We report the cross-country mean of coefficients in the heterogeneous parameter models [3]-[4] according to Hamilton (1992); standard errors in brackets are non-parametrically constructed following Pesaran and Smith (1995). An intercept, a group-specific linear trend and the quarterly average of the inflation rate as an exogenous variable are included in all models, yet not reported (available upon request). RMSE is the root mean square error; Share Trends (No. Trends) reports the share (number) of group-specific trends significant at the 5% level. \*, \*\*, \*\*\* indicates significance at the 1%, 5%, or 10% level.

*Source:* Authors' calculations.

Community fostered exports within the EU and has thus tremendously contributed to overall economic growth. The coefficient associated with government consumption is negative and even though more than halved under CCEMG, indicates a significant negative relationship between government expenditure and economic output (Fajnzylber et al. (2005); Loayza and Rancière (2006); López-Villavicencio and Mignon (2011)). High government expenditure can be considered a burden and may over time diminish a government's "fiscal space", for instance through having precommitted future budgetary resources to social insurance programs (Heller (2005)).<sup>23</sup>

<sup>23</sup>Defined according to Heller (2005) as "room in a government's budget that allows it to provide resources for a desired purpose without jeopardizing the sustainability of its

Comparing the results between the EU-core countries and their transition counterparts, we find in Table 2.6 a stronger contribution of investment to economic output in the transition countries regression. This result echoes the basic theory of decreasing marginal productivity in the growth literature, finding an ever-decreasing marginal impact of any extra unit of capital with respect to advancing economic development (Barro and Sala-i-Martin (2003)). Hence, it represents the different levels of economic development in the country subsamples. Whereas the level of capital accumulation is apparently of higher importance for transition countries, labor force size seems to matter on average less for long-term economic output, whose impact is diminished by almost two thirds in the homogeneous estimates and also got diminished under the heterogenous estimators. These results follow two out of the seven stylized transition facts recorded by Campos and Corricelli (2002): that “labor moved”, not geographically but from activity to unemployment, inactivity, and from public to private sector, restoring its contribution to GDP growth, and that investment shrank, from a situation where it was abundant but completely inefficient. The reduction in significance and size of the trade openness variable compared to the EU core may point to some limitations in the unequivocal view of overall beneficent trade openness. Recent literature, for instance, finds a negative effect of export concentration, most likely the case for our transition countries (Lederer and Maloney (2003)). Others stress the importance of policy complementation in non-trade areas with regard to trade liberalization, particularly in emerging countries (Chang et al. (2009)). For what regards transition countries, the trade collapse was caused by the dismantling of the Council for Mutual Economic Assistance (CMEA) and trade re-orientation. Trade is considered as the main factor, driving the initial huge output losses, and strong subsequent recoveries. Regarding government consumption, although with negative coefficient and significant at least in the FMOLS and to a lesser extent in the CCEMG specification, it seems to be less an issue for transition countries, probably driven by comparably lower Debt-to-GDP levels (Boone 

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financial position or the stability of the economy”.

and Maurel (1999)).

### 2.5.3 Panel Cointegration Framework

As Engle and Granger (1987) pointed out in their seminal work, cointegration and error correction are mirror images of each other. We thus continue by estimating a standard linear Panel Error-Correction Model (Panel ECM) in order to inspect the different convergence forces working on economic growth in either the EU core or transition countries.

Our equations include as short-run fundamentals the previously used variables in first differences and the Kocenda et al. (2013) exchange rate flexibility measure computed as the mean of percent exchange rate changes vis-à-vis the anchor currency Deutsch Mark/Euro. Government consumption as a short-run variable has been discarded.<sup>24</sup> The subsequent equation has the following form:

$$\Delta y_{i,t} = \mu_t + \theta z_{i,t-1} + \beta \Delta X'_{i,t} + \varepsilon_{i,t}. \quad (2.6)$$

where  $z_{i,t-1}$  represents the respective residuals of the previous long-run growth regressions lagged by one period. What we are most interested in is the respective coefficient  $\theta$  that describes in a linear way the adjustment speed to the long-term equilibrium growth rate.  $\Delta X_{i,t}$  is the vector of short-run controls with  $\Delta$  indicating the time series operator for a transformation into growth rates;  $\varepsilon_{i,t}$  is the i.i.d. residual term of the short-run equation. In addition, to check the robustness of our results and

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<sup>24</sup>All estimations have also been performed including the government consumption variable. However, apart from not being significant, results have shown to be more robust when excluding it from the variable set. Moreover, the insignificance of government consumption as a short-term control also corroborates recent findings of Eberhardt and Presbitero (2015). Results are available upon request.

considering the mixed evidence in favor of cointegration – especially in the case of transition countries – and also the potential presence of common factors in the dynamics of the series, we further compute above regression with MG, CCEMG and AMG estimators. Every time the residuals from the respective long-run growth models in the first step are included as error-correction terms.

Tables 2.7 and 2.8 below show for both country subsamples error-correction coefficients as residuals derived from above estimations in the first step.

Across all models in Tables 2.7 and 2.8, there is strong evidence of error correction as the high significance and the negative sign of the error-correction terms show. Of strong interest is the difference in speed of adjustment to the long-term growth equilibrium, to which the transition country group seems to converge faster than EU core countries under the two homogeneous and the heterogenous estimators in columns [1] – [4], both not accounting and accounting for cross-sectional dependence.<sup>25</sup> Consequently, whereas the developed EU economies show highly significant error-correction coefficients of between -0.154 with FMOLS and -0.415 under CCEMG, transition countries report coefficients of -0.248 and -0.380 respectively.

As an additional indication of convergence speed, we also compute the half-life<sup>26</sup> (here measured in quarters), which indicates “the length of time after a shock before the deviation in output shrinks to half of its impact” (Chari et al., 2000, p. 1161). In line with in size decreasing error-correction coefficients, the half-life values decline from about 4.5 to 1.3 quarters for the EU-core and from 3.7 to 1.4 for the transition countries according to the different model specifications. Even though error-correction coefficients show an increasing and half-life respectively a decreasing trend for both country groups with a continuous refinement of the estimator, values constantly remain higher throughout all estimators

<sup>25</sup>The corresponding Table B.2 for the AMG estimation for the EU-core is available in Appendix B.1.2.

<sup>26</sup>The half-life is computable as  $(\log(0.5)/\log(1 + \theta))$ .

Table 2.7: Linear Panel Error-Correction Model (EU-Core Countries)

Variables	Homogeneous Estimates		Heterogeneous Estimates	
	FMOLS [1]	DOLS [2]	MG [3]	CCEMG [4]
<i>Err. Corr. Coefficient</i>	-0.154*** [0.023]	-0.143*** [0.027]	-0.282*** [0.043]	-0.415*** [0.069]
<i>Short-Run Coefficients</i>				
$\Delta$ Investment	0.047*** [0.007]	0.037** [0.007]	0.001 [0.014]	-0.022 [0.011]
$\Delta$ Labor Force	0.126 [0.082]	0.077 [0.083]	-0.005 [0.166]	0.170 [0.199]
$\Delta$ Trade Integration	0.275*** [0.024]	0.259*** [0.025]	0.268*** [0.063]	0.043 [0.032]
ER Flexibility	-0.178 [0.108]	-0.198* [0.111]	-0.037 [0.090]	-0.065 [0.148]
Half-Life (in quarters)	4.145	4.492	2.096	1.295
RMSE	-	-	0.022	0.015
Share Trends (No. Trends)	-	-	0.214 (3)	0.071 (1)
Durbin-Watson	1.955	2.022	-	-
No. Countries	15	15	15	15
No. Observations	725	715	780	780

*Remarks:* Estimations are based on FMOLS, DOLS, MG, and CCEMG estimators. All specifications contain the respective long-run residuals as error-correction terms. Sample: 15 EU-core countries, quarterly data from 1995Q1 - 2010Q4. We report the cross-country mean of coefficients in the heterogeneous parameter models [3]-[4] according to Hamilton (1992); standard errors in brackets are non-parametrically constructed following Pesaran and Smith (1995). An intercept, a group-specific linear trend and the quarterly average of the inflation rate as an exogenous variable are included in all models, yet not reported (available upon request). RMSE is the root mean square error; Share Trends (No. Trends) reports the share (number) of group-specific trends significant at the 5% level. \*, \*\*, \*\*\* indicates significance at the 1%, 5%, or 10% level.

*Source:* Authors' calculations.

for the transition subsample. The overall tendency thus seems to confirm a somewhat faster adjustment of transition economies. This trend is also in accordance with recent results of Gros and Alcidi (2015), who find a faster adjustment of the Baltics and Bulgaria to the recent crisis and a respectively longer and less sharp adjustment for countries within the EMU.



Table 2.8: Linear Panel Error-Correction Model (Transition Countries)

Variables	Homogeneous Estimates		Heterogeneous Estimates	
	FMOLS [1]	DOLS [2]	MG [3]	CCEMG [4]
<i>Err. Corr. Coefficient</i>	-0.248*** [0.029]	-0.171*** [0.043]	-0.338*** [0.083]	-0.380*** [0.077]
<i>Short-Run Coefficients</i>				
$\Delta$ Investment	0.047*** [0.007]	0.023*** [0.007]	0.011 [0.024]	0.014 [0.021]
$\Delta$ Labor Force	0.365*** [0.084]	0.363*** [0.089]	0.217* [0.112]	0.06 [0.229]
$\Delta$ Trade Integration	0.041*** [0.007]	0.041*** [0.007]	0.093** [0.043]	0.006 [0.018]
ER Flexibility	-0.400*** [0.096]	-0.380*** [0.101]	-0.101** [0.194]	0.180 [0.184]
Half-Life (in quarters)	2.432	3.696	1.683	1.447
RMSE	-	-	0.025	0.014
Share Trends (No. Trends)	-	-	0.455 (5)	0.455 (5)
Durbin-Watson	1.612	1.729	-	-
No. Countries	11	11	11	11
No. Observations	477	471	488	488

*Remarks:* Estimations are based on FMOLS, DOLS, MG, and CCEMG estimators. All specifications contain the respective long-run residuals as error-correction terms. Sample: 11 transition countries, quarterly data from 1995Q1 - 2010Q4. We report the cross-country mean of coefficients in the heterogeneous parameter models [3]-[4] according to Hamilton (1992); standard errors in brackets are non-parametrically constructed following Pesaran and Smith (1995). An intercept, a group-specific linear trend and the quarterly average of the inflation rate as an exogenous variable are included in all models, yet not reported (available upon request). RMSE is the root mean square error; Share Trends (No. Trends) reports the share (number) of group-specific trends significant at the 5% level. \*, \*\*, \*\*\* indicates significance at the 1%, 5%, or 10% level.

*Source:* Authors' calculations.

A quick look at the short run controls for both country groups reveals, where significant, a positive relation with long-run growth across all specifications, except for exchange rate flexibility. The size of the investment coefficients does not vary considerably between EU-core and transition countries, and attracts a strong significance under the homogenous FMOLS and DOLS estimators. This result is not confirmed by the heterogeneous MG and CCEMG estimators, albeit with slightly higher investment coeffi-

cients for transition countries. Moreover, the size of the labor force seems to play a greater role as emphasized by larger coefficients and higher significance for the transition country sample. Conversely, trade integration matters more for the EU-core than for growth in emerging Europe; if significant, coefficients are again higher, what is in line with growth theory and previously pointed out structural reasons. This result may thus again reflect the close and long-lasting interconnectedness of Western European economies, while European integration is still fragmented and ongoing for Eastern Europe. As for exchange rate flexibility, the opposite is true and somewhat puzzling as apparently higher flexibility in the short run implies lower long-term growth for transition countries. The latter findings contrast somewhat with Kocenda et al. (2013) who find mildly positive short-run effects of exchange rate flexibility, yet a negative impact over the longer term. However, the fixed exchange rates hail primarily from domestic currency pegs to or the recent adaption of the Euro, what may positively contribute to domestic macroeconomic stability *via* its policy anchor function.<sup>27</sup> Moreover, as many transition countries are small and very open economies, they are also more vulnerable to external shocks. Due to the absence of exchange rate flexibility as a shock absorber, fixed exchange rates may also force transition countries to adjust faster internally to shocks as argued in Gros and Alcidi (2015) and are through a faster recovery potentially less harmful to economic growth.<sup>28</sup>

Note that the declining significance of many short-term controls under the heterogenous estimators does not imply an absence of any significant effects, but rather emphasizes the heterogeneity across countries with dynamics on average cancelling out.

The analysis up to this point investigated long-term behavior of economic growth and the speed of convergence for the two different subsamples, EU-core and transition countries. A number of empirical models were assessed

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<sup>27</sup>Conversely, results of Markiewicz (2006) would suggest a more likely imposition of flexible exchange rates in transition countries.

<sup>28</sup>Over the long run, fixed exchange rate arrangements further serve as a catalyst for productivity increases, wage austerity and price cuts (Maurel and Schnabl (2012)).

and we can conclude that error-correction is taking place. Results further depict a faster return of transition countries to their long-term growth. To explore nonlinearity of convergence, we now turn to an empirical model class that allows for different regimes in the process by relying on endogenous thresholds and by modeling a smooth process of potential regime-switches that are dependent on transition variables.

## 2.6 Nonlinear Specification

Results from the previous section suggest that convergence among countries towards their long-run growth trend in the two different country groups is not homogenous, but may rather depend on other specific factors, such as the controls examined before. We further assume, that the relation between these factors and the speed of convergence may be nonlinear in nature or may contain a nonlinear adjustment mechanism for different country groups and economic fundamentals, a feature the previous linear models would be unable to capture.

In order to further disentangle these relationships, we extend the previous linear error-correction framework and employ a panel smooth transition regression model developed by González et al. (2005) and Fok et al. (2005), following the work of Granger and Teräsvirta (1993) in a time series context. Panel smooth transition regression models allow for the modeling of different regimes and inherent nonlinear and time-varying convergence processes across countries and over time. In this particular model specification, the transition from one regime to the other is smooth and not discrete, as in the predecessor models of panel threshold regressions (PTR) developed by Hansen (1999).

### 2.6.1 Methodology

In general, the approach follows the three-step strategy by González et al. (2005) for PSTR models: (i) identification, (ii) estimation, and (iii) evaluation. In the identification step, homogeneity is tested against the nonlinear PSTR alternative and upon confirmation of non-linearity, a transition function either specified as  $m = 1$  (logistic) or  $m = 2$  (exponential) is to be selected.<sup>29</sup> The second step involves estimation of the model by multivariate non-linear least squares (NLS) once the data have been demeaned. In the evaluation step validity of the estimated model is verified along with a determination of the number of regimes, i.e. testing for non-remaining linearity.

First, the linear specification of our growth equation is tested against a PSTR alternative with threshold effects. We do so by testing the null hypothesis  $\gamma = 0$ . Due to the presence of unidentified nuisance parameters under the null, the transition function  $g(s_{i,t-j}; \gamma, c)$  is replaced by its first-order Taylor expansion around zero, following Luukonen et al. (1988) and González et al. (2005).

Three tests are usually identified in the literature to test for the linearity hypothesis  $\gamma = 0$ , or equivalently  $\beta_1^* = \dots = \beta_m^* = 0$ , namely the LM, the pseudo LRT, and the LMF statistics.<sup>30</sup> Since van Dijk et al. (2002) report better size properties in small samples for the F-statistic than the  $\chi^2$  based statistic, we only base our judgement on the F-statistic. The linearity hypothesis being rejected at the 1% level for both subsamples, we continue with the estimation of the nonlinear relationship.<sup>31</sup>

The function  $g(s_{i,t-j}; \gamma, c)$  is a transition function of the observable variable  $s_{i,t-j}$ , which is continuous, normalized, and bounded between 0 and 1. Its logistic specification can be defined as follows:

<sup>29</sup>From an empirical point of view, González et al. (2005) mention that only cases of  $m = 1$  and  $m = 2$  suffice to capture nonlinearities due to regime switching.

<sup>30</sup>The LM and pseudo-LRT statistics have a  $\chi^2$  distribution with  $mK$  degrees of freedom; the F statistic has a  $F(mK, TN - N - K(m + r + 1))$  distribution.

<sup>31</sup>Test results are available from the authors upon request.

$$g(s_{i,t-j}; \gamma, c) = \left( \frac{1}{1 + e^{-\gamma \prod_{j=1}^m (s_{i,t-j} - c_j)}} \right) \quad \text{with} \quad \gamma > 0, \quad (2.7)$$

where  $s_{i,t}$  denotes the transition variable,  $\gamma$  the speed of transition, and  $c$  the threshold parameter ( $c_1 \leq c_2 \leq \dots \leq c_m$ ). In our case of  $m = 1$ , the PSTR model reduces to a PTR model (Hansen (1999)) if  $\gamma \rightarrow \infty$ , and collapses into a linear regression model with fixed effects if  $\gamma \rightarrow 0$ .

### 2.6.2 The Model

Combining the long-run growth model approach from above with the modeling of the short-term dynamics from the linear panel ECM step, our PSTR-EC model can be written as follows:

$$\Delta y_{i,t} = \mu_t + \theta^0 z_{i,1} + \beta_0 \Delta X'_{i,t} + (\theta^1 z_{i,1} + \beta_1 \Delta X'_{i,t}) g(s_{i,t-j}; \gamma, c) + \varepsilon_{i,t}. \quad (2.8)$$

where  $\theta^0$  and  $\theta^0 + \theta^1$  are the error-correction coefficients of two regimes and  $X_{i,t}$  is a vector of time-varying (regime dependent) variables that are expected to influence economic growth. The error term  $\varepsilon_{i,t}$  is independent and identically distributed. To this end we employ again the same controls as for the linear error-correction model. Depending on the realization of the transition variable  $\gamma$ , the link between  $y_{i,t}$  and  $s_{i,t-j}$  is specified by a continuum of parameters. The two extreme regimes in our non-linear estimation are  $\beta_0$  under Regime 1 when  $g(s_{i,t-j}; \gamma, c) = 0$ , and  $\beta_0 + \beta_1$  under Regime 2, when  $g(s_{i,t-j}; \gamma, c) = 1$ .

Table 2.9: Estimated PSTR with Two Regimes and  $m = 1$  (EU-Core Countries)

Regime 1		Regime 2		Transition	
$\theta^0$	T-Statistics	$\theta^1$	T-Statistics	$\gamma_{Euro}$	$c_{Core}$
[1]	[2]	[3]	[4]	[5]	[6]
0.206***	2.78	-0.356***	-4.54	412.23	-0.062

Remarks: Model chosen according to AIC, BIC criteria and the lowest p-value in the linear tests. \*, \*\*, \*\*\* indicate significance at the 1%, 5%, or 10% level.

Source: Authors' calculations.

### 2.6.3 Results of the PSTR-ECM

The results of the model for both EU core countries and their transition counterparts are summed up in Table 2.9 and 2.10. For an interpretation, the main parameters of interest are the coefficients of the error-correction term  $z_{i,t}$ , in this case from the initial FMOLS estimation, in the two extreme regimes  $\theta^0$  and  $\theta^0 + \theta^1$ , the threshold parameter  $c$ , as well as the speed of transition parameter  $\gamma$ .

Several variables have been tried as transition parameters and we achieve significant results using the mean change of the PPI.<sup>32</sup> Table 2.9 shows that, in the case of the advanced EU countries, linearity is strongly rejected. The transition parameter estimate is large, reducing the transition function to an indicator function with a sharp and abrupt switch from one regime to the other. For EU core countries a threshold estimate of -0.062 (corresponding to a mean change in the PPI of 6.2% per quarter) splits adjustment to the long-term growth trend into two regimes, where for the regime below the threshold a positive and highly significant loading coefficient (0.206) is obtained. This implies that countries do not converge to their long-term growth trend but diverge instead.

However, when the price flexibility surpasses its threshold value and enters the second regime, the loading coefficient turns to be  $0.206 + (-0.356)$  and thus becomes significantly negative. Hence, within the second regime

<sup>32</sup>Calculated as described above following Ghosh et al. (2003), Schnabl (2009) and Maurel and Schnabl (2012)

Table 2.10: Estimated PSTR with Two Regimes and  $m = 1$  (Transition Countries)

Regime 1		Regime 2		Transition	
$\theta^0$	T-Statistics	$\theta^1$	T-Statistics	$\gamma_{Euro}$	$c_{Core}$
[1]	[2]	[3]	[4]	[5]	[6]
0.141	0.65	-316	-1.41	170.63	-0.084

Remarks: Model chosen according to AIC, BIC criteria and the lowest p-value in the linear tests. \*, \*\*, \*\*\* indicate significance at the 1%, 5%, or 10% level.

Source: Authors' calculations.

there is a strong tendency that the growth rate of output converges towards its long run equilibrium. Therefore, the more flexible pricing and wage setting in the market is, the faster economies are expected to recover from shocks.

This nonlinearity found for advanced EU economies does not show up in the transition country group (Table 2.10). Even though the threshold estimate and the speed of transition are lower, the different loading coefficients are not significant, i.e. growth rates do neither converge above -0.084, nor do they diverge below the threshold. The convergence process to the long-run growth rate is thus independent on the price flexibility level and nonlinearity for the group of Eastern European countries can thus be rejected.

This importance of price and wage flexibility for the EU core countries, which are either part of the Euro zone or have their currencies pegged to the Euro, to close in on their normal growth trend, follows the arguments on the architecture of optimal currency areas and monetary integration in general. Without the possibility or only under high costs to devalue a currency, international competitiveness needs to be restored in a different way. High factor mobility, especially labor mobility, has been the main proposition by Mundell (1961) for Europe to equilibrate asymmetric economic developments. Yet, even though improvements on labor mobility have been achieved due to the Schengen Agreement, the subsequent introduction of the Euro, and during the recent crisis, migration still re-

mains sluggish and underlines language or institutional barriers across European countries. This becomes in particular evident when compared, for instance, to the US, where domestic migration has traditionally been an equilibrating factor (Beine et al. (2013); Dao et al. (2014); Beyer and Smets (2015b)). According to our results, the primary push for a recovery from asymmetric shocks may thus come from falling wages and price adjustments in the crisis countries to a degree of above the threshold identified. Promising developments can respectively be observed in Greece, Ireland, Portugal, and Spain, which have undergone drastic adjustments in the context of the crisis.

## 2.7 Conclusion

This article studies the long-term convergence of economic growth back to its equilibrium after deviations among Western and Eastern European transition countries. By putting an emphasis on the capacity to rebound, the speed and a potential non-linearity during the convergence process, it provides important insights for the current debate on lasting effects of recessions at the European level. By employing several linear long-run estimators and subsequently a panel error-correction framework, we provide evidence for a strong error correction towards the long-run growth path. Moreover, the convergence process differs considerably and consistently in velocity for the two subsamples in which the transition economies outpace EU-core countries over the long run. This pattern remains stable across all estimators, even when accounting for heterogeneity among countries and cross-sectional dependence.

Regarding the results from the nonlinear specifications, a two-regime development in adjustment speed depending on price and wage flexibility exists in Western European countries. Our findings suggest that below the lower bound of a 6.2% quarterly average change in the producer price index, deviations from the long-run growth trend are not corrected and



are even enlarging. Above the threshold, countries converge at a rather fast pace. Transition countries on the other hand do not seem to encounter nonlinearities in their convergence process to their long-term growth rate.

Given the common currency or pegged exchange rates and the still mostly subdued labor mobility in Europe, the recovery from asymmetric shocks apparently needs to come from rather sharp declines in wages and prices in order to make up for the high costs of proper currency depreciation. Hence, results suggest that policy makers should successively break down labor market rigidities and allow for fast and strong price changes if the need arises to alleviate lost international competitiveness through internal adjustments and pave the way for recovery.

# 3

## **Firm Growth Dynamics and Financial Constraints: Evidence from Serbian Firms<sup>1</sup>**

### **3.1 Introduction**

In the sixth year after the Global Financial Crisis (GFC), the global economy currently seems to be once again on a crossroad where a normalization process with robust economic growth rates in the US entices the Federal Reserve to tighten monetary policy further, while still considerably low inflation rate expectations and a continued lack of growth force the ECB to expand unconventional monetary policies. However, the effectiveness of this approach does not come without criticism from various sides and demands for further supply-side reforms become louder. Recent comments came from the IMF that argued that in Europe a particular emphasis should be put on the support of innovative small and medium-size enterprises

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<sup>1</sup>Joint work with Milos Markovic (Université Paris 1 Panthéon-Sorbonne; E-mail: Milos.Markovic@univ-paris1.fr). We thank Mathilde Maurel and Sandra Poncet for their helpful advise. Comments from participants at the Bi-annual Economics PhD Workshop at the Université Paris 1 Panthéon Sorbonne and several seminars at the Paris School of Economics are gratefully acknowledged.

(SMEs), which play an important role in the European economy and are considered to be the backbone of innovation and growth.<sup>2</sup> Moreover, they even do so in times of economic recession. Research has shown that SMEs are particularly resilient to economic shocks and reveal positive employment effects (Honjo and Harada (2006); Henrekson and Johansson (2010)). In the EU, the sector employs 66.5 per cent of the entire workforce and creates 57.6 per cent of value added (Muller et al. (2014)).

The relative importance of the SME sector in the Central and Eastern European region (CEE) is comparable to the rest of Europe. However, the immediate adversities of the GFC were deeper entrenched in Eastern Europe, putting the region's SME sector on an even weaker recovery path. Employment went down by 0.5 per cent in the EU27 while there was a 2.7 per cent average reduction in the number of employees working in SMEs. At the same time, the cumulative average growth rate and number of employees in the period from 2009 until 2013 in all countries of the region were negative, implying that none of them reached pre-crisis levels in terms of the two key sector performance indicators.<sup>3</sup> Simultaneously, the SME sector in the rest of Europe recovered to the 2008 levels three years after the crisis breakout – in 2012.<sup>4</sup>

Undoubtedly, the crisis inflicted tremendous damage on the financial sector and the wave of the shock transited in many countries quickly to the real economy, primarily through reduced credit supply.<sup>5</sup> The capital scarcity teamed up with sudden tightening of credit conditions and the resulting reluctance of banks to take any risk, yielding an overall standstill of financial intermediation business in that period. Private sector yield

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<sup>2</sup>The demand has recently been articulated by IMF Deputy MD Min Zhu during the debate on “The New Growth Context” at the 2015 World Economic Forum in Davos.

<sup>3</sup>The value of the unweighted cumulative average growth rate of the SME employment and value added in CEE region was -1.83 per cent and -2.73 per cent.

<sup>4</sup>This occasion confirms the intuition of Correa and Iooty (2010) who study the effects of crisis on real activity in Eastern Europe and find strong evidence that growth-driving small and innovative portions of these economies (i.e. SMEs) were affected considerably more than large and well-established companies.

<sup>5</sup>See for example Bernanke et al. (1996) for a thorough review on the effects of credit market frictions on business cycle amplification and the “accelerator effect” it has on it.

spreads in developed markets rose sharply and companies were in a situation where they had to use either existing credit lines or invest by using their own cash reserves, which brought about a dramatic drop in overall investment volume in Europe (Campello et al. (2010); Duchin et al. (2010)). The performance of companies that find it difficult to raise funds externally due to varying reasons (i.e. financially constrained firms) suffered the most. However, contradicting these results, other researchers (e.g. Kahle and Stulz (2013); Hetland and Mjos (2012)) find evidence that the lending supply shock is not necessarily the dominant causal factor for financial and investment policies during the crisis and that investment levels of financially constrained firms were not more affected than investment levels of financially unconstrained firms.

In this paper, we explore a unique dataset of unlisted Serbian non-financial SMEs and large companies during the period from 2005 to 2012 in search for empirical evidence of a financial development dependent disparity in the provision of firm financing, which affects firm growth dynamics. Our research is inspired by the internal finance theory of growth formulated in the seminal paper of Carpenter and Petersen (2002)<sup>6</sup> who introduce a model where small firms with no access to debt (i.e. binding financial constraints) will exhibit a perfectly positive relationship between firm growth and cash flow. Relating to the “pecking order”-theory of Myers and Majluf (1984), firms prefer internal funds to equity finance and debt financing. To analyze this relationship for the Serbian firm sample, our empirical approach is based on the dynamic firm growth model formulated by Guariglia et al. (2011). We believe that the reason behind the previous observation that none of the SME sectors in CEE countries has reached pre-crisis production levels as opposed to counterparts from more financially developed European countries lies in internal and external financial constraints. These constraints are induced by firm characteristics and financial structures, which are not developed enough (in relative

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<sup>6</sup>They introduce a model where small firms with no access to debt (i.e. binding financial constraints) will exhibit a perfectly positive relationship between firm growth and internal finance.

terms) to provide appropriate financial support for business activity. Such structural impairments to financial intermediation may tend to further magnify financial constraints with respect to firm characteristics, causing additional deferral of investment and overreliance on internally generated cash flow.<sup>7</sup> In order to provide further evidence on potential structural differences and to set our results into perspective, we briefly analyze data on Belgium firms at a later stage in Section 3.7. Analog to Hutchinson and Xavier (2006), we consider Belgium as an example of a well-developed economy with a fully-fledged financial sector.

We find that Serbian companies are generally financially constrained, yet to a varying degree according to different firm-level characteristics. Young SMEs are the most dependent on internal funds, whereas older, large and micro-size firms do not seem to be overly reliant on retained earnings. Firm performance seems in general to play an important role in the provision of funding, where faster growing firms or more productive ones do not, according to our model, exhibit internal financial constraints. The same holds for foreign firms, which, due to institutional reasons, tend to crowd other companies out of the market. Eventually, financial constraints for the identified firms seem to be a constant issue and we do not find evidence of larger funding gaps inflicted by the financial crisis.

The paper is organized as follows. The next two sections provide a quick overview of the theory our analysis is based upon, presents the underlying hypotheses and previous research done in the field. Section 3.4 and 3.5 explain data and the estimation strategy. Results are discussed thereafter. The paper concludes with a summary of the findings as well as policy recommendations.

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<sup>7</sup>Throughout the chapter, we use cash flow, retained earnings or internal funds interchangeably.

## 3.2 Theory and Research Questions

### 3.2.1 Some Theory on Financial Constraints

The pecking order theory of finance by Myers and Majluf (1984) offers a suitable setting for explaining conceptually the mechanism in which constrained external access to finance can impair the performance of different companies based on their own characteristics and of the financial system in which they operate. The theory stipulates that informational asymmetries between the lender and borrower regarding investment opportunities (i.e. growth potential) a firm is facing will lead to differences in costs of using external versus internal funds to finance such investment<sup>8</sup>. A lack of information about the quality of the borrower and her projects results in the cost of capital containing the “lemons” premium to compensate for lack of certainty (i.e. risk) undertaken and potential moral hazard by the borrower (Akerlof (1970)). Generally, the fiercer the “dispute”, the higher the premium required by capital providers (i.e. the cost of external funds). The market mechanism in which the price of capital is determined is dysfunctional. This is reflected in the inability of the price of loans to clear credit markets in times of disequilibrium since, as formulated by Stiglitz and Weiss (1981), interest rates affect the nature of the loan transaction through adverse selection of the borrower (tendency of the lender not to extend loans to borrowers with unknown capacity to repay), and the incentives effect where the subsequent actions of the borrower depend on the terms prescribed by the lender (Hubbard (1998)). The original work by Fazzari et al. (1988) is the first to empirically test this theory on firm investment.

In their more recent pioneering paper, Carpenter and Petersen (2002) combine the above mentioned financing constraints theory with firm growth. They analyze an unbalanced panel containing a large sample of

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<sup>8</sup>Akerlof (1970) provides a solid foundation of the mechanism in which the informational asymmetry affects the general market allocation.

small US companies in the period from 1980-1992, thereby establishing the so-called “internal finance theory of growth”. Further investigated in subsequent research by e.g. Cummins et al. (2006) and Carpenter and Guariglia (2008), the theory stipulates that the sensitivity of investment to cash flow could be unrelated to the presence of financial constraints but should rather be associated with the fact that cash flow itself may be a proxy for investment opportunities. This is reflected by periods of high cash flow (i.e. profitable periods) generally coinciding with periods of increased investment opportunities.<sup>9</sup> The Carpenter and Petersen (2002) model predicts that, in the presence of binding financial constraints, firms would exhibit perfectly positive (one-for-one) relationships between the level of internal finance and growth. In a situation where firms would have access to debt markets, firms would be able to raise more debt based on the higher availability of cash, which is effectively increasing their collateral value. Therefore, an increase in internal funds of one dollar would lead to a slightly more than one dollar increase in total assets (i.e. growth). However, as this model consequently assumes that investment opportunities are highly elastic to the supply of finance, arguably a rather debatable conjecture, we can conclude that this approach (relating a firm’s total assets to its cash flow) indicates the potential existence of internal financial constraints.

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<sup>9</sup>To put it differently, whatever portion of investment is not explained by the investment opportunities will be explained by the variation in cash flow since cash flow is positively correlated with investment opportunities.

### 3.2.2 Research Questions to Answer

Against the backdrop of the internal finance theory stated above, we formulate our research to answer the following set of questions (i.e. hypotheses):

1. **To what extent are Serbian firms constrained by internal finance availability for growth?**

We argue that the underdevelopment in the financial market causes investments and thus firm growth of an average Serbian company to be constrained to internally generated cash. The relative underdevelopment is reflected primarily in the reduced credit supply induced by informational asymmetries (i.e. credit rationing) and the lack of appropriate market mechanisms (i.e. financial instruments) in Serbia. A useful measure of financial market development, the amount of private credit to GDP, was proposed by Arellano et al. (2012). This indicator stood at the level of 43 per cent in Serbia, while it was, for instance, at 58 per cent at the end of 2014 for Belgium, a country of similar size yet with a developed financial market. Research also supports the view of Serbian market suffering from imperfections, which go in favor of our hypothesis. Namely, Dimitrijevic and Najman (2008) find significant pre-crisis reluctance of Serbian banks to invest in reduction of informational asymmetries as they show persistent competitiveness only in the market segments, which are traditionally unconstrained by external finance. It is, however, important to note that even though the observation of high sensitivity of growth to cash flow is seen as a sign of financial constraints, it can be accompanied with relatively high growth rates for companies restricted by internal finance as long as they are able to generate sufficient internal liquidity to finance their own investment. This refers in particular to market segments, which have solid growth prospects, as documented recently by Guariglia et al. (2011).



**2. Does the sensitivity of growth to internal finance become higher in Serbia in the crisis period?**

Intensive financial market distress, such as the one that was witnessed during the GFC, tend to magnify the financial market flaws through increased informational asymmetry caused by overall risk aversion and ambiguity in times of severe market contraction that is marked with an acute shortage of credit supply. This effect is exacerbated in countries with a lower financial development level where various shortcomings of the financial system (from regulatory to behavioral) create diverging incentives for borrowers and suppliers of capital. Hence, we expect the sensitivity of growth to cash flow to be stronger in the crisis period in Serbia.

**3. Is the sensitivity of growth to internal finance (proxied by cash flow) more prominent in case of young and small firms?**

Recently, Clarke et al. (2012) reported that only 38 per cent of small companies in Eastern Europe and Asia were using external debt financing in 2008 and 2009, while this share was much higher (64 per cent) for large companies. This is a consequence of the capital market contraction where credit rationing mechanism causes reduction of financing to the companies which are unknown to the capital suppliers (i.e. where the informational asymmetry is higher). Much of earlier research confirms the notion of companies subject to binding financial constraints being smaller, younger and coming from less developed financial markets (Bernanke and Gertler (1995); Schiantarelli (1996); Beck et al. (2008); Becker and Sivadasan (2010); Arellano et al. (2012)). Our goal is to analyze whether this holds in the context of Serbia as well.

## 4. How does firm ownership in Serbia affect financial constraints?

Financial market underdevelopment and strong foreign bank presence may further exacerbate the aforementioned market frictions. Sharing this experience with other transition countries, since the beginning of the opening up process Serbia's economy has been largely dominated by foreign bank branches<sup>10</sup> (Dimitrijevic and Najman (2008); Cull and Martínez-Pería (2013); Kujundzic and Otasevic (2012)). Literature on foreign bank presence, however, is large (for an overview, see Claessens and van Horen (2013)) and views on whether and to what extent foreign banks contribute to economic performance and financial development of countries diverge. In some markets, research shows that foreign banks lower the overall costs and increase the quality of financial intermediation, increase access to financial services, and thus enhance the financial and economic performance of their borrowers (Claessens et al. (2001); Clarke et al. (2003); Martínez-Pería and Mody (2004); Claessens (2006)).<sup>11</sup> However, recent literature also suggests that both the GFC as well as the bank-dependent market structure in CEE countries may have actually impeded the exploitation of positive effects. Some studies show that the presence of foreign banks can be destabilizing when the parent bank is hit by a shock, especially when the foreign affiliate is not financed by local deposits (Cetorelli and Goldberg (2012b) and Cetorelli and Goldberg (2012a); Ongena et al. (2013); de Haas and van Lelyveld (2014)). This is expected to cause overall increase in risk aversion of a domestic affiliate causing a shift of credit supply to those groups of companies, which are perceived

<sup>10</sup>During the period of 2007 to 2011, the market share of foreign-owned banks (in per cent of total assets) was consistently above 70 per cent (Cihak et al. (2012)).

<sup>11</sup>These effects are thought to result from an increase in banking competition, the introduction and spillover of new and more sophisticated technologies, and from enhanced domestic regulatory reforms. Moreover, some evidence from several new EU member countries and Turkey shows that larger foreign bank presence in economies with less developed financial markets helped to ease access to finance during the crisis to otherwise constrained companies and boosted the economic recovery process (Clarke et al. (2012))

as less risky. While we cannot formally test the channels of credit, foreign-owned companies can be seen as firms which banks would prefer in normal and distressed times, especially having in mind the close relationship they maintain (Giannetti and Ongena (2012)), effectively lowering their level of financial constraints.

Another reason behind the low-risk profile of foreign companies is the fact that they are appreciated by banks for their quality of corporate governance, especially in emerging markets such as Serbia.<sup>12</sup> Recent evidence coming from Nguyen et al. (2015) also suggests that this seems to hold in particular during turbulent times. Authors show that corporate governance helped alleviate the credit supply shock caused by the GFC for those with good corporate governance practice.

State-owned firms, on the other hand, may profit from the close proximity to the government and banks under state control through easier access to finance. Moreover, there may be larger political willingness for granting direct or indirect subsidies and still existing soft budget constraints within these firms, as evidence for other transition countries suggests (e.g. Konings and Vandenbussche (2004); Lízal and Svejnar (2002)), and this further eases financial constraints. Therefore, we will test whether several classifications of firm ownership have an impact on financial constraints of Serbian firms.

We contribute to the related literature in several ways. First, we add to the growth determinants literature from a financial constraints' perspective by testing the effect of internal finance on firm growth in terms of total assets. Previous work examining the cash flow to investment sensitivity consists most importantly of literature by Fazzari et al. (1988), Kaplan and Zingales (1997, 2000), and Bond et al. (2003). Papers focusing on growth, besides Carpenter and Petersen (2002), include Wagenvoort (2003), and

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<sup>12</sup>Francis et al. (2013) supports this view by analyzing 14 different emerging economies.

Hutchinson and Xavier (2006). While the former analyzes a cross-section of European countries, our effort may essentially be considered as an update to the latter since Hutchinson and Xavier (2006) compare Slovenia and Belgium in terms of the role internal finance plays for the growth of SMEs. This chapter updates the previous work in the sense that almost a decade afterwards we are performing similar research again on a young, underdeveloped market economy in the last phase of its transition process – Serbia. Both countries build on the economic heritage of the former Yugoslavia with Slovenia being continuously the economic leader among the six former federal units.

Second, we also perform a micro-econometric analysis on the effect of internal finance on firm growth in the context of the GFC in Europe. Most of the crisis related research considers the internal finance – investment relationship, with the exception of Guariglia and Mizen (2012) who examine growth of Asian firms during the early crisis years in search for an explanation of a heterogeneous recovery of several Asian economies and the partial resilience of companies to the tremendous external shock.

Third, a battery of firm-level characteristics that we expect to influence the finance-firm growth relationship will be tested. We assess, for instance, whether foreign participation in the ownership of Serbian companies would vouch access to finance to these companies and influence their growth. Here we follow the intuition of Francis et al. (2013) who argue that corporate governance quality may add to a reduction in informational asymmetries and ease access to external finance. Moreover, Giannetti and Ongena (2012) find close a close relationship between foreign owned companies and foreign banks in Eastern Europe. We assume that these findings may particularly be true in the case of Serbia where foreign banks hold a majority share in the banking market (Ongena et al. (2013)). Other determinants are, for example, firm size, age, productivity or overall financial dependency.

### 3.3 Related Literature on Firm Growth

Our article is related to several strands of literature, which stem from a common theoretical framework and put the concept of financial market mechanisms under empirical scrutiny. Most of these papers focus on investigating the cash flow – investment relationship in the setup of the neoclassical model of investment (Summers (1981)) which primarily relates investment to investment opportunities proxied by Tobin's Q.<sup>13</sup> The theory stipulates that, in the absence of capital market imperfections, the variation in company's investment should be fully explained by investment opportunities thus leaving the cash flow and investment unrelated. However, in reality, as we already discussed due to numerous issues that impair the mechanisms of capital market allocation process, the investment is related to cash flow implying that there are companies which are not able to borrow at sufficiently low rates to finance their investment but are instead relying on the funds they generate from their own operations (i.e. financially constrained companies). Some of the most influential papers from the field include Fazzari et al. (1988, 2000) and Kaplan and Zingales (1997) which develop a fruitful dispute on the question of whether the financial constraints are the underlying reason for the observed sensitivity of investment to cash flow. Namely, Fazzari et al. (1988) argue that cash flow investment sensitivity increases with financial constraints which is the notion implicitly suggested by the pecking order theory, while Kaplan and Zingales (1997) show the opposite evidence where the most successful (liquid and profitable) companies exhibit the largest sensitivity. They attribute these findings to behavioral choices assumed by managers, which either include a risk-averse type of behavior of investing only when they are making profits or situations where managers decide not to seek funds externally today since they perceive it as running a risk of facing financial constraints in the future.

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<sup>13</sup>Tobin's Q is defined as the ratio between a firm's market value and the capital replacement costs.

Much research followed these ideas and attempted to demonstrate arguments, which would reconcile the evidence. The most comprehensive one is given by Guariglia (2008) who focuses on the importance of the selection criteria for determining whether a company is financially constrained or not, since ready-made classification schemes are not available. The author points to the obvious difference between the explicit characteristics of a financially constrained company versus implicit ones, where the first group includes age and size of a company while the latter comprises a set of financial ratios commonly used to separate financially constrained companies from their unconstrained peers (i.e. cash flow and interest coverage ratio).

Literature contains only several other papers further exploring Carpenter and Petersen (2002) idea of the “internal finance theory of growth” for emerging or transition countries. For instance, as already mentioned, Hutchinson and Xavier (2006) analyze the dataset of Belgian and Slovenian firms for the period spanning 1993-2000 and 1994-2002, respectively. Expectedly, they find evidence of internal finance playing a more important role in explaining the growth of Slovenian versus Belgian companies confirming the intuition of the former being more financially constrained. They also find that the growth of small companies (micro ones in particular) is more sensitive to the availability of internal funds than that of large companies in both countries. To our knowledge, this is the only study involving comparative analysis in the context of cash flow – growth relationship. More recently, Guariglia et al. (2011) explore the recent Chinese “growth puzzle” by analyzing the role of internal finance availability across a sample of companies split according to ownership types. The authors find strong evidence of private and foreign firms’ growth depending more on the availability of internally generated cash as opposed to that of state owned and collective firms. When put in relation with the growth rates observed in Chinese economy, these findings show that financial constraints are not necessarily a restricting factor for growth because if firms are sufficiently profitable their investment levels may be intact as they are able to finance it through retained earnings. These companies rely heavily

on their internal finance for growth (are financially constrained), but their growth is not affected by the limitations in access to external financing. Finally, the only paper relating the internal finance availability to growth of companies in the context of GFC is the work done by Guariglia and Mizen (2012). The authors look at the investment behavior of companies in eight Asian countries in the period from 2001-2009 to find evidence of internal finance being heavily used for investment and growth, which made them comparatively more resilient to external shocks. The results seem robust to cross-country sample splits and absolute levels of cash flow. The authors suggest that, apart from various capital market inefficiencies, the underlying reasons might be found in the precautionary behavior following the lessons learned from the earlier Asian crisis of 1997-98.

### **3.4 Data and Summary Statistics**

For our analysis, we employ a unique dataset on initially 17860 Serbian firms that has been collected from a survey of the Business Registry Agency (BRA) of Serbia and covers the period 2005-2012 on an annual basis. General company data (age, size, ownership) come from the Companies Registry while the financial data come from the Financial Statements and Solvency Registry of the BRA. Data on the annual CPI inflation rate is derived from the World Development Indicators database of the World Bank. Although some caution on transition country data is warranted, the data on Serbia profit from a relatively high quality, as all firms are required to report directly to the central bank independent of firm size.

We investigate only firms belonging to the manufacturing sector, excluding agricultural, financial or service firms. As our sample period is rather short, firms are required to have observations for every year in the sample to ensure that cyclical episodes or one-time observations do not blur our results; thus we operate with a balanced panel. We only keep firms with positive values for total sales and total assets to avoid firms under

Table 3.1: Summary Statistics

Variables	Mean [1]	Standard Deviation [2]	Minimum [3]	Maximum [4]
Asset growth	0.030	0.233	-1.907	1.876
Employment growth	0.007	0.215	-2.959	2.164
Sales growth	0.008	0.469	-8.296	4.971
Assets	1036.674	1439.741	5.853	17183.94
Sales	1010.955	1231.137	0.689	22478.19
Employees	40.431	49.057	6	1004
Age	14.413	6.931	2.008	94.09
Cash flow/total assets	0.111	0.118	-0.549	1.413
Labor productivity	30.737	32.286	0.059	576.012
Number of firms	1558	1558	1558	1558
Observations	10906	10906	10906	10906

*Remarks:* The table presents summary statistics for the 2006 to 2012 sample period. Assets and sales are expressed in '000 of national currency units and have been deflated by the national CPI inflation rate. Age is expressed in years elapsed since the incorporation date of the company and ratios in percentage terms. Labor productivity is the ratio of total real sales to number of employees.

*Source:* Authors' calculations.

restructuring or bankruptcy (Cleary (1999)). We further apply the typical 1 per cent-tails outlier cuts to control for potential accounting errors or abnormal firm-level shocks (Bond et al. (2003); Cummins et al. (2006)). Ultimately, 1558 Serbian firms yield a balanced panel of 10906 observations. The sample firms are distributed across several industry sectors and are primarily active in the wood, textile, food, metal, and rubber industries.

Table 3.1 represents summary statistics in form of mean values and standard deviations of our firm samples. Due to the calculation of growth rates for assets, employment, and sales, we lose one year of the initial sample size and hence include only data from 2006 onwards.

By looking at our sample statistics, Serbian firms show in terms of mean assets growth a rate of 3 per cent on average. The figure reported for the second growth category, sales growth, is considerably lower while employment growth drags behind with only 7 per cent. Serbian firms employ on average about 40 employees. The mean age, at 14.4 years, is



rather low, suggesting that the majority of firms were created during the transition period.

Compared to other studies on emerging countries, the average cash flow ratio at 11.1 per cent for Serbian firms lies below reported figures elsewhere for transition countries. For instance, across the transition country sample of Konings et al. (2003), our numbers come closest to the average shown by the Czech Republic (17 per cent), whereas Poland, Bulgaria and Romania exhibit ratios of up to two times the size. Standard deviations, however, are much lower for Serbian firms. The median value of 7.9 per cent is very close to the 8 per cent reported by Hutchinson and Xavier (2006) for Slovenian companies. Relative to Western European countries, though, the numbers are small. Bond et al. (2003) report a cash flow to capital ratio of 17.8 per cent for Belgium, 11.9 per cent for France or 13.4 per cent for the UK.

For a more recent time period, Arslan et al. (2014), focusing on the 1998-1999 Asian financial crisis as well as the Great Recession, report for Asian countries on average 7.2 per cent during the crisis and 7 per cent in the pre-crisis period. Firms analyzed by Arslan et al. (2006) during the Turkish financial crisis between 2000-2001 exhibit a rather low cash flow ratio of 3.6 per cent coming down from 11.5 per cent in the pre-crisis period.

As usually reported in the literature (e.g. Carpenter and Petersen (2002); Hutchinson and Xavier (2006); Guariglia et al. (2011)), there is a strong relation between asset growth and the cash flow ratio with the latter indicating potential firm growth according to what internal funds permit. By looking at our statistics, this link seems to be broken in Serbia. Despite of cash flow figures of around 11 per cent, firms exhibit positive yet low assets growth and sales growth rates. This divergence requires a proper control for investment opportunities in the subsequent econometric analysis in order to disentangle financial constraints and demand-side factors, also likely exacerbated by the crisis.

In the next section we estimate dynamic firm-level assets growth equations

that include cash flow to assess the degree of internal financial constraints Serbian firms are affected for firm growth.

### 3.5 Estimation Strategy

The baseline regression model follows Guariglia et al. (2011) and relies on the dynamic specification of the Carpenter and Petersen (2002) firm growth model as follows:

$$\begin{aligned} \text{Asset growth}_{i,t} = & \beta_0 \text{Asset growth}_{i,t-1} \\ & + \beta_1 \left( \frac{\text{Cash flow}}{\text{Total assets}} \right)_{i,t} + \text{error term}_{i,t} \end{aligned} \quad (3.1)$$

where the cash flow variable is defined as net operating revenues plus total depreciation and expressed as a ratio scaled to contemporaneous total assets to control for size effects.<sup>14</sup> The *error term* in the equation above can be expressed as  $\varepsilon_{i,t} = \mu_i + \tau_t + \epsilon_{i,t}$  and comprises time-invariant firm fixed-effects  $\mu_i$  that may influence growth and time-invariant measurement errors. It further entails time-specific effects  $\tau_t$  from potential business cycle factors that may affect all firms as well as an idiosyncratic component  $\epsilon_{i,t}$ . Moreover, all variables that were expressed in national currency units have been deflated by the national CPI inflation rate.<sup>15</sup>

In a first attempt, we estimate the above regression with a within-groups estimator whereby the firm-specific effects get purged due to a subtraction of firm means. We further account for time effects by including a time dummy at the year level. Standard errors are heteroscedasticity-consistent, robust to autocorrelation within panels and clustered at the firm level.

<sup>14</sup>To check for robustness, we also use beginning-of-period total assets as a scaling factor but results remained unaffected.

<sup>15</sup>Even though sectoral deflation or inflation rates may seem appropriate, data availability for Serbia does not allow a more detailed approach. As sectoral inflation rates largely move closely together, we follow Laeven and Valencia (2013) and employ the CPI inflation rate of Serbia as an approximation.

However, given the relatively large cross-section of firms, the short time dimension and the endogeneity of the lagged dependent variable, we also employ a first-difference Generalized Method of Moments approach (Arellano and Bond (1991)) and the system Generalized Method of Moments methodology introduced by Arellano and Bover (1995) and Blundell and Bond (1998).

This technique accounts for unobserved firm heterogeneity by estimating the equations in first-differences and controls for endogeneity by instrumenting the variables in differences with internal lags.<sup>16</sup> Apart from the lagged dependent variables, further endogeneity may arise from cash flow in the sense that firms experiencing higher growth in total assets may also be able to create higher changes in cash flow. Therefore all of our above regressors will be instrumented with their own lags.

In order to check for viability of the GMM specification, we follow the strategy of Bond (2002). Due to a likely downward bias of the within-groups estimator in short dynamic panels (Nickell (1981)), one would expect a consistent estimate of the coefficient on the lagged dependent variable to lie considerably above the within-groups estimate. If the estimates obtained from the GMM estimators lie close or below the within-groups coefficients, a threat of a potential downward bias would exist as well, possibly due to weak instruments.<sup>17</sup>

The results of the firm growth model in terms of total assets presented in

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<sup>16</sup>Results have not shown significant differences when estimated through forward orthogonal deviation as proposed by Arellano and Bover (1995).

<sup>17</sup>In the case of such a serious finite sample bias, an alternative system GMM estimator is proposed by Blundell and Bond (1998), which instead of instrumenting differenced variables with levels as in Arellano and Bond (1991) instruments levels with differences. This bias generally occurs when instruments for the endogenous variables in the first-differenced GMM estimator are not very informative, which is often the case in autoregressive models with persistent series (as often the case with macroeconomic time series) or where the variance of the fixed-effects is particularly high relative to the variance of the transitory shocks (Guariglia (2008)). Despite of not showing signs of misspecification, equations were also estimated with a two-step system GMM, thereby controlling carefully for instrument proliferation through collapsing the instrument matrix and correcting for a potential small sample bias following Windmeijer (2005). These results have ultimately proven to be more reliable.

Table C.1 in the Appendix C.1.1 do not point to a serious finite sample bias. The coefficients of the lagged dependent variable,  $Asset\ growth_{i,t-1}$ , are substantially higher under the first-difference and the system GMM estimators compared to the within-groups estimations.<sup>18</sup> Being overall highly significant, also the cash flow coefficients, as a test lagged once, however, rise considerably in magnitude after being estimated with GMM and obtain the largest coefficient with 1.026 under the system GMM estimator. This may result from taking into account the potential endogeneity of cash flow. As described by Carpenter and Petersen (2002), the coefficient of  $\beta_1 > 1$  implies a slightly higher than one-to-one relationship between the cash flow to assets ratio and firms' assets growth under imperfect capital markets and thus indicates a very strong internal financial constraint. Hutchinson and Xavier (2006) also consider adjustment costs as a potential factor. Investments in physical capital most likely require higher adjustment costs than other forms of investment.<sup>19</sup> Moreover, the lagged asset growth variable in the regressions exhibits negative and significant coefficients for all four specifications. This may be a sign of convergence among firms.

To evaluate whether the instruments are legitimate and the model is correctly specified, we assess whether the variables in the instrument set are uncorrelated with the error term in the relevant equation. In order to do so, we rely on two criteria. The first is Hansen's J or the J-test, which is a test for overidentifying restrictions. Under the null of valid instruments, this test is asymptotically distributed as a chi-squared with number of instruments minus number of parameters degrees of freedom.<sup>20</sup>

<sup>18</sup>Our results are also robust under a pooled ordinary least squares specification, but as expected, the lagged dependent variable is upward biased. In fact, all our results have been tested for a proper specification with respect to within-groups and OLS estimations. Moreover, for the OLS estimations, tests on omitted variable bias are rejected.

<sup>19</sup>For more details consult the seminal paper on adjustment costs of investment by Cooper and Haltiwanger (2006).

<sup>20</sup>As our GMM estimates are robust to heteroskedasticity, and the assumption of independent and homoscedastic residuals  $\epsilon_{i,t}$  across firms and over time seldom holds in practice, we rely on the J-test instead of the standard Sargan test (see Roodman (2009a) and Roodman (2009b)). The former may, however, over-reject the null hypothesis in case of an either large cross-sectional dimension or a moderate time dimension (see

We further test with the  $m$ -test for first, second, and if necessary, third-order serial correlation in the differenced residuals (represented as AR(1) and AR(2) in regression tables). In the presence of second order serial correlation (or first order serial correlation in levels), the instrument set needs to be restricted to lags three or deeper. These lags are valid once serial correlation in the differenced residuals of order three is rejected.

For all GMM specifications serial correlation of the second order can be rejected. However, the J-test with a value of 0.041 suggests a potential overidentification issue when the lagged cash flow term enters the equation. Together with a careful control against a finite sample bias *à la* Windmeijer (2005) and instrument proliferation through a collapsed instrument matrix, a robust specification under system GMM in column [4] can be confirmed. We therefore rely solely on system GMM for future estimations.

Instrument selection follows the subsequent strategy: We first employ the endogenous variables lagged two times as instruments.<sup>21</sup> If the tests for second-order serial correlation of the differenced residuals and/or the J-test fail, what may for instance happen if measurement errors occur, we opt in case of the former only for instruments lagged three times.

### 3.5.1 On Investment Opportunities

A limiting factor for a correct interpretation of results may lie in negative demand effects, which come particularly to mind when looking at the low (or even negative) sales growth figures in the descriptive statistics. As our dataset consists of only non-listed firms, we are unable to com-

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Blundell and Bond (2000); Bowsher (2002); Greenaway et al. (2014)). Moreover, there may be cases where the J-test statistic cannot be computed given the near singularity of variance-covariance of the moment conditions. This arises when the cross-sectional dimension is small relative to the number of instruments. Therefore, we always control for serial correlation in the differenced residuals as well.

<sup>21</sup>If the undifferenced error terms are i.i.d., then the differenced residuals should display first-order, but not second-order serial correlation.

pute Tobin's Q, which is defined as the market value of a firm over the replacement value of its total assets. This variable usually accounts for investment opportunities at the firm level and controls for a potential bias induced by the cash flow coefficient that could represent omitted investment opportunities (Cummins et al. (2006); Carpenter and Guariglia (2008)). Unfortunately, data availability does not allow for an inclusion of industry-level value added growth, as often done in the literature to proxy for Tobin's Q (see e.g. D'Espallier and Guariglia (2015); Guariglia et al. (2011)). Instead, we rely on the growth of real sales as a proxy for future demand, following the example of Hutchinson and Xavier (2006) and Konings et al. (2003).<sup>22</sup> As a second approach, we include subsector dummies interacted with disaggregated time dummies at the 2-digit NACE industry level (33 subsectors). This approach is a rather indirect way to account for investment opportunities and thus represents also a more general indicator for time varying demand shocks at the industry level<sup>23</sup> (Duchin et al. (2010); Gormley and Matsa (2014)). If the correlation of cash flow with investment opportunities were an issue, coefficients of the cash flow variable should be considerably lower than without controlling for it.<sup>24</sup>

After having properly accounted for investment opportunities, we further add firm-level variables in natural logarithm to our target covariates that according to Evans (1987) may impact firm growth such as firm age (measured in years from incorporation) and size (measured in number of

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<sup>22</sup>We employ the log change of real sales normalized by contemporaneous total assets following Hutchinson and Xavier (2006). Our results are robust to alternative definitions, such as real sales growth normalized by lagged total assets as in Konings et al. (2003) or future real sales growth normalized or not by contemporaneous total assets. Results available upon request confirm the main findings.

<sup>23</sup>As Carpenter et al. (1994) explain, the inclusion of disaggregated industry-time dummies does not come without additional costs. The dummies control for all time varying facts at the industry level and higher aggregates but also remove common cyclical components of the financial variables.

<sup>24</sup>As for a selection bias, Allayannis and Mozumdar (2004) argue that the inclusion of negative cash flow observations in the sample (i.e. firms in financial distress) could considerably influence cash flow sensitivities. We therefore re-estimate the results after eliminating all negative cash flow observations (which constitute around 18.4 per cent of the sample). Results show very similar sensitivities for different classification of firms and are thus not reported.

employees).

## 3.6 Results

Table 3.2 below presents results for the full sample with the added control variables. Apart from the choice of investment opportunities control with either sales growth in columns [1] – [2] or with interacted time-industry dummies in [3] - [4], the two specifications following Blundell and Bond (1998) differ in the choice of instruments.

**Table 3.2: Controlling for Investment Opportunities**

Dependent Variable: Asset Growth	SYS-GMM	SYS-GMM	SYS-GMM	SYS-GMM
	Fully Instrumented [1]	Partially Instrumented [2]	Fully Instrumented [3]	Partially Instrumented [4]
<i>Asset Growth</i> <sub><i>i,t-1</i></sub>	-0.098*** [0.034]	-0.070** [0.033]	-0.039* [0.021]	0.054** [0.021]
<i>Cash Flow</i> <sub><i>i,t</i></sub>	1.609*** [0.205]	1.188*** [0.382]	1.088*** [0.380]	1.214*** [0.228]
<i>Sales Growth</i> <sub><i>i,t</i></sub>	0.211 [0.143]	0.055 [0.154]		
<i>Size</i> <sub><i>i,t</i></sub>	0.037 [0.037]	0.020*** [0.004]	0.063* [0.036]	0.018*** [0.003]
<i>Age</i> <sub><i>i,t</i></sub>	-0.028** [0.012]	-0.022*** [0.007]	-0.026** [0.011]	-0.016* [0.008]
J (p-value)	0.599	0.394	1.000	0.017
AR(1)	-8.37	-15.90	-4.20	-15.20
AR(2)	-1.06	0.11	-1.22	0.03
Time FE	Yes	Yes	No	No
Sector-Time FE	No	No	Yes	Yes
Observations	9348	9348	9348	9348

*Remarks:* All GMM estimations were performed with the *xtabond2* routine by Roodman (2009a). The figures reported in parentheses are asymptotic standard errors. Standard errors and test statistics are asymptotically robust to heteroskedasticity. Instruments in columns [1] - [2] are *Asset growth*<sub>*i,t-2*</sub>, *(Cash flow/total assets)*<sub>*i,t-2*</sub> and *(Real sales growth/total assets)*<sub>*i,t-2*</sub>. The instrument matrix has been collapsed and the small sample bias has been corrected according to Windmeijer (2005). The Hansen J statistic is a test statistic of the overidentifying restrictions, distributed as a chi-squared under the null of instrument validity. AR(1) and AR(2) are tests for AR(n)-order serial correlation in the first-differenced residuals, asymptotically distributed as N(0,1) under the null of no serial correlation. \*\*\* indicates significance at the 1% level, \*\* indicates significance at the 5% level, and \* indicates significance at the 10% level.

*Source:* Authors' calculations.

In the first specification we choose to use instruments only for the dynamic

part of the equation and sales growth, whereas the second specification instruments for all variables included in the equation. We always employ instruments lagged twice unless stated otherwise.

When controlling for investment opportunities with either sales growth or disaggregated sector-industry fixed effects, coefficients of the cash flow variable report values close to the results of the baseline model for the system GMM estimation in column [4] of Table C.1. Point estimates are in all cases even slightly higher, what makes us conclude that the correlation between cash flow and investment opportunities is not likely to carry a large bias. Moreover, although showing the correct sign, the sales growth variable does not appear to be significant. Nonetheless, properly accounting for it also adds further precision to estimations and points at an overall strong reliance on internal financial resources for firm growth.

In terms of specification diagnostics of the different models, m-test results do not reject the validity of the estimator by indicating the absence of serial correlation (AR(1) is significantly negative, while AR(2) is not significant). However, we encounter some identification problems in the J-test when controlling with sector-time dummies under both fully and partially instrumented system GMM models in columns [3] - [4]. This is not the case anymore when inserting sales growth.<sup>25</sup> Moreover, the additional firm-level determinants of growth, size and age, are precisely estimated when only lagged firm growth, cash flow, and sales growth are instrumented.

Thus, we can state that even under investment opportunities and demand shock control Serbian firms suffer from strong internal financial constraints. Firm growth seems to be further positively driven by firm size, which contradicts the theory of smaller firms usually growing faster. The negative

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<sup>25</sup>Whereas column [3] reports a perfect p-value of 1.000 as the classic sign of instrument proliferation, column [4] shows a rather small value of 0.017. Column [2] yields a p-value of 0.394, which comes relatively close to the J-test results assessment of Roodman (2009a). Given that related research (e.g. Konings et al. (2003); Guariglia (2008); Guariglia et al. (2011)) reports higher and more volatile results, we take comfort in our specification tests presented in this work.



coefficient of the age variable, though, is in line with theory, which finds evidence that younger firms are more likely to grow faster than older ones. From hereon we thus include the sales growth variable as a control for investment opportunities in our regressions and instrument only partially for endogenous variables if not stated otherwise.<sup>26</sup>

### 3.6.1 Firm Growth and Crisis

The regression analysis presented above is based on the entire sample period and all firms. However, the time period of our analysis is characterized by a major economic shock, the Global Financial Crisis. Thus, after the establishment of the baseline model and the imposition of investment opportunity controls, we look into effects on the relation between firm growth and cash flow sensitivity potentially inflicted by the global financial crisis. For this purpose, we interact the cash flow variable in Equation (3.1) with a crisis dummy, which equals 1 for the years 2008-09 and 0 otherwise.<sup>27</sup> We further include the regular cash flow variable to allow for crisis effects on the cash flow sensibility. The model is estimated with time fixed effects, which subsume the crisis dummy. Moreover, we keep the previous controls in place and employ again the real sales growth variable as a control for investment opportunities and demand effects. Admittedly, however, given our annual data the account for a crisis effect can only remain rudimentary, as we are unable to track changes in corporate financial policies in more detail.

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<sup>26</sup>Results can also be confirmed by using the initial unbalanced panel dataset with some firms lacking observations for the whole sample period. Firms dropping out due to accounting errors or bankruptcy do thus not cloud our findings. Results are available upon request.

<sup>27</sup>The non-significance and size of the crisis dummy are robust to changes in the crisis period. Several crisis windows from 2007 to 2009, from 2008 to 2010, a single crisis year 2009, as well as a post-Lehman dummy for an entire regime shift have been tried.

**Table 3.3: Crisis Effects on the Growth-Cash Flow Sensitivity Relationship**

Dependent Variable:	
Asset Growth	[1]
$Asset\ Growth_{i,t-1}$	-0.098*** [0.034]
$Cash\ Flow_{i,t}$	1.609*** [0.205]
$Cash\ Flow_{i,t} * Crisis$	0.151 [0.378]
$Sales\ Growth_{i,t}$	0.211 [0.143]
$Size_{i,t}$	0.037 [0.037]
$Age_{i,t}$	-0.028** [0.012]
J (p-value)	0.599
AR(1)	-8.37
AR(2)	-1.06
Time FE	Yes
Observations	9348

*Remarks:* All GMM estimations were performed with the *xtabond2* routine by Roodman (2009a). The figures reported in parentheses are asymptotic standard errors. Standard errors and test statistics are asymptotically robust to heteroskedasticity. Instruments are  $Asset\ growth_{i,t-2}$ ,  $(Cash\ flow/Total\ assets)_{i,t-2}$  and  $(Real\ sales\ growth/Total\ assets)_{i,t-2}$ . The instrument matrix has been collapsed and the small sample bias has been corrected according to Windmeijer (2005). The Hansen J statistic is a test statistic of the overidentifying restrictions, distributed as a chi-squared under the null of instrument validity. AR(1) and AR(2) are tests for AR(n)-order serial correlation in the first-differenced residuals, asymptotically distributed as  $N(0,1)$  under the null of no serial correlation. \*\*\*, \*\*, \* respectively indicate significance at the 1% level, the 5% level, and the 10% level.

*Source:* Authors' calculations.

Results presented in Table 3.3 do not, to our surprise, confirm the hypothesis that the cash flow sensitivity of firm growth changes between tranquil and distressed times. Whereas the non-interacted cash flow term exhibits with a positive and precisely measured coefficient of 1.162 a high reliance on internal funds, the interacted term shows up as insignificant and very low. This hints at a continuous and severe constraint of firms when financing for expansionary activities is needed, independent of negative funding shocks such as the financial crisis.

Explanations for this continuous lack of funding can only be indicative. When, for instance, comparing average cash holdings during the years prior to the crisis (2005-2007) with the overall average, pre-crisis holdings with about 14.4 per cent exceed the sample average of 11.1 per cent in Table 3.1. A change in net cash becomes even more evident when looking at the last year before the crisis and the first year after. The cash flow level stood at 16.8 per cent in 2006 and was reduced to a level of 9.1 per cent in 2010. This may support the theory

that financially constrained firms hoarded cash before the crisis and were at least partly living on accumulated funds, cushioning the financial supply shock. The crisis thus would not have a significant different effect on the financial configuration of firms.

Moreover, as aforementioned, Serbia has a much less developed financial market, is highly bank dependent and banks have primarily been subsidiaries of foreign banks. Kahle and Stulz (2013) find that bank-dependent firms do not decrease capital expenditures more than other firms in the first years of the crisis and a bank lending shock may thus not be the first determinant for a decrease in firm growth. However, with firms being on average rather small, size may in general restrict them from obtaining financing due to lack of collateral, the presence of asymmetric information or agency costs. Whether this is the case and if other firm-level characteristics play a decisive role in being financially constrained will be the focus of the analysis below. Even though we do not find significant differences for crisis and non-crisis periods, we nonetheless control through separate estimations with crisis interaction terms.<sup>28</sup>

### 3.6.2 Cash Flow Dependence and External Financial Constraints

We further test if firms that face different external financial constraints or firm characteristics exhibit varying cash flow sensitivities with regard to firm growth. Therefore, we control for a variety of factors that typically influence the access to external finance, such as firm size and firm age (e.g. Schiantarelli (1996)). Moreover, we look into several firm performance parameters such as financial dependency, measured as high and low cash firms (Arslan et al. (2006)), firm productivity (labor productivity) (following Guariglia et al. (2011)), and whether firms belong on average to the faster or slower growing cohort. These performance indicators may

<sup>28</sup>Only significant results will be reported.

have a signaling effect to potential investors or banks and thus help to alleviate funding constraints. Additionally, we embark on a more detailed analysis of the impact by ownership structure below (e.g. Giannetti and Ongena (2012)).

Apart from the size categorizations, firm-level indicators are constructed as either lying on average above or below the sample median following Arslan et al. (2006) and Vermoesen et al. (2013). Firm size is measured according to the size designation of the European Union, which splits the sample in four categories: micro-, small, medium-size, and large firms. Firms are defined according to the different size classifications in terms of employee numbers: micro enterprises, which employ less than 10 persons, small enterprises employing at least 10 but less than 50 persons, and medium-sized enterprises employing between 50 and less than 250 persons. Everything above 250 persons is considered to be a large firm.<sup>29</sup> Following the literature, size is determined upon the firm entering the sample.

In order to allow for a comparison with Hutchinson and Xavier (2006), we estimate equation (3.1) for each size and external constraint category separately. Depending on whether subsets of firm age or size specifications will be assessed, the corresponding controls will be dropped to avoid collinearity.

Columns [1] to [4] in Table 3.4, where we first control for a differentiated cash flow sensitivity with respect to firm size, show a strong reliance on internal funds for the small and medium-size firms. While the cash flow terms for micro and large size are positive but insignificant, the cash flow variables attract with 1.112 and 1.629 two highly positive and precisely estimated coefficients for small and mid-size firms. It becomes evident that particularly small and medium-size enterprises (SMEs) suffer from financial constraints and thus need to rely on retained earnings for growth.

<sup>29</sup>This definition has been taken from the Annual Report on EU SMEs 2013/2014 - A Partial and Fragile Recovery, available at <http://ec.europa.eu/DocsRoom/documents/16121/attachments/1/translations/en/renditions/native>.

Table 3.4: Controlling for Size

Dependent Variable: Asset Growth	Micro Firms [1]	Small Firms [2]	Medium-Size Firms [3]	Large Firms [4]
<i>Asset Growth</i> <sub><i>i,t-1</i></sub>	-0.101** [0.043]	-0.051** [0.023]	-0.010 [0.050]	-0.391** [0.191]
<i>Cash Flow</i> <sub><i>i,t</i></sub>	0.379 [0.432]	1.112*** [0.255]	1.629** [0.682]	0.647 [0.926]
<i>Sales Growth</i> <sub><i>i,t</i></sub>	0.001** [0.000]	0.000* [0.000]	0.000 [0.000]	0.000 [0.000]
<i>Age</i> <sub><i>i,t</i></sub>	-0.002** [0.001]	-0.001* [0.001]	0.001 [0.001]	-0.001 [0.001]
J (p-value)	0.323	0.109	0.551	0.292
AR(1)	-8.41	-12.86	-6.64	-1.71
AR(2)	-0.41	1.12	-0.25	-0.79
Time FE	Yes	Yes	Yes	Yes
Observations	1812	5544	1884	102

Remarks: All GMM estimations were performed with the *xtabond2* routine by Roodman (2009a). The figures reported in parentheses are asymptotic standard errors. Standard errors and test statistics are asymptotically robust to heteroskedasticity. Instruments in all columns are *Asset growth*<sub>*i,t-2*</sub>, *(Cash flow/Total assets)*<sub>*i,t-2*</sub> and *(Real sales growth/Total assets)*<sub>*i,t-2*</sub>. The instrument matrix has been collapsed and the small sample bias has been corrected according to Windmeijer (2005). The Hansen J statistic is a test statistic of the overidentifying restrictions, distributed as a chi-squared under the null of instrument validity. AR(1) and AR(2) are tests for AR(n)-order serial correlation in the first-differenced residuals, asymptotically distributed as N(0,1) under the null of no serial correlation. \*\*\* indicates significance at the 1% level, \*\* indicates significance at the 5% level, and \* indicates significance at the 10% level.

Source: Authors' calculations.

Despite of being somewhat at odds with the conventional literature that finds strong internal financial dependence particularly for small firms, including also micro firms (see e.g. Hutchinson and Xavier (2006)), a constrained mid-size category has also been found in Audretsch and Elston (2002), albeit for German listed firms during the period from 1961 to 1989. In Germany, large firms have the ability to access internal and external sources of funds, very small ones seem to profit from the banking sector structure of many cooperative local banks. In Serbia, micro and large firms are apparently also able to avoid being cash strapped and tap other sources than primarily retained earnings, leaving SMEs as the odd one out.

Table 3.5: External Financial Constraints

Dependent Variable: Asset Growth	Young [1]	Old [2]	Low Cash [3]	High Cash [4]	Low Prod. [5]	High Prod. [6]	Low Growth [7]	High Growth [8]
<i>Asset Growth</i> <sub><i>i,t-1</i></sub>	-0.051** [0.025]	-0.059* [0.031]	-0.038 [0.026]	-0.075*** [0.028]	-0.042* [0.025]	-0.072** [0.030]	-0.082*** [0.027]	-0.053** [0.025]
<i>Cash Flow</i> <sub><i>i,t</i></sub>	0.582** [0.285]	1.675*** [0.407]	0.178 [0.309]	1.172*** [0.310]	1.118*** [0.329]	0.906** [0.352]	0.949*** [0.341]	0.699** [0.341]
<i>Sales Growth</i> <sub><i>i,t</i></sub>	0.000*** [0.000]	0.000 [0.000]	0.000*** [0.000]	0.000** [0.000]	0.001 [0.000]	0.000*** [0.000]	0.000 [0.000]	0.000*** [0.000]
<i>Size</i> <sub><i>i,t</i></sub>	-0.010 [0.011]	0.007 [0.021]	-0.019 [0.011]	-0.003 [0.012]	-0.015 [0.035]	-0.013 [0.014]	-0.009 [0.028]	-0.007 [0.008]
<i>Age</i> <sub><i>i,t</i></sub>			-0.008 [0.008]	-0.028** [0.012]	-0.013 [0.010]	-0.022* [0.012]	-0.005 [0.009]	-0.015* [0.009]
J (p-value)	0.088	0.745	0.382	0.503	0.805	0.652	0.848	0.065
AR(1)	-12.26	-10.64	-13.32	-12.33	-12.13	-11.96	-12.70	-12.51
AR(2)	2.51	-1.83	1.27	-0.05	-0.90	1.44	0.96	-0.28
Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	4722	4626	4304	5044	6232	3116	4674	4674

*Remarks:* All GMM estimations were performed with the *xtabond2* routine by Roodman (2009a). The figures reported in parentheses are asymptotic standard errors. Standard errors and test statistics are asymptotically robust to heteroskedasticity. Instruments in all columns are  $Asset\ growth_{i,t-2}$ ,  $(Cash\ flow/Total\ assets)_{i,t-2}$  and  $(Real\ sales\ growth/Total\ assets)_{i,t-2}$ . The instrument matrix has been collapsed and the small sample bias has been corrected according to Windmeijer (2005). The Hansen J statistic is a test statistic of the overidentifying restrictions, distributed as a chi-squared under the null of instrument validity. AR(1) and AR(2) are tests for AR(n)-order serial correlation in the first-differenced residuals, asymptotically distributed as  $N(0,1)$  under the null of no serial correlation. \*\*\* indicates significance at the 1% level, \*\* indicates significance at the 5% level, and \* indicates significance at the 10% level.

*Source:* Authors' calculations.

However, it is not only size but also age that matters (Bernanke and Gertler (1995); Honjo and Harada (2006); Arellano et al. (2012)). Under the hypothesis that younger firms are more likely to be financially constrained than older firms, due to lacking a reputation with banks or just being too “opaque” in their business model, we divide our sample into young and old firms.<sup>30</sup> Following the literature, this constraint should hold particularly in financially underdeveloped Serbia. Columns [1] and [2] in Table 3.5 look at the different firms with below or above the median age respectively. Under this specification we can observe that both age groups are dependent on internal funds. Older firms with a highly significant coefficient of 1.675 are, however, the most financially constrained. This result is not consistent with the conventional literature, which considers primarily young firms reliant on retained earnings (e.g. Schiantarelli

<sup>30</sup>We classify firms as young and old when their age is below or above the median values.

(1996); Hadlock and Pierce (2010)). Given that the cash flow ratio is slightly higher for older firms than for firms below the median age, a tentative explanation may be a higher risk aversion among managers of older firms and therefore a lower probability to seek external funding (see Kaplan and Zingales (1997)).

Moreover, financial constraints seem to be an issue for almost every firm independent of individual characteristic, although to varying degree. Judging by the size and the significance of the coefficients in Table 3.5, however, some differences between firms can be distilled. Firms with rather high cash cushions on average are considerably more financially constrained than their peers with on average low levels of retained earnings as columns [3] and [4] show.<sup>31</sup> These firms thus naturally rely on internally generated funds and are therefore very sensitive to marginal changes in constraints. Also high productivity and firms in the high growth cohort seem to show weaker signs of relying extraordinarily on retained earnings, as less significant and lower cash-flow coefficients demonstrate.

As a robustness check, we follow Honjo and Harada (2006) and divide our firm sample according to sample quartiles of the respective firm-level characteristics. The results are robust to our previous findings as again smaller, older, high cash firms, low growth firms, and those with a rather

<sup>31</sup>Apart from being only applicable to listed firms, conventional indices of financial dependence of firms have recently been found to be ineffective (Farre-Mensa and Ljungqvist (2016)). Thus, as an alternative, we move beyond a simple separation of firms according to their median cash flow and employ the recent approach suggested by Hovakimian and Hovakimian (2009) to endogenously evaluate the sensitivity of asset growth to cash flow for an unlisted firm ( $CFS_i$ ):

$$CFS_i = \sum_n^{t=1} \left( Asset\ growth_{i,t} * \frac{\left( \frac{Cash\ flow}{Total\ assets} \right)_{i,t}}{\sum_n^{t=1} \left( \frac{Cash\ flow}{Total\ assets} \right)_{i,t}} \right) - \frac{1}{n} \sum_n^{t=1} Asset\ growth_{i,t},$$

where  $n$  is the number of annual observations for firm  $i$ , and  $t$  indicates time. Cash flow sensitivities are thus given by the difference between the cash flow weighted time series average of total assets growth of a firm and its time series arithmetic average of assets growth. We use a 50 per cent cut-off point to distinguish between firms sensitive and non-sensitive to cash flow. Firms above the cut-off point exhibit positive and highly significant cash-flow coefficients. This finding suggests that our previously employed identification of cash-strapped firms correctly singles out firms that are more or less financially constrained. Results are not reported for brevity.

low productivity show strong internal financial constraints, whereas firms at the other end of the quartile range do not seem to suffer from this issue to a similar degree.

To sum up, we are able to test for and largely identify firm-level characteristics that have been singled out in the literature as being significant for access to external finance and thus ultimately determine internal financial constraints. It turns out that in the case of Serbia these constraints seem to be rather ubiquitous and not always selective with respect to previous findings in the literature. Nonetheless, allegedly economic stronger and better performing firms suffer less from internal financial constraints and may thus be able to tap financial sources elsewhere. That particularly medium-size SMEs and old firms face the harshest constraints, however, appears somewhat as a surprising result. Interestingly though, interacting firm characteristics with the crisis dummy to control for a changed cash flow sensitivity in distressed times always fails to yield significantly different results. This is inconsistent with the flight to quality hypothesis of banks, yet coincides with earlier findings for Italian manufacturing firms by Presbitero et al. (2014). The authors report that the credit crunch has not been harsher for smaller and economically weak firms.

The result that primarily SMEs firms are financially constrained, leads over to the question of firm ownership, i.e. are firms financially constrained because of their size or because their ownership structure conveys certain characteristics.

### **3.6.3 What Does Firm Ownership Tell?**

Existing research finds strong evidence of a persistent foreign bank – foreign company relationship in Eastern Europe (Giannetti and Ongena (2012)). Since the Serbian banking sector is dominated by subsidiaries of international banks we expect foreign owned companies to be less financially constrained than firms that are in majority domestically owned



(Hutchinson and Xavier (2006); Colombo and Stanca (2006); Blalock et al. (2008)). Moreover, we expect that foreign ownership can be considered as a good indicator for the quality of corporate governance and may thus also contribute to an elimination of financial constraints (Francis et al. (2013)). The same holds for firms with a majority stake owned by the government, which may, for instance, facilitate access to external finance or contribute through targeted policy instruments to lower financing barriers.<sup>32</sup>

In order to exploit the persistence of this relationship further, we take a look at the performance of foreign-owned firms in Serbia and their reliance on cash flow for firm growth compared to the largest ownership category, private firms, and state-owned counterparts. The attribute “foreign owned” is defined according to the enterprise survey as any firm with a majority stake owned either by a foreign company or person. The same holds for a firm being classified as “state-owned”, i.e. the government owns more than 50 per cent of the company.

Hence, we estimate the following regression:

$$\begin{aligned}
 Asset\ growth_{i,t} = & \beta_0 Asset\ growth_{i,t-1} + \beta_1 \left( \frac{Cash\ flow}{Total\ assets} \right)_{i,t} \\
 & + \beta_2 \left( \frac{Cash\ flow}{Total\ assets} \right)_{i,t} * Category_{i,t} \\
 & + \beta_3 \left( \frac{Real\ sales\ growth}{Total\ assets} \right)_{i,t} \\
 & + \beta_4 Controls_{i,t} + error\ term_{i,t}
 \end{aligned} \tag{3.2}$$

*Category* refers to the different dummy terms of firm-level ownership characteristics with which the cash flow variable will be interacted. The *Controls* term stands for the previously introduced age and size variables.

As a first approach, we explore the key variables reported in Table 3.6 split according to ownership categories. The average foreign firm exhibits

<sup>32</sup>As, for instance, Khwaja and Mian (2005) show for Pakistan, such preferential treatment through government connections can lead to sizeable inefficiencies among both banks and firms, resulting in higher borrowing and default rates.

Table 3.6: Firm Characteristics by Ownership

Variables	Foreign Means [1]	State-Owned Means [2]	Private Means [3]
Asset growth	0.015	-0.026	0.036
Employment growth	0.016	-0.072	0.016
Sales growth	0.033	-0.015	0.011
Assets	1799.028	2214.779	912.022
Sales	1985.124	1460.316	963.688
Employees	66.151	94.284	34.724
Age	10.037	16.853	14.164
Cash flow/total assets	0.087	0.033	0.120
Labor productivity	42.205	18.251	32.050
Number of firms	53	148	1407
Observations	371	1036	9849

*Remarks:* The table presents summary statistics for the 2006 to 2012 sample period. Assets and sales are expressed in '000 of national currency units and have been deflated by the national CPI inflation rate. Age is expressed in years elapsed since the incorporation date of the company and ratios in percentage terms. Labor productivity is the ratio of total real sales to number of employees.

*Source:* Authors' calculations.

a firm size of 66.15 employees.<sup>33</sup> Conversely, state-owned firms employ on average 94.28 employees and are thus larger than the average foreign firm and almost three-times as big as domestic private companies. Hence the average foreign and state-owned firm belongs to the group of median-sized enterprises. Mean firm growth for state-owned firms in all growth categories remains with negative values well below the level of private companies, the respective control group. Foreign firms grow particularly fast in real sales. Of particular interest for our analysis is the level of average retained earnings and performance in terms of labor productivity. Foreign owned firms constantly rely on a roughly 5 per cent higher cash flow ratio (on average 8.7 per cent) relative to their domestic state-owned peers (on average 3.3 per cent). Both figures are, however, lower than the private firm average of 12 per cent. This high level of cash flow for domestic private firms may signal a general strong reliance on internal funds for firm growth. Another striking observation is the comparison

<sup>33</sup>Given the low number of foreign owned firm-level observations, we refrain from disentangling according to firm size and pool all observations.

between productivity and firm size. Whereas foreign firms exhibit with 42.205 the strongest productivity performance, state-owned firms with by far the largest firm size only show a meager 18.251. Such a discrepancy may testify to still existing inefficiencies in the economy hailing from the transition process.

As a next step, we employ the model specification of Equation (3.2) for cash flow sensitivity and interact the cash flow variable with the foreign-owned and the state-owned dummy. Real sales growth controls again for investment opportunities.

Results in Table 3.7 column [1] show that compared to all firms, foreign-owned Serbian firms do not need to rely on internal funds for firm growth. The regular cash flow coefficient is highly significant and positive, thus indicating again strong internal financial constraints for the representative firm in our sample. This result confirms the initially postulated intuition regarding the comparatively high cash levels. In comparison, the interaction of cash flow with the foreign firm dummy attracts high significance and even a high negative value of -1.653, indicating no particular reliance on internal funds. In columns [2] and [3] we further control in a gradual manner for particularities in terms of productivity and firm size with respect to the different ownership types observed in the descriptive part above. Adding first the cash flow interacted with high labor productivity and subsequently with the SME size dummy, knowing that particularly small and medium-size firms are constrained, turns the coefficient of the regular cash flow variable insignificant. Controlling for size thus partly mops up the effect previously kept by the regular cash flow variable and indicates a size bias with respect to company financial access as previously found.

Conversely, the coefficients for foreign firms interaction term remain continuously negative and highly significant. Also Hutchinson and Xavier (2006) find lower cash flow sensitivities for foreign firms in Slovenia with respect to all firms, their coefficients, however, are still higher than those

Table 3.7: Firm Ownership and Cash-Flow Sensitivity

Dependent Variable:			
Asset Growth	[1]	[2]	[3]
$Asset\ Growth_{i,t-1}$	-0.092*	-0.097**	-0.069**
	[0.044]	[0.038]	[0.036]
$Cash\ Flow_{i,t}$	1.606***	1.468***	0.748
	[0.576]	[0.458]	[0.488]
$Cash\ Flow_{i,t} * Foreign$	-1.972***	-2.259***	-1.720**
	[0.709]	[0.649]	[0.667]
$Foreign_i$	0.161**	0.188***	0.146**
	[0.068]	[0.064]	[0.062]
$Cash\ Flow_{i,t} * State - Owned$	-0.901	-0.839	-0.528
	[0.825]	[0.721]	[0.717]
$State - Owned_i$	0.085	0.086	0.068
	[0.070]	[0.053]	[0.047]
$Cash\ Flow_{i,t} * High\ Productivity$		0.522	0.398
		[0.416]	[0.432]
$High\ Productivity\ Firms_i$		-0.044	-0.023
		[0.047]	[0.051]
$Cash\ Flow_{i,t} * SME$			0.482
			[0.404]
$SME_i$			-0.047
			[0.045]
$Sales\ Growth_{i,t}$	0.153	0.169	0.013
	[0.204]	[0.167]	[0.143]
$Size_{i,t}$	0.014*	0.013*	
	[0.008]	[0.007]	
$Age_{i,t}$	-0.027***	-0.029***	-0.030***
	[0.009]	[0.009]	[0.009]
J (p-value)	0.189	0.201	0.196
AR(1)	-6.67	-6.96	-16.73
AR(2)	-0.51	-0.54	0.35
Time FE	Yes	Yes	Yes
Observations	9348	9348	9348

Remarks: All GMM estimations were performed with the *xtabond2* routine by Roodman (2009a). The figures reported in parentheses are asymptotic standard errors. Standard errors and test statistics are asymptotically robust to heteroskedasticity. Instruments in all columns are  $Asset\ growth_{i,t-2}$ ,  $(Cash\ flow/Total\ assets)_{i,t-2}$  and  $(Real\ sales\ growth/Total\ assets)_{i,t-2}$ . The instrument matrix has been collapsed and the small sample bias has been corrected according to Windmeijer (2005). The Hansen J statistic is a test statistic of the overidentifying restrictions, distributed as a chi-squared under the null of instrument validity. AR(1) and AR(2) are tests for AR(n)-order serial correlation in the first-differenced residuals, asymptotically distributed as  $N(0,1)$  under the null of no serial correlation. \*\*\* indicates significance at the 1% level, \*\* indicates significance at the 5% level, and \* indicates significance at the 10% level.

Source: Authors' calculations.

we report. Combined with the rather low cash levels, this may hint at several particularities with respect to foreign-owned firms: foreign firms

are, for example, able to exploit their relationships with foreign banks, confirming previous findings from the literature on foreign bank – foreign company links (Giannetti and Ongena (2012)). They may also profit from their earlier observed strong labor productivity or through foreign majority stakes, both signaling better performance and corporate governance. Both indicators result in higher creditworthiness among foreign and local banks what ultimately helps them to obtain financing for expansionary activities.<sup>34</sup> Moreover, larger firms may be able to tap international capital markets. Becker and Sivadasan (2010) also show that foreign subsidiaries of other firms receive funding from their parent companies through internal capital markets what may further ease financial constraints. Moreover, there is no significant difference in the relationship between firm growth and cash flow sensitivity for state-owned companies compared to all firms. Being non-significantly different from other firms comes a bit as a surprise because it seems that according to our results the alleged proximity to the government does not pay off. We therefore do not observe a “political pecking order”<sup>35</sup> or soft budget constraints like in some other developing and transition countries.

Our results thus suggest a difference in the reliance on internal funds among different ownership categories, where foreign-owned firms seem to be the least constrained. Conversely, state-owned companies do not significantly differ from the financially-constrained representative firm. These findings, for instance, may corroborate earlier results by Harrison and McMillan (2003) for the Ivory Coast, where preferred financing of foreign firms crowds other firms out of the market, leaving them financially constrained for investment and growth.

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<sup>34</sup>As Kujundzic and Otasevic (2012) report, total loans to enterprises and households in Serbia have mostly a long term structure (> 5 years), of which the majority is foreign currency denominated.

<sup>35</sup>See, for instance, Poncet et al. (2010)’s findings on China. Note that in order to make definitive statements on such a pecking order one would need to explicitly look into financing decisions of firms with different majority owners.

### 3.7 A Comparison With a Developed Economy

Before reaching our concluding remarks, we want to put some of our obtained results into perspective and compare the Serbian firm-level financial constraints with Belgium, an economy featuring a more developed financial market.<sup>36</sup>

Hutchinson and Xavier (2006) compared Slovenia with Belgium for the periods 1993-2000 and 1994-2002 respectively; we thus consider this section to be an update to their study, given that Serbia has reached a level of development comparable to Slovenia in the examined period. In line with expectations of financial market development as elaborated in Section 3.2.1, access to finance should be considerably easier than in a more underdeveloped financial market like Serbia due to lower market “imperfections” Myers and Majluf (1984); Stiglitz and Weiss (1981). We thus hypothesize that the availability of internal funds does only play a minor or no role at all for Belgian firms along their growth trajectory.

In order to compare the degree of firm-level financial constraints, we perform the same estimations with Belgian data as for the Serbian firm dataset. In order to establish a sound model specification, we follow again the strategy of Bond (2002). The previous model specification checks apply and are correct throughout all estimations. Results on the estimations can be found in Appendix C.2.

The baseline regressions in Table C.2 do not show, with the exception of the fixed-effects estimator in column [1], any significant impact of cash flow on firm growth in general. The results on cash flow dependency are thus coherent with the theory and our expectations for a well-developed economy. They are also comparable with recent findings for a compara-

<sup>36</sup>Apart from a mature financial sector, Belgium offers a couple of other advantages. Data quality, for instance, is considered to be superior as Belgian firms also have to report directly to the central bank. Moreover, the size of the country in terms of population (Serbia: 7.6 million; Belgium: 11.2 million) and firms in the dataset (Serbia: 1558; Belgium: 1982) are roughly comparable. Data has been retrieved from the *Amadeus* database provided by Bureau van Dijk.

ble sample period in a firm-level investment framework by Vermoesen et al. (2013), who find either very low and significant or non-significant coefficients for the cash flow variable.

Analog to our previous analysis for Serbia, we also control in the Belgian case for investment opportunities and demand shocks through either real sales growth or interacted fixed effects. Results are in Appendix C.2.2.<sup>37</sup> We find again no significant internal financial constraints for Belgian firms; regarding the controls on age or size, only the size variable does exhibit a highly positive impact on firm growth.

As a consequence, we split again our sample with respect to the previously employed size categories. Interestingly, medium-size firms in Belgium have been financially constrained during our sample period as Table C.4 shows. Although with a coefficient of 1.209 somewhat lower than for Serbian medium-size firms in Table 3.4, the coefficient is still considerably above one and thus indicates a strong reliance on internal funds for expansionary activities. In contrast, Hutchinson and Xavier (2006) find significant cash flow coefficients for SMEs with 0.68 of almost half the size during an earlier period. Although a crisis effect in our sample may be a reason for this difference, it is, as in the Serbian case, not discernible when explicitly testing for it.<sup>38</sup> Firms of different size do apparently not rely predominately on retained earnings and are thus considerably less financially constrained. The same result applies to previously identified firm characteristics which do not seem to influence the funding of expansionary activities.

Concluding, Belgian firms behave with respect to their cash flow sensitivity as expected and therefore present a suitable counter-example for an advanced economy with a well-developed financial sector. Although we generally do not find significant internal financial constraints for firms, medium-sized companies are the only firms that require internal funding.

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<sup>37</sup>Although none of the variables is significant, column [2] with the partially instrumented controls remains our favorite due to the lowest p-value in the J-test.

<sup>38</sup>Results are not included here and may be available from the authors.

### 3.8 Conclusion

In this paper we analyze firm-level data of Serbia on internal financial constraints for firm growth. With our results from dynamic panel data regressions we are able to update findings of Hutchinson and Xavier (2006) who assess almost a decade earlier credit constraints of Slovenia and Belgium. Serbian firms in general face high financial constraints and exhibit a strong reliance on internal funds for firm growth. The firms with the tightest constraints consist of small and medium-size enterprises as well as comparatively old firms. The latter finding may be the result of higher risk aversion of managers. Moreover, firms that perform better in terms of an overall growth trajectory, labor productivity and those which are less dependent on retained earnings face significantly fewer internal financial constraints. In comparison, only medium-size Belgian firms exhibit strong reliance on retained earnings, thus confirming our theory of a generally functioning and developed financial sector.

By looking at majority ownership stakes of Serbian firms, foreign-owned firms do not seem to rely much on cash flow, suggesting that strong foreign bank – foreign firm ties found by Giannetti and Ongena (2012) or internal capital markets as observed by Becker and Sivadasan (2010) seem to mitigate constraints. State-owned enterprises, on the other hand, do not seem to largely profit from government involvement in their business activities.

Results suggest that in light of a general heavy reliance on internal funds for SMEs a relief of funding constraints for these firms through policy initiatives is highly recommended. Better and a more diversified access to finance through banks for all firm segments should be given priority. The fact that state-owned companies are still the largest firms yet the least efficient ones calls for a continuation of restructuring, an increase in efficiency and a continuous abolishment of soft budget constraints. Moreover, the development of alternative funding options such as capital markets instead of a mere concentration on the banking sector may be



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a solution to more sustainable and equal access to finance and thus firm growth.

# 4

## Revisiting Finance and Growth in the Transition Economies - A Panel Causality Approach <sup>1</sup>

### 4.1 Introduction

Ever since the seminal work of King and Levine (1993a) and Levine (1997), the relationship between financial development and economic growth has been a hotly debated matter. Arguments have either been turning around a chicken and egg question of which side is precipitating the other or whether financial development is beneficial for economic growth at all and if so, to what extent.

Regarding the former, literature usually points at a potential two-way causality between financial development and economic growth. Patrick (1966) was among the first examining these issues. Based on the two hypotheses that either financial development precedes economic growth or that growth creates demand for financial intermediation, he coined the

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<sup>1</sup>I thank Mathilde Maurel, Robert C. M. Beyer and Max Breitenlechner for their highly valuable comments.

terms “supply-leading” and “demand-following” of financial development with respect to income per capita.

Assessments of the above relation between finance and growth come often in the form of panel data analysis covering either very large panels of both advanced and emerging countries (see e.g. Beck et al. (2014), or focus on particular regions (Yu et al. (2012); Hassan et al. (2011)). Generally, in cross-country studies the “finance-led growth” hypothesis, where financial development exerts mainly a positive causal impact on real output, has found a more profound reverberation in research, particularly with regard to banking sector development (Beck et al. (2000b); Calderon and Liu (2003); Christopoulos and Tsionas (2004); Loayza and Rancière (2006); Bangake and Eggoh (2011)).

Yet, results have not always been clear-cut and the beneficial impact of financial development has been found to be subject to several limitations with respect to country characteristics. Rioja and Valev (2004), for example, report positive effects for countries with more developed financial systems and uncertain effect for countries with low-level financial development. In a different study Masten et al. (2008) claim positive growth effects for less financially developed countries that vanish beyond a certain threshold. In a study on Latin America, De Gregorio and Guidotti (1995) identify weak regulatory systems that prevent the region from reaping positive growth effects of financial sector development.

In this regard, Eastern European countries and the European periphery have recently received renewed attention. Caporale et al. (2015) and Cojocaru et al. (2015), for instance, look at transition countries to study the relationship between financial development and economic growth. They find that financial development, which is proxied by credit to GDP ratios and liquid liabilities, does not stimulate economic growth in transition countries concordantly. The group of Eastern European economies is particularly appealing to study this relationship for several reasons: they entered transition with very low levels of financial development, they faced

varying pace along the development process and exhibit strong dominance of foreign banks in the market. At the same time complementary capital markets are to a large extent underdeveloped. Moreover, regulatory systems are widely considered to still remain in poor shape.

This study provides a new attempt to disentangle the finance and growth nexus for a total of 15 Eastern European transition countries over a sample period spanning a time frame of 1994 to 2014. For this purpose we rely on a recently developed causality approach by conducting panel Granger causality tests following Konya (2006). This approach is based on Seemingly Unrelated Regressions (SUR) and Wald tests with country specific bootstrap critical values. The use of this methodology for the transition country sample bares a couple of advantages. Since it is a system approach, it can account for parameter slope heterogeneity and cross-sectional dependence. Therefore, it allows testing for Granger causality for each country individually and exploits at the same time the advantages that come from richer panel datasets. By exploiting the spatial information from the panel data setting on transition countries, this econometric approach allows for detecting for how many and for which transition countries there exists in the Granger sense a one-way causality, two-way causality or no causality at all.

There are other benefits of the methodology of Konya (2006). Since bootstrap critical values are computed, this methodology does not need to pretest for time-series properties. Precisely, the series under consideration may be stationary or cointegrated. Then, depending on the time-series properties of the data, they can be in levels, first differences or some higher difference. Finally, thanks to bootstrap critical values the approach can deal with the shortcomings of small T samples. This last property is relevant for European periphery countries where time series are generally short and come in annual frequency.

This paper adds to the finance and growth literature in several ways. To our knowledge it is the first study that employs a panel Granger causality

method accounting for differences across countries and cross-country correlations on the transition economies. Compared to other pooled panel data methods, the employed method enables us to attach results to each individual country in the sample instead of country groups or regions. With the exception of Cojocaru et al. (2015), it also analyses a broader transition country set than in many previous studies. Moreover, apart from assessing financial development across several dimensions, we also include foreign consolidated claims to proxy for a large cross-border exposure of the banking sectors. Given the length of the data series used, we are also able to indirectly account for a potential impact of the recent Global Financial Crisis and the European debt crisis on the finance-growth relationship. Additionally, we link our study to recent results on non-monotonic relationship between financial development and economic growth.

The rest of the paper is structured as follows. Section 4.2 briefly reviews the theory of financial development and growth and links it to key literature in general and for transition countries in particular. Section 4.3 explains the methodology and Section 4.4 the data used in more detail. Results are presented in Section 4.5 while Section 4.6 concludes.

## 4.2 Financial Development and Growth

According to conventional economic theory, financial development is considered to positively influence economic growth (Pagano (1993)). Financial systems, often in the form of financial intermediaries such as banks or stock markets, help to overcome market frictions in the form of informational asymmetries and transaction costs ultimately spurring growth. Levine (1997) identifies five key functions through which this is achieved: (i) the efficient allocation of resources, which increases the social marginal productivity of capital, (ii) the diversification and hedging of risk, (iii) the mobilization of savings, (iv) exertion of corporate control,

and a general (v) facilitation of the exchange of goods and services.

Although all functions may be considered separately, they cumulatively contribute to economic growth. Usually, profitable projects, market conditions and the capacity of managers are costly and difficult to evaluate for the individual saver. Due to this information asymmetry, savers will be reluctant to invest and capital may thus not reach its most valuable destination. Through the mobilization and bundling of savings, financial intermediaries are able to economize on the acquisition of information about investments and funnel capital into the most profitable projects. Occurring investment risks are thereby hedged for the individual saver by allocating capital to different projects and thus mitigating potential “idiosyncratic shocks such as unobservable taste or liquidity shocks, and diversifiable risks from the volatility of asset returns” (Pagano, 1993, p. 616). Apart from financing investment worthy projects and technology, financial intermediaries further exert through their provision of funding control over managers and monitor the ongoing process of project development.

Already early theoretical literature, although not explicitly developed, constructs its argumentation around the aforementioned functions and draws conclusions about causalities between financial development and economic growth. Schumpeter (1912), for example, considers credit markets as an important driver of economic growth, arguing that entrepreneurs require credit to finance innovation and the adoption of new production techniques. Also other economists, such as McKinnon (1973) and Shaw (1973), argue that a well-developed financial system exerts positive effects on economic growth. This view, however, does not find universal acclaim. It is contested, for example, by Robinson (1952) who advocates a rather passive reaction of financial development to economic growth. According to his argumentation, the financial sector grows through a higher demand for financial services driven by economic growth. Both directional hypotheses and potential staggered interactions like feedback loops have later been further developed by, among others, Greenwood and Jovanovic (1990), Berthélemy and Varoudakis (1996),

and Blackburn and Hung (1998).

King and Levine (1993a,b) are among the very first to test this relationship empirically. They show that bank development measured as liquid liabilities (M3) divided by GDP helps explain economic growth in a sample of more than 80 countries<sup>2</sup>. Beck et al. (2000b,a) improve on the previous studies on the variable side by including only credit to private firms, thus exclude credit to the public sector, and technically by controlling for reverse causality through instrumental variable methods. Beck et al. (2000b) note that financial development might influence growth either through improvements of savings allocation (the technology channel) or through an increase in domestic savings rates and the attraction of foreign capital (the capital accumulation channel). Levine and Zervos (1998) and Beck and Levine (2004) expand the analysis and assess the relationship between economic growth and stock markets as well as banks. Both studies provide a positive joint significance as well as an independent impact of stock market development and bank development on growth. Despite of the latter controlling for simultaneity bias and omitted variable bias, they reach the similar conclusion that stock markets provide different financial services from banks<sup>3</sup>.

Conversely, Rousseau and Wachtel (2011) by analyzing a later time span than previous studies discover that the link between financial development and economic growth has been weakened over time and even become negative during periods of financial crises. They thus confirm results from Loayza and Rancière (2006) that over the long-run financial development supports economic growth, yet financial fragility in the form of crises in maturing markets may hamper a positive relationship in the short run. Focusing entirely on the long-run and analyzing both banking and stock markets through composite indicators, Seven and Yetkiner (2016) find

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<sup>2</sup> In the same vein but on a more microeconomic perspective, Rajan and Zingales (1998) show that in countries with well-developed financial systems, industries that are heavy users of external finance grow relatively faster than other industries.

<sup>3</sup>For a recent and thorough overview on the subject matter we refer readers to the excellent studies by Ang (2008) and Pisali (2013).

a significant and positive impact of both measures on economic growth in low- and middle-income countries. However, the relationship turns negative in high-income countries.

Research on such nonlinearity in the relationship has very recently been further deepened by Arcand et al. (2015); Beck et al. (2014); Breitenlechner et al. (2015) and Pagano (2013). By using industry-level data, Pagano (2013) finds that financial development benefits in particular countries with relatively under-developed financial sectors (non-OECD countries) or industries, which profit the most from an easing of financial constraints. Moving one step further ahead, Arcand et al. (2015) identify thresholds beyond which finance exerts a negative effect on growth. Through country- and industry-level data the authors provide evidence that a credit to the private sector level of beyond a range of 80 to 120% of GDP, depending on estimation method and time period, produces harmful effects to output growth. Results in Breitenlechner et al. (2015) show similar thresholds for financial development proxied by private credit and liquid liabilities (80 to 130% respectively). Beck et al. (2014) find analog results for a set of mature economies, where accounting for the frequency of financial cycles as well as non-intermediary activities in banks' business models pushes the "negative finance" boundary outward. Explanations for non-monotonic behavior are, for instance, an increasing importance of market-based intermediation (Demirgüç-Kunt et al. (2013)) or the "brain-drain" of skilled workers from the manufacturing to the financial sector due to an attractive extraction of rents from investors (Philippon and Reshef (2013)). Beck et al. (2012) argue that in mature financial sectors an increasing allocation of credit to households instead of firms may hamper growth, as financing is used for consumption rather than investment.<sup>4</sup>

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<sup>4</sup>Another reason may be excessive leverage on the financial intermediaries' side and balance sheet recessions, which protract recoveries after crises (Rajan (2006)).



### 4.2.1 Financial Sector Development and Growth in Transition Economies

Transition countries, however, exhibit a particular trajectory of financial development that needs to be taken into account when analysing them. The opening up in the early stages of the transitioning process from a socialist to a market-oriented economy was accompanied by the creation of market-oriented financial institutions. Due to a hitherto largely mono-banking system with the central bank combining the functions of a monetary authority and of commercial banks, laws had to be created that allowed private banks to be founded and foreign banks to enter.<sup>5</sup> Particularly through the access of foreign banks to the markets policy makers were hoping to obtain both regulatory and technological know-how from abroad to improve lending practice and allocation of funds in the new created banking sectors.

As a result, foreign banks bought former state banks, which so far existed only along functional lines, and opened up new branches and subsidiaries. Most transition economies thus encountered a rapid expansion of their banking sectors due to the entry of new or foreign banks and a decline in government ownership. Since then, foreign banks have played a crucial role in the establishment and development of a financial system in the transition countries.

Yet during the 1990s, many countries went through financial crises in the transition process, because such profound disruptions of the economic process created macroeconomic turbulences<sup>6</sup>. Inefficient regulation and a lack of adequate collateral guidelines often resulted in soft budget constraints with a continuation of bad lending practices and a gradual recognition of the existing low loan quality within state-owned banks ('flow problem' and 'stock issue', (Bonin and Wachtel, 2003, p. 8)). This drove

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<sup>5</sup>A more detail description on the transformation process of Eastern European financial systems can be found, for example, in Cottarelli et al. (2005) and Bonin et al. (2014).

<sup>6</sup>For a detailed account of banking crises in transition countries consult Laeven and Valencia (2012).

many firms and ultimately banks into insolvency with poor bankruptcy laws aggravating the financial disorder.

As it has been shown above, a substantial body of empirical research has investigated the relationship between financial development and economic growth with the primary result of a positive impact, particularly for economies with low and intermediate levels of financial development. Under circumstances specific to transition countries, however, our knowledge is still rather limited. Only very few papers have tackled this issue across a larger cross-section of transition economies. Koivu (2002) and Dawson (2003) have been among the very early studies to look into this matter, although both time spans of analysis cover only the first few years after the transition. The first study finds that the margin between lending and deposit interest rates negatively and significantly affected growth, yet the depth of the financial sector in terms of credit provision has no effect. The same holds for Dawson (2003) using liquid liabilities (M3) as the variable for financial development<sup>7</sup>. Fink et al. (2009), using a short period from 1995 to 2000, find a positive impact of financial intermediation on growth; whereas domestic credit is helpful in promoting growth, private credit and stock market capitalization do not exert any significant effect. Two very recent articles expand the time frame up to the beginning of the recent crisis. Caporale et al. (2015) generally find a positive yet insignificant relationship between financial development in the form of domestic credit to the private sector and growth in Eastern Europe. Conversely, monetization and increased efficiency in the financial sector strengthen economic development. Moreover, despite of providing some evidence on the importance of private credit from the banking sector for growth, Cojocaru et al. (2015) emphasize particularly the importance of financial system efficiency and competitiveness.

Moreover, turning again to nonlinearities in the finance-growth nexus, Masten et al. (2008) find considerable threshold effects for Euro area

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<sup>7</sup> By replicating the Dawson (2003) model for an extended time period, Gillman and Harris (2004) confirm its results and even find a negative influence of financial depth once accounting for inflation rates.

accession countries between 1996 and 2004 relative to their level of financial development. During 1993-2003, Mehl et al. (2006) show that foreign bank penetration sometimes had a positive and significant influence on growth in South-Eastern Europe. Financial deepening in form of financial monetization and intermediation, however, had a significant negative effect.

Besides some research on a cross-sectional basis, studies were also conducted for specific countries. A recent example by Kenourgios and Samitas (2007) covers Poland where credit availability has been identified as important for long-run economic growth; stock market liquidity, however, does not seem to play a pivotal role.

#### **A Quick Look at Some Indicators**

Even though the number of studies is still rather limited, these countries generally provide an excellent test environment on the finance and growth nexus because they exhibit bank-based financial systems, which are still relatively new and the degree of development varies considerably across economies.

These developments in the financial sector are also reflected in the figures of Table 4.1. It provides a snapshot of several indicators of the banking sectors for our transition country sample and confirms the developments over time outlined at the beginning of section 4.2.1.

Between 1995 and 2013, the number of banks in transition countries has decreased overall, though to varying degree, reflecting the outlined process of market consolidation during that period. The exceptions were Albania and Macedonia where banks in the market actually increased by almost the same number, from 6 to 16 and from 6 to 15 respectively. With it also bank concentration declined in the majority of countries and values currently vary tremendously, ranging from 41% in Poland to 82% in

Table 4.1: Main Indicators of Financial Sector Development

Country	Number of Banks		Bank Concentration		Foreign Banks in %		Foreign Bank Assets in % of Total Assets	
	1995	2013	1995	2013	1995	2013	1995	2013
Albania	6	16	-	57	50	85	-	89
Bosnia-Herzegovina	-	27	-	44	-	64	-	87
Bulgaria	41	30	95*	44	7	65	29*	62
Croatia	54	30	34*	59	2	52	0	90
Czech Republic	55	44	71*	62	42	62	17	85
Estonia	19	16	79*	62	26	75	2	97
Hungary	43	35	53*	75	49	80	19	56
Latvia	42	26	79*	51	26	55	36	58
Lithuania	15	15	83*	82	0	75	0	91
Macedonia	6	15	-	68	50	67	-	68
Poland	81	69	50*	41	22	76	4	76
Romania	24	39	-	58	33	82	11*	79
Serbia	112	31	99*	43	2.7	66	-	75
Slovakia	33	28	69*	77	55	67	19	75
Slovenia	39	23	43*	51	15	35	4	25

Sources: EBRD Structural and Institutional Change Indicators; Claessens and van Horen (2015); Raiffeisen Research, CEE Banking Sector Report, various issues; Cihak et al. (2012); \* for 1996 figures.

Lithuania.<sup>8</sup> However, at the same time both the percentage share among all banks and of assets claimed by foreign banks with respect to total assets were rising. Some countries, such as Lithuania and Estonia, experienced drastic shifts in their market structure with foreign bank assets accounting for almost 100 percent of total bank assets in 2013.

In the following, we provide a brief account of the methodology used to analyze the finance-growth nexus in transition countries and present the data.

### 4.3 Methodology

Examining the literature, causality tests based on panel data have been employed by relying on different estimation techniques. Among the most popular ones stand the Generalized Method-of-Moments (GMM) and IV techniques, which allow only for the intercept to differ across countries

<sup>8</sup>Bank concentration is measured as assets of the three largest banks as a share of total commercial bank assets.

but not to control for contemporaneous correlation among the error terms and slope heterogeneity (see e.g. Levine and Zervos (1998); Beck et al. (2000b); Beck and Levine (2004); Shen and Lee (2006); Caporale et al. (2015); Cojocaru et al. (2015)).<sup>9</sup> A second bivariate approach introduced by Dumitrescu and Hurlin (2012) controls for slope heterogeneity and takes into account cross-sectional dependence among panel units. Andrianyah and Messinis (2015) recently expand the former to a trivariate model following the approach by Toda and Yamamoto (1995). A major shortcoming of both approaches, however, is that the rejection of the null of non-causality does not provide any guidance on the number or the identification of particular panel units for which the non-causality is rejected.

A third approach on which we rely for our analysis has been proposed by Konya (2006). Also Konya (2006) allows dealing with cross-sectional dependence and slope heterogeneity. Besides, being based on Seemingly Unrelated Regressions (SUR) systems and bootstrapped critical values for country specific Wald tests, Granger causality can be tested on each individual country separately and thereby account for potential cross-section dependence across countries<sup>10</sup>. This question is crucial and responds to the complex nature of the interactions and dependencies that generally exist over time and across the individual units in the panel. For instance, observations of firms, industries, regions and countries tend to be cross-correlated as well as serially dependent. As pointed out by Breitung (2005), the cross-section dependence can arise for a variety of reasons, including spatial regional spill-over effects, common unobserved shocks such as the recent financial crisis, social interactions, or a combination of these factors. Thus shocks affecting one country may also affect other countries because of a high degree of cultural similarities as

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<sup>9</sup> As shown by Pesaran et al. (1999), unless slope coefficients are identical GMM estimators may lead to inconsistent and thus misleading parameter estimations.

<sup>10</sup>The country-by-country analysis thereby allows to account for varying effects in the finance-growth nexus due to e.g. different stages of financial development (see e.g. Masten et al. (2008); Rioja and Valev (2004)) which may not become apparent when merely pooling data.

well as trade and financial integration. This point may well be justified in our case due to the common Soviet heritage and, for instance, the strong economic integration with western European countries as well as a deep penetration of domestic markets by European banks<sup>11</sup>. Econometrically, ignoring the impact of cross-section correlation yields seriously biased estimates (Philipps and Sul (2003); Andrews (2005)). Thus, in presence of cross-section dependence, a system of Seemingly Unrelated Regressions (SUR) is more efficient than that of an equation-by-equation application of least-squares (OLS) ((Zellner, 1962, p. 363)).

In addition, due to the bootstrap critical values for the Wald tests the approach we use in this paper requires no pre-testing for unit roots and cointegration<sup>12</sup>. This is an important advantage since unit root and cointegration tests often suffer from low power and lead to contradictory results. The bootstrapping approach can also deal with small T samples what is very useful given the data employed in this study<sup>13</sup>.

Moreover, another issue to be considered is the heterogeneity in estimated parameters for each individual of the panel in order to impose a restriction for the causal relationship. As Granger (2003) points out, the causality from one variable to another variable by imposing the joint restriction for the whole panel is a strong null hypothesis. Assuming homogeneity for parameters in a panel data setting does not enable to capture heterogeneity due to country specific characteristics (Breitung (2005)). Whereas in many economic relationships such as the financial development and economic growth nexus it is highly possible that a significant relationship may exist

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<sup>11</sup>The importance of common and country-specific shocks to banking integration and (bank) capital flows among, for instance, OECD countries has very recently been confirmed in a study by Cesa-Bianchi et al. (2016).

<sup>12</sup>This is a generalization of the methodology developed by Philipps (1995) and Toda and Yamamoto (1995). The authors provide evidence that statistical inference in the context of a VAR in levels can be conducted by means of standard asymptotic theory (normal and mixed limit theories), i.e. no unit root limit theory is required. Thus, without prior knowledge on the stationary properties of the series in the system, Wald tests with country-specific bootstrap critical values can be used to test for Granger causality.

<sup>13</sup> A similar bootstrap method has been developed by Emirmahmutoglu and Kose (2011), which is based on lag-augmented VARs. However, this approach can become very costly for short time series and exhibits serious size distortions under small T.

in some countries, the opposite may also be true in other countries. In particular, the homogeneity assumption for the CESEE countries in analyzing causal relationships between financial development and economic growth may result in misleading findings. Even though the common economic heritage of these countries has created many similarities, a certain degree of heterogeneity in terms of financial development and economic structure exist. Coricelli (2001), for instance, points at some independence in the decisions of firms in Hungary, Poland and former Yugoslavia, where also monetary holdings and trade credit were allowed. The situation was different in Bulgaria, Romania, and the Soviet Union. Thus, slope heterogeneity in parameters can easily be assumed for our analysis.

Using the framework of Konya (2006), the causality between financial development and economic growth is investigated through the following trivariate system:

$$\begin{cases} gdp_{i,t} = \alpha_{1,i} + \sum_{s=1}^{lgdp_i} \beta_{1,i,s} gdp_{i,t-s} + \sum_{s=1}^{lfd_i} \gamma_{1,i,s} fd_{i,t-s} + \sum_{s=1}^{lto_i} \delta_{1,i,s} to_{i,t-s} + \varepsilon_{1,i,t} \\ fd_{i,t} = \alpha_{2,i} + \sum_{s=1}^{lfd_i} \beta_{2,i,s} gdp_{i,t-s} + \sum_{s=1}^{lgdp_i} \gamma_{2,i,s} fd_{i,t-s} + \sum_{s=1}^{lto_i} \delta_{2,i,s} to_{i,t-s} + \varepsilon_{2,i,t} \end{cases} \quad (4.1)$$

where  $i$  ( $i = 1, \dots, N$ ) is the index of the country,  $t$  ( $t = 1, \dots, T$ ) the index of the period, and  $lgdp_i$ ,  $lfd_i$  and  $lto_i$  denote the lag lengths. The error terms,  $\varepsilon_{1,i,t}$  and  $\varepsilon_{2,i,t}$  are assumed to follow white-noise processes (which exhibit zero means and constant variances that are individually, serially uncorrelated).  $gdp$  denotes the natural logarithm of real GDP per capita,  $fd$  the natural logarithm of the respective measures for financial development (which are described in more detail in Section 4.4) and  $to$ , the natural logarithm of the trade openness variable.

In the trivariate system above the main interest concentrates on the bivariate, one-period ahead relationship between economic growth ( $gdp$ ) and financial development ( $fd$ ). Trade openness enters as an auxiliary variable and does not directly influence the Granger causality tests. The reason for

this inclusion lies in the potential two-sided impact trade openness has on both GDP development and financial market depth and ensures better testing of the Granger causality. Bangake and Eggoh (2011), for instance, use trade openness as an exogenous control variable for testing causality between economic growth and several financial indicators. Almarzoqi et al. (2015) find a positive influence of increasing trade openness on financial depth. Financial development in developing countries has also been found to be growth enhancing through positive effects on trade in the long run by Kim et al. (2010). In the short-run, however, positive trade effects may be subject to financial fragility.<sup>14</sup> Moreover, a linear time trend is included in all models to mitigate a potential omitted variable bias.

Note that in the two equations above, every country has the same predetermined, i.e. lagged exogenous and endogenous variables. Konya (2006), however, splits these equations into two groups, one group consisting of equations on  $gdp$ , the other of equations on  $fd$ :

$$\begin{cases} gdp_{1,t} = \alpha_{1,1} + \sum_{s=1}^{lgdp_1} \beta_{1,1,s} gdp_{1,t-s} + \sum_{s=1}^{lfd_1} \gamma_{1,1,s} fd_{1,t-s} + \sum_{s=1}^{lto_1} \delta_{1,1,s} to_{1,t-s} + \varepsilon_{1,1,t} \\ \vdots \\ gdp_{N,t} = \alpha_{1,N} + \sum_{s=1}^{lgdp_1} \beta_{1,N,s} gdp_{N,t-s} + \sum_{s=1}^{lfd_1} \gamma_{1,N,s} fd_{N,t-s} + \sum_{s=1}^{lto_1} \delta_{1,N,s} to_{N,t-s} + \varepsilon_{1,N,t} \end{cases} \quad (4.2)$$

and

$$\begin{cases} fd_{1,t} = \alpha_{2,1} + \sum_{s=1}^{lfd_2} \beta_{2,1,s} gdp_{1,t-s} + \sum_{s=1}^{lgdp_2} \gamma_{2,1,s} fd_{1,t-s} + \sum_{s=1}^{lto_2} \delta_{2,1,s} to_{1,t-s} + \varepsilon_{2,1,t} \\ \vdots \\ fd_{N,t} = \alpha_{2,N} + \sum_{s=1}^{lfd_2} \beta_{2,N,s} gdp_{N,t-s} + \sum_{s=1}^{lgdp_2} \gamma_{2,N,s} fd_{N,t-s} + \sum_{s=1}^{lto_2} \delta_{2,N,s} to_{N,t-s} + \varepsilon_{2,N,t} \end{cases} \quad (4.3)$$

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<sup>14</sup> Almarzoqi et al. (2015) criticize the use of (imports + exports)/GDP as a variable for trade openness under the rationale that some countries are forced to export and values may therefore be misleading. Instead, imports/GDP are recommended. As a robustness check we also use this measure. However, given that trade openness is not directly involved in the Granger causality tests a major difference in the results is not discernible. Results have also been tested through a bivariate model without the inclusion of trade openness. Additional results are available from the author upon request.



Contrary to system (4.1), each equation in system (4.2) and (4.3) belongs to a different country and is estimated with a different sample. Thus each equation has different predetermined variables and the only possible link among individual regressions is the cross-sectional dependence (contemporaneous correlation among the error terms). Hence, these equations are not VAR but SUR systems. After obtaining SUR estimations, country-specific bootstrap critical values of the Wald test (generated by 10,000 replications) are used to implement the Granger causality test procedure.<sup>15</sup> Please refer to the Appendix D.1.1 for a detailed description of the bootstrap procedure.

According to above systems, there is one-way Granger causality from  $fd$  to  $gdp$  in country  $i$  if in equation (4.2) not all  $\gamma_{1,i}$ 's are zero but in (4.3) all  $\beta_{2,i}$ 's are zero; there is one-way Granger causality from  $gdp$  to  $fd$  if in the first equation all  $\gamma_{1,i}$ 's are zero but in the second not all  $\beta_{2,i}$ 's are zero; a two-way Granger causality exists if neither all  $\beta_{2,i}$ 's nor all  $\gamma_{1,i}$ 's are zero and no causality exists if both  $\gamma_{1,i}$ 's and  $\beta_{2,i}$ 's are zero.

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<sup>15</sup>The panel Granger causality tests were performed with a TSP 5.1 routine. I thank Baris Tekin for useful codes.

## 4.4 Data

Our sample contains in total 15 Eastern European countries (Albania, Bosnia-Herzegovina, Bulgaria, Croatia, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Macedonia, Poland, Romania, Serbia, Slovakia, Slovenia) and annual data series cover the maximum period of 1993-2014, thus including the 2008 financial crisis and the recent European debt crisis. This gives us the opportunity to inspect the finance growth relationship in more detail. We restrict our data to start in the mid 1990s, thus excluding potential macroeconomic turbulences from early transition years and for which data are not available.

Data are collected from World Bank databases (World Development Indicators and Global Financial Development Indicators<sup>16</sup>) and set into natural logarithm. Following previous literature (Levine and Zervos (1998); Beck and Levine (2004); Peia and Roszbach (2015)), economic development is measured as real GDP per capita (**GDPPC**) in constant 2005 US dollars<sup>17</sup>. To proxy for financial development, two initial indicators are considered: broad money measured by the ratio of money and quasi money (**M2**) to GDP and domestic credit to the private sector (**DCPS**) as share of GDP. These are standard indicators of financial development often used in the literature, which measure two slightly different financial sector aspects (Levine and Zervos (1998); Beck et al. (2000b); Berthélemy and Varoudakis (1996)). The measure M2 to GDP comprises currency plus demand and interest bearing liabilities of banks and non-financial intermediaries divided by GDP. This proxy is the broadest measure of financial intermediation and considers three types of financial institutions: central banks, deposit money banks, and other financial institutions. Domestic credit to the private sector refers to financial resources provided to the

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<sup>16</sup>Original data come from Cihak et al. (2012).

<sup>17</sup>Real GDP per capita figure is superior to total real GDP figures, because some of the errors inherent in the estimation of the level of GDP and of population tend to be offsetting (Heston (1994)). Note that during our sample period population in many transition countries fell. For Cojocaru et al. (2015) growth in output per capita mirrors to some degree this decline.

private sector, such as loans, purchases of non-equity securities, trade credits and other account receivables that establish a claim for repayment. Credit to the central government or public enterprises is excluded. Higher levels of this variable could therefore stand for greater financial intermediary development through an increased provision of credit, potentially triggered by lower transaction costs and more advanced financial services. However, De Gregorio and Guidotti (1995) also emphasize a potential misleading interpretation in financially underdeveloped economies, where such high levels, instead of being linked to better financial development, impede economic growth through careless lending or over-lending, often encouraged by government interventions leading to moral hazard. Similar caution is warranted when examining the meaning of the broad money (M2) variable as low levels can either mean under-development of the banking sector or a highly sophisticated banking sector that allows for a reduction of money balances and instead promotes investment into other products.<sup>18</sup> Broad money (M2) thus reflects the deposit gathering activity of the financial system, while domestic credit is an indicator that captures the ability of the financial sector to support the economy. Domestic credit to the private sector by banks (DCPSB) to GDP has also been employed in recent studies on financial development for regions with a strong banking sector (e.g. De Gregorio and Guidotti (1995); Menyah et al. (2014)), but data for CESEE economies are of insufficient quality and highly correlated with DCPS (0.98).

Moreover, the ratio of commercial bank assets to all (commercial plus central) bank assets (**BA**) is used to measure the degree to which commercial banks versus the central bank allocate society's savings (e.g. Rioja and Valev (2004); Andrés et al. (2004); Saci et al. (2009)). The underlying intuition is that commercial banks are more likely to identify profitable investments, monitor managers' decisions, facilitate risk management and mobilize savings than central banks. Commercial banks are thought to

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<sup>18</sup>High levels, in contrast, may indicate that money is used as a store of value in absence of more attractive options (Khan and Senhadji (2000)). Although being well aware of its deficiencies, due to a lack of alternative data and its still popular usage in the literature we employ this variable as well.

be more effective than central banks in allocating savings to productive investment projects. An increase in this ratio may indicate a better and more sizeable allocation of savings and therefore benefit economic growth.

Previous studies, such as Levine (1996) and Rousseau and Wachtel (2000) have added indicators of the size and liquidity of stock markets, but they are mostly underdeveloped in transition countries and series not available over longer time periods.

#### 4.4.1 Foreign Bank Presence

Moreover, the banking system in the transition economies has become more and more dependent on the activities of foreign banks as shown above. In fact, in most transition countries the financial architecture has converged towards a bank-based system with substantial foreign ownership. These, mainly from Western European countries, control the majority of assets and capital flows in the financial markets. Research has shown that their entry has boosted economic growth through extending credit to the private sector (Cottarelli et al. (2005)), enhanced competition and contributed to attract foreign direct investment (see e.g. Bonin et al. (2005); Havrylchyk and Jurzyk (2011)). However, the lack of effective regulation, anti-trust legislation and mergers and acquisitions can lead to excessive concentration, while anti-competitive practices and abuse of dominant position may also occur.

Therefore, additionally to the aforementioned variables on financial depth, we follow Cetorelli and Goldberg (2011) and Avdjiev et al. (2012) and employ the ratio of consolidated foreign claims (CFC) to GDP of banks reporting to the Bank for International Settlements (BIS) to account for the high reliance on cross-border loans and thus for the large domination of foreign banks in the different markets<sup>19</sup>.

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<sup>19</sup> Because we generate bootstrap critical values, countries are selected to obtain a balanced panel, which is contingent on data availability. Hence, different financial variables embrace varying countries and time periods: M2/GDP for 1994-2014 (without

Table 4.2: Development of Key Variables Over Time

Country	M2		DCPS		CFC		BA		GDPPC	
	1995	2013	1995	2013	1995	2013	1995	2013	1995	2013
Albania	47.81	84.18	3.76	37.58	6.25	58.58	64.34	92.51	1412.75	3465.41
Bosnia-Herzegovina	-	61.20	-	62.01	5.95	58.17	-	99.99	881.81	3376.87
Bulgaria	67.03	83.75	40.02	69.64	22.86	68.64	88.27	99.88	2917.44	4835.66
Croatia	20.96	69.62	26.19	76.72	3.12	131.14	99.33	99.99	6574.14	10471.93
Czech Republic	68.71	78.07	65.70	55.36	17.94	103.25	97.46	99.99	9932.46	14390.32
Estonia	16.25	54.78	16.18	73.70	2.30	89.28	99.66	99.96	5148.73	12343.31
Hungary	46.78	68.59	21.83	50.76	21.58	75.98	40.76	99.22	7583.87	11363.61
Latvia	18.94	54.93	8.11	60.70	1.02	70.01	95.15	-	3596.90	9457.68
Lithuania	20.87	45.29	14.69	46.22	1.87	55.10	99.58	99.61	3985.27	10450.05
Macedonia	11.77	56.54	23.11	49.20	1.70	39.19	97.15	93.11	2510.67	3840.42
Poland	31.61	58.88	16.85	53.93	5.45	62.43	83.62	100.00	5251.04	10870.31
Romania	30.58	37.88	-	41.42	6.05	57.16	84.10	-	3324.16	5583.87
Serbia	-	44.29	-	43.57	-	69.10	-	99.84	1780.04	3799.29
Slovakia	59.53	60.75	35.75	48.37	7.11	88.44	87.99	99.68	6001.10	11765.55
Slovenia	31.07	64.08	24.69	70.79	5.31	64.46	98.11	99.31	12410.30	18530.73

Sources: World Bank Development Indicators, Global Financial Development Indicators (2015); all variables in % of GDP except GDP per Capita (in 2005 \$US)

Caution, however, is advised when interpreting the data. Whereas CFC may indeed indicate the presence of foreign banks and a reliance on cross-border loans, the variable may also simply represent the size of the financial market at hand. In order to give more credibility to our results, in a later section CFC have been cross-checked where possible with other institutional indicators on foreign bank presence such as foreign bank assets to total assets as well as our efficiency indicator BA. Hence, we are at least partly able to provide more specific evidence of foreign bank penetration in contrast to mere domestic bank lending.

Table 4.2 below provides a brief account of key variables used in this study and their development over the sample period.

Across the whole country sample, all financial indicators have experienced a tremendous increase during the period from early transition to 2013. On average, the M2 over GDP ratio increased about two times and domestic credit by 3.5 times. Macedonia experiences the largest increase of all transition countries in monetization, and credit provision grew the most

Croatia, Bosnia-Herzegovina, and Serbia), Domestic Credit/GDP for 1996-2014 (without Bosnia-Herzegovina and Serbia), Commercial BA/(Commercial and Central Bank Assets) for 1997-2013 (without Bosnia-Herzegovina, Latvia, and Romania), Foreign Claims/GDP for 1995-2013 (without Serbia).

in Albania. Consolidated foreign claims faced the largest surge overall, in many cases a more than ten-fold augmentation peaking in Latvia with the highest percentage increase. However, comparing mean values for the sample period of our transition countries with other regions in the world, eastern Europe still exhibits an intermediate level of financial development. The cross-sectional average of the transition countries stands for the DCPS ratio at 40.49%, for more developed western European countries such as Austria, Germany or the UK at levels exceeding 90%. At the other end of the scale with less than 10% lie developing countries such as Cambodia or Yemen. This difference is even more pronounced when considering the money supply ratio M2. Transition countries overall reveal an average of 46.87%, while highly developed economies such as Luxembourg show ratios of beyond 400% of GDP.

Despite of showing some heterogeneity across countries and an increase in the ratio over the years, commercial bank assets over total (commercial and central bank) assets has an average of 94.03 % over time. This is comparable to other western European countries, which are close to 100%.

However, not only the financial variables but also GDP per capita has risen significantly during the last 15 years. On average, residents of each country had twice the income per capita in 2013 than in 1995. Yet, the average disguises quite some heterogeneity in economic development with respect to per capita income levels. Slovenia, for instance, kept its principal position among all transition countries considered with the highest per capita GDP level of 18530.73\$US in 2013, and Bosnia-Herzegovina still remained at the lower end with 3376.87\$US. Additional country-by-country and whole-sample summary statistics can be found in Table D.2 in Appendix D.2.

## 4.5 Empirical Results

Before estimating the Granger causalities for our variables, we need to specify the optimal lag length and test for cross-sectional dependence among the panel units in order to select the appropriate estimator. The choice of the lag length is essential because the causality test may be sensitive to the lag structure. Following Konya (2006), the maximal lags are allowed to vary across variables but remain the same across equations. For relatively large panels with varying lags across countries, variables and equations, the computational burden would otherwise increase tremendously. In order to select the optimal lag length via minimizing both the Aikaike Information Criterion (AIC) and the Schwarz Bayesian Information Criterion (SBIC), the equation systems are estimated for each pair of  $lfd_1$ ,  $lgdp_1$ ,  $lto_1$ , and  $lfd_2$ ,  $lgdp_2$ , and  $lto_2$  respectively by assuming a lag range from 1 to 3. Both information criteria clearly select one lag for each variable combination. Consequently, we only report results for which the information criteria have been minimized. Results of the optimal lag determination can be found in Table D.1 of Appendix D.1.2.

As mentioned above, for testing cross-sectional dependence among regressors we conduct the Lagrange multiplier test ( $CD_{BP}$ ) by Breusch and Pagan (1980) and, due to its good small sample properties (for both T and N small), the test (CD) developed by Pesaran (2004) which is based on pair-wise correlation coefficients<sup>20</sup>.

Table 4.3 reports the results for all financial variables employed. Both tests strongly reject the null hypothesis of no cross-sectional correlation at either the 1 or the 5 per cent significance level. Given above test results, movements in one variable of a particular country may well influence developments in other economies; strong economic and financial links across the transition economies can thus be inferred. This confirms the suitability

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<sup>20</sup> Even though several other cross-sectional dependence tests have been tested, Moscone and Tossetti (2009) consider the Pesaran (2004) cross-sectional dependence test as the most efficient.

**Table 4.3: Tests for Cross-Sectional Dependence**

	M2	DCPS	BA	CFC
<b>CD<sub>BP</sub></b>	353.078***	253.158***	258.830***	343.203***
<b>CD</b>	5.373***	5.615***	8.795***	1.970**

*Remarks:* Under the null hypothesis of no cross-sectional dependence, the Breusch and Pagan (1980) statistic test ( $CD_{BP}$ ) follows a Chi-square distribution with  $N(N-1)/2$  degrees of freedom. The Pesaran (2004) test (CD) is distributed as a standard normal. For test implementation, log GDP per capita is used for each test as the dependent variable. \*\*\*, \*\* indicate a rejection of the null hypothesis at the 1 per cent and the 5 per cent significance level.

*Source:* Author's calculations.

of the SUR estimator against the country-by-country OLS estimator.

#### 4.5.1 Financial Development - Economic Growth Causality

After having checked the viability of the employed estimator, Table 4.4 and Table 4.5 present in the form of plus and minus signs the significant results of the Granger causality tests for all financial variables. Boldface signs indicate significance levels at 1 per cent, normal signs stand for 5 per cent or lower. Whereas Table 4.4 shows the direction from financial development to economic growth, Table 4.5 provides causalities running from economic growth to the respective financial variable. Detailed results on the country-specific Wald tests and the coefficients can be found in the tables of Appendix D.3. Note that the concept of Granger causality is primarily a statistical one and does not necessarily coincide with economic causation. Care therefore needs to be taken when interpreting results for policy recommendations.

When looking at Tables 4.4 and 4.5, it is noticeable that causality varies widely in direction and size across the transition country sample with respect to the financial indicator in place. This is not only true in terms of significance of the Wald test statistics of the Granger causality tests but also with respect to coefficients in the equations estimated, which are



Table 4.4: Directions of Causality

Financial Indicator	M2/GDP [1]	DCPS/GDP [2]	DCPS/GDP [3]	BA/GDP [4]	BA/GDP [5]	CFC/GDP [6]
<b>Causality</b>	<b>From Financial Development to Economic Growth</b>					
Albania	+		-	-	-	
Bosnia-Herzegovina						+
Bulgaria				+	+	+
Croatia		-	-	+	+	+
Czech Republic	-	-	-	-	-	+
Estonia	+			+	+	
Hungary	-			+	+	
Latvia		+	+			+
Lithuania	+			+	+	+
Macedonia		+	+	+	+	+
Poland		-	-		+	-
Romania	-	-	-			+
Serbia						
Slovakia			-		+	+
Slovenia	-		-	+	+	+
Austria					+	
Germany			-			
<b>Total (+, -)</b>	(3, 4)	(2, 4)	(2, 7)	(7, 2)	(10, 2)	(10, 1)

*Remarks:* Boldface plus or minus signs (+, -) indicate the positive (negative) directional link given by the panel heading for the indicated financial indicators at the 1% significance level; plus or minus signs (+, -) indicate a positive (negative) effect at the 5% significance level or less. Reported signs are derived from the entries in the Tables of Appendix D.3.

*Source:* Author's calculations.

on average larger for the growth-finance direction than for the opposite causality. Consequently, we analyze them in the following step-by-step according to direction of causality, significance and size of coefficients.

Examining the overall picture for causality from conventional measures of financial development to economic growth in columns [1] and [2] in Table 4.4, we find that financial sector development in the form of M2 to GDP and DCPS to GDP negatively Granger causes economic growth to some extent. In four out of seven and four out of six significant cases, financial monetization and domestic credit provision respectively have a negative impact on per capita economic growth. This is at odds with the conventional literature on the finance and growth relationship, which finds a predominantly positive impact, even when comparing with recent studies on nonlinearities within the relation (Arcand et al. (2015); Breitenlechner

et al. (2015))<sup>21</sup>. However, our findings are generally in line with the experience of Eastern European transition countries (e.g. Yu et al. (2012)). The results also confirm previous evidence from Mehl et al. (2006), who find a negative and often significant effect of financial monetization and intermediation on economic growth for South-Eastern European countries, albeit for an earlier period. In contrast, with a causality in the majority positive across transition countries, commercial bank assets over total assets (BA) in column [4] convey a rather different picture. Although BA also aims to proxy for the degree of financial development, compared to the M2 and DCPS variables it rather measures the risk sharing and information gathering capacity of the banking sector than its mere size and depth. Through the positive impact on growth, the superior allocation capabilities of commercial banks *vis-à-vis* central banks seem to play an essential role in many of the transition countries. In a similar way, consolidated foreign claims also exert an overall positive impact on GDP per capita in these countries.

As mentioned earlier in Section 4.3, the methodology used allows for accounting for cross-sectional dependence among transition countries. However, close financial and trade ties exist to a large extent also with neighbouring western European countries.<sup>22</sup> Germany and Austria are particularly connected with transition countries through foreign bank presence and a strong eastern European integration in the supply chain of companies in these countries.

To cover potential contributions of spillovers from these countries, we add them to the country set and re-estimate regressions for domestic credit

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<sup>21</sup>As described in the literature review in Section 4.2, thresholds of DCPS and financial monetization for insignificance or a negative impact of finance on growth are considerably higher than experienced by transition countries (see Table 4.2). Moreover, particularly for low and intermediate levels of financial development results are usually positive.

<sup>22</sup>The deep financial integration between the EU and transition countries has very recently been confirmed by Fadejeva et al. (2016) who analyze spillover effects of financial shocks originating in the EU. They find that negative shocks to Euro area loan supply and aggregate demand trigger large eastern European contractions in total credit and output.

extension DCPS and the ratio of commercial banking assets BA.<sup>23</sup> Results presented in columns [3] and [5] generally confirm the findings from estimations with the transition country sample and even partly increase the significance for individual countries. Below, we have a more differentiated look at the results for the individual variables and countries and to analyze the different channels through which causalities may manifest themselves.

### Countries and Causes

Although allowing for more general tendencies, the observations above exhibit quite some heterogeneity across countries. Somewhat contrasting with Caporale et al. (2015), who find a positive but insignificant impact of domestic credit on economic growth for their different subsamples, results of the Granger causality tests point at a foremost negative causality for the countries with a significant relationship. Croatia, Poland and Romania, for instance, exhibit mildly negative signs. The Czech Republic is a negative outlier in terms of significance, indicating negative causality from credit provision to growth at the 1% level. This negative trend becomes even more apparent when adding Austria and Germany to the sample, where Albania, Slovakia and Slovenia now also display negative causalities at low significance levels. Moreover, the significance of the negative relationship for Poland and Romania rises.<sup>24</sup> Among the Baltics, only Latvia shows a positive and highly significant relationship, whereas for Estonia and Lithuania the test statistics remain non-significant. While Bulgaria does not show any significance for the conventional variables, Macedonia is the only other country with a strong positive influence of credit provision on growth.

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<sup>23</sup>Due to data limitations, these are the only variables where a re-estimation with the extended country set was possible.

<sup>24</sup>Note also the non-significance of the credit variable for Austria and the even slightly negativity for Germany. This may be related to the high degree of financial sector development in high-income economies, which, according to Arcand et al. (2015); Beck et al. (2014) and Breitenlechner et al. (2015), lead to no significant or a negative contribution to economic growth due to reasons explained earlier in Section 4.2.

A key component in explaining the heterogeneity in above results may be the quality of regulatory system and institutions, which have previously been found to play an essential role for beneficial financial development in general (Beck et al. (2000b); Demetriades and Law (2006)) and for twelve Latin American countries in particular (De Gregorio and Guidotti (1995)). They have also shown to exert strong influence on the relationship in transition countries (Mehl et al. (2006)). The positive or at least non-negative impact of DCPS and M2 on economic growth in Bulgaria, Estonia and Latvia is according to Cottarelli et al. (2005) primarily related to their status as “early birds”, i.e. early and more pronounced financial development. Rapid privatization, public sector retrenchment and a general improvement of market-oriented institutions may have helped to base financial deepening on more solid grounds than in other countries. The predominantly positive relationship between the financial indicators and economic growth in the Baltic countries thus may reflect a more advanced legal and regulatory system.

The overall rather negative tendency in the other countries in terms of credit extension and monetization for economic growth is more in line with recent results of Cojocaru et al. (2015), who single out a continuous persistence of soft budget constraints, state-owned enterprises and state-owned banks as reasons for a distortive allocation of credit. These findings have previously been confirmed by Yu et al. (2012) who find no relationship between finance and growth in the short run (less than 10 years) but a positive in the long run, mainly due to ill-enforced legal systems and political instability. Moreover, Cottarelli et al. (2005) group the negative outliers Albania, Czech Republic, and Romania as “sleeping beauties”, where a delayed cleaning up of banks’ balance sheets and a slower development of accounting standards may, at least partly, explain a negative Granger causality between financial development and growth. The same may also hold for Croatia and Slovenia which attract rather negative signs for the conventional indicators.<sup>25</sup>

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<sup>25</sup>Although several transition economies entered the OECD during our sample period, the results do not provide clear evidence of a relationship between OECD membership

In order to further check on the latter channel for a disruptive finance-growth nexus, we follow Pagano (2013) and calculate for the transition countries simple pairwise correlations between DCPS and the bank “Z-score”, a measure of bank creditworthiness<sup>26</sup>. A negative correlation reflects a decreased creditworthiness of a country’s banks with increasing credit provision, potentially putting the stability of the banking system at risk.<sup>27</sup> Positive correlations on the other hand usually indicate further room for profits in the banking sector through credit extension and are thus primarily encountered in financially underdeveloped countries. Negative correlations have usually been found for mature economies where DCPS ratios cross high thresholds, analogue to the negative territory boundary in the non-monotonicity literature of financial development (Arcand et al. (2015)). When examining the correlation coefficients for the transition countries, negative values for Albania, the Czech Republic as well as Romania do not only back up the above “sleeping beauties” hypothesis but also confirm our results of a primarily negative relationship between DCPS and growth. According to the negative correlations obtained, firms in these countries do not increase profitability with increasing credit provision what may have a negative impact on banks’ profits and capital base. The same conclusion can be drawn for Slovenia. The comparatively high negative correlations for Bulgaria and Estonia seem first to stay in contrast to previous results. However, they may also underline that these countries’ regulatory systems seem more apt to deal with extended credit provision and are able to ensure financial stability.

A further disruptive effect on the relationship between conventional financial development and economic growth may be the plurality of major

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(and the accompanied build-up of efficient institutions) and positive impact of financial development.

<sup>26</sup>The bank “Z-score” is calculated as the the sum of return on assets (ROA) and the equity/assets ratio, divided by the standard deviation of ROA. Data come from Cihak et al. (2012).

<sup>27</sup>Negative correlations have been found for Albania (-0.12), Bulgaria (-0.71), Czech Republic (-0.30), Estonia (-0.47), Macedonia (-0.30), Romania (-0.13), Slovenia (-0.62). The other countries in the sample exhibit low positive correlations.

domestic financial and banking crises, particularly in the late 1990s<sup>28</sup>. Analyzing large yet different country sets, Rousseau and Wachtel (2011) and Breitenlechner et al. (2015) consider the incidence of banking crises as the reason for a weakening of the finance-growth link in recent years. This finding corroborates the behavior of the transition countries when further expanding the dataset. When comparing, for instance, the performance of Bulgaria, Estonia, Latvia and Lithuania against western European countries during the Global Financial Crisis, Gros and Alcidi (2015) find that these countries were able to adjust quicker to the shock than the western counterparts. The large share of foreign ownership helped the banking sector to cushion negative loan shocks and avoid a full-blown banking crisis, what may have dented economic growth further (see e.g. Gardó and Martin (2010)).

The results for the size of the commercial bank assets ratio are reported in column [4] of Table 4.4, where the variable is found to have a primarily positive effect on growth. The level of significance, however, varies among transition countries, what confirms previous results on 30 developing countries of Saci et al. (2009). When enlarging the country set with Austria and Germany in column [5], results are generally affirmed; Poland, Slovakia and Slovenia gain additional significance for a positive relationship. While Austria exhibits a low significant yet still positive impact on growth, it is insignificant for Germany and thus relates to results in Andrés et al. (2004) who find a weak positive relationship in OECD countries. Moreover, the hypothesis, as for instance argued in Pagano (1993), that a rather concentrated banking market may fail to allocate funds efficiently to investments cannot be confirmed for the majority of countries. As in Cojocaru et al. (2015), efficiency seems to matter more for growth than the sheer depth of the financial market.

We now turn to the last variable in the above table, consolidated foreign

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<sup>28</sup>E. g. Bulgaria in 1997, Croatia in 1998/1999, or Albania in 1997, and recently the Global Financial Crisis; unfortunately, it is technically not possible to test with the approach at hand for a differentiated impact of the recent financial crisis due to too short time series combined with a relatively large cross-section.

claims. In order to support our results, we compute country correlations between the CFC variable and the ratio of foreign bank assets over total assets.<sup>29</sup> When examining foreign claims as a variable for foreign bank exposure of the economy in column [6] of Table 4.4, results look rather different. Almost all countries except for Albania, Estonia and Hungary, exhibit a positive and significant Granger causality originating at CFC and run to economic growth. For Slovakia, Croatia and the Czech Republic the relationship is also positive yet only mildly at the 10 percent significance level. With the exception of Poland, this result blends well with the recent findings of positive effects of foreign bank activity, such as introducing superior lending techniques, increasing efficiency or exercising more cautious lending<sup>30</sup>. Allen et al. (2011) also emphasize the subsidiary structure in transition countries, where many foreign banks are “locked in” due to long-term loan commitments of subsidiaries that cannot be recalled easily. This organisational structure of banks may certainly have helped to insulate the region against a stronger crisis impact. However, foreign banks are also suspected to “cherry pick” clients, potentially leaving other domestic banks to deal with less credit-worthy or “opaque” customers (de Haas (2014)).

#### 4.5.2 Economic Growth - Financial Development Causality

By examining results on causality running from economic growth to financial development in Table 4.5, the reverse Granger causality across all financial indicators is in the majority positive and seems to follow more

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<sup>29</sup>For all positive and significant causality results, the correlations between CFC and the foreign bank assets ratio are positive, yet to varying degrees. The average correlation is 0.55, while individual country correlations are ranging from 0.95 for Romania to a low 0.16 for Lithuania. Although we cannot with absolute certainty conclude that only foreign bank activity is measured, we nonetheless can infer from our results the direction of causality. The series for the foreign bank assets ratio have been taken from Cihak et al. (2012).

<sup>30</sup>The importance of the efficiency aspect gains additional support through an average correlation of 0.63 with the commercial bank assets variable.

the argumentative line of Robinson (1952). He argues that economic growth precipitates financial development as a result of higher demand for financial services for a growing economy. Apart from a high significance of the Wald test statistics, this finding can further be substantiated by significantly larger estimated coefficients in the equations compared to those estimated for the opposite causalities (see Appendix D.3). The only relationship with comparatively small coefficients belongs to the BA variable. However, the commercial bank assets ratio exhibits a very high persistency over time across all countries and financial sector development may have therefore not be reflected to a similar degree as in other variables.

The least significant Granger causalities appear for the liquid liability variable M2. In contrast, GDP per capita drives in almost all countries DCPS in a positive way. This also holds in the extended country version, where Austria and Germany attract positive and significant causalities. Given the observed discrepancy particularly for the variable on domestic credit extension, our results cannot confirm a clear positive bi-directional causality in the short run as in Hassan et al. (2011).

Reasons for this rather strong positive Granger causality across all financial variables in general and for DCPS in particular may come to a large extent from the rather unusual and ad-hoc creation of financial sectors, which have been dominated by foreign banks in the transition countries. The opening-up of these countries after decades of no free market access has created plenty of opportunities for banks to tap uncharted territory and provide services to new markets and customers. This development has further been encouraged by local authorities in order to attract missing know-how, technology and capital. It was further meant to raise corporate governance and competitiveness among existing local banks. As a result, foreign investors started to enter the transition banking markets on a large scale at the turn of the millennium, with particularly Austrian, German, Italian and French banks taking the lead Gardó and Martin (2010).

Moreover, the step-by-step integration into the EU or at least the promise



Table 4.5: Directions of Causality

Financial Indicator	M2/GDP [1]	DCPS/GDP [2]	DCPS/GDP [3]	BA/GDP [4]	BA/GDP [5]	CFC/GDP [6]
<b>Causality</b>	<b>From Economic Growth to Financial Development</b>					
Albania	+	+	+	+	+	+
Bosnia-Herzegovina			+			+
Bulgaria	+	+	+	+	+	+
Croatia			+			
Czech Republic		+	+	+	+	
Estonia		+	+	+	+	
Hungary	+	+	+	-	-	+
Latvia		+	+			
Lithuania	+	+	+	+	+	
Macedonia	-	+	+			
Poland	+	+	+			+
Romania	+	+	+			+
Serbia				+	+	
Slovakia		+	+	+	+	-
Slovenia		+	+	+	+	+
Austria			+			
Germany		-	+			
<b>Total (+, -)</b>	<b>(6, 1)</b>	<b>(12, 0)</b>	<b>(16, 0)</b>	<b>(8, 1)</b>	<b>(8, 1)</b>	<b>(7, 1)</b>

*Remarks:* Boldface plus or minus signs (+, -) indicate the positive (negative) directional link given by the panel heading for the indicated financial indicators at the 1% significance level; plus or minus signs (+, -) indicate a positive (negative) effect at the 5% significance level or less. Reported signs are derived from the entries in the Tables of Appendix D.3.

*Source:* Author's calculations.

to become a member in the future has triggered increasing FDI and trade flows, often followed by a deep integration of eastern European countries into western supply chains. In order to finance expansionary activities of firms, financial institutions provided the necessary funding through foreign subsidiaries or local banks. The prospect of future EU accession, entitled by Luengnaruemitchai and Schadler (2007) as “halo effect” of the EU/euro area, and the sustained good medium- and long-term economic prospects of the region (despite of rising economic imbalances in some countries in the run-up to the crisis) seem to have bolstered confidence among investors to set up shop in eastern Europe over the middle to long-term.

## 4.6 Conclusion and Policy Implications

This paper examines the financial development and growth relationship for 15 Eastern European economies during 1994 – 2014 through a panel Granger causality analysis with bootstrapped Wald tests, which accounts for cross-sectional correlation and country-specific heterogeneity.

By comparing overall results in terms of direction, the significance of causalities as well as the size of the estimated coefficient, we can conclude that finance in transition countries primarily follows economic growth. The most sizeable difference is discernible for the domestic credit provision variable, which exerts on the one hand a primarily negative impact on economic growth, yet is on the other positively driven by GDP per capita.

Thus, our study provides also evidence that for transition countries financial deepening does not always seem to be beneficial for economic growth. The partly negative impact of monetization and particularly domestic credit provision points at a rather detrimental development for economic growth in the short run and thus requires a more prudential approach to financial development.

Conversely, increasing efficiency through assets held by commercial bank and a strong reliance on cross-border loans seems to be in the majority of transition countries advantageous for economic growth. Apart from the rather favorable view of foreign-owned intermediaries in the region, however, such a bank-based financial system may also pose severe risks to financial stability in times of distress (Winkler (2009)). In order to reap benefits from further financial market deepening regulation and banking supervision within and across borders need to be expanded that are appropriately developed and capable of ensuring financial stability.

To achieve some isolation and resilience against shocks to the banking system, other key segments of a more mature financial market need to either be strengthened in transition countries or progressively installed.

Even though the development of stock markets did not seem to play a major role for economic growth in early stages of transition (Fink et al. (2009); Hagmayr and Haiss (2007)), stock markets have recently been linked in the literature to fostering economic growth in middle-income countries (Shen and Lee (2006)) and in more advanced economies (e.g. Yu et al. (2012); Peia and Roszbach (2015)). Leaving the period of transition further behind, the development of capital markets together with sophisticated regulatory systems for the existing banking sector may thus be the next element of a more sustainable growth experience combined with a right amount of financial sector depth.

# Conclusion

Since the early 2000s, the European Union and its enlargement into the east have brought to its member countries prosperity, economic stability and the concomitant lower unemployment rates. Driven by a growing integration through trade and financial flows as well as the introduction of the common currency, Europe has to a large extent delivered on its promise to work towards a “[...]sustainable development based on balanced economic growth [...] aiming at full employment”.<sup>31</sup> However, the recent crisis events have turned these favorable developments upside down, revealing tremendous heterogeneity and excessive imbalances among countries. Since then, overall rather meagre economic growth has so far been manifesting a divide primarily between North and South and also between old and new member states. In the four chapters of my PhD thesis I study several topics related to these dichotomies and provided, where possible, potential policy recommendations for an appropriate response to these challenges. Chapters 1 and 2 analyze heterogeneity in terms of regional unemployment and growth convergence. Chapters 3 and 4 focus on the impact of financial development on growth, both on the firm and country level.

In Chapter 1, Robert Beyer and I explore empirically the dynamics of regional unemployment rates as well as their intra-distributional mobility in Europe. Moreover, we disentangle continental, country and region-specific contributions to regional unemployment during the run-up to the

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<sup>31</sup>An excerpt of the Article 2(3) of the Treaty of Lisbon.

recent crises and in the aftermath. This chapter thus contributes to the literature on regional unemployment disparities through several important findings. In the first part, by means of non-parametric methods, we find a convergence among regional rates during the period of 1996-2007. The outbreak of the crisis reversed these developments and heterogeneity has been strongly increasing since then. Moreover, a strong persistence of regional unemployment rates is discernible over time. Regions move up and down but mainly according to European developments, relative rates between regions persist. In the second part, the use of a hierarchical factor model allows for a differentiated analysis of continental, country and region-specific contributions to the described regional behavior. With an overall contribution of 41 per cent of European fluctuations to regional movements, we provide evidence for European unemployment cycles. Country contributions are nearly as important. Moreover, whereas the convergence between 1996 and 2007 is to a large extent driven by country factors, we attribute the divergence between 2007 and 2013 to both country and region-specific factors. In view of the observed results, regional unemployment needs to be tackled on a regional, national and European level. While the European effort may, for instance, contain an augmentation of structural funds for underperforming regions, a solution on a national and regional level may consist in further abolition of labor market rigidities.

Chapter 2 analyses the rebound capacity of economic growth in western European and transition countries after economic shocks. This joint work with Olivier Damette and Mathilde Maurel dwells in particular on the velocity of return to the normal growth path as well as potential nonlinearities in the convergence processes of both country groups. This chapter thus contributes to the recent discussion on potential long-term effects of recessions and what ultimately triggers economic growth after an economic downturn. Applying an error-correction framework, we find that significant convergence appears in both subsamples, but that transition countries outpace the western subsample in the return to the long-run growth equilibrium. Moreover, our findings on nonlinearities suggest

that for western European countries, the more flexible prices and wages adjust, the faster the return to the normal growth path. Regarding the more general contribution to the literature, the chapter sets itself apart from existing research by relying on European and transition countries, by using recently developed estimators that take explicitly into account cross-section dependence and by examining nonlinearities in the rebound process with respect to certain transition variables.

In chapter 3, a joint work with Milos Markovic, we assess the sensitivity of firm growth to cash flow for Serbian companies during the period 2005-2012 through a dynamic panel analysis. Compared to the existing literature, we consider several additional aspects. First, a unique dataset on Serbian nonlisted firms is employed and compared with cash flow sensitivities of Belgian companies. We find sizeable and significant internal financial constraints for Serbian firms with small and medium-size enterprises being affected the most. Moreover, firms that generally perform better in terms of growth and labor productivity, and are on average less dependent on internal funds, exhibit lower constraints. A differentiation by ownership category shows that foreign-owned companies do not seem to rely much on cash flow. State-owned firms, however, do not set themselves apart from the representative constrained firm. This suggests that while financial constraints of foreign firms may be alleviated either through close foreign bank - foreign company relationships or firm-internal capital markets, state-owned firms do not profit from soft budget constraints or government subsidies. In comparison, Belgian firms, with the exception of medium-size companies, do not show significant dependency on retained earnings. Our analysis thus confirms a significantly different environment in both countries regarding access to funding, most likely related to different financial market development and structure. To mitigate funding issues for firms, the endorsement of policies to support financial market development other than the banking sector may be a promising strategy. Moreover, policy initiatives by international organisations such as the European Bank of Reconstruction and Development to boost lending particularly to SMEs through dedicated credit lines should

be increased.

Finally, in chapter 4 I take a closer look at the relationship between financial development and economic growth in a sample of 15 transition countries. By employing a panel Granger causality framework across several financial indicators on financial market depth, efficiency and foreign bank presence, I show that causality runs predominantly from GDP per capita to financial development. The findings therefore support a demand-following hypothesis of the finance-growth nexus. Conversely, findings on the causality from financial development to economic growth are to some extent negative, although the size of the relationship is lower than for the opposite causality. Nonetheless, domestic credit provision in particular seems to exert a significant negative influence on economic growth in the majority of countries, which may point at existing deficiencies in banking supervision. In order to improve the situation of sustainable financial development, a more balanced development in terms of bank and capital markets is advisable, together with a strengthening of market regulations. Through this analysis I contribute in particular to the rather limited empirical literature on finance and growth in transition countries. Furthermore, by explicitly accounting for individual country causalities with respect to each employed variable, this chapter sheds some light on specific country characteristics and links the findings to the recent literature on non-monotonocities in the finance and growth relationship.

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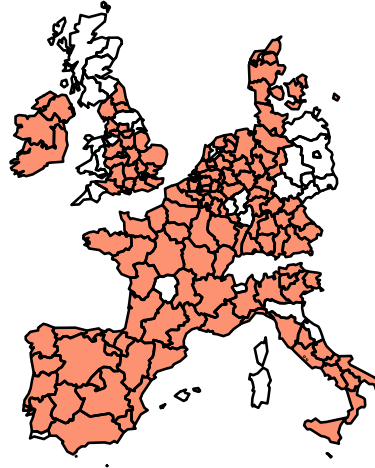
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# **Appendix A**

## **Polarization or Convergence?**

## A.1 Appendix: Geographical Coverage



**Figure A.1: European Regions**

*Source:* Eurostat NUTS2 data.

## A.2 Regions

Table A.1: List of Included Regions

<b>Belgium</b> Région de Bruxelles-Capitale/Brussels Hfdst. Gew. Antwerpen Limburg (BEL) Oost-Vlaanderen Vlaams Brabant West-Vlaanderen Brabant Wallon Hainaut Liège Luxembourg (BEL) Namur	<b>Germany</b> Stuttgart Karlsruhe Freiburg Tübingen Oberbayern Niederbayern Oberpfalz Oberfranken Mittelfranken Unterfranken Schwaben Bremen Hamburg Darmstadt Giessen Kassel Braunschweig Hannover Lüneburg Weser-Ems Düsseldorf Köln Münster Detmold Rhein Hessen-Pfalz Saarland Schleswig-Holstein	Lincolnshire East Anglia Bedfordshire, Hertfordshire Berkshire, Buckinghamshire, Oxfordshire Surrey, East-West Sussex Essex Greater London Hampshire, Isle of Wight Kent Avon, Gloucestershire, Wiltshire Dorset, Somerset Hereford-Worcestershire, Warwickshire Shropshire, Staffordshire West Midlands (county) Greater Manchester Lancashire Northern Ireland	<b>Luxembourg</b> Luxembourg
<b>Denmark</b> Denmark	<b>Great Britain</b> Cleveland, Durham Cumbria Northumberland, Tyne and Wear South Yorkshire West Yorkshire Derbyshire, Nottinghamshire Leicestershire, Northamptonshire	<b>Ireland</b> Ireland	<b>Netherlands</b> Groningen Friesland Drenthe Overijssel Gelderland Utrecht Zuid-Holland Noord-Holland Zeeland Noord-Brabant Limburg (NLD)
<b>France</b> Île de France Champagne-Ardenne Picardie Haute-Normandie Centre Basse-Normandie Bourgogne Nord-Pas-de-Calais Lorraine Alsace Franche-Comté Pays de la Loire Bretagne Poitou-Charentes Aquitaine Midi-Pyrénées Rhône-Alpes Auvergne Languedoc-Roussillon Provence-Alpes-Côte d'Azur	<b>Italy</b> Piemonte Liguria Lombardia Trentino - Alto Adige Veneto Friuli - Venezia Giulia Toscana Umbria Lazio Abruzzo Molise Campania Puglia Basilicata Calabria Sicilia	<b>Portugal</b> Norte Centro (PRT) Lisboa e Vale do Tejo Alentejo	<b>Spain</b> Galicia Asturias Cantabria Pais Vasco Navarra Rioja Aragón Madrid Castilla y León Castilla-La Mancha Extremadura Cataluña Comunidad Valenciana Andalucía Región de Murcia

## **Appendix B**

### **What Does It Take to Grow Out of Recession?**



## B.1 Additional Subsample Estimations

### B.1.1 Long-Run Estimations with Augmented Mean Groups Estimators

Table B.1: Long-Run Determinants of Economic Growth (EU-Core Countries)

Variables	AMG
	[1]
Investment	0.012 [0.011]
Labor Force	0.206 [0.241]
Trade Integration	0.156*** [0.052]
Government Consumption	-0.097 [0.106]
Common Dynamic Process	0.820*** [0.110]
RMSE	0.020
Share Trends (No. Trends)	0.867 (13)
No. Countries	15
No. Observations	796

*Remarks:* Estimations are based on the AMG estimator. Sample: EU core countries, quarterly data from 1995Q1 - 2010Q4. We report the cross-country mean of coefficients in the heterogeneous parameter models according to Hamilton (1992); standard errors are non-parametrically constructed following Pesaran and Smith (1995). An intercept, a group-specific linear trend and the quarterly average of the inflation rate as an exogenous variable are included in all models, yet not reported. RMSE is the root mean square error; Share Trends (No. Trends) reports the share (number) of group-specific trends significant at the 5% level. \*, \*\*, \*\*\* indicates significance at the 1%, 5%, or 10% level.

*Source:* Authors' calculations.

## B.1.2 Error-Correction with Augmented Mean Group

Table B.2: Linear Panel Error-Correction Model (EU-Core Countries)

Variables	AMG [1]
<i>Err. Corr. Coefficient</i>	-0.640*** [0.046]
<i>Short-Run Coefficients</i>	
$\Delta$ Investment	0.002 [0.010]
$\Delta$ Labor Force	0.020 [0.174]
$\Delta$ Trade Integration	0.138*** [0.046]
ER Flexibility	-0.271*** [0.091]
Common Dynamic Proces	0.502*** [0.105]
Half-Life (in quarters)	0.678
RMSE	0.015
Share Trends (No. Trends)	0.400 (6)
Durbin-Watson	-
No. Countries	15
No. Observations	780

*Remarks:* Estimations are based on the AMG estimator. Sample: EU-core countries, quarterly data from 1995Q1 - 2010Q4. We report the cross-country mean of coefficients in the heterogeneous parameter models according to Hamilton (1992); standard errors are non-parametrically constructed following Pesaran and Smith (1995). An intercept, a group-specific linear trend and the quarterly average of the inflation rate as an exogenous variable are included in all models, yet not reported. RMSE is the root mean square error; Share Trends (No. Trends) reports the share (number) of group-specific trends significant at the 5% level. \*, \*\*, \*\*\* indicates significance at the 1%, 5%, or 10% level.

*Source:* Authors' calculations.

## **Appendix C**

# **Firm Growth Dynamics and Financial Constraints**

## C.1 Firm-Level Estimations for Serbia

### C.1.1 Baseline Regressions

Table C.1: Baseline Regressions with Specification Checks

Dependent Variable: Asset Growth	FE [1]	FD-GMM [2]	FD-GMM [3]	SYS-GMM [4]
$Asset\ Growth_{i,t-1}$	-0.172*** [0.013]	-0.059*** [0.019]	-0.075*** [0.012]	0.059*** [0.019]
$Cash\ Flow_{i,t}$	0.387*** [0.049]	0.982*** [0.218]		1.026*** [0.230]
$Cash\ Flow_{i,t-1}$			0.851*** [0.181]	
J (p-value)		0.232	0.041	0.935
AR(1)		-17.10	-17.04	-17.46
AR(2)		0.58	0.35	0.59
Time FE	YES	YES	YES	YES
Observations	9348	7790	7790	9348

*Remarks:* All GMM estimations were performed with the *xtabond2* routine by Roodman (2009a). The figures reported in parentheses are asymptotic standard errors. Standard errors and test statistics are asymptotically robust to heteroskedasticity. Instruments in column [4] are  $Asset\ growth_{i,t-2}$ ,  $(Cash\ flow/Total\ assets)_{i,t-2}$ . In columns [4] the instrument matrix has been collapsed and the small sample bias has been corrected according to Windmeijer (2005). The Hansen J statistic is a test statistic of the overidentifying restrictions, distributed as a chi-squared under the null of instrument validity. AR(1) and AR(2) are tests for AR(n)-order serial correlation in the first-differenced residuals, asymptotically distributed as  $N(0,1)$  under the null of no serial correlation. \*\*\* indicates significance at the 1% level, \*\* indicates significance at the 5% level, and \* indicates significance at the 10% level.

*Source:* Authors' calculations.

## C.2 Firm-Level Estimations for Belgium

### C.2.1 Baseline Regressions

Table C.2: Baseline Regressions with Specification Checks

Dependent Variable: Asset Growth	FE [1]	FD-GMM [2]	FD-GMM [3]	SYS-GMM [4]
<i>Assets Growth</i> <sub><i>i,t-1</i></sub>	-0.165*** [0.017]	-0.015 [0.023]	0.005 [0.025]	-0.012 [0.022]
<i>Cash Flow</i> <sub><i>i,t</i></sub>	0.175*** [0.057]	0.410 [0.388]		0.059 [0.176]
<i>Cash Flow</i> <sub><i>i,t-1</i></sub>			-0.664* [0.391]	
J (p-value)		0.841	0.681	0.895
AR(1)		-12.09	-11.63	-12.74
AR(2)		-1.18	-1.07	-1.54
Time FE	YES	YES	YES	YES
Observations	11892	9910	9910	11892

*Remarks:* All GMM estimations were performed with the *xtabond2* routine by Roodman (2009a). The figures reported in parentheses are asymptotic standard errors. Standard errors and test statistics are asymptotically robust to heteroskedasticity. Instruments in column [4] are  $Asset\ growth_{i,t-2}$ ,  $(Cash\ flow/Total\ assets)_{i,t-2}$ . In columns [4] the instrument matrix has been collapsed and the small sample bias has been corrected according to Windmeijer (2005). The Hansen J statistic is a test statistic of the overidentifying restrictions, distributed as a chi-squared under the null of instrument validity. AR(1) and AR(2) are tests for AR(n)-order serial correlation in the first-differenced residuals, asymptotically distributed as  $N(0,1)$  under the null of no serial correlation. \*\*\* indicates significance at the 1% level, \*\* indicates significance at the 5% level, and \* indicates significance at the 10% level.

*Source:* Authors' calculations.

## C.2.2 Investment Opportunities

Table C.3: Controlling for Investment Opportunities

Dependent Variable: Asset Growth	SYS-GMM		SYS-GMM	
	Fully Instrumented [1]	Partially Instrumented [2]	Fully Instrumented [3]	Partially Instrumented [4]
<i>Asset Growth</i> <sub><i>i,t-1</i></sub>	-0.005 [0.021]	-0.012 [0.039]	-0.006 [0.022]	-0.013 [0.021]
<i>Cash Flow</i> <sub><i>i,t</i></sub>	0.110 [0.243]	0.060 [0.178]	0.120 [0.254]	0.098 [0.203]
<i>Sales Growth</i> <sub><i>i,t</i></sub>	-0.000 [0.000]	-0.000 [0.000]		
<i>Size</i> <sub><i>i,t</i></sub>	0.172*** [0.046]	0.005** [0.002]	0.167*** [0.044]	0.005** [0.002]
<i>Age</i> <sub><i>i,t</i></sub>	-0.021 [0.014]	0.001 [0.003]	-0.019 [0.013]	0.001 [0.003]
J (p-value)	0.869	0.915	0.946	0.972
AR(1)	-12.59	-12.72	-12.58	-12.63
AR(2)	-1.38	-1.54	-1.39	-1.51
Time FE	Yes	Yes	No	No
Sector-Time FE	No	No	Yes	Yes
Observations	11892	11892	11892	11892

*Remarks:* All GMM estimations were performed with the *xtabond2* routine by Roodman (2009a). The figures reported in parentheses are asymptotic standard errors. Standard errors and test statistics are asymptotically robust to heteroskedasticity. Instruments in columns [1] - [2] are  $Asset\ growth_{i,t-2}$ ,  $(Cash\ flow/Total\ assets)_{i,t-2}$  and  $(Real\ sales\ growth/Total\ assets)_{i,t-2}$ . The instrument matrix has been collapsed and the small sample bias has been corrected according to Windmeijer (2005). The Hansen J statistic is a test statistic of the overidentifying restrictions, distributed as a chi-squared under the null of instrument validity. AR(1) and AR(2) are tests for AR(n)-order serial correlation in the first-differenced residuals, asymptotically distributed as  $N(0,1)$  under the null of no serial correlation. \*\*\* indicates significance at the 1% level, \*\* indicates significance at the 5% level, and \* indicates significance at the 10% level.

*Source:* Authors' calculations.

### C.2.3 Controlling for Size

Table C.4: Controlling for Size

Dependent Variable: Asset Growth	Micro Firms [1]	Small Firms [2]	Medium-Size Firms [3]	Large Firms [4]
$Asset\ Growth_{i,t-1}$	0.000 [0.066]	-0.027 [0.035]	-0.014 [0.031]	0.068 [0.066]
$Cash\ Flow_{i,t}$	-0.466 [0.875]	-0.116 [0.093]	1.209*** [0.303]	-0.344 [0.425]
$Sales\ Growth_{i,t}$	0.001 [0.003]	-0.000 [0.000]	0.000** [0.000]	-0.000 [0.000]
$Age_{i,t}$	0.006 [0.013]	-0.007 [0.005]	0.008 [0.007]	0.015 [0.009]
J (p-value)	0.207	0.641	0.857	0.133
AR(1)	-4.45	-6.29	-5.03	-5.53
AR(2)	-0.77	0.65	-0.35	-1.30
Time FE	Yes	Yes	Yes	Yes
Observations	990	767	4788	1520

*Remarks:* All GMM estimations were performed with the *xtabond2* routine by Roodman (2009a). The figures reported in parentheses are asymptotic standard errors. Standard errors and test statistics are asymptotically robust to heteroskedasticity. Instruments in all columns are  $Asset\ growth_{i,t-2}$ ,  $(Cash\ flow/Total\ assets)_{i,t-2}$  and  $(Real\ sales\ growth/Total\ assets)_{i,t-2}$ . The instrument matrix has been collapsed and the small sample bias has been corrected according to Windmeijer (2005). The Hansen J statistic is a test statistic of the overidentifying restrictions, distributed as a chi-squared under the null of instrument validity. AR(1) and AR(2) are tests for AR(n)-order serial correlation in the first-differenced residuals, asymptotically distributed as  $N(0,1)$  under the null of no serial correlation. \*\*\* indicates significance at the 1% level, \*\* indicates significance at the 5% level, and \* indicates significance at the 10% level.

*Source:* Authors' calculations.

## C.2.4 External Financial Constraints

Table C.5: External Financial Constraints

Dependent Variable:	Young	Old	Low Cash	High Cash	Low Prod.	High Prod.	Low Growth	High Growth
Asset Growth:	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]
<i>Asset Growth</i> <sub><i>i,t-1</i></sub>	0.012 [0.023]	-0.043 [0.030]	0.016 [0.027]	-0.075*** [0.032]	-0.001 [0.025]	-0.010 [0.033]	-0.063* [0.035]	0.014 [0.023]
<i>Cash Flow</i> <sub><i>i,t</i></sub>	0.011 [0.482]	0.014 [0.203]	-0.012 [0.113]	0.120 [0.467]	0.129 [0.329]	0.359 [0.486]	0.106 [0.234]	0.304 [0.383]
<i>Sales Growth</i> <sub><i>i,t</i></sub>	0.000 [0.000]	-0.000 [0.000]	0.000 [0.000]	-0.000 [0.000]	0.001 [0.001]	-0.000 [0.000]	-0.000 [0.000]	-0.000 [0.000]
<i>Size</i> <sub><i>i,t</i></sub>	-0.003 [0.006]	0.008** [0.003]	0.001 [0.004]	0.006 [0.005]	-0.016 [0.028]	0.006 [0.003]	0.004 [0.002]	0.004 [0.004]
<i>Age</i> <sub><i>i,t</i></sub>			0.001 [0.005]	0.003 [0.012]	0.009 [0.005]	0.002 [0.005]	0.005 [0.004]	-0.003 [0.004]
J (p-value)	0.418	0.919	0.521	0.243	0.640	0.465	0.921	0.599
AR(1)	-9.66	-8.67	-8.23	-9.58	-9.27	-8.94	-9.15	-9.54
AR(2)	-1.51	-0.76	-1.25	-0.15	-1.03	-0.45	-0.21	-1.70
Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	5958	5934	5886	6006	5946	5946	5964	5964

*Remarks:* All GMM estimations were performed with the *xtabond2* routine by Roodman (2009a). The figures reported in parentheses are asymptotic standard errors. Standard errors and test statistics are asymptotically robust to heteroskedasticity. Instruments in all columns are  $Asset\ growth_{i,t-2}$ ,  $(Cash\ flow/Total\ assets)_{i,t-2}$  and  $(Real\ sales\ growth/Total\ assets)_{i,t-2}$ . The instrument matrix has been collapsed and the small sample bias has been corrected according to Windmeijer (2005). The Hansen J statistic is a test statistic of the overidentifying restrictions, distributed as a chi-squared under the null of instrument validity. AR(1) and AR(2) are tests for AR(n)-order serial correlation in the first-differenced residuals, asymptotically distributed as  $N(0,1)$  under the null of no serial correlation. \*\*\* indicates significance at the 1% level, \*\* indicates significance at the 5% level, and \* indicates significance at the 10% level.

*Source:* Authors' calculations.



## **Appendix D**

### **Revisiting Finance and Growth**

## D.1 Technical Appendix

### D.1.1 Bootstrap Procedure

The bootstrap procedure of Konya (2006) for our trivariate model setup functions as follows:

**Step 1:** Estimation of equation (4.2) under the null hypothesis ( $H_0$ ) of non-causality from  $fd$  to  $gdp$  by imposing  $\gamma_{1,i,s} = 0$  for all  $i$  and  $s$  and obtaining the residuals as below:

$$e_{H_0,i,t} = gdp_{1,t} - \hat{\alpha}_{1,i} - \sum_{s=1}^{l_{gdp_1}} \hat{\beta}_{1,i,s} gdp_{1,t-s} - \sum_{s=1}^{l_{to_1}} \hat{\delta}_{1,i,s} to_{i,t-s} \quad (D.1)$$

Use of these residuals to build the  $N \times T[e_{H_0,i,t}]$  matrix.

**Step 2:** Resampling of these residuals by preserving the contemporaneous correlation between residuals in equation (4.2). To achieve this, instead of drawing the residuals on a country-by-country basis, a full column from the  $[e_{H_0,i,t}]$  matrix is randomly selected at a time. These selected bootstrap residuals are denoted as  $[e_{H_0,i,t}^*]$  where  $t = 1, \dots, T^*$  can be greater than  $T$ .

**Step 3:** Generation of bootstrap sample of  $gdp$  under the null hypothesis of non-causality from  $fd$  to  $gdp$ :

$$gdp_{i,t}^* = \hat{\alpha}_{1,i} + \sum_{s=1}^{l_{gdp_1}} \hat{\beta}_{1,i,s} gdp_{1,t-s}^* + \sum_{s=1}^{l_{to_1}} \hat{\delta}_{1,i,s} to_{i,t-s} + [e_{H_0,i,t}^*] \quad (D.2)$$

**Step 4:** Substitution of  $gdp_{i,t}$  with  $gdp_{i,t}^*$  and estimation of equation (4.2) without any parameter restrictions and a subsequent implementation of the Wald test for each country to test the null hypothesis of non-causality.

**Step 5:** Construction of empirical distributions of the Wald test statistics by repeating Steps 2 to 4 many times (10,000 replications) and generation of bootstrap critical values corresponding to the appropriate percentiles. The same procedure is applied to test for non-causality from  $gdp$  to  $fd$  in system (4.3) (again using  $to$  as auxiliary variable).

## D.1.2 Lag Selection

Table D.1: Lag Selection Criteria

AIC/SBC	Lag 1	Lag 2	Lag 3
Transition Country Sample			
<b>M2 → GDP</b>	-7.219/-6.970	-6.196/-5.947	-6.017/-5.770
<b>GDP → M2</b>	-5.040/-4.791	-4.657/-4.409	-4.749/-4.502
<b>DCPS → GDP</b>	-7.084/-6.839	-6.319/-6.078	-6.110/-5.874
<b>GDP → DCPS</b>	-1.029/-0.784	-1.016/-0.774	-0.864/-0.628
<b>BA → GDP</b>	-7.173/-6.932	-6.452/-6.216	-6.219/-5.991
<b>GDP → BA</b>	-7.908/-7.666	-6.730/-6.494	-6.486/-6.258
<b>CFC → GDP</b>	-7.224/-6.977	-6.431/-6.187	-6.288/-6.046
<b>GDP → CFC</b>	-3.713/-3.465	-3.347/-3.102	-3.110/-2.869
Extended Country Sample			
<b>DCPS → GDP</b>	-7.184/-6.939	-6.404/-6.163	-5.197/-4.961
<b>GDP → DCPS</b>	-1.022/-0.777	-0.021/0.220	1.134/1.372
<b>BA → GDP</b>	-7.289/-7.048	-6.572/-6.336	-5.413/-5.185
<b>GDP → BA</b>	-7.927/-7.686	-6.899/-6.663	-6.625/-6.397

Sources: Author's calculations

## D.2 Sample Statistics

Table D.2: Sample Statistics

		Mean	Std. Dev.	Min	Max
<b>Albania</b>	M2	67.99	12.89	37.67	84.74
	DCPS	17.47	15.11*	3.50	39.46
	BA	79.29	11.15	58	92.51
	CFC	26.72	21.97	3.85	58.58
	GDP per Capita	2361.45	820.27	1131.33	3517.79
<b>Bosnia-Herzegovina</b>	M2	44.32	13.50	22.14	63.86
	DCPS	50.99	13.65	26.15	66.76
	BA	99.99	0.01	99.98	100
	CFC	30.98	27.35	2.41	84.97
	GDP per Capita	2466.90	901.92	595.69	3424.85
<b>Bulgaria</b>	M2	59.08	18.70	25.81	83.75
	DCPS	43.88	24.41	8.64	73.11
	BA	87.21	13.75	64.28	99.88
	CFC	44.61	28.16	10.06	89.99
	GDP per Capita	3654.12	875.14	2655.48	4955.56
<b>Croatia</b>	M2	55.54	17.67	20.96	80.60
	DCPS	40.32	16.71	24.56	76.72
	BA	99.92	0.11	99.61	99.88
	CFC	72.17	54.64	1.53	159.63
	GDP per Capita	9169.47	1827.50	5724.23	11712.45
<b>Czech Republic</b>	M2	63.27	7.48	53.43	78.07
	DCPS	49.03	12.46	28.38	66.42
	BA	98.12	1.75	95.71	99.99
	CFC	58.49	31.32	6.32	103.25
	GDP per Capita	12388.58	2089.77	9083.84	15130.46
<b>Estonia</b>	M2	40.41	18.00	16.25	66.67
	DCPS	59.75	27.92	16.18	105.11
	BA	99.84	0.23	99.04	99.98
	CFC	73.35	50.31	1.20	152.98
	GDP per Capita	9008.50	2801.19	4841.61	12702.44
<b>Hungary</b>	M2	52.46	7.49	44.13	68.59
	DCPS	42.83	17.32	21.46	68.75
	BA	85.83	17.94	48.97	99.22
	CFC	62.76	29.23	20.95	117.88
	GDP per Capita	9855.14	1644.29	7250.38	11803.06
<b>Latvia</b>	M2	35.35	13.42	18.94	72.91
	DCPS	48.18	33.97	7.17	104.56
	BA	94.89	3.78	88.33	99.38
	CFC	50.53	42.22	0.12	124.00
	GDP per Capita	6581.68	2324.68	3489.95	9724.54
<b>Lithuania</b>	M2	33.52	11.75	16.09	49.48
	DCPS	32.91	20.92	10.94	69.73
	BA	99.82	0.14	99.55	99.97
	CFC	38.55	31.53	0.16	91.71
	GDP per Capita	7125.56	2457.32	3864.13	10784

*Continued on next page...*

		Mean	Std. Dev.	Min	Max
<b>Macedonia</b>	M2	36.30	19.02	11.28	73.85
	DCPS	32.17	13.24	17.60	59.34
	BA	91.91	5.17	82.86	98.52
	CFC	14.74	13.23	0.16	41.78
	GDP per Capita	3089.60	512.34	2510.67	3979.19
<b>Poland</b>	M2	44.68	9.30	31.61	61.27
	DCPS	32.90	13.39	16.85	53.39
	BA	97.48	3.62	90.75	100.00
	CFC	36.29	21.11	5.45	67.89
	GDP per Capita	7866.35	2061.75	4671.31	11238.75
<b>Romania</b>	M2	33.26	4.10	26.01	39.25
	DCPS	25.28	15.89	7.12	46.15
	BA	95.59	6.29	82.42	100.00
	CFC	32.83	27.85	5.68	76.42
	GDP per Capita	4300.61	997.15	2955.21	5753.47
<b>Serbia</b>	M2	29.16	13.80	10.45	48.10
	DCPS	33.46	11.43	16.18	50.01
	BA	96.07	3.23	90.26	99.84
	CFC	64.23	13.89	42.82	87.17
	GDP per Capita	2785.08	781.18	1667.43	3799.29
<b>Slovak Republic</b>	M2	58.94	3.41	53.51	65.73
	DCPS	38.27	16.78	1.12	55.45
	BA	99.31	1.05	95.95	99.96
	CFC	53.63	34.70	2.15	106.86
	GDP per Capita	8808.32	2315.53	5366.31	12196.08
<b>Slovenia</b>	M2	46.81	13.71	27.07	67.04
	DCPS	51.94	25.83	22.20	92.29
	BA	99.38	0.33	98.63	99.77
	CFC	40.00	29.82	2.66	87.78
	GDP per Capita	16585.84	2937.54	11274.21	20871.88
<b>Transition Sample</b>	M2	47.60	17.16	11.28	84.74
	DCPS	41.51	23.31	1.12	105.11
	BA	94.49	9.93	48.97	100.00
	CFC	48.82	36.46	1.02	159.63
	GDP per Capita	7069.81	4367.46	595.69	20871.88

Sources: Author's calculations

### D.3 Granger Causality Results

Table D.3: Causality Results M2

Panel A: H0: Financial Development (M2/GDP) Does Not Cause Economic Growth					
Country	Coefficient	Test Statistic	Critical Values		
			1%	5%	10%
Albania	0.332	17.387***	97.270	80.785	73.124
Bulgaria	0.039	1.461	26.744	21.769	19.318
Czech Republic	-0.113	15.053***	19.790	15.908	13.874
Estonia	0.107	35.465***	4.490	2.992	2.382
Hungary	-0.308	57.653***	43.148	36.362	33.407
Latvia	-0.004	0.535	41.551	29.916	25.222
Lithuania	0.125	23.812***	26.619	21.767	19.503
Macedonia	0.017	0.770	7.811	5.669	4.784
Poland	-0.031	0.311	12.694	9.398	7.901
Romania	-0.097	3.924*	49.608	36.807	31.220
Slovakia	0.048	0.903	13.003	8.846	7.129
Slovenia	-0.040	7.540***	7.507	4.400	3.389

Panel B: H0: Economic Growth Does Not Cause Financial Development (M2/GDP)					
Country	Coefficient	Test Statistic	Critical Values		
			1%	5%	10%
Albania	0.515	32.181***	81.955	51.019	40.195
Bulgaria	1.384	10.001***	24.641	15.190	11.091
Czech Republic	0.145	0.270	7.005	3.844	2.687
Estonia	0.739	5.211**	5.304	3.089	2.147
Hungary	0.321	10.004***	6.425	4.036	3.085
Latvia	0.004	0.002	15.051	9.191	6.832
Lithuania	0.353	3.016*	15.682	9.184	6.625
Macedonia	-1.142	3.046*	17.859	9.816	6.775
Poland	1.416	43.353***	50.322	29.794	22.601
Romania	0.449	9.089***	13.956	7.964	5.729
Slovakia	0.240	0.815	23.669	13.060	9.836
Slovenia	-0.116	0.489	23.134	12.221	8.594

Remarks: "Coefficient" denotes the estimated coefficient of the lag of  $\log(M2/GDP)$  in the equation testing for Granger causality from  $\log(M2/GDP)$  to  $\log(GDP \text{ per capita})$ . "Test Statistic" represents the corresponding Wald test statistic for Granger causality in Panel A. The opposite causality is tested in Panel B. \*\*\*, \*\*, \* indicate the rejection of the null hypothesis at the 1, 5, and 10 per cent significance level.

Source: Author's calculations.

Table D.4: Causality Results DCPS

Panel A: H0: Financial Development (DCPS/GDP) Does Not Cause Economic Growth					
Country	Coefficient	Test Statistic	Critical Values		
			1%	5%	10%
Albania	-0.027	0.593	7.524	3.136	1.782
Bulgaria	-0.013	1.428	4613.346	2974.685	2316.259
Croatia	-0.065	3.110*	200.258	127.765	103.303
Czech Republic	-0.053	38.589***	116.004	56.131	40.529
Estonia	-0.076	2.476	78.788	54.239	44.456
Hungary	-0.057	2.653	106.799	82.248	70.725
Latvia	0.153	23.502***	129.558	66.554	46.119
Lithuania	-0.013	0.290	98.289	58.937	46.200
Macedonia	0.064	37.281***	59.509	39.292	32.629
Poland	-0.065	4.018	54.156	29.125	20.891
Romania	-0.061	3.062**	871.613	543.065	436.519
Slovakia	-0.001	0.0152	10.877	6.024	4.412
Slovenia	-0.041	1.814	21.739	14.097	11.261

Panel B: H0: Economic Growth Does Not Cause Financial Development (DCPS/GDP)					
Country	Coefficient	Test Statistic	Critical Values		
			1%	5%	10%
Albania	2.603	40.766***	513.862	299.479	230.687
Bulgaria	3.912	34.302***	12.061	6.229	4.175
Croatia	0.288	1.513	29.269	15.169	10.291
Czech Republic	0.796	4.320**	37.640	18.396	12.186
Estonia	1.408	106.250***	9.652	5.397	3.686
Hungary	0.932	14.297***	74.800	39.641	27.517
Latvia	0.841	20.329***	36.323	24.885	19.782
Lithuania	1.875	34.297***	51.432	24.421	16.343
Macedonia	1.360	5.137**	112.201	59.339	43.041
Poland	2.765	34.909***	115.171	66.173	49.171
Romania	2.758	44.306***	93.395	53.202	39.944
Slovakia	12.273	4.040**	18.620	9.298	6.094
Slovenia	1.300	48.722***	29.927	14.102	9.252

Remarks: "Coefficient" denotes the estimated coefficient of the lag of log(Domestic credit to the private sector/GDP) in the equation testing for Granger causality from log(Domestic credit to the private sector/GDP) to log(GDP per capita). "Test Statistic" represents the corresponding Wald test statistic for Granger causality in Panel A. The opposite causality is tested in Panel B. \*\*\*, \*\*, \* indicate the rejection of the null hypothesis at the 1, 5, and 10 per cent significance level.

Source: Author's calculations.



Table D.5: Causality Results DCPS Extended

Panel A:					
H0: Financial Development (DCPS/GDP) Does Not Cause Economic Growth					
Country	Coefficient	Test Statistic	Critical Values		
			1%	5%	10%
Albania	-0.054	3.883**	20.732	10.601	7.183
Bulgaria	-0.001	0.018	4390.222	2751.722	2133.652
Croatia	-0.045	3.889**	621.735	334.185	248.707
Czech Republic	-0.071	128.6553***	152.509	68.783	44.103
Estonia	-0.053	1.924	187.179	113.051	86.190
Hungary	-0.040	1.624	43.549	29.408	23.853
Latvia	0.160	41.077***	312.505	133.653	87.829
Lithuania	-0.009	0.186	340.668	185.309	138.567
Macedonia	0.043	30.935***	125.055	71.853	53.619
Poland	-0.080	6.859***	136.368	74.466	52.704
Romania	-0.102	9.490***	1529.346	833.474	626.334
Slovakia	-0.006	6.499**	36.138	17.773	11.491
Slovenia	-0.055	4.607**	26.194	12.681	8.229
Austria	0.024	2.200	804.261	410.389	282.215
Germany	-0.167	17.152***	626.122	258.586	151.457

Panel B:					
H0: Economic Growth Does Not Cause Financial Development (DCPS/GDP)					
Country	Coefficient	Test Statistic	Critical Values		
			1%	5%	10%
Albania	2.529	42.738***	1445.090	840.431	616.442
Bulgaria	3.462	29.819***	21.170	11.062	7.381
Croatia	0.408	3.823*	77.861	37.480	24.226
Czech Republic	0.667	3.278*	70.941	35.567	23.111
Estonia	1.352	118.806***	53.535	26.947	18.566
Hungary	0.856	14.374***	130.583	54.412	34.824
Latvia	0.735	20.700***	227.848	132.385	98.269
Lithuania	1.829	42.468***	124.574	59.738	39.018
Macedonia	1.156	6.172**	332.414	171.848	115.202
Poland	3.405	88.859***	373.910	182.961	124.777
Romania	2.867	56.627***	363.654	199.534	141.609
Slovakia	9.781	3.035*	62.194	34.626	24.818
Slovenia	1.347	60.721***	92.962	47.672	31.840
Austria	0.649	0 3.052*	91.594	55.891	41.378
Germany	1.078	28.575***	104.214	59.814	43.315

Remarks: "Coefficient" denotes the estimated coefficient of the lag of log(Domestic credit to the private sector/GDP) in the equation testing for Granger causality from log(Domestic credit to the private sector/GDP) to log(GDP per capita). "Test Statistic" represents the corresponding Wald test statistic for Granger causality in Panel A. The opposite causality is tested in Panel B. \*\*\*, \*\*, \* indicate the rejection of the null hypothesis at the 1, 5, and 10 per cent significance level.

Source: Author's calculations.

Table D.6: Causality Results BA

Panel A: H0: Financial Development (BA) Does Not Cause Economic Growth					
Country	Coefficient	Test Statistic	Critical Values		
			1%	5%	10%
Albania	-0.094	4.014**	169.201	115.404	94.305
Bulgaria	0.363	37.815***	121.373	71.853	57.121
Croatia	4.478	5.116**	10.963	5.683	4.173
Czech Republic	-1.487	174.542***	145.341	108.291	94.109
Estonia	11.201	16.227***	4220.499	2783.767	2295.979
Hungary	0.199	30.518***	174.931	130.969	115.123
Lithuania	14.292	13.234***	25.265	11.808	8.282
Macedonia	0.243	37.284***	235.620	139.155	107.669
Poland	0.064	0.175	50.022	31.098	25.115
Serbia	-0.034	0.158	105.868	69.094	60.433
Slovakia	0.289	1.431	256.027	172.977	144.571
Slovenia	2.752	3.064*	171.350	107.332	84.204

Panel B: H0: Economic Growth Does Not Cause Financial Development (BA)					
Country	Coefficient	Test Statistic	Critical Values		
			1%	5%	10%
Albania	0.895	202.366***	89.794	57.011	44.863
Bulgaria	0.451	4.306**	85.066	48.369	36.549
Croatia	0.001	0.095	47.271	34.474	29.220
Czech Republic	0.074	38.560***	136.000	76.656	57.947
Estonia	0.002	42.519***	46.306	26.541	20.123
Hungary	-0.617	270.024***	140.126	78.051	55.539
Lithuania	0.007	19.023***	14.833	10.129	8.212
Macedonia	0.110	0.295	19.727	10.661	7.167
Poland	-0.037	0.847	94.560	52.639	36.855
Serbia	0.247	11.855***	22.582	10.777	7.525
Slovakia	0.023	3.126*	29.970	17.732	13.793
Slovenia	0.018	414.850***	7.899	3.662	2.461

Remarks: "Coefficient" denotes the estimated coefficient of the lag of log(Commercial Bank Assets/Commercial and Central Bank Assets) in the equation testing for Granger causality from log(Commercial Bank Assets/Commercial and Central Bank Assets) to log(GDP per capita). "Test Statistic" represents the corresponding Wald test statistic for Granger causality in Panel A. The opposite causality is tested in Panel B. \*\*\*, \*\*, \* indicate the rejection of the null hypothesis at the 1, 5, and 10 per cent significance level.

Source: Author's calculations.

Table D.7: Causality Results BA Extended

Panel A:					
H0: Financial Development (BA) Does Not Cause Economic Growth					
Country	Coefficient	Test Statistic	Critical Values		
			1%	5%	10%
Albania	-0.113	8.128***	884.123	497.099	367.740
Bulgaria	0.302	123.009***	324.880	190.292	145.621
Croatia	4.104	6.184**	36.461	17.872	11.538
Czech Republic	-1.442	252.452***	839.589	465.625	344.625
Estonia	10.568	23.546***	13849.174	8199.954	6377.094
Hungary	0.194	61.887***	1660.757	1095.726	870.291
Lithuania	21.721	79.441***	114.640	43.500	26.569
Macedonia	0.321	121.090***	801.553	443.885	333.457
Poland	0.244	3.511*	150.826	92.673	72.874
Serbia	0.009	0.020	544.848	286.854	204.511
Slovakia	0.507	16.199***	1200.745	620.092	465.145
Slovenia	2.859	15.240***	920.667	453.422	328.120
Austria	1.959	3.250*	109.578	54.240	37.374
Germany	1.285	2.006	756.158	528.173	446.348

Panel B:					
H0: Economic Growth Does Not Cause Financial Development (BA)					
Country	Coefficient	Test Statistic	Critical Values		
			1%	5%	10%
Albania	0.886	282.081***	296.612	168.560	125.991
Bulgaria	0.573	20.386***	218.441	115.035	83.245
Croatia	0.000	0.048	75.453	54.227	45.693
Czech Republic	0.068	41.578***	574.263	324.324	248.251
Estonia	0.002	80.112***	117.190	65.995	46.488
Hungary	-0.595	482.624***	465.709	234.654	160.294
Lithuania	0.007	23.759***	24.560	13.943	10.895
Macedonia	0.037	0.044	33.455	17.512	11.918
Poland	-0.045	1.774	292.411	131.790	84.292
Serbia	0.227	20.021***	62.971	33.051	23.364
Slovakia	0.035	10.838***	81.864	47.253	35.515
Slovenia	0.018	24.172***	35.065	21.038	15.401
Austria	0.006	1.996	99.320	58.710	46.650
Germany	0.002	0.739	719.025	383.804	271.450

Remarks: "Coefficient" denotes the estimated coefficient of the lag of log(Commercial Bank Assets/Commercial and Central Bank Assets) in the equation testing for Granger causality from log(Commercial Bank Assets/Commercial and Central Bank Assets) to log(GDP per capita). "Test Statistic" represents the corresponding Wald test statistic for Granger causality in Panel A. The opposite causality is tested in Panel B. \*\*\*, \*\*, \* indicate the rejection of the null hypothesis at the 1, 5, and 10 per cent significance level.

Source: Author's calculations.

Table D.8: Causality Results CFC

Panel A: H0: Financial Development (CFC/GDP) Does Not Cause Economic Growth					
Country	Coefficient	Test Statistic	Critical Values		
			1%	5%	10%
Albania	0.001	0.006	59.626	59.626	19.902
Bosnia-Herzegovina	0.043	84.392***	112.817	66.104	51.479
Bulgaria	0.060	21.901***	27.598	13.952	9.769
Croatia	0.014	4.573**	361.203	213.435	168.823
Czech Republic	0.078	36.032***	83.941	42.246	28.618
Estonia	0.008	1.150	371.615	210.611	158.632
Hungary	0.028	1.044	47.249	27.941	21.589
Latvia	0.033	10.041***	103.915	54.057	40.182
Lithuania	0.062	22.120***	51.844	30.785	23.237
Macedonia	0.039	36.643***	157.261	80.099	57.346
Poland	-0.018	9.874***	72.847	35.335	23.730
Romania	0.081	21.688***	33.061	15.957	10.477
Slovakia	0.016	3.345*	153.675	76.074	54.670
Slovenia	0.113	76.066***	289.042	197.341	165.252

Panel B: H0: Economic Growth Does Not Cause Financial Development (CFC/GDP)					
Country	Coefficient	Test Statistic	Critical Values		
			1%	5%	10%
Albania	3.064	8.201***	104.471	48.170	30.874
Bosnia-Herzegovina	0.586	3.670*	1516.828	858.557	637.455
Bulgaria	4.729	104.110***	120.532	55.924	35.164
Croatia	0.520	1.297	22.763	11.746	8.128
Czech Republic	-0.345	1.522	20.536	10.882	7.385
Estonia	0.128	0.105	19.734	10.348	6.947
Hungary	2.069	61.571***	26.628	14.022	9.122
Latvia	0.400	1.263	115.919	53.254	33.427
Lithuania	0.557	2.628	46.426	22.207	14.366
Macedonia	-0.271	0.041	73.296	33.010	20.800
Poland	1.367	5.981*	174.905	100.573	74.859
Romania	2.427	23.379***	55.417	28.955	19.964
Slovakia	-1.273	9.446***	77.621	43.980	33.069
Slovenia	2.872	25.806***	33.118	17.163	11.947

Remarks: "Coefficient" denotes the estimated coefficient of the lag of log(Consolidated Foreign Claims/GDP) in the equation testing for Granger causality from log(Consolidated Foreign Claims/GDP) to log(GDP per capita). "Test Statistic" represents the corresponding Wald test statistic for Granger causality in Panel A. The opposite causality is tested in Panel B. \*\*\*, \*\*, \* indicate the rejection of the null hypothesis at the 1, 5, and 10 per cent significance level.

Source: Author's calculations.



## **Essays on Growth, Unemployment and Financial Development**

Le sujet de cette thèse porte sur l'analyse de l'hétérogénéité et des dynamiques du chômage régional, des conséquences de chocs négatifs sur la croissance économique et du lien entre le développement financier et la croissance au niveau des entreprises et des pays. Le chapitre 1 montre les dynamiques distributionnelles du chômage régional Européen. Conjointement avec Robert Beyer, nous étudions le comportement des taux de chômage régionaux autour de l'introduction de l'Euro et la crise financière mondiale. En plus, nous examinons les contributions européennes et nationales aux changements relatives dans le temps. Le chapitre 2 propose une analyse empirique de la convergence de la croissance économique de l'Europe de l'ouest et les pays en transition. Dans ce travail en collaboration avec Olivier Damette et Mathilde Maurel, nous étudions la capacité à sortir d'une période de récession. En plus, nous analysons une nonlinéarité potentielle dans le processus de sortie. Le chapitre 3 centre son analyse sur l'étude des contraintes financières internes de la croissance des entreprises en Serbie. Conjointement avec Milos Markovic, nous étudions le degré de dépendance aux flux de liquidité des entreprises serbes pour leurs activités d'expansion et les comparons avec ceux des firmes belges. Enfin, dans le chapitre 4, j'explore la relation entre le développement financier et la croissance économique dans les pays en transition. Dans un cadre de causalité Granger en panel, j'analyse les effets de différents indicateurs financiers sur le PIB par tête et inversement.

**Mots-clés:** croissance économique, développement financier, chômage régional, contraintes financières

## **Essays on Growth, Unemployment and Financial Development**

The subject of this doctoral thesis deals with the analysis of regional unemployment heterogeneity and dynamics, the response of economic growth to negative shocks and the link between financial development and growth on a firm and country level. Chapter 1 shows the distributional dynamics of European regional unemployment. In this joint work with Robert Beyer, we study the behaviour of regional unemployment rates with respect to the introduction of the Euro and the Global Financial Crisis and analyze European and country contributions to relative changes over time. Chapter 2 provides an empirical analysis into growth convergence of western European and transition countries after negative shocks. A collaboration with Olivier Damette and Mathilde Maurel, we study the rebound capacity, the speed of convergence to the normal growth path as well as nonlinearities along the process. Chapter 3 takes a closer look at internal financial constraints of firm growth in Serbia. A joint work with Milos Markovic, we show how much Serbian firms depend on cash flow for their expansionary activities and compare our sensitivity results with Belgium, a country with an advanced financial sector. Finally, in chapter 4 I explore the relationship between financial development and economic growth in transition countries. Through a panel Granger causality framework different financial indicators and their effects on per capita GDP as well as opposite causalities are assessed.

**Keywords:** Economic growth, financial development, regional unemployment, financial constraints