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Convergence économique en Europe : migrations, cycles, politiques monétaire et budgétaire

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Membre de l'Université Paris Lumières

Rémi Odry

Convergence économique en Europe : migrations, cycles, politiques monétaire et budgétaire

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À mes parents, Dounia et Guy.

TABLE OF CONTENTS

Introduction	7
Bibliographie	15
1 Academic Convergence and Migration: The Effect of the Bologna Process on European Mobility	19
1.1 Introduction	19
1.2 Migration trends	23
1.3 Methodology and data	28
1.3.1 Theoretical model	28
1.3.2 Empirical model	30
1.4 Results	33
1.5 Conclusion	39
1.6 Appendix	41
References	41
2 Monetary Policy and Business Cycle Synchronization in Europe	55
2.1 Introduction	55
2.2 Data and Methodology	60
2.2.1 Data	60
Dependent variable	60
Explanatory variables	62
2.2.2 Wavelets	65
2.2.3 System GMM panel dynamic estimator	70

2.3	Results	72
2.3.1	Wavelet correlations	72
2.3.2	System GMM estimation	73
2.4	Conclusion and policy implications	85
	References	86
3	Fiscal Reaction Function in Europe	97
3.1	Introduction	97
3.2	Data and Methodology	101
3.2.1	Data	101
3.2.2	Methodology	102
3.3	Results	108
3.4	Conclusion	112
	References	114
	Conclusion et perspectives	119

INTRODUCTION

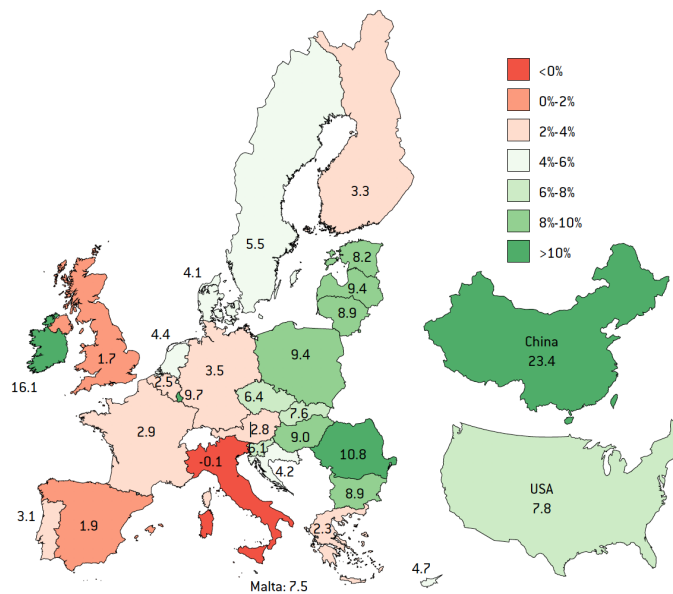
Introduction

La pandémie de Covid-19 a provoqué une crise économique sans précédent en Europe et dans le monde. Pour y faire face, les pays européens ont mis en place des politiques budgétaires très actives, le plus souvent qualifiables de “mixtes”, soutenant l’offre et la demande. Malgré la nécessité d’une coordination entre pays de ces politiques de relance ([OECD \(2021\)](#)), les plans adoptés aux niveaux nationaux ne paraissent pas tenir compte des interdépendances au sein de la zone euro. Cette approche semble pourtant à rebours de ce que la situation nécessite. D’après [Aussilloux et al. \(2020\)](#), cette non-coordination pourrait accroître les déséquilibres des comptes courants pré-existants et induire des divergences dans les sentiers de croissance nominaux et réels, dans la compétitivité ou favoriser des crises soudaines de la balance des paiements ([Mazzocchi and Tamborini \(2021\)](#)). De plus, comme le montre le graphique 1, la crise actuelle renforcerait les divergences économiques dans les années à venir, et accentuerait le phénomène de double vitesse en Europe.

Ces tendances sont dangereuses pour la zone euro et l’Union Européenne à plus d’un titre : premièrement, elles réduisent l’efficacité d’une politique monétaire commune et privent ainsi la zone euro d’un outil essentiel pour faire face aux crises. Comme le rappelait Benoît Coeuré en 2017 : “The closer countries are to the euro area average, the more likely it is that our policy is appropriate for them.”¹ Deuxièmement, elles conduisent à réunir des pays aux situations et caractéristiques économiques très différentes dans un espace où les barrières et protections

1. Speech by Benoît Coeuré, Member of the Executive Board of the ECB, at the Competitiveness Research Network (CompNet) conference on "Innovation, firm size, productivity and imbalances in the age of de-globalization" in Brussels, 30 June 2017.

Figure 1 – Croissance cumulée pour la période 2019-2023 (prévision)



Source: Bruegel based on IMF WEO (April 2021). Note: forecast EU cumulative growth from 2019 to 2023 is 4.1%. Countries in red are thus below the EU average; those in green are above. Irish GDP numbers reflect the large role of foreign multinationals and should be treated with care.

Source : [Claeys et al. \(2021\)](#)

économiques sont réduites. Cette configuration accentue notamment les mouvements de capitaux et les rend destabilisants, au détriment des pays les plus fragiles, et maintient des inégalités de revenu et de niveau de vie importantes entre pays. Contrairement aux Etats-Unis d’Amérique, ces inégalités de revenu ne peuvent pas être corrigées par des mouvements migratoires, car la mobilité des travailleurs européens est faible, ni par des transferts fiscaux faute d’une autorité fiscale importante. Elles participent, enfin, au développement d’un sentiment d’injustice sociale en Europe, menaçant ainsi l’Union Européenne comme organisation politique. Cette menace est d’autant plus grande que le processus d’intégration européen est inachevé et incomplet, et les situations individuelles hétérogènes.

La convergence économique est donc une dimension essentielle de l’Union Economique et Monétaire (UEM). Mais qu’entend-t-on par “convergence économique” ? Plusieurs définitions sont possibles, qui dressent un tableau large de ce qu’est la convergence économique. Dans la

lignée du Rapport Delors qui soulignait, en 1989, l'importance de la convergence économique : "But the Committee is fully aware that the process of achieving monetary union is only conceivable if a high degree of economic convergence is attained", le traité de Maastricht (1992) établit des premiers critères de convergence pour rejoindre la zone euro :

- une dette publique inférieure à 60%,
- un déficit budgétaire inférieur à 3%,
- un taux d'intérêt de long terme n'excédant pas de plus de 2 points de pourcentage celui des trois États membres présentant les meilleurs résultats,
- un taux d'inflation qui n'excède pas de plus de 1,5 points de pourcentage celui des trois États membres de l'Union européenne présentant les meilleurs résultats.

Les deux aspects de la politique économique d'un pays sont concernés par ces critères : (i) les conditions sur le taux d'inflation et le taux d'intérêt² impactent la politique monétaire, (ii) les conditions sur la dette publique et le déficit la politique budgétaire. L'idée est alors de s'assurer de la stabilité des taux de change réels bilatéraux entre les pays membres et de la soutenabilité sur le long terme des finances publiques. Ces critères sont qualifiés dans la littérature de **nominaux** puisqu'ils ne sont pas ajustés de l'inflation. Empiriquement, il est difficile de conclure de façon nette à une convergence nominale des économies européennes : on note une diminution de la dispersion des taux d'inflation en Europe avant l'adoption de l'euro, mais une stagnation de celle-ci ensuite. Les taux d'intérêt de long terme ont également convergé jusqu'en 2007, avec un *spread* vis-à-vis du taux allemand de moins en moins grand, mais on constate une inversion de cette tendance depuis la crise de 2007.

Plusieurs critiques sur le choix de ces critères peuvent être formulées. Premièrement, les différentiels d'inflation peuvent permettre des ajustements du taux de change réel nécessaires pour faire face à des différentiels de compétitivité au sein d'une zone monétaire. Deuxièmement, les critères relatifs à la politique budgétaire ne permettent pas aux autorités fiscales de faire face à

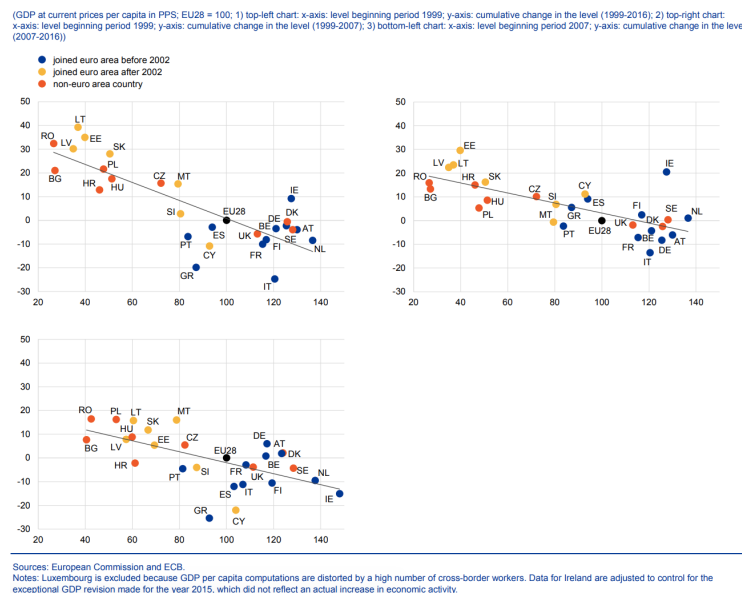
2. Il s'agit également d'un critère impactant la politique budgétaire puisqu'il reflète la perception qu'ont les marchés de la solvabilité d'un Etat.

des chocs asymétriques. Enfin, ces critères ne tiennent pas compte d'indicateurs réels comme la croissance ou le chômage. L'appellation "convergence économique" est employée dans le cadre du Rapport Delors et du traité de Maastricht, en opposition au terme de "convergence juridique", qui désigne la compatibilité grandissante des législations nationales avec les traités et les statuts du système européen de banques centrales. La convergence nominale se focalise principalement sur l'étude des taux d'inflation et d'intérêt. La convergence **réelle** s'intéresse, elle, au niveau du revenu et de la productivité. Elle peut se définir comme le processus par lequel le niveau du Produit Intérieur Brut (PIB) réel par tête des économies à faible revenu "rattrape" celui des économies à haut revenu de manière durable.

De cette approche de la convergence, deux concepts ont été développés : la β -convergence et la σ -convergence. La première notion (β -convergence) désigne le processus par lequel des pays à faible revenu affichent une croissance plus importante que celle de pays à haut revenu. Ils connaissent alors ce que l'on peut appeler un processus de rattrapage. La seconde notion (σ -convergence) renvoie à une réduction de la disparité entre pays. Le graphique 2 illustre bien la β -convergence au sein de la zone euro. Il présente l'évolution du PIB par habitant par rapport à son niveau initial en 1999. Les pays ayant rejoint l'euro après 2002 (principalement des pays de l'Europe de l'Est) et ayant les PIB réels par tête les plus faibles ont connu un rythme de croissance parmi les plus élevés de la zone euro. Cette tendance est particulièrement marquée entre 1999 et 2007. Il est intéressant de noter également que la convergence des pays fondateurs de l'euro (ayant adopté l'euro avant 2002) n'a pas été des plus impressionnantes. On peut penser à l'Espagne dont l'écart avec la moyenne européenne sur les 18 années présentées ne s'est pas réduit, ou encore la Grèce et l'Italie qui ont vu une aggravation de leur situation relative.

Comment expliquer ces évolutions de la convergence ? Un premier volet de la réponse à cette question est macroéconomique. Premièrement, des pays comme l'Espagne, la Grèce et le Portugal ont connu des booms de croissance importants et instables avant la crise de 2008, principalement alimentés par une demande fondée sur le crédit, qui n'ont pas donné lieu à des réformes

Figure 2 – Evolution du PIB par habitant pour les pays de l'EU28 (changement cumulé 1999-2016, 1999-2007 et 2007-2016)



Source : Diaz del Hoyo et al. (2017).

structurelles, institutionnelles ou à une régulation macroprudentielle, et ont permis l'apparition de déséquilibres intérieurs et extérieurs importants (augmentation de la dette privée, du déficit extérieur, apparition de bulles immobilières,...). La crise de 2007 a entraîné une récession particulièrement violente pour ces pays, qui a profondément impacté leur convergence avec le reste du continent européen. Deuxièmement, l'intégration financière n'a pas permis une convergence durable des pays de la périphérie. La théorie néoclassique prévoit que, dans un espace de libre circulation des capitaux, les investisseurs orientent leurs fonds vers les pays les plus pauvres puisqu'il s'agit des pays avec les productivités marginales du capital les plus élevées. On assisterait alors à une augmentation des capacités productives de ces pays qui connaîtraient, en conséquence, une croissance beaucoup plus rapide. Des flux de capitaux considérables ont pu être observés vers les pays périphériques d'Europe avant la crise de 2007, mais il s'agissait principalement d'investissements de portefeuille, plus instables et moins propices à une croissance durable et de long terme, et non d'investissements directs à l'étranger (FDI).

Une deuxième volet de la réponse concerne la synchronisation des cycles économiques et financiers. Il existe une riche littérature sur les cycles économiques en économie, et celle sur leur synchronisation n'est pas en reste. [De Grauwe and Ji \(2016\)](#) démontrent qu'il existe une très forte corrélation entre les cycles économiques des pays européens, qui a globalement augmenté au cours du temps. Cependant, on observe depuis la crise de 2007 une divergence dans l'amplitude de ces cycles ([Franks et al. \(2018\)](#)). Ce constat indique une plus grande convergence des économies européennes, et, par conséquent, une optimalité de la zone euro, mais invite à revoir l'ampleur des politiques budgétaires à adopter pour chaque pays. Les cycles financiers ont reçu moins d'attention mais impactent tout autant la convergence des économies européennes. En effet, les périodes de prospérité financière stimulent temporairement la croissance, et provoquent des déséquilibres financiers qui se traduisent, au retournement du cycle, par une situation de surendettement impactant les ménages et les entreprises. L'analyse de l'évolution des cycles montre une désynchronisation sur la période 1999-2007, autrement dit celle de la mise en place de l'euro, alors que l'on constate une amélioration de la synchronisation après la crise des subprimes.

Enfin, un troisième volet de la réponse est institutionnel. Le rôle des institutions, comme organisations concrètes, abstraites ou comme règles, dans la croissance économique a fait l'objet de nombreuses études.³ [Masuch et al. \(2016\)](#) se sont focalisés sur le lien entre institutions et croissance de long terme en Europe. En tenant compte de différents niveaux d'endettement des pays, ils montrent que des institutions de qualité, qui se traduisent notamment par une bonne gouvernance et une forte adaptabilité de l'administration, permettent de fortement réduire l'impact de la dette sur la croissance. [Giannone et al. \(2011\)](#) se focalisent sur un moment particulier, à savoir la crise des subprimes, et montrent également qu'une bonne gouvernance a permis d'atténuer les effets de la crise. [Diaz del Hoyo et al. \(2017\)](#) constatent aussi une forte corrélation entre le niveau du revenu par tête d'un pays et la qualité de ses institutions. La Grèce, le Portugal,

3. [North \(1990\)](#) démontre par exemple le lien entre propriété intellectuelle et la croissance, [Barro \(1996\)](#) le lien entre démocratie et croissance. Enfin, [Han et al. \(2014\)](#) montrent qu'une bonne gouvernance est associée à une croissance plus rapide.

l'Espagne et l'Italie apparaissent comme les pays ayant les indices de qualité les plus bas, ce qui expliquerait en grande partie leur faible convergence avec les autres économies européennes. Une attention particulière aux rigidités d'autres institutions comme le marché du travail leur permet également de mettre en évidence de rôle de ces rigidités dans la lenteur du processus de convergence : ces rigidités entravent l'ajustement des salaires et des prix, et empêchent ainsi une réallocation optimale du travail et du capital. Ces résultats appuient l'idée qu'une convergence de la qualité des institutions est nécessaire pour la convergence économique.

Ainsi, la convergence économique recouvre de nombreuses dimensions et définitions qui se complètent. Cette inflation d'approches révèle l'importance de ce phénomène, mais aussi sa complexité. **Notre thèse vise à contribuer à ce champ de recherche en analysant la convergence économique sous trois angles : celui des migrations et de l'impact des structures académiques sur celles-ci, celui de la synchronisation des cycles économiques européens et de son lien avec la politique monétaire sur ces derniers, et enfin celui des politiques budgétaires et de ses déterminants.**

Le premier chapitre aborde la question de la convergence sous le prisme des migrations. En effet, les migrations de personnes représentent un enjeu crucial pour l'économie européenne et l'apparition d'un tissu économique spécifiquement régional, pouvant réguler ses déséquilibres internes. Elles sont aussi la garantie d'une zone monétaire optimale. Nous nous intéressons plus particulièrement au lien qui peut exister entre la similarité et l'uniformisation des systèmes éducatifs et des diplômes qu'a entraîné le processus de Bologne, et les flux d'individus au niveau européen. Nous tenons également compte des transformations institutionnelles, telles que l'adhésion à l'Union Européenne et l'adoption de l'euro. Nous estimons un modèle de gravité, habituellement utilisé dans cette littérature, et considérons plusieurs estimateurs pour assurer la robustesse de nos résultats : les *moindres carrés ordinaires* (OLS), les *moindres carrés ordinaires ajustés* (SOLS), la pseudo-maximum de vraisemblance dans un modèle de Poisson (PPML) et l'*estimateur binomial négatif* (NB). Se basant sur un panel comportant 30 pays sur la période

2004-2017, nous ne pouvons conclure à un impact significatif du processus de Bologne sur les migrations en Europe. La diaspora apparaît comme un élément clé de ces migrations alors que la langue parlée et la distance géographique ne semblent plus être des facteurs aussi pertinents qu'auparavant pour l'étude des migrations en Europe. Ces résultats sont importants car ils questionnent en partie l'utilité et la mission de la politique européenne dans le domaine de l'éducation supérieure, et invitent à de nouvelles réflexions sur les déterminants des migrations.

Nous constatons également que les migrations sont impactées par l'intégration européenne : positivement lorsqu'il s'agit de l'Union Européenne (plus particulièrement son élargissement), mais négativement lorsqu'il s'agit de l'adoption de l'euro. Ce résultat surprenant met en avant un acteur important de la construction européenne : la politique monétaire. Notre chapitre 2 s'intéresse à son impact, non plus sur les migrations, mais sur la synchronisation des cycles, autre aspect important de la convergence des économies et de l'apparition d'un bloc européen cohérent. Notre approche est innovante sur deux points intrinsèquement liés : (i) nous avons recours aux *ondelettes*, un outil encore peu utilisé en économie mais qui tend à l'être de plus en plus, et qui permet la décomposition d'un signal complexe dans un plan fréquence/temps. Cette décomposition nous permet (ii) de pouvoir décomposer l'impact de la politique monétaire sur plusieurs fréquences pour prendre en compte les temporalités différentes des canaux de transmission de la politique monétaire. Pour cela, notre approche combine les ondelettes avec un estimateur GMM (*Generalized Method of Moments*) sur un panel de 10 pays, tous membres de la zone euro, sur la période 2000Q1-2018Q3. Nous estimons les corrélations dynamiques obtenues à l'aide des ondelettes entre les cycles économiques des différents pays, et les reprenons pour étudier l'impact que la politique monétaire, à travers le *shadow short rate*, a sur eux. Nos résultats montrent que la politique monétaire joue un rôle non négligeable dans la synchronisation des cycles en Europe. En effet, lorsque le *shadow short rate* diminue, la synchronisation des cycles à court et à long terme tend à augmenter. Son effet est le plus faible sur la synchronisation à moyen terme.

La politique monétaire n'est pas le seul outil dont dispose le décideur public impactant la

synchronisation des cycles. La politique budgétaire, l'autre pilier de la politique économique, a ce que l'on a appelé un impact "variant"⁴ en fonction de la fréquence que l'on adopte. Si les divergences de politiques budgétaires accentuent la désynchronisation des cycles à très court terme et à long terme, elles semblent permettre une synchronisation à moyen terme, que l'on peut imputer au rôle d'ajustement des politiques budgétaires. Cette capacité d'ajustement n'est cependant possible que si les autorités fiscales disposent d'une marge de manoeuvre. Le contexte actuel a permis de rappeler également le rôle essentiel des politiques budgétaires en temps de crise, et plus globalement dans la construction européenne, ainsi que les désaccords existant quant à leur direction et leurs emplois. Le chapitre 3 s'intéresse aux déterminants de la politique budgétaire des pays européens. Pour cela, nous adoptons une fonction de réaction fiscale que nous construisons de manière à prendre en compte les capacités prospective et rétroactive des autorités fiscales. Nous incluons également dans les variables explicatives la notation sur les marchés, les dates des élections à différentes temporalités, et un indicateur de la politique monétaire. Nous estimons notre modèle avec un estimateur à effet fixe, un estimateur LSDV et un estimateur bootstrap, pour tenir compte des dimensions de notre panel. Ce dernier est composé de 19 pays, sur la période allant de 1991 à 2019 (29 années). Nos estimations montrent que les autorités fiscales prennent en compte les développements et inquiétudes des marchés, et tendent à les rassurer en diminuant les déficits budgétaires. Elles anticipent aussi les élections en augmentant leurs dépenses l'année précédente, un constat qui corrobore la théorie des cycles politiques. Enfin, les autorités budgétaires prennent également en compte les évolutions de la politique monétaire européenne : elles augmentent leur déficit lorsque les conditions de financement sont favorables.

4. "switching effect"

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ACADEMIC CONVERGENCE AND MIGRATION: THE EFFECT OF THE BOLOGNA PROCESS ON EUROPEAN MOBILITY

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1.1 Introduction

Migration plays a key role in shaping regional economies through many different channels. Indeed, it can be (i) a solution to the demographic challenge faced by European countries (see [Pedersen et al. \(2008\)](#)), (ii) a substantial factor for the smooth running of common currency areas such as the Euro Zone ([Mundell \(1961\)](#)),¹ and (iii) a tool to correct productivity differences and labor market mismatches ([Kennan \(2013\)](#), [Clemens and Pritchett \(2019\)](#)). It has also been shown to facilitate income convergence in Europe ([Fischer and Pfaffermayr \(2018\)](#)) and boost

1. A broadly accepted precondition of optimal currency areas (OCA) is high labor mobility across regions or countries composing the former. This criteria relies on the smoothing effect of labor mobility across the labor markets included in the common currency area and seems consistent with the few experiences at our disposal.

innovation in both private and public sectors ([Bosetti et al. \(2015\)](#), [Fassio et al. \(2019\)](#)). Despite the great importance of human flows in the stability and development of regional institutions and economies, the literature concludes to the presence of strong rigidities impeding individual mobility in Europe when comparing to other economically and demographically similar regions ([House et al. \(2018\)](#)). They are obviously several likely explanations for the weakness of migrations proper to Europe. Some are historical, cultural or institutional (as linguistic barriers) and out of the range of short- to middle-term political actions; but structural and conjectural reforms are still possible.

The Bologna Process (BP) is one of them. Launched in 1998 with the Bologna declaration, it is defined as “a mechanism promoting intergovernmental cooperation between 48 European countries in the field of higher education.”² It aims at bringing more coherence in the higher education systems of European Union (EU) members and beyond, throughout the European Higher Education Area (EHEA). Three important measures of the higher education systems in the EHEA members are due to the Bologna Process: (i) the Licence-Master-Doctorat (LMD) schemes, (ii) the mutual recognition of qualifications obtained in universities abroad, and (iii) the common system of quality assurance to “strengthen the quality and relevance of learning and teaching”. Consequently, it allows greater flows of European students and directly impacts two out of the three closely connected specifiers of labor force identified in [Docquier et al. \(2019\)](#), namely migration and education : (i) education, by promoting a specific learning framework and ensuring the quality of curricular content; and (ii) migration, by promoting the harmonization of formations and skills comparability between foreign and native workers. This chapter investigates this possibility and aims at quantifying the effects of the Bologna Process on migration within Europe.

Our chapter belongs to the body of literature on the determinants of migration. We focus on the impact of an institutional factor on bilateral migration in a defined area, i.e. European countries members of the EHEA. Empirical works on migration have been impeded by the lack

2. European Commission.

of sufficiently large and reliable samples until recently. To overcome this constraint, [Chiswick \(1978\)](#) rely on the *1970 Census of Population* 5 percent questionnaire and focus on a cross-section analysis. He outlines a strong wage assimilation of foreign-born migrants in the U.S., partly due to investment in postschool training to adapt the U.S. labor market. [Decressin and Fatás \(1995\)](#) (henceforth, DF) apply the strategy developed in the seminal paper of [Blanchard and Katz \(1992\)](#)³ to analyze labor migrations in regions within Europe.⁴ They find that, contrary to the US,⁵ most of the regional shocks in European regions are absorbed by changes in the participation rate and not by migration flows. [Obstfeld et al. \(1998\)](#) reach the same conclusion but both articles neglect structural variables as labor market specificities or educational attainment. Several authors have focused on finer region-based approach with the same strategy, highlighting the different characteristics of migrations in distinct groups of countries ([Jimeno and Bentolila \(1998\)](#);[Bornhorst and Commander \(2006\)](#);[Dao et al. \(2014\)](#)). Concurrently to these studies, the refinement of statistical information gathering has allowed a growing number of researchers to directly use migration flows and thus new models, such as gravity equations ([Ortega and Peri \(2013\)](#); [Arpaia et al. \(2016\)](#); [Chakrabarti and Sengupta \(2017\)](#)) or panel data econometrics ([Hunt \(2006\)](#)).

Skills and wages play a substantial role in explaining migration flows ([Borjas \(2001\)](#),[Hunt \(2006\)](#)). While [Sanderson and Kentor \(2008\)](#) show that Foreign Direct Investments (FDI) have a positive impact on migration from less-developed countries, [Jayet and Marchal \(2016\)](#) achieve a subtlest conclusion controlling for skills with a variant of the Ricardian model. They observe that FDIs have a different impact on migration flows following the level of qualification of migrants. Using a two-countries model, they demonstrate that skilled workers and FDIs are complement, whereas unskilled workers and FDIs are substitutes. Similar results are found by [Hoxhaj et](#)

3. They adopt an indirect method to capture labor migration by examining the joint behavior of employment rate, participation rate, and employment growth, and postulate that any change of the latter variable unexplained by the two previous ones has to stem from migration. Then, they estimate models of regional labor markets using a vector autoregressive model (VAR).

4. They disaggregated their sample to obtain regions with similar population size. Five countries were divided in several regions while six were treated as a single region.

5. [Blanchard and Katz \(1992\)](#) notice that interstate migration is the main adjustment variable following a regional shock within the US.

al. (2016) who studied migrations and capital intensity of firms in Sub-Saharan Africa using a negative binomial model. Additional factors come into play: incomplete information about wages as deficient housing and rental market in host countries have, inter alia, a negative impact on migrations (Bornhorst and Commander (2006); Bonin et al. (2008)).

A second strand of the literature suggests that institutions – in a broad sense – also affect migration. It can be labor market institutions (Blanchard and Wolfers (2000)),⁶ higher education quality (Hanushek and Kimko (2000)), language or European institutions. Bartz and Fuchs-Schündeln (2012) investigate the effects of linguistic diversity, the Euro Zone and the Schengen area membership on labor mobility in Europe. They find that language differences are impeding a greater integration of the labor market in Europe, while European institutions have no impact. Beine et al. (2019), Beyer and Smets (2015) and Arpaia et al. (2016) reach a more nuanced response.

Most of the studie above-mentioned use EU membership, participation to the European Monetary Union or to the Schengen Area as proxies of the European integration to study the impact it can have on labor mobility. However, other European policies and institutions may have a significantly equal, if not greater, impact on intra-European migrations such as the Bologna Process. As stated by Fries-Tersch et al. (2018), limited language skills and deficiency in recognition of qualification are the main obstacles to getting a suitable job in the case of EU15 and EU13 movers while employment opportunity is an important pull factor for mobile workers. The Bologna Process deals with both of these barriers as it aims at harmonizing educational systems, qualifications recognition and increasing internal mobility of students.⁷ Suppositions have been made on the (positive) impact of the Bologna Process on labor mobility (Bonin et al. (2008); Beyer and Smets (2015); de la Rica et al. (2013)) but, to our knowledge, neither theoretical nor empirical studies have been conducted to assess the impact of the Bologna Process on labor mobility in Europe.

6. In Blanchard and Wolfers (2000), “labor market institutions” refer to unemployment insurance system for instance, or legal framework that regulates labor.

7. As pointed out by de la Rica et al. (2013), internal mobility of students may help them to improve their second-languages skills, be aware of cultural specificities proper to foreign countries and characteristic features of their labor markets.

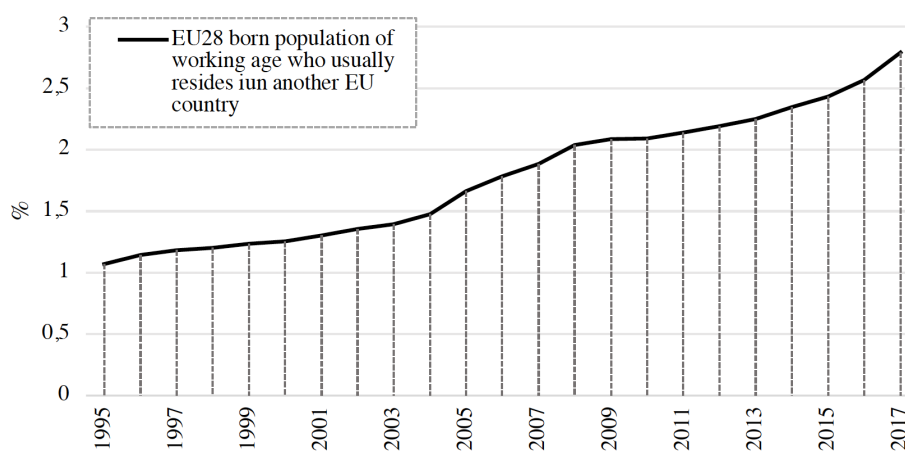
We aim at filling this gap in the present chapter. We go further than the previous literature that mainly focuses on flows into one country only, and rely on a large panel of bilateral flows between most of the European countries. We estimate several regressions models on migration flows from 26 to 30 OECD countries, all of them member of the EHEA, annually for the period 2004-2017. We define a Bologna Process Indicator based on the bi-annual reports produced by the Bologna Implementation Coordination Group. Our estimations show that the Bologna Process has not clearly identify effect on bilateral flows of migrants.

The rest of the chapter is organized as follows. Section 1.2 provides some brief stylised facts on migration in Europe. Section 1.3 describes the theoretical model used to justify our empirical approach, as well as the data necessary to estimate the impact of the Bologna Process on migrations. In Section 1.4 we present and discuss the results. Section 1.5 concludes the chapter.

1.2 Migration trends

Migration within Europe has increased overall for the last decades. As it can be seen in Figure 1.1, the share of EU28 born population living in another EU28 country has steadily grown, from 1.07% in 1995 to 2.57% in 2016. Particularly, the 2004 enlargement to Eastern

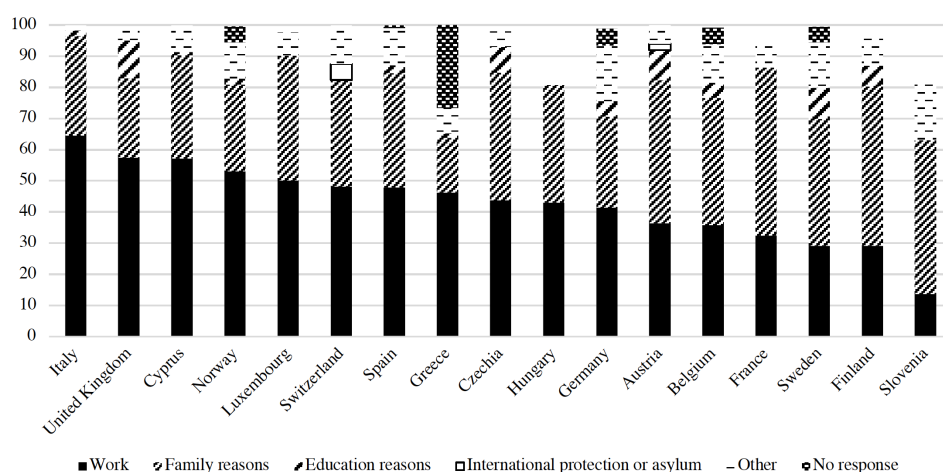
Figure 1.1 – Share of the EU28 population living in another EU28 country



Source : Eurostat, author's calculations

European countries has strongly and positively impacted migration within Europe. The 2007 subprime crisis had no observable effects (but it corresponds with the enlargement of the EU to Romania and Bulgaria). A slowdown in migrations flows is noticeable in 2010, supposedly consecutive to the debt crisis in Europe. In spite of a significant increase, mobility in Europe remains limited when compared to the US inter-States one (OECD (2018)). Reasons to move are different between Europeans (i.e. EU28 citizens here) and non-Europeans. As can be seen in Figures 1.2 and 1.3, work is the most common reason cited among the EU28 movers (43% on average against 37% for family reasons), while immigrants from non-EU28 countries move mainly because of family-related reasons (respectively 29% and 45%). These results partly reveal the barriers faced by migrants from non-European countries in accessing the labor market.

Figure 1.2 – Reasons to migrate for EU28 citizens, 2014 survey

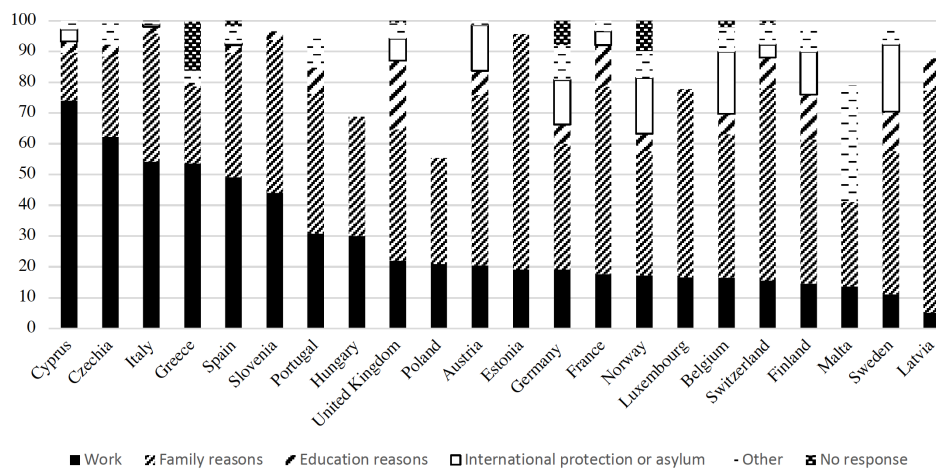


Source : Eurostat, own calculation

Europeans also tend to move more often when they already have found a job in the host country before migrating (Figure 1.4) than non-European migrants (Figure 1.5). EU28 citizens that have found a job in the host country before moving represent half of the work-related migrations of EU28-countries citizens against just over one third of non-EU28 migrants.

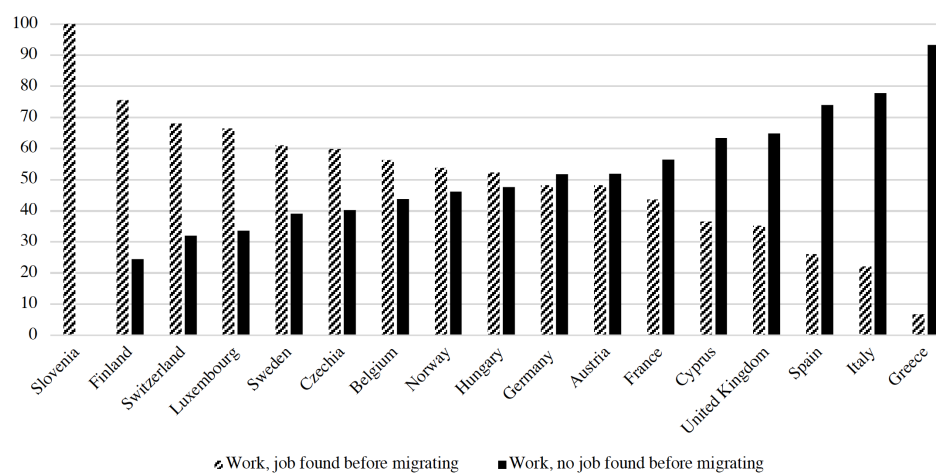
Their employability has also increased these last years to a broader extent than the one of non-European movers. As illustrated in Figure 1.6, the employment rate of European citizens has increased since 2006 and particularly the one of skilled workers (“tertiary”). Unskilled workers

Figure 1.3 – Reasons to migrate for non-EU28 citizens, 2014 survey



Source : Eurostat, own calculation

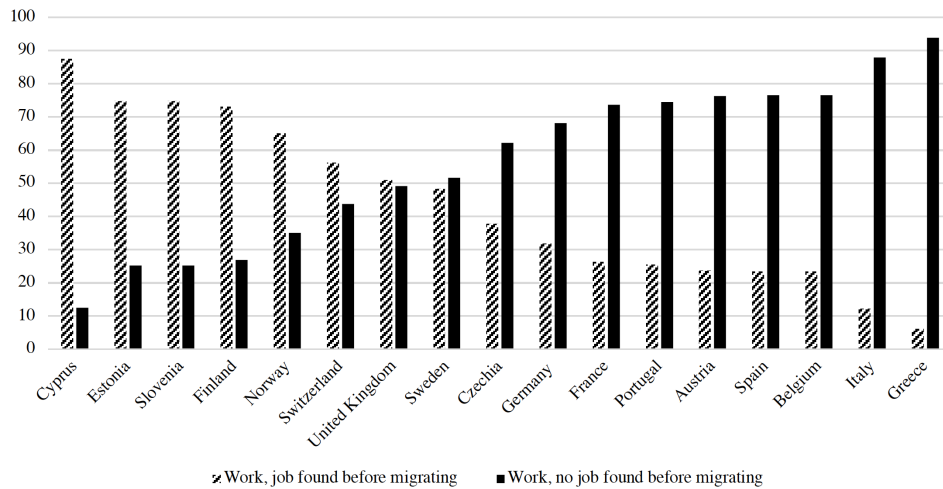
Figure 1.4 – EU28 migrants by jobs search process, 2014 survey



Source : Eurostat, own calculation

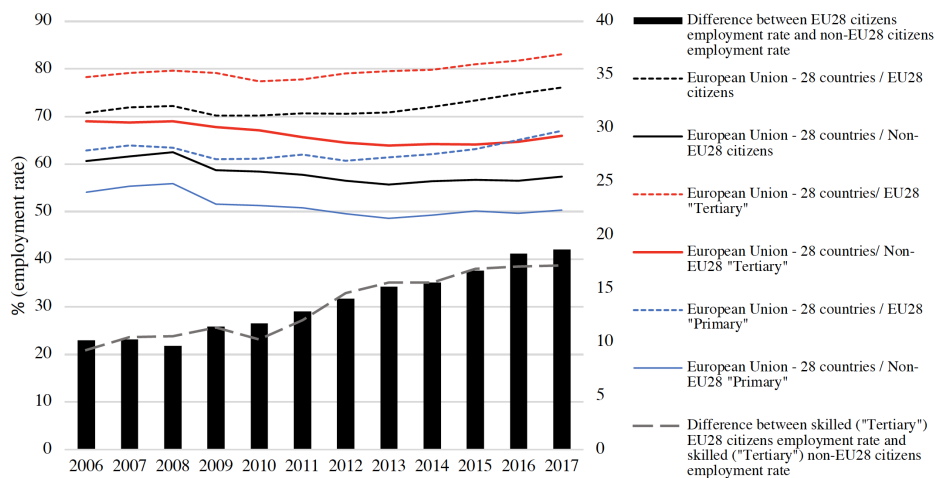
(“primary”) have also known an increase in their employability abroad, but to a lesser extent. On the contrary, the employment rate of non-European workers has not significantly moved since 2013 and the employment rate of skilled non-EU28 workers has faintly risen. The same conclusion can be inferred from the difference between employment rates : the immigrant employment rate gap, both indistinctly from the level of skills and controlling for it, has widened between 2009 and 2017.

Figure 1.5 – Non-EU28 migrants by jobs search process, 2014 survey



Source : Eurostat, own calculation

Figure 1.6 – Employment rate for immigrants from EU28 and non-EU28 countries in EU28 countries, 2006-2017

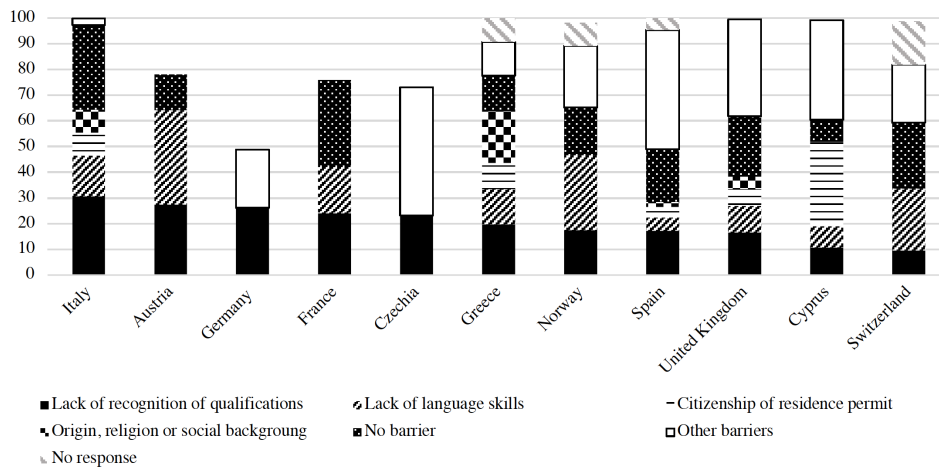


Source : Eurostat, own calculation (left axis is for the percentage differences)

The causes of unemployability among immigrants are different depending on their origin countries. Employed EU28 citizens mainly did not face any barrier on the job market or mention the lack of language skills of the host country (Figure 1.7), while employed non-EU28 citizens more frequently cite the lack of recognition of qualifications as an obstacle than European ones (Figure 1.8). At the sight of the report date (2014) where the above-mentioned numbers are

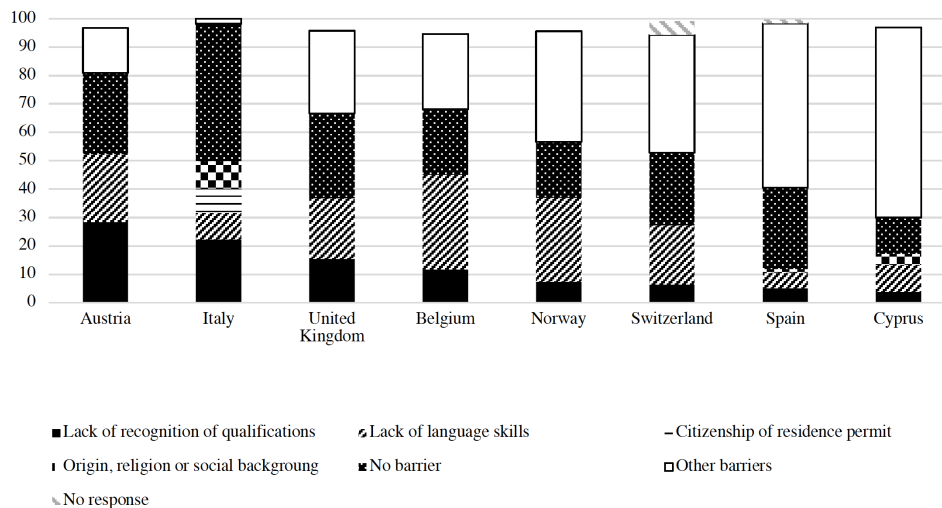
extracted from, we can identify the first consequences of the Bologna Process, who aims at reducing heterogeneity among diplomas and qualifications.

Figure 1.7 – Obstacles to getting a suitable job faced by employed non-EU28 citizens



Source : Eurostat

Figure 1.8 – Obstacles to getting a suitable job faced by employed EU28 citizens



Source : Eurostat

1.3 Methodology and data

1.3.1 Theoretical model

A common and effective way to study migration flows is the ‘gravity model’. Pionnered by [Tinbergen \(1962\)](#) in international trade flows,⁸ it has progressively become the workhorse for analyzing intra- and international migration flows. In the previous section, we stressed the importance of labor market situations and, implicitly, of wages in migration choices. Accordingly, our empirical analysis is based on a theoretical model known as the income maximisation approach (IMA) ([Roy \(1951\)](#), [Borjas \(1987\)](#)). It has the advantage of being seamlessly estimated and to substantiate the actual literature on international migrations ([Beine et al. \(2019\)](#)). The IMA is a derivation of a random utility model (RUM) where agents optimally chose their location through the maximization of an expected utility.⁹ They choose between a set of countries, including their home country, each one with specific characteristics. Equation (1.1)¹⁰ presents the utility of an agent from the country i willing to stay in this country at time t :

$$u_{ii,t} = \ln[E(y_{i,t})] + A_{i,t} + \varepsilon_{i,t} \quad (1.1)$$

where $u_{ii,t}$ is the utility of agent i . It log-linearly depends on the potential income the agent can get in his actual country ($E(y_{i,t})$) and linearly on the native country specificity ($A_{i,t}$). $\varepsilon_{i,t}$ is an independent and identically distributed (iid) extreme-value distributed random term ([McFadden \(1984\)](#)). The equation slightly differs when the agent migrates, giving Equation (1.2) :

$$u_{ij,t} = \ln[E(y_{j,t})] + A_{j,t} - C_{ij} + \varepsilon_{j,t} \quad (1.2)$$

8. [Ravenstein \(1855\)](#) is the first to indirectly use the notion of gravity to explain migration in the United-Kingdom.

9. “RUM discrete choice models are based on the assumption that the utility of the alternative i of the choice set $C = 1, 2, \dots, m$ is the sum of a deterministic component or systematic utility V_i and a random component ϵ_i that accounts for the error in the perception of the utility : $U_i = V_i + \epsilon_i$ ” ([Del Castillo \(2016\)](#)).

10. We adopt the notation of [Beine et al. \(2019\)](#)

Here, $u_{ij,t}$ is the utility the agent can gain from migrate to j from i at time t . It is also log-linearly depending on the expected income ($E(y_{j,t})$), the migration j -country specificity (A_j) and the cost of migration (C_{ij}) the agent would receive or bear in the destination country j . We suppose that there is no cost to support when deciding to stay in the native country. $\varepsilon_{j,t}$ satisfies the same condition as $\varepsilon_{i,t}$.

The distributional assumption of the random term is important. As shown by [McFadden \(1974\)](#), under this assumption the probability model of migration is the multinomial logit :

$$Pr(u_{ij,t} = \max_k u_{ik,t}) = \frac{\exp(u_{ij,t})}{\sum_k \exp(u_{ik,t})} \quad (1.3)$$

Reasoning at a macro-level, the probability in (1.3) takes the form of the ratio between the number of migrants to the country j ($N_{ij,t}$) and the total population of country i ($N_{i,t}$). In view of this and considering Equations (1.1) and (1.2), we can define the equilibrium rate to emigrate for a i -country population a time t as :

$$\frac{N_{ij,t}}{N_{i,t}} = \frac{\exp[\ln[E(y_{j,t})] + A_{j,t} - C_{ij,t}]}{\sum_k \exp[\ln[E(y_{k,t})] + A_{k,t} - C_{ik,t}]} \quad (1.4)$$

Similarly, we can define the equilibrium equation for the i -country population to stay in its country as :

$$\frac{N_{ii,t}}{N_{i,t}} = \frac{\exp[\ln[E(y_{i,t})] + A_{i,t}]}{\sum_k \exp[\ln[E(y_{k,t})] + A_{k,t} - C_{ik,t}]} \quad (1.5)$$

From (1.4) and (1.5), we can deduce the equation of the equilibrium bilateral migration rate, to which we apply the logarithm:

$$\ln\left(\frac{N_{ij,t}}{N_{ii,t}}\right) = \ln\left(\frac{E(y_{j,t})}{E(y_{i,t})}\right) + A_{j,t} - A_{i,t} - C_{ij,t} \quad (1.6)$$

and simply rewrite the equation to obtain the expression of the i -to- j migration flow :

$$\ln(N_{ij,t}) = \ln[E(y_{j,t})] - \ln[E(y_{i,t})] + A_{j,t} - A_{i,t} - C_{ij,t} + \ln(N_{ii,t}) \quad (1.7)$$

Equation (1.7) is useful since it allows us to decompose the migration flow between two countries in separate elements we can measure independently. The bilateral migration flow ($\ln(N_{ij,t})$) depends on the expected income $\ln[E(y_{j,t})] - \ln[E(y_{i,t})]$, the difference of country characteristics ($A_{j,t} - A_{i,t}$), the cost of migration ($C_{ij,t}$), but also the number of native workers from country i staying in their own country at time t ($\ln(N_{ii,t})$).

1.3.2 Empirical model

We assume that the expected labor income in a given country of destination i can be decomposed into its GDP per capita ($GDP_{i,t}$) and its employment rate ($un_{i,t}$). Country specificities ($A_{i,t}$) include institution-related variables, such as the adhesion to the Euro area ($EZ_{i,t}$, equals to 1 when the country i joins the Euro area), the European Union membership ($EU_{i,t}$, equals 1 when the country i joins the European Union), the Schengen area ($Schengen_{i,t}$, equals 1 when the country i joins the Schengen area) and the community of migrants already present in country j , i.e. the Diaspora ($\ln(Dias_{i,t})$). We add a dummy variable related to the Bologna Process (BP) ($\sum_{n=1}^5 BP_{n,i,t}$, n being the level of implementation of the BP in the country i at time t). To that, as proxies to migration costs, we add a geographical distance variable from a j country ($Dist_{ij}$) and a common language variable ($Comlan_{ij}$) as a proxy to cultural distance. Thus, the utility of the agent can be expressed as :

$$\begin{aligned}
 \ln[E(y_{j,t})] + A_{j,t} - C_{ij,t} = & \ln(GDP_{j,t} + un_{j,t}) + EZ_{j,t} \\
 & + EU_{j,t} + Schengen_{j,t} + \ln(Dias_{j,t}) \\
 & + \sum_{n=1}^5 BP_{n,j,t} - (Dist_{ij} - Comlan_{ij})
 \end{aligned} \tag{1.8}$$

From (1.7) and (1.8), we derive the following estimated equation :

$$\begin{aligned}
\ln(N_{ij,t}) = & \beta_0 + \beta_1 \ln(GDP_{j,t}) + \beta_2 \ln(un_{j,t}) \\
& + \beta_3 EZ_{j,t} + \beta_4 EU_{j,t} + \beta_5 Schengen_{j,t} + \beta_6 \ln(Dias_{j,t}) \\
& + \beta_7 \sum_{n=1}^5 BP_{n,j,t} \\
& + \beta_8 Dist_{ij} + \beta_9 Comlan_{ij} \\
& + \alpha_{i,t} + \epsilon_{ij,t}
\end{aligned} \tag{1.9}$$

α_i represents the i -country-varying fixed effect. We include this fixed effect to embody the advantages individuals can get from staying in their origin country, the i -country population staying in this country, and a time-varying fixed effect : $\alpha_{i,t} = \ln[E(y_{j,t})] + A_{i,t} + \ln(N_{ii,t}) + \alpha_t$, ensuring the equilibrium condition and the multilateral resistance (Bertoli and Moraga (2013)). We do not include a time-invariant dyadic effect (α_{ij}), indistinguishable from the cost variables ($Comlan_{ij}$ and $Dist_{ij}$). Assuming that, as $A_{j,t} = EZ_{j,t} + EU_{j,t} + Schengen_{j,t} + \sum_{n=1}^5 BP_{n,j,t}$, we could also have written $A_{i,t} = EZ_{i,t} + EU_{i,t} + Schengen_{i,t} + \sum_{n=1}^5 BP_{n,i,t}$, and deduced the alternative equation, respecting the equilibrium condition :

$$\begin{aligned}
\ln(N_{ij,t}) = & \beta_0 + \beta_1 \ln(GDP_{i,t}) + \beta_2 \ln(un_{i,t}) \\
& + \beta_3 EZ_{i,t} + \beta_4 EU_{i,t} + \beta_5 Schengen_{i,t} + \beta_6 \ln(Dias_{j,t}) \\
& + \beta_7 \sum_{n=1}^5 BP_{n,i,t} + \beta_8 Dist_{ij} + \beta_9 Comlan_{ij} + \alpha_{j,t} + \alpha_{i,t} + \epsilon_{ij,t}
\end{aligned} \tag{1.10}$$

We may face an estimation issue: as written in Beine et al. (2009), the occurrence of zero values for the dependent variable in a large portion of the observations can lead to inconsistent OLS estimates. Figure 1.9 shows the percentage frequency histogram of our dependent variables *inflows*. Approximately 4% of our migration flows observations have a zero value. This percent decreases to slightly less than 1.5% when we take the logarithm of *inflows*. In the first case, the distribution of *Inflows* is close to the over-dispersed Poisson or over-dispersed Negative Binomial

distributions.¹¹ When taking the logarithm of our variable of interest, the obtained distribution seems to fit a Negative Binomial or a Poisson distribution : the dispersion is reduced compared to the previous situation. 15.24% of our values are missing. The Poisson Pseudo-Maximum Likelihood (PPML) estimator developed by Santos Silva and Tenreyro (2006) can deal with over-dispersed Poisson distribution and thus be a good candidate to estimate our model. Another method which deals with the distribution features but is less frequent in the literature is the Negative Binomial regression model.¹² These estimators are maximum or pseudo-maximum likelihood estimators. The PPML estimator is designed to take into account fixed effects and estimate model with count data as dependent variable. The Negative Binomial share the same objective, but they are two-part model. The Poisson regression model is given by:

$$y_i \sim \text{Poisson}(\mu_i) \tag{1.11}$$

with

$$\mu_i = \exp(x_i\beta + offset_i) \tag{1.12}$$

The Negative Binomial regression model is distinguished from the Poisson regression model since it supposes an omitted variable in the data generating process of μ_i :

$$\mu_i = \exp(x_i\beta + offset_i + v_i) \tag{1.13}$$

where

$$e^{v_i} \sim \text{Gamma}(1/\alpha, \alpha) \tag{1.14}$$

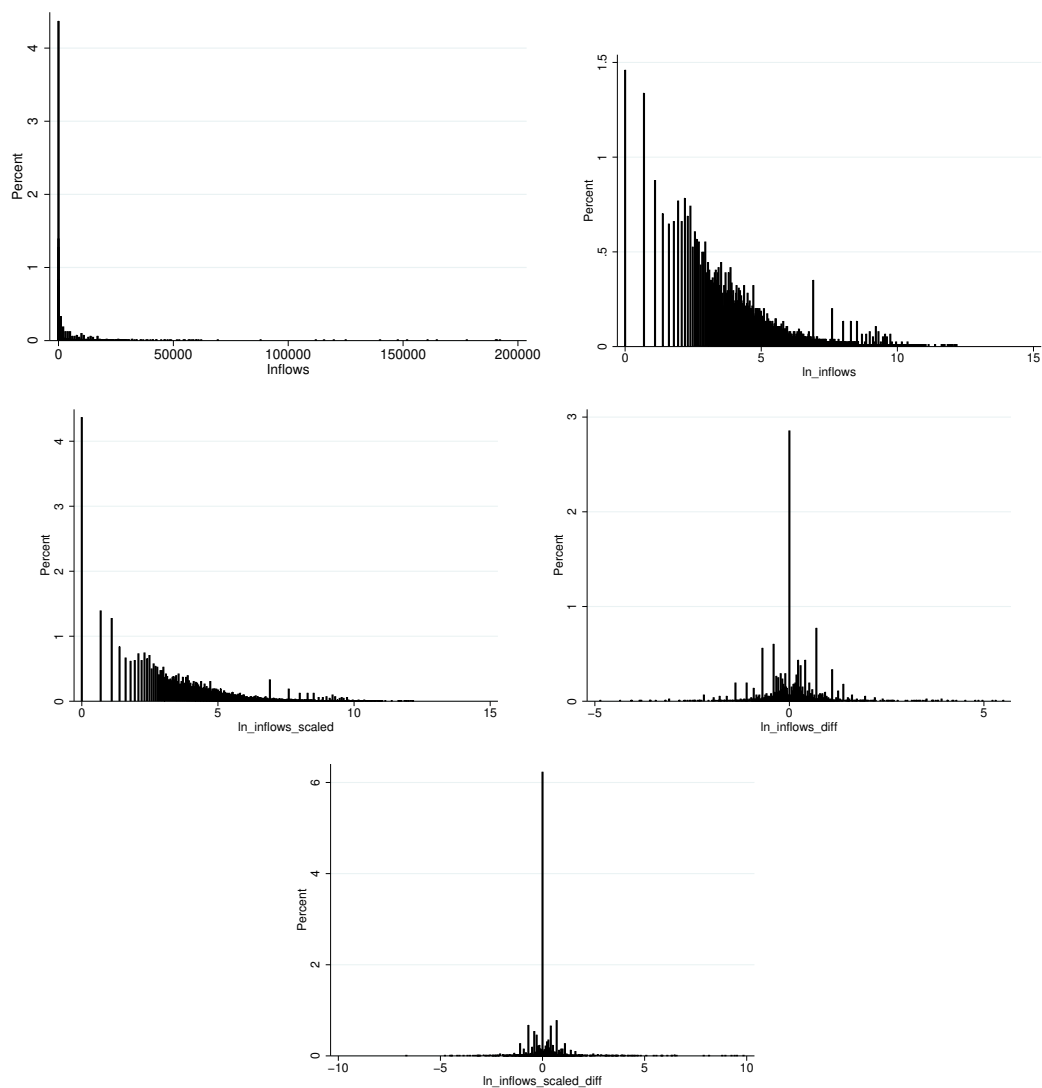
This parametrization allows us to take into account the over-dispersion of the Poisson distribution. We also use more common techniques such as the Ordinary Least Square (OLS) and the Scaled Ordinary Least Square (SOLS) estimators. The SOLS consists of a modification of the OLS estimator procedure : we add 1 to every value prior to the log-transformation to not lose

11. When over-dispersion is observed, standard errors and p-values tend to be too small.

12. The Zero-inflated Poisson (ZIP) or the Zero-inflated Negative Binomial (ZINB) regression constitute alternative candidates but require the use of an instrumental variable.

the zero-valued data (graph (2;1) in Figure 1.9).

Figure 1.9 – Distribution of the dependent variables Inflows



1.4 Results

Table 1.1 presents the results of the estimation of Equation (1.9), with the different specifications previously mentioned.¹³ The first column of each estimator is a control regression, omitting the key variables “Bologna Process indicator (ind.)”. The first specification for columns

¹³. The plurality of estimators will also help us in checking the robustness of our results.

(1) and (2) is the OLS estimator. Outcomes in columns (3) and (4) are obtained with the SOLS (Scaled OLS) method, while columns (5) and (6) present the results from the PPML estimators. Columns (7) and (8) show the results we achieved from the Negative Binomial estimator (NegBin).

Overall, our results suggest that the Bologna Process, implemented in the destination country plays an ambiguous role in explaining bilateral migration flows. As it can be seen in Table 1.1, the OLS, SOLS and the PPML estimates conclude to a significant but unexpected evolution of the BP process: compared to the highest level of implementation (BP = 5), BP = 2 and BP = 4 lead to lower migration flows incoming, but BP = 3 is associated to a higher level of migration flows (respectively 0.107%, 0.753% and 0.184%). The Negative Binomial estimates do not indicate any effect of the BP on migration (only “BP = 2” is significant and negative.) We, then, cannot conclude to a clearly significant, positive and growing effect of the Bologna Process on migration flows, but we can notice that implementing the Bologna Process has a small positive impact.

Other institutional factors impact migration flows. In this way, being a member of the European Union for the destination country influences the flows positively when significant, increasing by an average of 0.26% the flows. The Diaspora has a significant and positive impact in every estimations, in line with the results in [Beine et al. \(2009\)](#). Being a member of the Eurozone has no clear effect : only two estimators out of four identify a significant effect with contradicting signs. Indeed, the SOLS estimates indicates a negative effect of the Eurozone membership of approximately 0.256% while the PPML one shows a positive impact of 0.330%. Surprisingly, the common language, the distance between countries and the Schengen area do not affect bilateral flows.

Concerning the control variables, it is worth noting that GDP seems to have a significant and positive impact, going from 0.1% to 0.6%. In other words, an increase in GDP in the destination countries attracts more flows from other countries. Results of the unemployment variable are in line with the findings in the literature : an increase of 10% in the unemployment rate leads to a drop of 2.8% to 9.5% of bilateral migration flows.

Table 1.1 – Destination-country specific determinants of Migration in Europe

	OLS		SOLS		PPML		NegBin	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
GDP	0.312**** (0.0813)	0.324**** (0.0847)	0.407**** (0.104)	0.667**** (0.129)	-0.187 (0.141)	-0.170 (0.139)	0.108**** (0.0200)	0.106**** (0.0218)
Unemployment	-0.340**** (0.0786)	-0.286**** (0.0774)	-0.455**** (0.124)	-0.418*** (0.129)	-0.934**** (0.137)	-0.958**** (0.140)	-0.0407** (0.0195)	-0.0324 (0.0197)
Eurozone	0.0839 (0.0704)	0.109 (0.0680)	-0.252*** (0.0965)	-0.264*** (0.0971)	0.347**** (0.0953)	0.322**** (0.0949)	-0.00520 (0.0160)	-0.00139 (0.0163)
EU membership	0.253*** (0.0918)	0.223** (0.0902)	0.443**** (0.131)	0.509**** (0.139)	0.0136 (0.138)	0.0642 (0.139)	0.0844**** (0.0235)	0.0800**** (0.0238)
Diaspora	0.830**** (0.0212)	0.815**** (0.0212)	0.722**** (0.0419)	0.687**** (0.0441)	0.883**** (0.0389)	0.879**** (0.0395)	0.145**** (0.00405)	0.141**** (0.00417)
Schengen	-0.0929 (0.126)	-0.158 (0.126)	-0.294** (0.142)	-0.597**** (0.162)	0.0464 (0.167)	0.0178 (0.168)	0.0457 (0.0314)	0.0309 (0.0320)
Common Language	0.168 (0.231)	0.165 (0.227)	0.106 (0.363)	0.155 (0.348)	0.0173 (0.119)	0.0268 (0.118)	-0.00463 (0.0285)	-0.00413 (0.0286)
Distance	0.00174 (0.0558)	-0.0328 (0.0559)	-0.0267 (0.0936)	-0.0585 (0.0938)	0.199*** (0.0737)	0.183** (0.0728)	-0.00246 (0.0116)	-0.00959 (0.0117)
Bologna ind. = 2		-0.987**** (0.152)		-0.486*** (0.170)		-1.556**** (0.287)		-0.298**** (0.0685)
Bologna ind. = 3		0.107* (0.0600)		0.753**** (0.136)		0.184** (0.0850)		0.0222 (0.0239)
Bologna ind. = 4		-0.102*** (0.0345)		-0.249**** (0.0551)		-0.0767* (0.0408)		-0.0215 (0.0154)
Bologna ind. = 5		0 (.)		0 (.)		0 (.)		0 (.)
Constant	-3.788**** (1.060)	-3.566**** (1.084)	-3.475*** (1.175)	-5.655**** (1.264)	0.129 (1.760)	0.185 (1.704)	-0.676** (0.292)	-0.582* (0.304)
<i>N</i>	4784	4784	4969	4969	4969	4969	4784	4784
<i>R</i> ²	0.878	0.882	0.618	0.636				
AIC	11325.2	11161.8	18210.2	17962.5	4482838.0	4387868.8	18505.4	18483.8
BIC	13519.6	13375.6	20417.4	20189.2	4485090.8	4390102.1	21081.6	21079.4

Note : the dependent variable for the OLS and the Negative Binomial (NegBin) estimator is $\ln(\text{inflows})$ while the SOLS estimator uses $\ln(\text{scaled inflows})$ and the PPML one uses inflows. The variable "Bologna ind. = 5" has been omitted because of collinearity problem. Robust standard errors in parentheses, * : $p < 0.1$, ** : $p < 0.05$, *** : $p < 0.01$, **** : $p < 0.001$

Equation (1.9) focuses on one side of the phenomenon: controlling only for how the Bologna Process is implemented in the destination country indicates how the national labor market requirements are harmonized, in term of skills or qualifications. But it gives limited information on migrants themselves. We now estimate the impact of the Bologna Process implementation in the origin country on migration flows with Equation (1.10). The results will cover the other side of the Bologna Process effect, i.e. the formation of migrants.

Estimate of Equation (1.10) are presented in Table 1.2. Variables GDP, Unemployment, Eurozone, EU membership, Schengen, and the Bologna Indicators ones are proper to the sending country, while the variables Diaspora, Common Language and Distance are identical to those in Table 1.1. Table 1.2 is organised as Table 1.1.

Similarly to the above, we do not find evidence that the Bologna Process implementation in

the origin country plays a role in influencing bilateral migration flows. Indeed, no significant and continuous results appears. The PPML and the NegBin estimators conclude to no significant results of the Bologna Process in the sending country, while the OLS estimator indicates a slight upward trend (a positive impact of the Bologna Process implementation) and the SOLS estimator a positive tendency but only one significant result.

Table 1.2 – Origin-country specific determinants of Migration in Europe

	OLS		SOLS		PPML		NegBin	
	(1)	(2)	(3)	(4)	(1)	(2)	(3)	(4)
GDP	-0.211**** (0.0521)	-0.243**** (0.0556)	-0.257**** (0.0604)	-0.304**** (0.0646)	-0.285*** (0.0985)	-0.288*** (0.0964)	-0.0212* (0.0128)	-0.0275** (0.0136)
Unemployment	0.166** (0.0788)	0.168** (0.0737)	0.165* (0.0966)	0.155* (0.0895)	0.306**** (0.0888)	0.303**** (0.0842)	0.0451** (0.0190)	0.0445** (0.0194)
Eurozone	-0.231**** (0.0499)	-0.198**** (0.0498)	-0.209**** (0.0573)	-0.159*** (0.0564)	-0.332**** (0.0912)	-0.345**** (0.0959)	-0.0568**** (0.0159)	-0.0503**** (0.0166)
EU membership	0.585**** (0.0938)	0.564**** (0.0920)	0.466**** (0.109)	0.439**** (0.107)	1.195**** (0.192)	1.202**** (0.195)	0.115**** (0.0187)	0.111**** (0.0192)
Diaspora	0.792**** (0.0219)	0.790**** (0.0218)	0.758**** (0.0274)	0.755**** (0.0273)	0.769**** (0.0340)	0.769**** (0.0336)	0.137**** (0.00397)	0.136**** (0.00400)
Schengen	0.387**** (0.0580)	0.382**** (0.0569)	0.312**** (0.0664)	0.301**** (0.0650)	0.195** (0.0912)	0.212** (0.0893)	0.0811**** (0.0172)	0.0800**** (0.0173)
Common Language	-0.244* (0.144)	-0.246* (0.144)	-0.279* (0.144)	-0.278* (0.145)	-0.00371 (0.130)	0.00478 (0.130)	-0.0602** (0.0280)	-0.0610** (0.0281)
Distance	-0.0102 (0.0516)	-0.0135 (0.0524)	0.00576 (0.0633)	0.00572 (0.0635)	-0.0836 (0.0653)	-0.0938 (0.0671)	-0.0138 (0.0108)	-0.0141 (0.0110)
Bologna ind. = 2		-0.230* (0.139)		-0.207 (0.153)				-0.0347 (0.0412)
Bologna ind. = 3		-0.123** (0.0580)		-0.181*** (0.0665)		0.115 (0.222)		-0.0255 (0.0208)
Bologna ind. = 4		-0.0345 (0.0380)		-0.0290 (0.0418)		0.0976 (0.205)		-0.00593 (0.0162)
Bologna ind. = 5		0 (.)		0 (.)		0.00281 (0.214)		0 (.)
Constant	0.931 (0.656)	1.354** (0.681)	1.713** (0.766)	2.296*** (0.805)	0.927 (1.553)	0.568 (1.448)	0.758**** (0.194)	0.839**** (0.202)
<i>N</i>	4784	4784	4969	4969	4969	4969	4784	4784
<i>R</i> ²	0.900	0.900	0.871	0.872				
AIC	10299.5	10284.9	12745.3	12724.8	3185845.7	3169097.2	18045.6	18049.7
BIC	11600.6	11605.4	14080.1	14079.1	3187187.0	3170451.5	19405.0	19428.4

Note : the dependent variable for the OLS and the Negative Binomial (NegBin) estimator is $\ln(\text{inflows})$ while the SOLS estimator uses $\ln(\text{scaled inflows})$ and the PPML one uses inflows. The variable “Bologna ind. = 5” has been omitted because of collinearity problem, except for the PPML estimator where The variable “Bologna ind. = 2” has been omitted because of collinearity problem. Robust standard errors in parentheses, * : $p < 0.1$, ** : $p < 0.05$, *** : $p < 0.01$, **** : $p < 0.001$

Regarding the other variables, we first find a robust elasticity of the GDP. A 10% increase of the GDP in the home country lead on average to a 2.6% decrease of the bilateral flows (0.25% for the NegBin estimator). This result is in line we what one can expect since higher revenues reduce the incentive to leave the country. The unemployment rate also impacts, in the expected way, the bilateral migration flows: depending on the estimation method, a 10% increase of the unemployment rate in a country can trigger a rise of 1.6% to 3% of the outgoing flows.

Surprisingly, being a member of the Eurozone has a negative impact on outgoing migration

flows. This result contradicts several works such as [Ortega and Peri \(2013\)](#) and [Beine et al. \(2019\)](#) and contrast with what the literature indicates. Explaining this result would need longer analysis and investigations, proper to an independent article and, in consequences, beyond the scope of this article.

A core-periphery analysis

Using Equations (1.9) and (1.10), we refined our analysis by cutting our samples in two sub-samples: the core countries and the peripheral countries. This dissociation seems legitimate as keeping the sample as a whole is gathering a group of economically and socially heterogeneous countries. Moreover, migration flows can behave differently following the level of the GDP per capita ([Zelinsky \(1971\)](#)). Our distinction roughly take into account these phenomenons. The results are displayed in Tables 1.3 and 1.4.

When focusing on destination-specific characteristics, we can hardly conclude to any specific effect of the Bologna Process. The NegBin and the PPML estimators fails to identify half of the Bologna Process state of implementation coefficients. The OLS and SOLS estimators do not identify clearly the variable “Bologna ind. = 5” and “Bologna ind. = 2”, which make the findings relative to the two other Bologna Indicators difficult to interpret. While the unemployment has the expected effect (an increase in the receiving country decrease the incoming flows of migrants), the GDP variable negatively impact the inflows in 5 out of 8 estimations. Distance seems to have no impact in most of the case (excepted with the SOLS estimators). The Eurozone, the EU membership and the Schengen area have no noticeable effect contrary to the Diaspora which plays a strongly significant and positive role (approximately 0,7% following a 1% positive shock). A plausible explanation is the long and irreversible nature of the institutional changes in our sub-sample. In the previous case, the destination countries presented a higher variance in terms of institutional changes (successive entries in the Eurozone, the European Union and the Schengen Area). In the present sub-sample, this variance is diminished by the similar political timeline and the nature of the variables used (dummies).

Applying the same strategy as below, we adopt the origin-country characteristics and obtain

Table 1.3 – Destination-country specific determinants of Migration in Europe: Peripheral to Core

	OLS		SOLS		PPML		NegBin	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
GDP	-0.889 (0.555)	-0.967* (0.524)	-2.704*** (0.944)	-1.726** (0.735)	-0.927 (1.382)	-0.889 (1.408)	-0.231* (0.136)	-0.243* (0.145)
Unemployment	-0.708*** (0.147)	-0.705*** (0.143)	-1.328*** (0.312)	-1.069*** (0.269)	-1.306*** (0.317)	-1.326*** (0.304)	-0.123** (0.0489)	-0.123** (0.0496)
Eurozone	0.191 (0.161)	0.196 (0.157)	-0.525* (0.303)	-0.367 (0.262)	0.263 (0.339)	0.254 (0.332)	-0.0167 (0.0414)	-0.0163 (0.0416)
EU membership	-0.210 (0.228)	-0.215 (0.221)	-0.635** (0.313)	-0.288 (0.273)	-0.156 (0.483)	-0.0820 (0.490)	-0.0628 (0.0497)	-0.0621 (0.0519)
Diaspora	0.763*** (0.0346)	0.763*** (0.0345)	0.616*** (0.0914)	0.620*** (0.0883)	0.899*** (0.0586)	0.901*** (0.0579)	0.121*** (0.00706)	0.121*** (0.00706)
Schengen	-0.0115 (0.201)	-0.0545 (0.197)	0.0534 (0.241)	-0.398 (0.279)	0.423 (0.360)	0.384 (0.342)	0.0815 (0.0682)	0.0730 (0.0696)
Common Language	0 (.)	0 (.)	0 (.)	0 (.)			0 (.)	0 (.)
Distance	-0.0729 (0.0859)	-0.0810 (0.0852)	-0.398** (0.158)	-0.398** (0.154)	0.112 (0.161)	0.117 (0.165)	-0.0206 (0.0194)	-0.0222 (0.0195)
Bologna ind. = 2		0 (.)		0 (.)		-0.182 (0.118)		-0.0214 (0.0254)
Bologna ind. = 3		-0.0785 (0.0706)		0.573*** (0.216)		-0.0707 (0.160)		0 (.)
Bologna ind. = 4		-0.114* (0.0587)		-0.297*** (0.0893)				0 (.)
Bologna ind. = 5		0 (.)		0 (.)				-0.0102 (0.0417)
Constant	11.24* (6.660)	12.25* (6.294)	36.04*** (12.34)	25.07** (9.684)	10.42 (16.63)	10.15 (16.87)	3.579** (1.624)	3.734** (1.731)
<i>N</i>	1783	1783	1844	1844	1844	1844	1783	1783
<i>R</i> ²	0.900	0.900	0.621	0.635				
AIC	3603.0	3597.4	6586.0	6517.0	1860324.8	1837767.8	7007.9	7011.1
BIC	4541.1	4546.5	7535.4	7477.5	1861274.2	1838733.7	8116.1	8130.3

Note : the dependent variable for the OLS and the Negative Binomial (NegBin) estimator is $\ln(\text{inflows})$ while the SOLS estimator uses $\ln(\text{scaled inflows})$ and the PPML one uses inflows. The variables linked to the Bologna Process are 0 when omitted because of collinearity problem. in this sub-sample, common language counts no positive value. Robust standard errors in parentheses, * : $p < 0.1$, ** : $p < 0.05$, *** : $p < 0.01$, **** : $p < 0.001$

the Table 1.4. Here also, it is hard to conclude to any effect of the Bologna Process implemented in the origin-country. Despite the ability of the estimators to properly compute the BP variables, no significant results emerge from the different estimation. Distance has the expected signs: increasing the distance of 1% reduces the flows of 0.21% in average. GDP and unemployment have no clear effect on peripheral-to-core flows. Indeed, the variables GDP and unemployment are significantly different from 0 in 2 out of 8 cases, but the sign of their coefficient is in line with what one would expect. Joining the Eurozone impacts negatively the outgoing flows of nationals, with a bigger effect than when we take the entire sample (0.24 in average against 0.198 when studying all the bilateral flows). Becoming a member of the European Union leads to broader flows of nationals leaving for another EU countries (0.59 in average when including the NegBin estimates). Consequently, integrating the EU eases the rigidities faced by migrants and supports the existence of the Euro. The Diaspora impacts positively the outgoing flows from peripheral countries, independently from the adopted estimation technique, in similar dimension as with the complete sample. Finally, the Schengen area fosters peripheral-to-core migration in a bigger way than in Table 1.2, stressing out the importance of already present communities for Central and Eastern Europe migrants.¹⁴

1.5 Conclusion

In this chapter, we analyze the impact of the Bologna Process in the destination and origin country on migration flows within Europe. We have adopted several econometric methods to estimate a gravity model founded on an income maximisation approach. We first investigate a "global" effect of the Bologna Process implementation in a country and the impact it has on inflows. We then restricted our analysis to a specific couple of countries, "core-periphery", where the Bologna Process may be more crucial from a political demographic and economic point of view.

Our main finding is the limited, if not non-significant, impact of the Bologna Process on

14. We estimate this model using variables in first difference with the OLS and SOLS estimators only. Results are shown in Tables 1.5, 1.6, 1.7 and 1.8 in Appendix.

Table 1.4 – Origin-country specific determinants of Migration in Europe : Peripheral to Core

	OLS		SOLS		PPML		NegBin	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
GDP	-0.0573 (0.0979)	-0.0699 (0.0980)	-0.113 (0.136)	-0.146 (0.135)	-0.771*** (0.287)	-0.732** (0.297)	-0.0217 (0.0304)	-0.0272 (0.0321)
Unemployment	0.242* (0.133)	0.267** (0.121)	0.173 (0.183)	0.180 (0.168)	0.143 (0.156)	0.223 (0.152)	0.0533 (0.0341)	0.0527 (0.0362)
Eurozone	-0.372*** (0.0707)	-0.340*** (0.0745)	-0.331*** (0.121)	-0.279** (0.117)	-0.191 (0.170)	-0.243 (0.186)	-0.0645** (0.0279)	-0.0559* (0.0305)
EU membership	0.524*** (0.123)	0.503*** (0.122)	0.307** (0.153)	0.285* (0.150)	1.437*** (0.231)	1.517*** (0.237)	0.0713** (0.0295)	0.0664** (0.0301)
Diaspora	0.728*** (0.0269)	0.726*** (0.0271)	0.691*** (0.0525)	0.686*** (0.0525)	0.756*** (0.0467)	0.773*** (0.0427)	0.117*** (0.00629)	0.117*** (0.00636)
Schengen	0.666*** (0.105)	0.673*** (0.101)	0.457*** (0.126)	0.436*** (0.125)	0.161 (0.140)	0.194 (0.134)	0.138*** (0.0306)	0.140*** (0.0316)
Common Language	0 (.)	0 (.)	0 (.)	0 (.)			0 (.)	0 (.)
Distance	-0.238*** (0.0714)	-0.249*** (0.0733)	-0.307*** (0.0971)	-0.319*** (0.0968)	-0.250** (0.113)	-0.235** (0.114)	-0.0537*** (0.0183)	-0.0549*** (0.0186)
Bologna ind. = 2		-0.233 (0.143)		-0.296 (0.186)				-0.0276 (0.0536)
Bologna ind. = 3		-0.0542 (0.0686)		-0.175** (0.0798)		0.192 (0.219)		-0.00396 (0.0348)
Bologna ind. = 4		-0.0376 (0.0576)		-0.114 (0.0843)		0.0485 (0.211)		0.00849 (0.0322)
Bologna ind. = 5		0 (.)		0 (.)		-0.0495 (0.237)		0 (.)
Constant	1.238 (1.256)	1.452 (1.256)	2.866 (1.851)	3.416* (1.882)	8.824*** (3.128)	7.800** (3.042)	1.166*** (0.381)	1.232*** (0.404)
<i>N</i>	1697	1697	1757	1757	1844	1844	1783	1783
<i>R</i> ²	0.266	0.267	0.509	0.508				
AIC	649.8	652.2	1924.6	1930.4	1485089.5	1460040.9	6944.5	6949.8
BIC	1345.7	1364.4	2646.8	2669.0	1485856.7	1460824.7	7800.3	7822.1

Note : the dependent variable for the OLS and the Negative Binomial (NegBin) estimator is $\ln(\text{inflows})$ while the SOLS estimator uses $\ln(\text{scaled inflows})$ and the PPML one uses inflows. The variable “Bologna ind. = 5” has been omitted in estimations because of collinearity problem, except for the PPML estimator where it is the variable “Bologna ind. = 2” that has been omitted, for similar reason. Robust standard errors in parentheses, * : $p < 0.1$, ** : $p < 0.05$, *** : $p < 0.01$, **** : $p < 0.001$

bilateral migration. When an effect can be noticed, it can take the form of an increasing function of the level of implementation, meaning that the higher the quality of the implementation, the bigger the migrants flows. This phenomenon is happening when focusing on the implementation of the Bologna Process in the origin country but is absent when studying the level of implementation in the destination country.

Other important results are worth being noticed. GDP has an expected impact in most of the cases, i.e. it increases incoming flows and reduces outgoing flows of migrants. The reverse effect can be noticed about the unemployment: it reduces the incoming flows of migrants and increases the outgoing ones. These results are in line with the literature, as are the effects of diasporas. Focusing on a certain direction of flows (peripheral to core countries), we notice the great importance of diasporas for migration when migrants come from Eastern and Central Europe rather than Western Europe. Common language and distance are traditional factors but seem to have a limited relevance when studying migration in Europe. Regarding the former, a first plausible explanation is the prevalence of English in business and the greater ability of Europeans to speak it. Distance does not play a clear and unmistakable role since it is sensible to the estimator used.

Finally, the impact of the Euro and the EU membership surprise by their nature. A promising extension of our study would be to investigate the specific effects of the Euro and the EU membership on migration. This is left for future research.

1.6 Appendix

Table 1.5 – Destination-country specific determinants of Migration in Europe (first difference)

	OLS		SOLS	
	(1)	(2)	(3)	(4)
GDP	3.079**** (0.396)	3.278**** (0.400)	3.111**** (0.394)	3.777**** (0.419)
Unemployment	0 (.)	0 (.)	0 (.)	0 (.)
Eurozone	-0.0326*** (0.0108)	-0.0233** (0.0118)	0.0255* (0.0147)	0.0670*** (0.0207)
EU membership	0.0187 (0.0117)	0.0274** (0.0123)	0.0222* (0.0134)	0.0816**** (0.0191)
Diaspora	-0.0408 (0.0770)	-0.0472 (0.0784)	-0.159* (0.0879)	-0.189** (0.0919)
Schengen	0.0511 (0.0426)	0.0318 (0.0433)	0.0842* (0.0429)	-0.00362 (0.0450)
Common Language	-0.0422** (0.0180)	-0.0437** (0.0182)	-0.0359 (0.0448)	-0.0334 (0.0451)
Distance	0.00739 (0.0119)	0.00925 (0.0122)	0.00904 (0.0159)	0.0234 (0.0160)
Bologna ind. = 2		-0.191*** (0.0580)		-0.483**** (0.0887)
Bologna ind. = 3		-0.0132 (0.0168)		-0.171**** (0.0330)
Bologna ind. = 4		-0.0436*** (0.0133)		-0.212**** (0.0342)
Bologna ind. = 5		0 (.)		0 (.)
Constant	0.183 (0.194)	0.190 (0.193)	0.0989 (0.209)	0.0951 (0.208)
<i>N</i>	4369	4369	4566	4566
<i>R</i> ²	0.068	0.071	0.008	0.030
AIC	5175.6	5164.8	9293.0	9196.8
BIC	7192.4	7200.7	11323.7	11246.9

Note : the dependent variable for the OLS estimator is $\ln(\text{inflows}_t) - \ln(\text{inflows}_{t-1})$ while the SOLS estimator uses $\ln(\text{inflows}_t + 1) - \ln(\text{inflows}_{t-1} + 1)$. The variable "Bologna ind. = 5" and "Unemployment" have been omitted because of collinearity problem. Robust standard errors in parentheses, * : $p < 0.1$, ** : $p < 0.05$, *** : $p < 0.01$, **** : $p < 0.001$

Table 1.6 – Origin-country specific determinants of Migration in Europe (first difference)

	OLS		SOLS	
	(1)	(2)	(3)	(4)
GDP	-0.993**** (0.197)	-0.994**** (0.197)	-1.091**** (0.226)	-1.100**** (0.227)
Unemployment	0 (.)	0 (.)	0 (.)	0 (.)
Eurozone	-0.0335*** (0.0106)	-0.0350*** (0.0106)	-0.0231* (0.0126)	-0.0244* (0.0128)
EU membership	0.1000**** (0.0142)	0.0999**** (0.0142)	0.127**** (0.0201)	0.127**** (0.0203)
Diaspora	-0.200*** (0.0658)	-0.202*** (0.0664)	-0.171*** (0.0649)	-0.174*** (0.0653)
Schengen	-0.0737**** (0.0129)	-0.0702**** (0.0129)	-0.0682**** (0.0170)	-0.0651**** (0.0167)
Common Language	0.00489 (0.0162)	0.00522 (0.0162)	-0.0126 (0.0306)	-0.0122 (0.0309)
Distance	0.0151** (0.00649)	0.0139** (0.00640)	0.00188 (0.00781)	0.00134 (0.00769)
Bologna ind. = 2		-0.000122 (0.0253)		0.0132 (0.0251)
Bologna ind. = 3		0.0186 (0.0124)		0.0145 (0.0157)
Bologna ind. = 4		0.00942 (0.0103)		0.0111 (0.0143)
Bologna ind. = 5		0 (.)		0 (.)
Constant	0.0190 (0.0604)	0.0169 (0.0606)	0.0859 (0.0656)	0.0796 (0.0669)
N	4369	4369	4566	4566
R^2	0.433	0.432	0.617	0.617
AIC	2963.7	2968.2	4915.3	4920.6
BIC	4138.1	4161.7	6123.5	6148.1

Note : the dependent variable for the OLS estimator is $\ln(\text{inflows}_t) - \ln(\text{inflows}_{t-1})$ while the SOLS estimator uses $\ln(\text{inflows}_t + 1) - \ln(\text{inflows}_{t-1} + 1)$. The variable “Bologna ind. = 5” and “Unemployment” have been omitted because of collinearity problem. Robust standard errors in parentheses, * : $p < 0.1$, ** : $p < 0.05$, *** : $p < 0.01$, **** : $p < 0.001$

Table 1.7 – Destination-country specific determinants of Migration in Europe: Peripheral to Core (first difference)

	OLS		SOLS	
	(1)	(2)	(3)	(4)
GDP	1.880**** (0.537)	2.207**** (0.564)	2.946**** (0.740)	3.743**** (0.875)
Unemployment	0 (.)	0 (.)	0 (.)	0 (.)
Eurozone	-0.0515**** (0.0149)	-0.0593**** (0.0165)	0.00238 (0.0220)	0.0498 (0.0356)
EU membership	-0.00974 (0.0171)	-0.00680 (0.0182)	-0.00423 (0.0188)	0.0455* (0.0242)
Diaspora	-0.191 (0.124)	-0.181 (0.127)	-0.392** (0.161)	-0.451*** (0.171)
Schengen	0.0285 (0.0642)	0.0267 (0.0648)	0.0942 (0.0784)	-0.0105 (0.0761)
Common Language	0 (.)	0 (.)	0 (.)	0 (.)
Distance	0.0122 (0.00881)	0.0103 (0.00932)	0.0394** (0.0157)	0.0381** (0.0152)
Bologna ind. = 2		0 (.)		0 (.)
Bologna ind. = 3		0.0459 (0.0314)		-0.110** (0.0556)
Bologna ind. = 4		-0.0108 (0.0180)		-0.179*** (0.0542)
Bologna ind. = 5		0 (.)		0 (.)
Constant	0.320 (0.199)	0.326 (0.198)	-0.0125 (0.234)	0.108 (0.217)
<i>N</i>	1697	1697	1757	1757
<i>R</i> ²	0.234	0.235	0.040	0.055
AIC	745.2	743.4	3117.5	3091.2
BIC	1653.1	1662.2	4036.7	4021.3

Note : the dependent variable for the OLS estimator is $\ln(\text{inflows}_t) - \ln(\text{inflows}_{t-1})$ while the SOLS estimator uses $\ln(\text{inflows}_t + 1) - \ln(\text{inflows}_{t-1} + 1)$. The variable "Bologna ind. = 5" and "Unemployment" have been omitted because of collinearity problem. Robust standard errors in parentheses, * : $p < 0.1$, ** : $p < 0.05$, *** : $p < 0.01$, **** : $p < 0.001$

Table 1.8 – Destination-country specific determinants of Migration in Europe: Peripheral to Core (first difference)

	OLS		SOLS	
	(1)	(2)	(3)	(4)
GDP	-2.152**** (0.241)	-2.103**** (0.243)	-2.108**** (0.316)	-2.091**** (0.320)
Unemployment	0 (.)	0 (.)	0 (.)	0 (.)
Eurozone	-0.0766**** (0.0161)	-0.0674**** (0.0166)	-0.0679*** (0.0241)	-0.0645** (0.0282)
EU membership	0.155**** (0.0213)	0.148**** (0.0217)	0.174**** (0.0302)	0.172**** (0.0314)
Diaspora	-0.174 (0.132)	-0.174 (0.132)	-0.222 (0.140)	-0.222 (0.141)
Schengen	-0.130**** (0.0188)	-0.127**** (0.0191)	-0.0898*** (0.0275)	-0.0895*** (0.0286)
Common Language	0 (.)	0 (.)	0 (.)	0 (.)
Distance	0.00104 (0.00910)	-0.00138 (0.00940)	-0.000427 (0.0102)	-0.00142 (0.0101)
Bologna ind. = 2		-0.0374 (0.0334)		-0.0154 (0.0412)
Bologna ind. = 3		0.00965 (0.0179)		0.00121 (0.0295)
Bologna ind. = 4		0.0171 (0.0187)		0.00370 (0.0321)
Bologna ind. = 5		0 (.)		0 (.)
Constant	0.174* (0.0925)	0.181* (0.0968)	0.164* (0.0985)	0.170* (0.101)
N	1697	1697	1757	1757
R^2	0.266	0.267	0.509	0.508
AIC	649.8	652.2	1924.6	1930.4
BIC	1345.7	1364.4	2646.8	2669.0

Note : the dependent variable for the OLS estimator is $\ln(\text{inflows}_t) - \ln(\text{inflows}_{t-1})$ while the SOLS estimator uses $\ln(\text{inflows}_t + 1) - \ln(\text{inflows}_{t-1} + 1)$. The variable "Bologna ind. = 5" and "Unemployment" have been omitted because of collinearity problem. Robust standard errors in parentheses, * : $p < 0.1$, ** : $p < 0.05$, *** : $p < 0.01$, **** : $p < 0.001$

Table 1.9 – Value of the Bologna Process

<i>Country</i>	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
ALB	3	3	3	2	3	3	3	3	3	3	3	3	3	3
AUT	4	4	4	4	4	4	3	3	3	4	4	5	5	5
BEL	4	4	3	3	4	4	4	4	4	5	5	5	5	5
BIH	2	2	3	4	4	4	2	2	2	4	4	3	3	3
CHE	4	4	4	3	4	4	4	4	4	5	5	5	5	5
CYP	4	4	4	4	3	3	3	3	3	3	3	3	3	3
CZE	5	5	4	5	4	4	4	4	4	3	3	3	3	3
DEU	4	4	4	3	3	3	4	4	4	5	5	4	4	4
DNK	5	5	5	4	5	5	5	5	5	5	5	5	5	5
ESP	3	3	3	5	4	4	3	3	3	4	4	4	4	4
EST	4	4	4	5	4	4	4	4	4	4	4	5	5	5
FIN	4	4	5	4	4	4	4	4	4	4	4	5	5	5
FRA	4	4	4	4	4	4	4	4	4	5	5	5	5	5
GBR	4	4	4	3	4	4	4	4	4	4	4	4	4	4
HRV	3	3	4	4	4	4	4	4	4	4	4	5	5	5
HUN	4	4	4	5	4	4	3	3	3	3	3	4	4	4
IRL	5	5	5	4	4	4	5	5	5	5	5	4	4	4
ISL	5	5	5	5	4	4	4	4	4	4	4	5	5	5
ITA	4	4	4	4	3	3	3	3	3	4	4	4	4	4
LIE	5	5	4	4	4	4	4	4	4	3	3	5	5	5
LTU	4	4	4	4	4	4	4	4	4	5	5	5	5	5
LUX	3	3	4	4	3	3	4	4	4	4	4	5	5	5
LVA	4	4	4	4	4	4	4	4	4	4	4	3	3	3
MLT	4	4	4	4	3	3	3	3	3	4	4	3	3	3
NLD	5	5	4	5	4	4	5	5	5	4	4	5	5	5
NOR	5	5	5	4	5	5	5	5	5	5	5	5	5	5
POL	4	4	4	4	4	4	4	4	4	5	5	5	5	5
PRT	3	3	4	4	5	5	3	3	3	4	4	5	5	5
ROU	3	3	4	3	5	5	4	4	4	4	4	4	4	4
SRB	2	2	4	4	4	4	3	3	3	4	4	4	4	4
SVK	4	4	4	4	2	2	2	2	2	2	2	3	3	3
SVN	4	4	4	3	3	3	3	3	3	4	4	5	5	5
SWE	4	4	5	4	5	5	4	4	4	4	4	4	4	4
TUR	3	3	4	4	4	4	3	3	3	3	3	4	4	4

Table 1.10 – Descriptive statistics - Peripheral-Core Migration

<i>Variable</i>	<i>Count</i>	<i>Mean</i>	<i>Std. dev.</i>	<i>Min</i>	<i>Max</i>
inflows	4675	2508.975	9378.665	1	192172
scaled inflows	4675	2509.975	9378.665	2	192173
ln(inflows)	4675	5.812134	2.161366	0	12.16615
ln(scaled inflows)	4675	5.836344	2.118347	.6931472	12.16615
ln(first difference inflows)	4675	.0638773	.4502899	-2.456736	5.220356
ln(first difference scaled inflows)	4675	.0614008	.417284	-2.414289	4.532599
ln(GDP per capita)	4675	10.63837	.4786719	9.439443	11.56423
ln(first difference GDP per capita)	4675	.0092938	.0254838	-.088975	.068573
ln(unemployment)	4675	1.920208	.4735183	.8113745	3.261705
ln(first difference unemployment)	4675	.0092938	.0254838	-.088975	.068573
Eurozone	4675	.551016	.4974438	0	1
Schengen	4675	.9610695	.19345	0	1
EU membership	4675	.8085561	.3934796	0	1
ln(Distances)	4675	7.034339	.7115011	4.087945	8.324355
Common off. language	4675	.0539037	.2258518	0	1
Stock of foreign-born migrants	4675	8.238437	2.268727	2.302585	14.22828
Bologna ind. = 1	4675	0	0	0	0
Bologna ind. = 2	4675	.0175401	.1312865	0	1
Bologna ind. = 3	4675	.1516578	.3587272	0	1
Bologna ind. = 4	4675	.4660963	.4989026	0	1
Bologna ind. = 5	4675	.3647059	.4813991	0	1

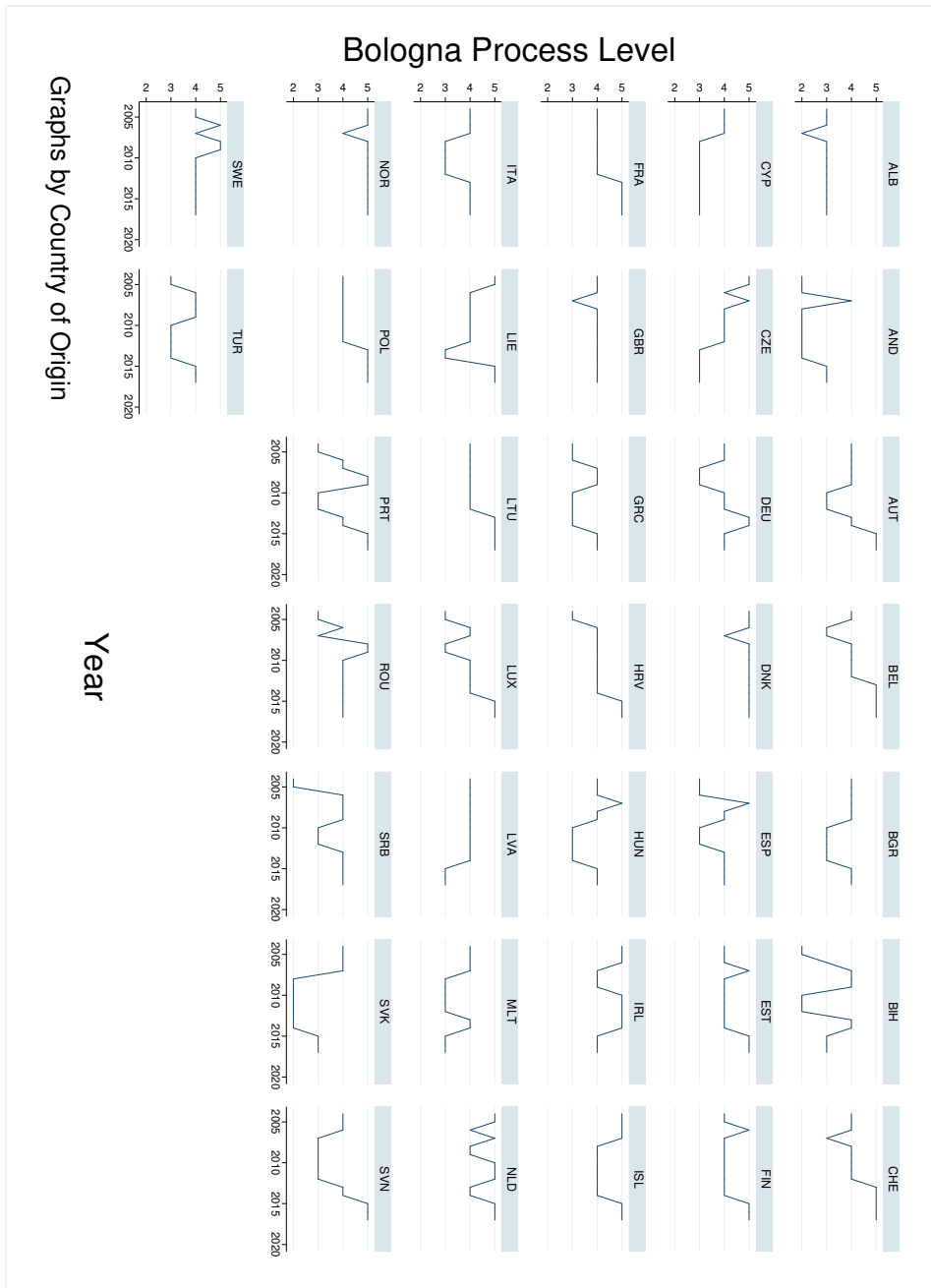


Figure 1.10 – Evolution by country of the Bologna Process Indicator

Source : Bologna Process Stocktaking Reports

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MONETARY POLICY AND BUSINESS CYCLE SYNCHRONIZATION IN EUROPE

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2.1 Introduction

There have been numerous policy recommendations and initiatives to face the financial and economic consequences of the Covid-19 crisis. This diversity of responses reflects the unequal ways in which European countries were hit. Indeed, at a country-level, or even at a region-level, European economies have reacted very differently, depending on their productive structure (Prades Illanes and Tello (2020)) and, as a consequence, are likely to require specific policy responses. In addition, this crisis challenges the relevance of already existing policies and institutions, especially common ones such as the euro currency. The pandemic indirectly revives the debate on the efficiency and relevance of the euro and, by extension, on what constitutes an optimal currency area (OCA) and its features, a concept introduced by Mundell (1961), McKinnon (1963) and Kenen (1969).

The European integration and the emerging idea of a common and single currency area in the 1990s have increased the number of works and discussions on the feasibility of a European Monetary Union (EMU).¹ A strand of this research has focused on the synchronization

1. Especially since the Maastricht Treaty in 1992.

of business cycles among European countries. Following [Mundell \(1961\)](#), business cycle synchronization (BCS) is one of the main prior conditions for a successful currency union² and contributes to more efficient monetary policies and fiscal coordination. Conversely, business cycle *de*-synchronization can threaten the viability of a currency union ([Ahmed et al. \(2018\)](#)). For these reasons, BCS is of significant importance for both researchers and policymakers in Europe.

Several works have studied the relationship between monetary policy and BCS, focusing on the impacts the former may have on the latter. So far, there have been numerous works on the impact of the adoption of the euro as a common and single currency ([Christodouloupoulou \(2014\)](#); [Antonakakis and Tondl \(2014\)](#); [Belke et al. \(2017\)](#)), but few on the impact of the common and single European monetary policy for all member countries over time. Yet monetary policy can have a strong effect on output.³ This effect is not homogeneous among European countries and can depend on the joint effect of country-specific financial and economic context ([Ouerk et al. \(2020\)](#)), financial characteristics ([Elbourne et al. \(2018\)](#)) or spillovers ([Burriel and Galesi \(2018\)](#)). Beyond the individual dimension, the effect of the monetary policy is also depending on the transmission channel used,⁴ which can vary across temporally ([Gutiérrez \(2006\)](#)). Finally, monetary policy can affect macroeconomic variables in very different ways when adopting a frequency approach ([Crowley and Hudgins \(2017\)](#)).⁵ The objectives of central banks can differ depending of the timescale adopted: monetary authorities can, for example, react very quickly (i.e. in the short run) to inflation news while the price level is mostly determined by the money supply in the long run, but also by the (slow) evolution of institutions and the replacement of policymakers ([Aguiar-Conraria et al. \(2008\)](#)). It is then important to adopt a frequency approach to the study of monetary policy impact. Our idea can be formulated as follows: the “one-size-fits-all” policy lead by the ECB, when applied to a diverse set of countries, give place

2. Other prior conditions include: a high trade integration, fiscal coordination and transfers, and a high degree of labor mobility ([Mundell \(1961\)](#))

3. Including *à la* Mundell-Fleming models ([Jordà et al. \(2020\)](#)) where, originally, the monetary policy efficiency is very limited.

4. [Beyer et al. \(2017\)](#) counts 9 transmission channels: the *interest rate* channel, the *monetary* channel, the *exchange rate* channel, the *asset price and wealth* channels, the *balance sheet and profitability* channel, the *bank funding and lending* channel, the *bank capital* channel, the *risk-taking* channel and the *expectations* channel

5. More generally, The need for a frequency-time approach of macroeconomics relationship has been shown in [Ramsey et al. \(1998\)](#).

to country-specific reactions which, in turn, result in different BCS processes at different terms. Our chapter aims at measuring this correlation and, if it exists, to determine the path of the monetary policy that achieves the greatest BCS.

Several factors have been investigated to explain the BCS of European countries. [Frankel and Rose \(1998\)](#), who were among the first to investigate this topic in Europe, use a single equation model with instrumental variable estimations to study the impact of trade between countries on their business cycle synchronization. They find a positive and strong relationship between bilateral trade intensity and BCS, but highlight the endogenous nature of the OCA. Specifically, the EMU could positively impact trade intensity between its members, fulfilling one of the conditions of its sustainability. This empirical observation is consistent with the one obtained by [Otto et al. \(2001\)](#). The latter, following [Frankel and Rose \(1998\)](#), rely on a single-equation model with instrumental variable estimations to study the impact of trade on BCS⁶, but also include financial links and monetary policy coordination.

A broad strand of the literature has investigated the impact of trade and its forms on BCS. [Imbs \(2004\)](#), who extends the set of independent variables to include country specialization, uses a system of simultaneous equations to tackle the endogeneity issue. He refines conclusions on the impact of trade by showing that intra-industry trade has a significant role in BCS, as does financial integration. Similar results are found by [Abbott et al. \(2008\)](#), who estimate a model with fixed and random effects to take into account potentially unobservable factors; [Alimi \(2015\)](#), who uses the Generalized Method of Moments (GMM) for a dynamic panel; and [Duval et al. \(2014\)](#), with an instrumental variable regression. The simultaneous equation strategy is also adopted by [Pentecôte et al. \(2015\)](#), who study the impact of trade exchange composition (i.e., changes in intensive or extensive margin) on BCS in the European Monetary Union. While they find that trade intensity has a significantly positive impact on BCS, new trade flows are shown to have a negative effect on output convergence, similar to the effect of specialization ([Krugman \(1993\)](#)). [Beck \(2019\)](#), with Bayesian Model Averaging (BMA), also supports the positive role of bilateral trade on BCS, but questions the possible role of a free trade area. Beyond its positive impact,

6. Their sample is broader than the one of [Frankel and Rose \(1998\)](#) as it is composed of 17 OECD countries.

trade intensity can also induce leading and lagging behaviors in BCS (Magrini et al. (2008)).

Another branch of the literature considers the impact of financial variables on BCS (Otto et al. (2001); Imbs (2004)) and finds a positive relationship between financial integration and BCS. Foreign Direct Investments (FDI) may have an ambiguous effect, since they can improve European BCS through its trade enhancing (Antonakakis and Tondl (2014); Jos Jansen and Stokman (2014)), but also negatively impact it as investors seek out to reduce their asset risk, and tend to diversify their portfolio with assets from less correlated economies (García-Herrero and Ruiz (2008)).⁷ Eventually, Cerqueira and Martins (2009) and Kalemlı-Ozcan et al. (2013) explore the reaction of BCS to financial openness and banking integration, and conclude to a negative effect of them on BCS.

Other factors explaining BCS have been explored, such as country specialization (Siedschlag and Tondl (2011); Déés and Zorell (2012)) or wage differential (Gächter et al. (2017)), with both of which have been found to be negatively correlated to the BCS. Lukmanova and Tondl (2017) employ the simultaneous equations method with the Seemingly Unrelated Regression (SUR) estimator to explore the impact of macroeconomic imbalances. They show that differences in the current account balance between members of the euro area can lead to business cycle divergence.

The effects of policies on BCS, the central topic of our study, account for fewer works in literature. ?, Degiannakis et al. (2016) and Bunyan et al. (2020) explore the impact of fiscal policy on output convergence. Otto et al. (2001) proxy the monetary policy using the volatilities of the spread between real short-term interest rates, and the bilateral exchange rates. While monetary policy coordination, understood as weak bilateral exchange rate volatility, has an impact on BCS (i.e. lower bilateral exchange rate correlated with higher output growth), the interest rate spread seems to have no significant effect on the latter. Altavilla (2004) captures the effect of the EMU employing a MSIH(3)-VAR(2) model⁸ and business cycles of seven countries. The results show the business cycles of European countries to be closer to each other than to the cycle of the U.S. since the establishment of the Maastricht Treaty. Partially similar results

7. This assumption corresponds to the conclusion of the standard international real business cycle model

8. Markov Switching model with three-regime shifting the Intercept of the VAR(2) and regime-dependent Heteroscedasticity.

are reached by [Papageorgiou et al. \(2010\)](#) using a rolling window approach: they notice a peak in European BCS within the 1992-1999 period, while the following 2000-2009 period sees a decreasing correlation of cycles. Conversely, [Gächter and Riedl \(2014\)](#) and [Degiannakis et al. \(2014\)](#) observe a positive effect of the adoption of the single currency on European BCS, with a feasible system GMM estimator and a scalar-BEKK model, respectively. Although monetary union has allowed a greater cross-country spillover effect of country-specific shocks (and thus an increase in co-movement within its members), it has also lead to more heterogeneous responses to common variations of the economic environment ([Enders et al. \(2013\)](#)). Other works have included a core-periphery dichotomy to refine the study of BCS in Europe. [Konstantakopoulou and Tsionas \(2011\)](#) and [Belke et al. \(2017\)](#) show that different regimes of synchronization are occurring in Europe: a core group characterized by a BCS, and peripheral countries failing to do so. This dichotomy may have been promoted by the implementation of the euro ([Lehwald \(2013\)](#)).

Falling into this strand of the literature, we investigate the role of monetary policy in explaining BCS in Europe between 2000 and 2018. To this end, we combine the wavelet analysis and a system General Method of Moments (GMM) panel dynamic estimator. To our knowledge, the wavelet method has been seldom used yet to study the relationship between monetary policy and business cycle synchronization. It will help us define the correlation of business cycles at different frequencies. With this output, we estimate a model with a system GMM panel dynamic estimator. Our results show that the effect of monetary policy is twofold: it is negative on the very-short-term and the long-term, but positive in the short- and medium-terms. The range of its effects surely reveals the relevance of a frequency approach as economic variables react differently following the adopted term. The impact that the set of unconventional monetary policies had on maintaining a coherent economic and monetary union is twofold: the reverse relationship between the SSR and the BCS at short and long-term indicates that uncommon monetary policy, or at least expansionary one, can be an efficient emergency response to face cyclical downturn as well as a long-term tools for economic convergence. In contrast, the fiscal policy tend to sustain business cycle synchronization by correcting the country-specific charac-

teristics at medium-term, while short-term and long-term fiscal divergence appears to have a harmful impact on the BCS.

The rest of the chapter is organized as follows: Section 2.2 introduces the methods adopted and the data used. Section 2.3 presents the results we obtain. Finally, Section 2.4 concludes.

2.2 Data and Methodology

2.2.1 Data

We rely on a set of 10 European countries, namely Austria, Belgium, Finland, France, Germany, Ireland, Italy, Netherlands, Portugal and Spain, over the period 2000Q1-2018Q3. All of the above-mentioned countries are members of the euro area, and in consequence subject to the monetary policy adopted by the ECB. We focus on pairwise synchronization between countries. In that respect, we have 45 country pairs and, consequently, 3375 country pair-quarter observations.⁹

Dependent variable

We first extract the business cycles by filtering GDP data series with a Beveridge-Nelson (BN) filter (Kamber et al. (2018)). The Beveridge-Nelson filter presents a number of advantages, such as large amplitudes or persistent estimates of the output gap. Cycles estimated by the BN filter are less subject to revisions than the ones estimated with the Hodrick-Prescott (HP) filter or the Christiano-Fitzgerald (CF) one, for example. From the cycle we obtained, we compute our dependent variable - business cycle synchronization - between countries i and j at each time and frequency with continuous wavelets.¹⁰ The wavelets are used as an adaptative filter as opposed to traditional tools requiring low or high bandpass filters to extract or decompose a series. On this basis, the wavelets allow to study and extract multiple cycles with different periods generally hidden in the time domain (Drago and Boxall (2002)) or requiring many methods to extract them

9. Table 2.1 presents the variables used, the transformations we performed and the sources.

10. The methodology is presented for the wavelets later in the article.

separately. In addition, wavelet transforms have the ability to preserve the time information of frequency components of a time series, unlike the Fourier transform or Adaptive Spectrum analysis ([Adamowski et al. \(2009\)](#); [Quiroz et al. \(2011\)](#)). This property allows to analyze the cycles' evolution across time.

Applying to GDP data, we can extract a wide range of business cycles from one time series and analyze their volatility or time evolution, highlighting changes or breaks due to events localized in a particular time. [Yogo \(2008\)](#) uses wavelet decomposition to describe the gross domestic product of the USA and extract various business cycles. The author indicates that this approach is similar to the Baxter-King filter in their objectives, but more useful as it allows both time and frequency representation of all (sub-) cycles in the initial GDP series. By decomposing the GDP with wavelets, he presents the different cycles obtained, indicating that before the 1960s the dominant business cycle has a period of 8-16 quarters while after 1970 a great part of variations is due to low-frequency cycles of 16-32 quarters.

The wavelet approach is also useful in a multivariate case, as we can catch the time-dynamic correlation between two series through wavelets coherence-phases. The analysis of series linkages is then put into a time-frequency space providing a multidimensional view of correlation and co-movements between two series.

The wavelet decompositions are useful to analyze and describe all components of a univariate time series, including trends. However, trends are in this case considered multifrequency components because their effects are divided across all frequencies ([Drago and Boxall \(2002\)](#)). [Craigmile and Percival \(2014\)](#) indicate that trend estimation or detection through wavelets is conditional to the presence of "noise", which could disturb the extraction of all the different cycles. In addition, they indicate that wavelets are useful to describe cycles and, on the necessity to associate wavelets with other methods to properly study trend through wavelets (as [Prokoph et al. \(2012\)](#) or [Pandey et al. \(2017\)](#) did recently in hydrology). They also discuss the different kinds of wavelet regarding their different objectives: some wavelets are better suitable to model trends, while others are used to estimate cycles, creating a trade-off between the accuracy of cycles and the trend. [Nalley et al. \(2012\)](#) also indicate that trend extraction or estimation by

wavelets is possible but it requires the trend extraction frequencies to be defined clearly.

However, in a multivariate case, the wavelet approach is useful to study the time-frequency correlation and co-movement dynamics. [Kahraman and Ünal \(2016\)](#) use wavelets to study the relationships between financial variables, but they model trend and frequency components separately. The cross-decompositions of two trended time series could be affected by a spurious correlation because, by nature, low-frequencies components are correlated when there are trends.

In our chapter, on top of using wavelets to describe cycles and trends, we employ this technique to compute the time-varying correlation between business cycles at different periods which can be used as explanatory variables. The wavelets provide intermediary results on correlations and we should limit the potential effects of trends on the extraction of cycles. Then, we remove trend from GDP data in order to properly analyze the business cycles without the effect of the trend on frequencies considered as a boundary effects, as mentioned by [Craigmle and Percival \(2014\)](#).

Explanatory variables

A conventional approach to embody monetary policy is to take the main refinancing operation (MRO) rate. This indicator is relevant when studying the conventional monetary policy (CMP) led by central banks. For example, [Galariotis et al. \(2018\)](#) use it to assess the impact of CMP on expectations and sentiments. However, in the aftermath of the 2007-08 financial crisis, the MRO appeared to be a limited tool for central bankers as its interest rate (set by the ECB) was approaching the zero lower bound (ZLB). Several central banks implemented then unconventional measures to face this limitation, such as the Long Term Refinancing Operations (LTROs) or the Securities Markets Programme (SMP) for the European Central Bank.

In order to measure the impact of the unconventional monetary policy (UMP), [Galariotis et al. \(2018\)](#) and [Kenourgios et al. \(2019\)](#) use dummy variables equal to one the date the program is implemented or announced, and zero otherwise. This method faces some limits: it does not take into account the nature of monetary policy (except if the number of dummy variables used is representative of the panel of UMP), nor its magnitude.

Another strategy is to work with the ECB Balance Sheet. Indeed, it incorporates the nature and the amount of the different UMP. This strategy is adopted by [Boeckx et al. \(2017\)](#) and [van den End and Pattipeilohy \(2017\)](#), among others, to study the effect of UMP on economic activity and inflation. Nevertheless, this approach does not take into account the announcement effect. As reminded by [Ouerk et al. \(2020\)](#), agents anticipate the future decisions of Central Banks (as in January 2015 regarding the quantitative easing). To overcome this obstacle, [Ouerk et al. \(2020\)](#) rely on the Shadow Short Rate (SSR). Developed by [Black \(1995\)](#) and popularized by [Wu and Xia \(2016\)](#) and [Krippner \(2014\)](#), it is a “quantitative measure that indicates the overall stance of the monetary policy when the conventional monetary policy instrument (the short-term policy rate) is at the ZLB” ([Kuusela and Jari \(2017\)](#)) and consists of a decomposition of the observed yield curve into a shadow yield curve plus an option. It embodies both aspects of the UMP (announcement and measure effects) and can be positive or negative. We opt for Leo Krippner’s SSR as our monetary policy variable in the rest of the chapter.

We adopt the most common and relevant control variables to study BCS: the fiscal policy divergence, the export flows, the saving rate difference and the labor cost difference.

We proxy divergence in fiscal policies adopted in countries i and j with the absolute difference of the Cyclically Adjusted net Lending and net Borrowing (CALB) for each country’s general government:

$$\text{Diff in CALB}_t = |\text{CALB}_{i,t} - \text{CALB}_{j,t}| \quad (2.1)$$

This variable is of particular interest since it is the country-based side of economic policy in Europe (the common and shared policy being the monetary one).

Another important variable is the export flow. We do not use the gross flows of exports but rather divide the sum of the bilateral flows by the sum of the respective countries’ GDPs. It gives a relative size of trade flows between the two countries:

$$\text{Sum of Exports}_{ij,t} = \frac{\text{Exports}_{i,t} + \text{Exports}_{j,t}}{\text{GDP}_{i,t} + \text{GDP}_{j,t}} \quad (2.2)$$

The saving rate difference proxies the consumer side of the economy and is calculated as follows:

$$\text{Diff in Savings}_t = \left| \text{Savings}_{i,t} - \text{Savings}_{j,t} \right| \quad (2.3)$$

Finally, similarly to [Lukmanova and Tondl \(2017\)](#), we use the labor cost as a proxy of the different development of wages:

$$\text{Diff in Labor cost}_{i,j,t} = \left| \text{Labor cost}_{i,t} - \text{Labor cost}_{j,t} \right| \quad (2.4)$$

Table 2.1 – Variables’ description and data sources

Variable	Title	Source	Frequency	Transformation
CALB	Cyclically adjusted net lending (+) or net borrowing (-) of general government: Adjustment based on potential GDP Excessive deficit procedure (UBLGAP) CALB	AMECO Database	Annual	Quadratic match-average
Bilateral Trade Flows	EU trade by HS6	Eurostat	Monthly	Average of 3 months to obtain the quarterly value
Labour Cost	Unit labour costs and labour productivity (employment based), Total economy	OECD	Quarterly	-
Shadow short rate	Month-End SSR series	Leo Krippner’s Website	Monthly	-
GDP	Gross Domestic Product	Eurostat	Quarterly	-
Saving Rate	Household saving rate	Eurostat	Annual	Quadratic match-average

2.2.2 Wavelets

We use the wavelet phase coherence analysis to estimate the synchronization between the business cycles at each time t and frequency f . Then, we create the dependent variable of the model. The wavelets approach, popularized by [Grossmann and Morlet \(1984a\)](#), is a theoretical extension and a methodological improvement of the (co-)spectral analysis and frequency decomposition of a series. It allows a time-based representation of the frequency component of a signal (in our case, time series) and to realize a time-frequency analysis. Although it has been theoretically developed in a continuous form with the Continuous Wavelets Transform (CWT), the required computational power was a major obstacle to its practical implementation. That is why discretized versions have been elaborated: [Mallat \(1989, 2001, 2009\)](#) made the link between multiresolution analysis and wavelets, reducing substantially the computational time on a discrete basis with the Maximal Overlap Discrete Wavelets Transform (MODWT).

In economics, wavelets can be used to extract different types of cycles in economic series depending on the frequencies and the periods. This methodology allows the analysis of the relations between variables in a new time-frequency space. [Gençay et al. \(2003, 2005\)](#) and [Mestre and Terraza \(2018a,b, 2019\)](#) use the discrete wavelet transform to study the Capital Asset Pricing Model (CAPM) considering frequencies as different investment horizons for agents (long-term, middle-term, short-term). Their works show that results in terms of portfolio risks and allocations can be differentiated following the horizon, which implies the presence of frequency dynamics of co-movements between variables. [Rua and Nunes \(2009\)](#) use coherence and phase of CWT to capture long- and short-term co-movements between international financial markets. The authors highlight the importance of relying on wavelet transform to study causality and inter-dependencies between variables. [Vacha and Barunik \(2012\)](#) and [Bekiros et al. \(2016\)](#) also rely on coherence and phase of CWT to study diversification of portfolio through the time-frequency relationship between assets and commodity prices. Analogously, [Auth \(2013\)](#) and [Bekiros and Marcellino \(2013\)](#) focus on hedge funds and the dynamic of exchange rates, and show that the intensity of the relationship between variables depends on the different cycle

frequencies adopted.

Continuous Wavelets Transform (CWT)

The time-frequency analysis using continuous wavelets represents an improvement of the Fourier approach as it allows a time representation of a series' frequency components. Wavelets theory has been formulated by Grossmann and Morlet (1984b), Meyer et al. (Septembre 1987) and Meyer (1992), and popularized by Mallat (1989, 2001, 2009) and Daubechies (1992) in signal treatment.

A continuous wavelets transform is based on a *mother wavelet* noted $\psi(t)$, translated by τ and dilated by s to extract the information of a series $x(t)$ on several frequencies. Overall translated-dilated versions of $\psi_{\tau,s}(t)$ form the following *wavelet family* :

$$\psi_{\tau,s}(t) = \frac{1}{\sqrt{s}}\psi\left(\frac{t-\tau}{s}\right) \quad (2.5)$$

The CWT consists of projecting $x(t)$ on the family $\psi_{\tau,s}(t)$ to obtain the variations of the series in the neighbourhood of $t \mp \tau$ and of frequency amplitude of s . Varying τ and s , we get the following wavelets coefficients $W(s, \tau)$:

$$W(s, \tau) = \int_{-\infty}^{+\infty} x(t) \frac{1}{\sqrt{s}}\psi^*\left(\frac{t-\tau}{s}\right)dt \quad (2.6)$$

with $\psi^*\left(\frac{t-\tau}{s}\right)$ being the complex conjugate of $\psi_{\tau,s}(t)$.

We can reconstruct $x(t)$ with the following reverse operation:

$$x(t) = \frac{1}{C_\psi} \int_{-\infty}^{+\infty} \int_{-\infty}^{+\infty} \psi_{\tau,s}(t)W(s, \tau) \frac{d\tau ds}{s^2} \quad (2.7)$$

The expression highlights the C_ψ condition of existence of the wavelets (Calderón (1964)):

$$C_\psi = \int_0^{+\infty} \frac{|\hat{\Psi}(f)|^2}{f} df < +\infty \quad (2.8)^{11}$$

where f denotes the frequency and $\hat{\Psi}(f)$ the Fourier transform of the mother wavelet. This condition is respected if $\psi(t)$ has a zero mean and keeps the same variance when decomposed:

$$\int_0^{+\infty} \psi(t) dt = 0 \quad \text{and} \quad \int_0^{+\infty} |\psi(t)|^2 dt = 1 \quad (2.9)$$

There are several mother wavelet families with different features related to their orthogonality, symmetry or compact support (as showed by [Farge \(1992\)](#) and [Daubechies \(1992\)](#)). Here, we will use the (continuous) complex Morlet wavelet $\psi_M(t)$, characterized by an equilibrium between the time and the frequency localization:

$$\psi_M(t) = \pi^{-1/4} e^{if_0 t} e^{-\frac{t^2}{2}} \quad (2.10)$$

where $i^2 = -1$ and f_0 is the non-dimensional frequency which, in our case, equals 6 to satisfy the admissibility condition. We realize a frequency sampling for the practical implementation because of limited computational power. Facing obstacles in the use of CWT, [Lau and Weng \(1995\)](#) and [Torrence and Compo \(1998\)](#) define the whole s_j scales of a J maximal order CWT decomposition with a good resolution and reasonable computational time. These formulas are defined from the size of the series N (thus from δ_t , the time step) and the frequency step δ_j :

$$s_j = S_0 \cdot 2^{j\delta_j}, \forall j \in [0, \dots, J] \quad (2.11)$$

$$J = \frac{1}{\delta_j} \left\lfloor \log_2 \left(\frac{N\delta_t}{s_0} \right) \right\rfloor = \frac{1}{\delta_j} \left\lfloor \log_2 \left(\frac{N}{2} \right) \right\rfloor$$

The smaller δ_j , the bigger the number of intermediary scales and the finer the frequency mesh s_j . The choice of δ_j is also linked to the mother wavelet. In our case, the value must not exceed 0.5. We fix the value of δ_j at 1/8 to obtain a consistent frequency mesh with a reasonable computational time.

The interpretation of the frequency scales s_j can be facilitated by expressing them in Fourier

11. f being the frequency and $\hat{\Psi}(f)$ the Fourier transform of the mother wavelet

Period, whose unity is similar to the initial series. Meyers et al. (1993) propose a Conversion Factor (CF) proper to the Morlet wavelet used:

$$T_j = s_j * \frac{4\pi}{f_o + \sqrt{2 + f_0^2}} \quad (2.12)$$

$$CF = \frac{4\pi}{f_o + \sqrt{2 + f_0^2}} = 1.033 \quad (2.13)$$

Wavelet Phase Coherence

The CWT allows to redefine some statistical notions as correlation in time-frequency space. Notions of coherence and phase are similar, in terms of interpretation, to the determination coefficient (i.e., R^2)(Grinsted et al. (2004)) but transcript statistical information depending on the time (time dynamic) and the frequency (frequency dynamic) we are interested in.

Considering two time functions $x(t)$ and $y(t)$ with similar size N , we can deduce the wavelet coefficients (respectively, $W_x(s, \tau)$ and $W_y(s, \tau)$) via the CWT. The time-frequency co-variance can be obtained by crossing the wavelet coefficients:

$$SW_{xy}(s, \tau) = W_x(s, \tau)W_y^*(s, \tau) \quad (2.14)$$

where $SW_{xy}(s, \tau)$ is the cross transform, $W_x(s, \tau)$ are the wavelet coefficients from the transform, and $W_y^*(s, \tau)$ is the conjugate complex of $W_y(s, \tau)$.

The wavelet coherence, noted $WQ(s, \tau)$, between two functions is achieved by dividing the wavelets crossed spectrum by the power spectrum of each function:¹²

$$WQ(s, \tau) = \frac{|G(s^{-1}.SW_{xy}(s, \tau))|^2}{G(s^{-1}.|W_x(s, \tau)|^2).G(s^{-1}.|W_y(s, \tau)|^2)} \quad (2.15)$$

We can then notice the similarity between the coherence and the coefficient of determination. For each frequency scale s_j defined by δ_j and each time moment, we obtain a value between 0

12. We use the R-package of Gouhier et al. (2019) based on the program of Torrence and Compo (1998).

and 1. However, in our case, they are complex due to the use of the Morlet wavelets. In its real representation, the coherence is equal to 1 regardless of the value of τ , making its interpretation useless. The use of a time-frequency smoothing, noted $G(\cdot)$, is necessary to get interpretable values in practice. A time-based smoothing $G_{time}(\cdot)$ for a fixed scale s is first made, then come the smoothing of frequency scales for a given moment t , noted $G_{scale}(\cdot)$. The general smoothing operator $G(\cdot)$ is written as follows:

$$G(W(s, \tau)) = G_{scale}(G_{time}(W(s, \tau))) \quad (2.16)$$

The mathematical expressions of G_{scale} and G_{time} are given by [Torrence and Webster \(1999\)](#):

$$G_{time}(\cdot) = W(s\tau)c_1^{\frac{-t^2}{2s^2}} \quad (2.17)$$

$$G_{scale}(\cdot) = W(s\tau)c_2\Pi(0.6s) \quad (2.18)$$

where c_1 and c_2 are the *constants of normalization* and $\Pi(\cdot)$ is the rectangular function that takes the value 1 in the interval $[-0.5; 0.5]$ and 0 otherwise.

The difference in phase between two series (hereafter named "phase difference") is the complementary value needed to get the sign of the relationship as well as the mutual influences between the variables (with the notion of "leader").

The phase function in wavelets, noted $\theta_{xy}(s, \tau)$, is defined as the arc-tangent of the ratio between the imaginary part \Im and the real part \Re of $SW_{xy}(s, \tau)$:

$$\theta_{xy}(s, \tau) = \arctan\left(\frac{\Im(SW_{xy}(s, \tau))}{\Re(SW_{xy}(s, \tau))}\right) \quad (2.19)$$

The study of the phase value, ranging between $[-\pi, \pi]$, allows us to analyze the sign of the relationship and the mutual influences between the two variables, indicating the "leader" variable.

From Equations (15) and (19), we extract a correlation coefficient at each time and frequency

representing the BCS between two countries i and j such as:

$$\text{BCS}_{ij,s,\tau} = \vartheta_{s,\tau} \cdot \sqrt{WQ(s,\tau)} \quad (2.20)$$

where $\vartheta_{s,\tau}$ is a phase parameter indicating the sign of the correlation between the two variables according to the value of the phase function.

$$\vartheta_{s,\tau} = \begin{cases} 1, & \text{if } |\theta_{xy}(s,\tau)| \in [0, \frac{\pi}{2}] \\ -1, & \text{if } |\theta_{xy}(s,\tau)| \in [\frac{\pi}{2}, \pi] \end{cases}$$

2.2.3 System GMM panel dynamic estimator

An important issue raised from our data is the possible *endogeneity* of our variables. [Frankel and Rose \(1998\)](#), who estimated a robust positive relationship between trade and business cycle synchronization, addressed this problem in the dynamic of the estimated relationship: stronger trade linkages would increase BCS which, in turn, would increase trade flows between countries. In response to that, [Imbs \(2004\)](#) will be the first to rely on a dynamic approach by adopting a system of simultaneous equations. This method deals with the endogeneity of the model by employing external instruments for each explanatory variable. However, if this approach allows us to solve a problem, it creates another one with the selection of the instrumental variables.

The other problem is the possible correlation between the lagged dependent variable and country-specific effects. A solution is to take the model in difference but the source of correlation would simply be the difference of the above-mentioned variables.¹³

To deal with these issues and avoid the selection of non-relevant instruments, we adopt the strategy of [Cerqueira and Martins \(2009\)](#) and [Bunyan et al. \(2020\)](#) with a *system GMM panel dynamic estimator*. First, it corrects the bias due to the correlation between the unobservable fixed effects and the lagged values. Second, it allows us to get from the data their own instruments: the lagged values of the data are relevant instruments since they can be correlated to the

13. In these both cases of endogeneity, the OLS estimations are biased.

variation of the next value without being correlated to the variation of the actual error term. Resorting to the GMM regarding the characteristics of our sample may not appear as the optimal solution. Indeed, the GMM estimator works fine in samples with large N and small T , but become inconsistent as the number of instruments grows quadratically with T . To overcome this issue, we apply the double filter IV and GMM estimator developed by Hayakawa et al. (2019), whose properties lead to an unbiased estimator when both N and T are large.

Our model is:

$$\text{BCS}_{ij,t,f} = \alpha + \beta_1 \text{BCS}_{ij,t-1,f} + \beta_{2,f} \text{SSR}_t + \beta_k X'_{ij,t,f} + \alpha_{ij} + \alpha_t + u_{ij,t,f} \quad (2.21)$$

with $\text{BCS}_{ij,t,f}$ our BCS between a given pair of countries i and j at time t and at frequency f , $\text{BCS}_{ij,t-1,f}$ its lagged value, SSR_t the shadow short-rate, $X'_{ij,t}$ the matrix of control variables, α_{ij} a country pair fixed effect, α_t a time fixed effect and $u_{ij,t}$ the error term. $X'_{ij,t}$ includes the exports variable, the difference in CALB, the difference in saving rates and the difference in labor costs. As the estimation method requires to take the model in differences, the country pair fixed effects are eliminated. The coefficient of interest is $\beta_{2,f}$ here. Since it is the link to monetary policy variable, we will be able to measure the sign and the significance of the monetary policy at different frequencies f . We also estimate a model to take into account a possible level effect of the SSR by creating the interaction variables $I_t^{\text{SSR}^+}$ and $I_t^{\text{SSR}^-}$ as follows:

$$\begin{aligned} \text{BCS}_{ij,t,f} = & \alpha + \beta_1 \text{BCS}_{ij,t-1,f} \\ & + \beta_{2,f} \text{SSR}_t * I_t^{\text{SSR}^-} + \beta_{3,f} \text{SSR}_t * I_t^{\text{SSR}^+} \\ & + \beta_k X'_{ij,t,f} + \alpha_{ij} + \alpha_t + u_{ij,t,f} \end{aligned} \quad (2.22)$$

$$I_t^{\text{SSR}^-} = \begin{cases} 1, & \text{if } \text{SSR}_t < 0 \\ 0, & \text{otherwise} \end{cases}, I_t^{\text{SSR}^+} = \begin{cases} 1, & \text{if } \text{SSR}_t > 0 \\ 0, & \text{otherwise} \end{cases}$$

Finally, our results are presented along with the Sargan-Hansen test of the overidentifying restric-

tions¹⁴ and the Arellano-Bond test for autocorrelation of the first-differenced residuals ($AR(1)$ and $AR(2)$).

2.3 Results

2.3.1 Wavelet correlations

Figures 2.1 to 2.9 present the correlograms for the business cycles of the ten countries selected. The color-coding ranges from blue (low synchronization) to red (high synchronization) and the black lines delineate the strong coherency area. The period (the y-axis) goes from 2 (6 months) to 32 (8 years). Here, the notion of lead is not to be understood as a causal relationship (for example, “the belgium cycle explains the german one”), but more as the observed correlation (when common movements occur, the belgium cycle predates the german one).

In most of the figures presented, we can first notice that the synchronization is “in phase”.¹⁵ In other words, we mainly observe a positive correlation of the cycles.¹⁶ Then, we note a peak in the synchronization of cycles between mid-2007 and 2010 for the short/medium-term period (1.5 years to 2.5/3 years), which corresponds to the 2007 subprime crisis period. Since it was a common and global shock, most of the countries’ economies reacted similarly: a drastic fall of their outputs. So it is no surprise to us to notice that business cycles of most of European countries were in phase.

Ireland seem to have considerably de-synchronized cycles with the rest of our sample. Our result corroborates those obtained by [Aguiar-Conraria and Joana Soares \(2011\)](#): after 2011, the Irish business cycle does not seem to be synchronized with any of the European business cycles. In the face of this observation, we can rightly wonder if the Irish economy is tailored for the euro area. To a lesser extent, Portugal’s business cycles seem independent from those of the other European countries, with the exception of Italy. However, unlike what we can observe for

14. The results of the Sargan-Hansen test of the overidentifying restrictions maybe be questioned since the test can be biased by data features such as persistence or large time series ([Richard et al. \(2001\)](#)).

15. In regions of high significance (delimited with a dark line), arrows are pointing right in almost every case.

16. Otherwise, it would mean that the cycles are significantly in anti-phase. This result would raise a certain number of issues regarding the relevance of the euro area.

Ireland, Portugal appears to be incrementally synchronized”, notably at medium-term (2 to 4 years cycles). Finally, Spain also presents a limited synchronization of its cycles with the rest of Europe.

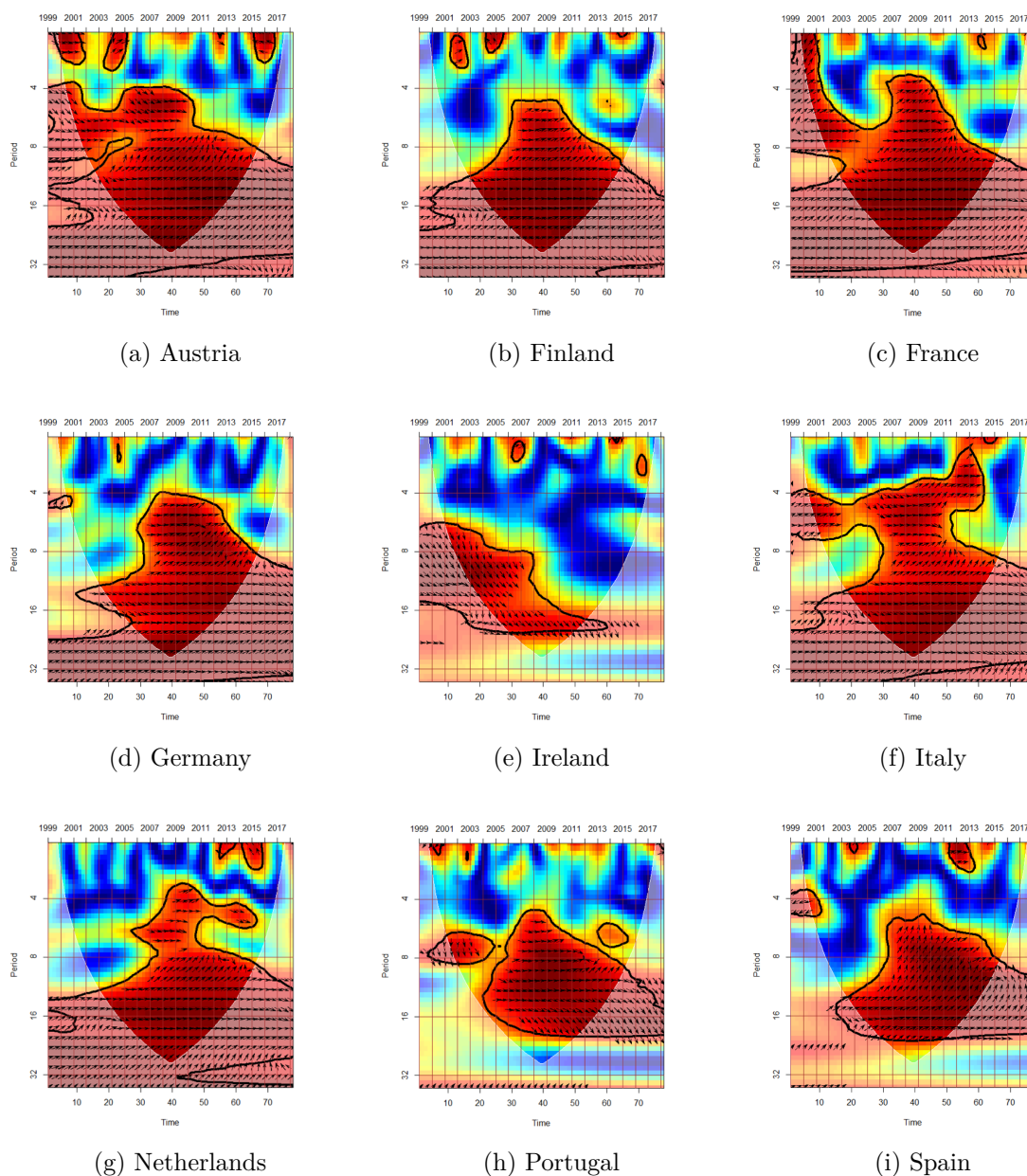
We can identify two countries which are the center of what is usually named the “European core”: France and Germany. Both have highly synchronised business cycles with other European countries (Figures 2.4 and 2.5). This “cyclic” proximity reveals a geographical one: the European core is mostly composed of northern European countries, with common borders (France, Germany, Belgium, Netherlands, Austria, Finland), while countries such as Portugal, Spain and Ireland have their own business cycle patterns.

Italy has strong cycle synchronizations with most of the countries composing our panel, remarkably strong and deep with Spain and Portugal. This outcome reflects the ambiguous situation of Italy as part of the European core and the European periphery (Ahlborn and Wortmann (2018)).

2.3.2 System GMM estimation

Table 2.2 shows the results of the model estimations. The Sargan-Hansen test and the Arellano-Bond tests highlight the good statistical properties of our estimates. In this model, all our variables are considered as endogenous variables. The model is estimated with 4 different dependent variables: the correlation at a 6 months frequency ($Corr. 6m_t$), at 1 year ($Corr. 1y_t$), 2 years ($Corr. 2y_t$), and 4 years ($Corr. 4y_t$). The variety of frequencies will help us control the effect of monetary policy at different horizons and determine the short-, medium- and long-run determinants of the BCS. The 6 months frequency represents the short-run period, the 1 year and 2 years frequencies the medium-run period, and the 4 years frequency the long-run period. The model with the correlation at 6 months shows the short-term drivers of correlations. In this case, besides the lagged value of the dependent variable ($Corr. 6m_{t-1}$ with a significant positive coefficient that equals to 0.832), the exports play a negative role in the synchronization of the business cycles ($-4.86e^{-10}$). This result may be surprising since we expect a transmission of business cycle movement to commercial partners through trade. However, significant flows and

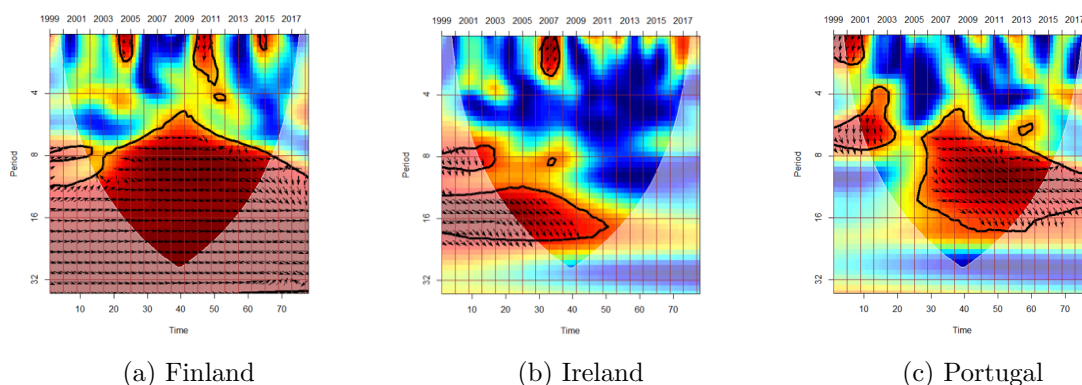
Figure 2.1 – Wavelet correlation with Belgian business cycles.



Note: Morlet mother wavelets, 1/12 frequency step, phase difference plotted with arrows, significance of R^2 at 5% by Monte-Carlo method (300 simulations). If the arrows are pointing right then X (here, Belgium) and Y (here, countries mentioned below the graph) are in phase (positive correlation). If the arrows are pointing left then X and Y are in anti-phase (negative correlation). The phase difference, θ , is useful to analyze “lead-Lag” indicating if X (or Y) leads Y (or X):

- If $\theta \in [\frac{\pi}{2}, \pi]$, then Y lead X in anti-phase: arrow pointing **up-left**.
- If $\theta \in [-\frac{\pi}{2}, 0]$, then Y lead X in phase: arrow pointing **down-right**.
- If $\theta \in [0, \frac{\pi}{2}]$, then X lead Y in phase: arrow pointing **up-right**.
- If $\theta \in [-\pi, -\frac{\pi}{2}]$, then X lead Y in anti-phase: arrow pointing **down-left**.

Figure 2.2 – Wavelet correlation with Austrian business cycles.



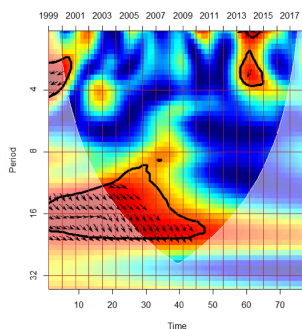
Note: Morlet mother wavelets, 1/12 frequency step, phase difference plotted with arrows, significance of R^2 at 5% by Monte-Carlo method (300 simulations). If the arrows are pointing right then X (here, Austria) and Y (here, countries mentioned below the graph) are in phase (positive correlation). If the arrows are pointing left then X and Y are in anti-phase (negative correlation). The phase difference, θ , is useful to analyze “lead-Lag” indicating if X (or Y) leads Y (or X):

- If $\theta \in [\frac{\pi}{2}, \pi]$, then Y lead X in anti-phase: arrow pointing **up-left**.
- If $\theta \in [-\frac{\pi}{2}, 0]$, then Y lead X in phase: arrow pointing **down-right**.
- If $\theta \in [0, \frac{\pi}{2}]$, then X lead Y in phase: arrow pointing **up-right**.
- If $\theta \in [-\pi, -\frac{\pi}{2}]$, then X lead Y in anti-phase: arrow pointing **down-left**.

trade specialization make countries more vulnerable to fluctuation of their partners’ demands, and in consequence, can lead to business cycle divergences. The difference in labor costs plays a positive role on BCS. Put differently, an increase in the labor cost difference, proxying the wage difference, increases the synchronization of the business cycles. In that sense, our results are in conflict with the findings of [Gächter et al. \(2017\)](#). The saving rate difference also plays a positive role with a coefficient that equals to 0.287. The BCS is sensible to the difference in consumption and saving structure between economies. Surprisingly, the divergence in implemented fiscal policies has a negative impact on BCS (-0.031). This result reflects different reactions to country-specific economic stimuli, since the timeframe of our sample contains important crisis periods. Finally, the coefficient associated to our variable of interest SSR_t is significant: -0.276 . Thus, at a very short-term, a decrease of the shadow rate and/or the implementation of unconventional monetary policy helps the synchronization of the European business cycles.

Models at a 1-year and 2-years frequency point approximately in the same direction: the

Figure 2.3 – Wavelet correlation with Finnish business cycles.



(a) Ireland

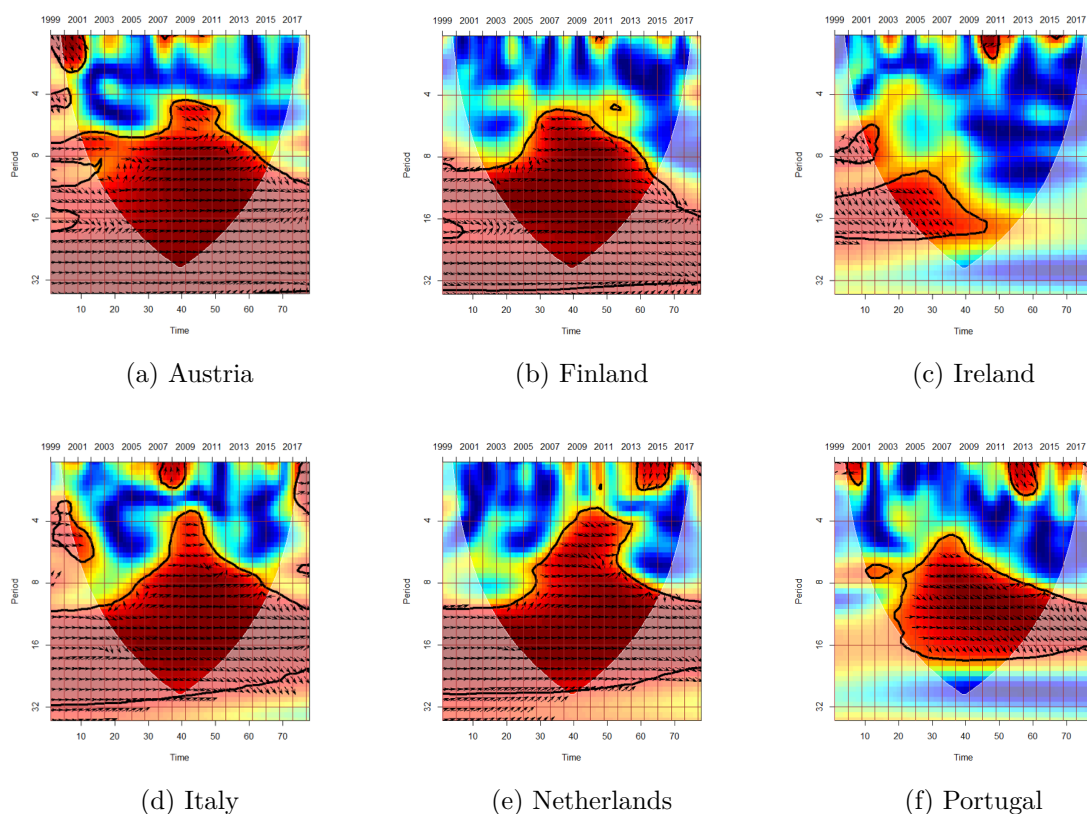
Note: Morlet mother wavelets, 1/12 frequency step, phase difference plotted with arrows, significance of R^2 at 5% by Monte-Carlo method (300 simulations). If the arrows are pointing right then X (here, Finland) and Y (here, countries mentioned below the graph) are in phase (positive correlation). If the arrows are pointing left then X and Y are in anti-phase (negative correlation). The phase difference, θ , is useful to analyze “lead-Lag” indicating if X (or Y) leads Y (or X):

- If $\theta \in [\frac{\pi}{2}, \pi]$, then Y lead X in anti-phase: arrow pointing **up-left**.
- If $\theta \in [\frac{-\pi}{2}, 0]$, then Y lead X in phase: arrow pointing **down-right**.
- If $\theta \in [0, \frac{\pi}{2}]$, then X lead Y in phase: arrow pointing **up-right**.
- If $\theta \in [-\pi, \frac{-\pi}{2}]$, then X lead Y in anti-phase: arrow pointing **down-left**.

labor difference, here as a negative impact (-0.0178 and -0.0172), which is more coherent with what we find in the literature. The fiscal policy divergence also has a reverse impact: 0.027 and 0.0200 . With a “one-size-fits-all” monetary approach, fiscal policy is the main tool to balance the specificity of countries. It is then not a surprise to see a positive impact of divergent fiscal policies adopted, supporting growth of countries with country-adequate policies. The Shadow Short Rate impacts also positively the BSC, indicating that a tighter monetary policy improves the BSC in Europe at a short-medium term. Eventually, we notice that trade impacts positively the BCS, contrary to its effect at the short frequency.

Finally, the model at a 4-years frequency brings us more information on the determinants of long-term synchronization. The SSR has a negative impact: a reduction of SSR leads, at long-term, to an increase in BCS between European countries (-0.0772). Numerous explanations can be given to explain the results, such as the positive impact that low interest rates can have on investment, which in turn, affects the economy. The reduction of labor cost differences decreases

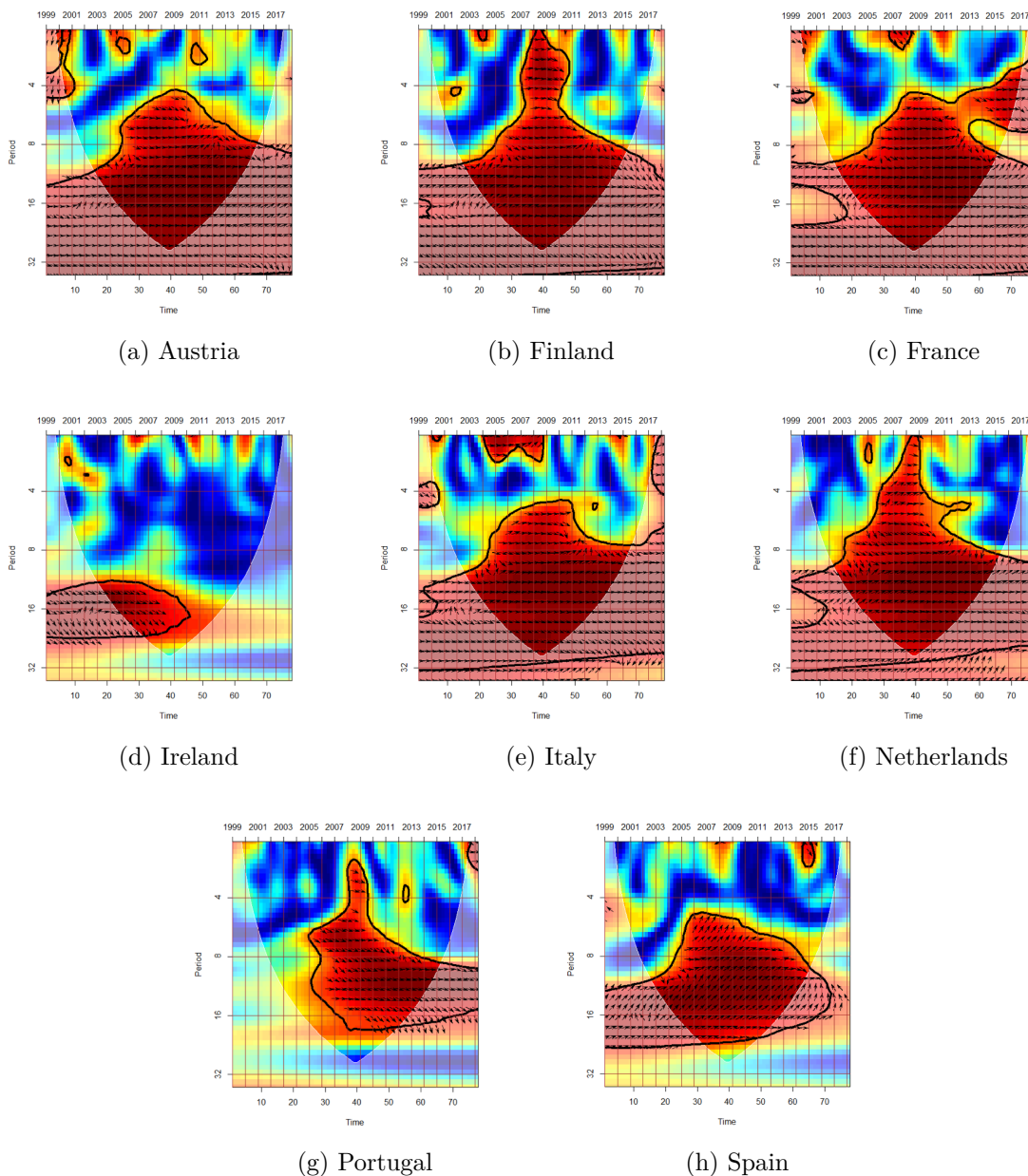
Figure 2.4 – Wavelet correlation with French business cycles.



Note: Morlet mother wavelets, 1/12 frequency step, phase difference plotted with arrows, significance of R^2 at 5% by Monte-Carlo method (300 simulations). If the arrows are pointing right then X (here, France) and Y (here, countries mentioned below the graph) are in phase (positive correlation). If the arrows are pointing left then X and Y are in anti-phase (negative correlation). The phase difference, θ , is useful to analyze “lead-Lag” indicating if X (or Y) leads Y (or X):

- If $\theta \in [\frac{\pi}{2}, \pi]$, then Y lead X in anti-phase: arrow pointing **up-left**.
- If $\theta \in [-\frac{\pi}{2}, 0]$, then Y lead X in phase: arrow pointing **down-right**.
- If $\theta \in [0, \frac{\pi}{2}]$, then X lead Y in phase: arrow pointing **up-right**.
- If $\theta \in [-\pi, -\frac{\pi}{2}]$, then X lead Y in anti-phase: arrow pointing **down-left**.

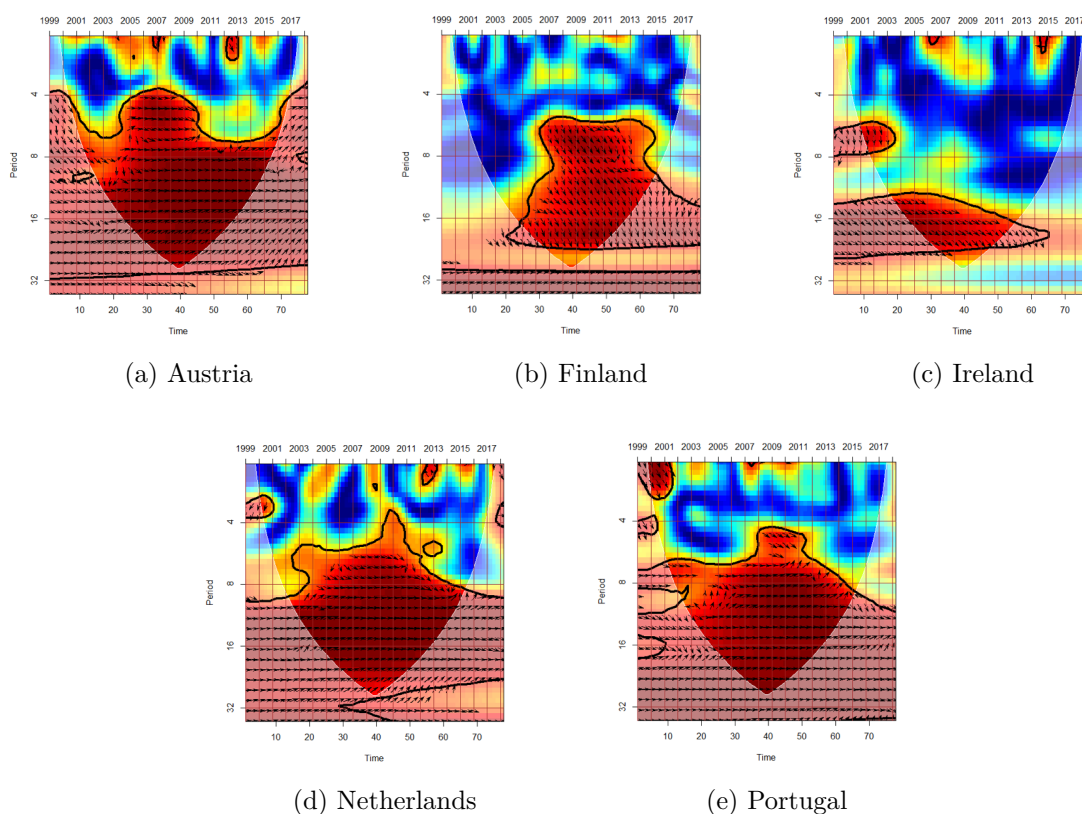
Figure 2.5 – Wavelet correlation with German business cycles.



Note: Morlet mother wavelets, 1/12 frequency step, phase difference plotted with arrows, significance of R^2 at 5% by Monte-Carlo method (300 simulations). If the arrows are pointing right then X (here, Germany) and Y (here, countries mentioned below the graph) are in phase (positive correlation). If the arrows are pointing left then X and Y are in anti-phase (negative correlation). The phase difference, θ , is useful to analyze “lead-Lag” indicating if X (or Y) leads Y (or X):

- If $\theta \in [\frac{\pi}{2}, \pi]$, then Y lead X in anti-phase: arrow pointing **up-left**.
- If $\theta \in [-\frac{\pi}{2}, 0]$, then Y lead X in phase: arrow pointing **down-right**.
- If $\theta \in [0, \frac{\pi}{2}]$, then X lead Y in phase: arrow pointing **up-right**.
- If $\theta \in [-\pi, -\frac{\pi}{2}]$, then X lead Y in anti-phase: arrow pointing **down-left**.

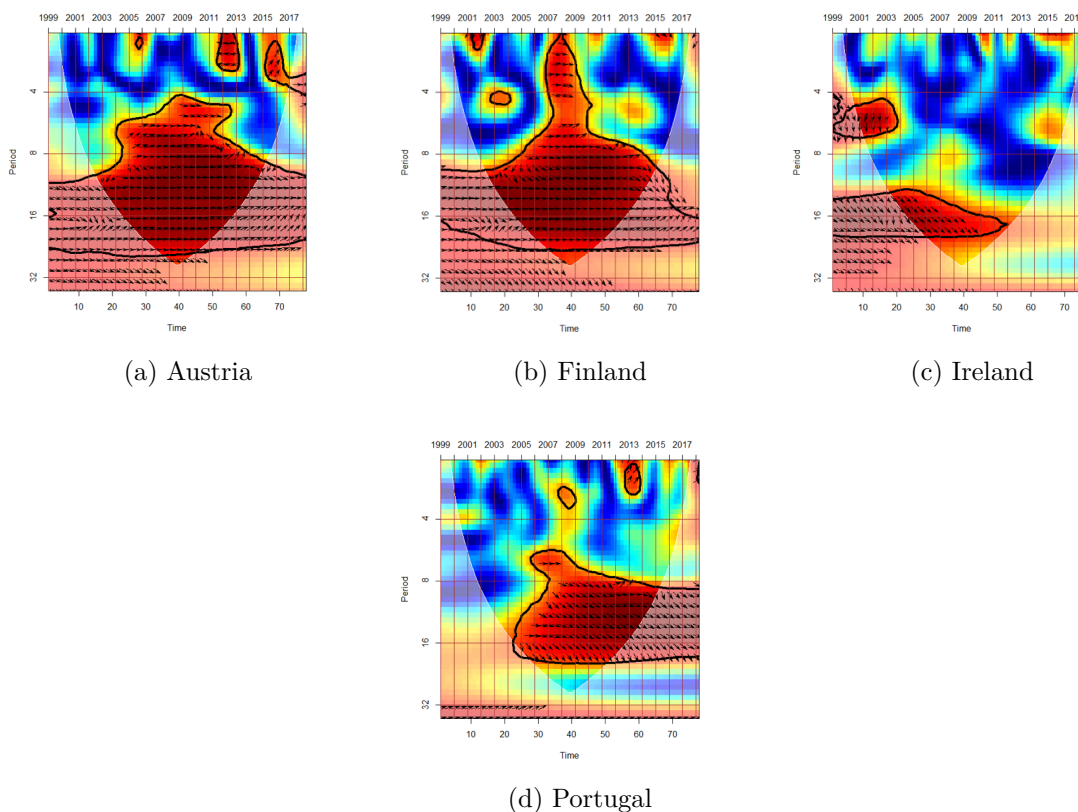
Figure 2.6 – Wavelet correlation with Italian business cycles.



Note: Morlet mother wavelets, 1/12 frequency step, phase difference plotted with arrows, significance of R^2 at 5% by Monte-Carlo method (300 simulations). If the arrows are pointing right then X (here, Italy) and Y (here, countries mentioned below the graph) are in phase (positive correlation). If the arrows are pointing left then X and Y are in anti-phase (negative correlation). The phase difference, θ , is useful to analyze “lead-Lag” indicating if X (or Y) leads Y (or X):

- If $\theta \in [\frac{\pi}{2}, \pi]$, then Y lead X in anti-phase: arrow pointing **up-left**.
- If $\theta \in [-\frac{\pi}{2}, 0]$, then Y lead X in phase: arrow pointing **down-right**.
- If $\theta \in [0, \frac{\pi}{2}]$, then X lead Y in phase: arrow pointing **up-right**.
- If $\theta \in [-\pi, -\frac{\pi}{2}]$, then X lead Y in anti-phase: arrow pointing **down-left**.

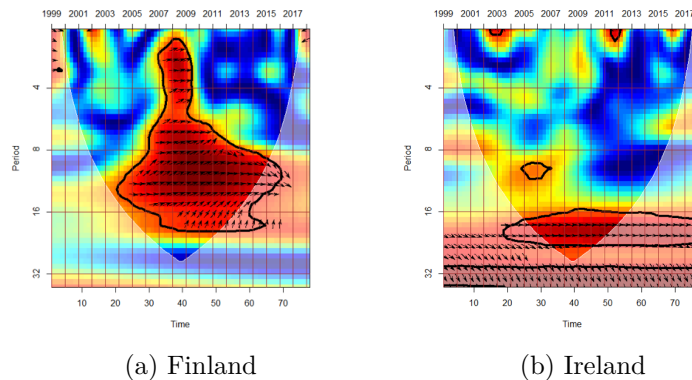
Figure 2.7 – Wavelet correlation with Dutch business cycles.



Note: Morlet mother wavelets, 1/12 frequency step, phase difference plotted with arrows, significance of R^2 at 5% by Monte-Carlo method (300 simulations). If the arrows are pointing right then X (here, Netherlands) and Y (here, countries mentioned below the graph) are in phase (positive correlation). If the arrows are pointing left then X and Y are in anti-phase (negative correlation). The phase difference, θ , is useful to analyze “lead-Lag” indicating if X (or Y) leads Y (or X):

- If $\theta \in [\frac{\pi}{2}, \pi]$, then Y lead X in anti-phase: arrow pointing **up-left**.
- If $\theta \in [-\frac{\pi}{2}, 0]$, then Y lead X in phase: arrow pointing **down-right**.
- If $\theta \in [0, \frac{\pi}{2}]$, then X lead Y in phase: arrow pointing **up-right**.
- If $\theta \in [-\pi, -\frac{\pi}{2}]$, then X lead Y in anti-phase: arrow pointing **down-left**.

Figure 2.8 – Wavelet correlation with Portuguese business cycles.



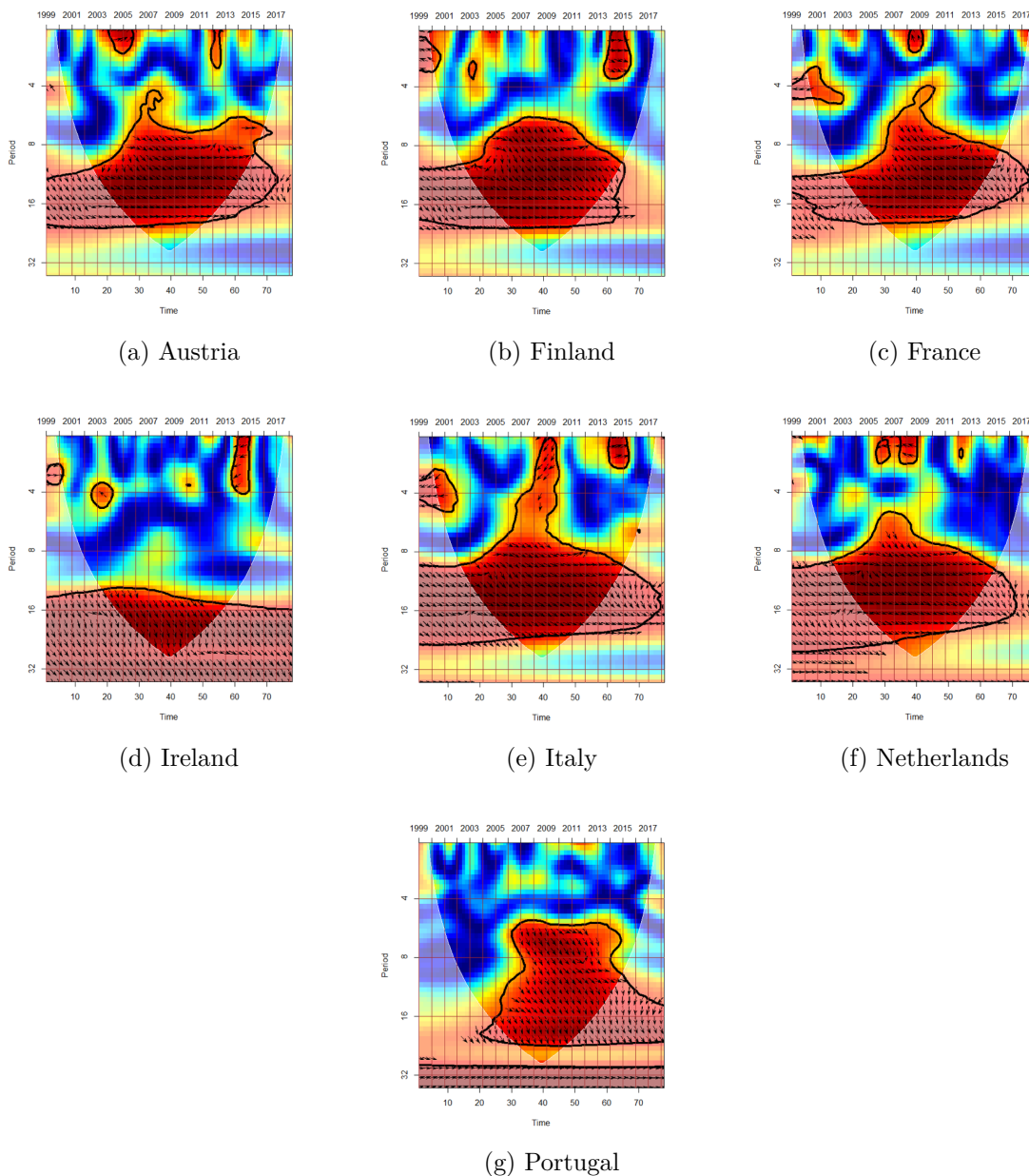
Note: Morlet mother wavelets, 1/12 frequency step, phase difference plotted with arrows, significance of R^2 at 5% by Monte-Carlo method (300 simulations). If the arrows are pointing right then X (here, Portugal) and Y (here, countries mentioned below the graph) are in phase (positive correlation). If the arrows are pointing left then X and Y are in anti-phase (negative correlation). The phase difference, θ , is useful to analyze “lead-Lag” indicating if X (or Y) leads Y (or X):

- If $\theta \in [\frac{\pi}{2}, \pi]$, then Y lead X in anti-phase: arrow pointing **up-left**.
- If $\theta \in [\frac{-\pi}{2}, 0]$, then Y lead X in phase: arrow pointing **down-right**.
- If $\theta \in [0, \frac{\pi}{2}]$, then X lead Y in phase: arrow pointing **up-right**.
- If $\theta \in [-\pi, \frac{-\pi}{2}]$, then X lead Y in anti-phase: arrow pointing **down-left**.

the BCS (0.0097), which coincides with the effect this variable has at the very short-term (6 months). The difference in fiscal policies reappears as a negative determinant of the BCS with a positive coefficient at -0.00843 . In this way, the effect of un-synchronized fiscal policies on BCS is twofold: they are useful to correct country-specific features at short-medium term, but they worsen the BSC at long-term. The labor cost difference plays an unexpected positive role (0.00976), as at short-term frame, which worth an analysis on its own. It reveals the role played by conventional and unconventional monetary policies led since 2009. Indeed, with the 2007-2008 financial crisis and the sovereign debt crisis in 2010, the ECB has implemented a set of unconventional monetary policy which are not transcribed in the MRO rates. To incorporate them in a unique indicator like the SSR, the latter must be able to be negative. In our case, it seems that a negative SSR, proxying UMP, has a positive impact on BCS on the long-run.

It is important to check for any level effect since a positive or a negative SSR embodies different monetary policy, using different channels and, consequently, having different magni-

Figure 2.9 – Wavelet correlation with Spanish business cycles.



Note: Morlet mother wavelets, 1/12 frequency step, phase difference plotted with arrows, significance of R^2 at 5% by Monte-Carlo method (300 simulations). If the arrows are pointing right then X (here, Spain) and Y (here, countries mentioned below the graph) are in phase (positive correlation). If the arrows are pointing left then X and Y are in anti-phase (negative correlation). The phase difference, θ , is useful to analyze “lead-Lag” indicating if X (or Y) leads Y (or X):

- If $\theta \in [\frac{\pi}{2}, \pi]$, then Y lead X in anti-phase: arrow pointing **up-left**.
- If $\theta \in [-\frac{\pi}{2}, 0]$, then Y lead X in phase: arrow pointing **down-right**.
- If $\theta \in [0, \frac{\pi}{2}]$, then X lead Y in phase: arrow pointing **up-right**.
- If $\theta \in [-\pi, -\frac{\pi}{2}]$, then X lead Y in anti-phase: arrow pointing **down-left**.

Table 2.2 – Impact of Monetary and Fiscal Policies on business cycle Correlations (unique SSR)

<i>Variables</i>	(1)	(2)	(3)	(4)
	<i>Corr. 6m_t</i>	<i>Corr. 1y_t</i>	<i>Corr. 2y_t</i>	<i>Corr. 4y_t</i>
Sum of Exports	-4.86e-10** (2.37e-10)	1.73e-10 (1.18e-10)	1.12e-10** (4.80e-11)	-2.39e-10** (1.03e-10)
Labor difference	0.0987**** (0.0257)	-0.0178*** (0.00600)	-0.0172*** (0.00643)	0.00976** (0.00410)
Saving difference	0.287** (0.114)	0.0116 (0.00743)	-0.0298 (0.0299)	0.00453** (0.00227)
CALB difference	-0.0319*** (0.0103)	0.0274**** (0.00760)	0.0200** (0.00782)	-0.00843** (0.00359)
SSR	-0.276*** (0.0978)	0.0676** (0.0283)	0.0694**** (0.0170)	-0.0772** (0.0307)
<i>Corr. 6m_{t-1}</i>	0.832**** (0.0189)			
<i>Corr. 1y_{t-1}</i>	0.766**** (0.0502)			
<i>Corr. 2y_{t-1}</i>	0.773**** (0.0696)			
<i>Corr. 4y_{t-1}</i>	0.974**** (0.0305)			
Country fixed effects	yes	yes	yes	yes
Time fixed effects	yes	yes	yes	yes
<i>N</i>	3330	3330	3330	3330
Sargan-Hansen test	0.2705	0.9976	0.9777	0.2705
Arellano-Bond test (AR(1))	0.0000	0.0027	0.0000	0.0001
Arellano-Bond test (AR(2))	0.8911	0.1169	0.1875	0.1586

Note: the dependent variables are the correlations at a 6 months (*Corr. 6m_t*), 1 year (*Corr. 1y_t*), 2 years (*Corr. 2y_t*) and 4 years (*Corr. 4y_t*) frequency. Standard errors are corrected with the [Windmeijer \(2005\)](#) finite-sample correction. To estimate our model, we used a two-step system GMM estimator. All the variables are endogenous. Robust standard errors in parentheses, * : $p < 0.1$, ** : $p < 0.05$, *** : $p < 0.01$, **** : $p < 0.001$. The values for the tests are the *p-values*.

Table 2.3 – Impact of Monetary and Fiscal Policies on business cycle Correlations (dual SSR)

	(1)	(2)	(3)	(4)
<i>Variables</i>	<i>Corr. 6m_t</i>	<i>Corr. 1y_t</i>	<i>Corr. 2y_t</i>	<i>Corr. 4y_t</i>
Sum of Exports	-3.17e-10** (1.35e-10)	-1.25e-10** (4.95e-11)	2.02e-10** (9.80e-11)	-1.41e-10* (7.90e-11)
Labor difference	0.0300**** (0.00901)	0.00349 (0.00422)	-0.0109*** (0.00353)	0.00370** (0.00189)
Saving difference	0.0153 (0.0117)	-0.00724 (0.0249)	-0.118** (0.0469)	0.0165** (0.00779)
CALB difference	-0.0193*** (0.00737)	0.0134*** (0.00456)	0.0194** (0.00869)	-0.00689** (0.00325)
SSR (-)	-0.0593** (0.0247)	-0.0640* (0.0336)	0.0111 (0.0374)	-0.0126** (0.00630)
SSR (+)	-0.242*** (0.0861)	0.0326 (0.0322)	0.0637 (0.0431)	-0.119*** (0.0451)
<i>Corr. 6m_{t-1}</i>	0.795**** (0.0191)			
<i>Corr. 1y_{t-1}</i>		0.903**** (0.0317)		
<i>Corr. 2y_{t-1}</i>			0.841**** (0.0343)	
<i>Corr. 4y_{t-1}</i>				0.858**** (0.0267)
Country fixed effects	yes	yes	yes	yes
Time fixed effects	yes	yes	yes	yes
<i>N</i>	3330	3330	3330	3330
Sargan-Hansen test	0.3081	0.9859	0.7747	0.3081
Arellano-Bond test (AR(1))	0.0000	0.0000	0.0044	0.0057
Arellano-Bond test (AR(2))	0.4035	0.1052	0.1910	0.2000

Note: the dependent variables are the correlations at a 6 months (*Corr. 6m_t*), 1 year (*Corr. 1y_t*), 2 years (*Corr. 2y_t*) and 4 years (*Corr. 4y_t*) frequency. Standard errors are corrected with the Windmeijer (2005) finite-sample correction. To estimate our model, we used a two-step system GMM estimator. All the variables are endogenous. Robust standard errors in parentheses, * : $p < 0.1$, ** : $p < 0.05$, *** : $p < 0.01$, **** : $p < 0.001$. The values for the tests are the *p-values*.

tudes and amplitudes. This implies adopting a non-linear approach with interaction variables, as presented in equation (2.22). Table 2.3 displays the estimation results of this model where SSR interacts with two variables, depending on its value: $I_t^{SSR^+}$ and $I_t^{SSR^-}$.¹⁷

Broadly speaking, our previous results are not affected by our new specification. Trade has still a significant and negative effect on the BCS (except at a 2-year frequency), supporting the idea of *de*-synchronizing trade specialization. Labor cost difference fosters the BCS at almost every frequency, while the effect of the saving rate difference is ambiguous: it has a strong negative effect at a 2-year frequency (-0.118) but a positive one at a 4-year frequency (0.0165). The effects of fiscal policy differences seem to diverge following the frequency adopted: at very short- and long-terms, divergence in the adopted fiscal policy reduces the BCS, while it amplifies it at medium-term (1 and 2 year frequencies). As it can be seen, a positive SSR, mainly corresponding to the period of conventional monetary policy (2000-2011), negatively impacts the BCS of European countries (-0.242 for 6-months frequency, -0.119 for 4-years frequency), except at a 1-year and 2-year time-frame. The monetary policy also has an appreciable effect when it is composed of unconventional policy, i.e., mostly when the SSR is negative (2012-2018). A negative SSR has a positive impact in the 6-months and 4-years time-frames (resp. -0.0593 and -0.0126). At short- and at long-term, the adoption of unconventional monetary policy seems to improve the synchronization of business cycles.

2.4 Conclusion and policy implications

This chapter contributes to the literature on business cycle factors by looking at the link between monetary policy and synchronization of business cycles in Europe. So far, the literature has investigated the role of monetary policy by reducing it to the adoption of the euro or the interest rate spread evolution, excluding the variety of monetary policies implemented and their time-varying aspect. While previous works have treated business cycles with a unique frequency dimension, we adopt a more detailed approach involving a frequency-dependent analysis. From a

17. In Table 2.3, $SSR_t * I_t^{SSR^+}$ is named $SSR_t(+)$ and $SSR_t * I_t^{SSR^-}$ is named $SSR_t(-)$.

macroeconomic point of view, our chapter investigates a well-known issue with a new approach, the wavelet method, allowing us to study the monetary policy-BCS relationship at different terms. To our knowledge, this method has never been used to study the relationship between monetary policy and business cycle synchronization.

In a second step, we use a system GMM dynamic panel to study the relationship between the shadow short rate and time-varying pairwise synchronizations at different frequencies. It helps us distinguish the short-, medium- and long-term effect of monetary policy on synchronization. We took into account the potential level effect by dividing the SSR between its positive and its negatives values. As regards the control variables, our model included the differences in labor cost, the saving rates and the cyclically adjusted net lending and net borrowing, as well as the sum of exports divided by the sum of GDP.

Relying on a sample of European countries over the period 2000Q1-2018Q4, we find evidence of a connection between business cycle synchronization and monetary policy. At a short-term level, monetary policy has a noticeable relationship with the European BCS, along with other factors such as labor costs, saving rates and CALB differences. The CALB difference, proxying fiscal policy divergence (or convergence), interestingly has “switching” effects: it positively impacts the BCS at short- to medium-term period, indicating that the country-adapted fiscal policy might be better for business cycle synchronization in regular time, but reduce the latter at very-short- and long-term, highlighting the importance of sound and sustainable public finances.

Finally, our findings offer an empirical contribution to the literature on the endogeneity of optimal currency areas. Synchronization of business cycles is a key aspect for the optimal efficiency of monetary policy and, in this work, we show the strong relationship between the two. Focusing on the difference between the positive and negative SSR, we may think of an optimal interest rate, i.e. a value of the interest rate that achieve the greatest business cycle synchronization. In regard to the value of the coefficient, this hypothetical optimal interest rate may be very close to zero. On the long-run, policy makers may consider unconventional monetary policy as a relevant tool to result in greater BSC in Europe.

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FISCAL REACTION FUNCTION IN EUROPE

A first version of this chapter (Odry, R. (2021), "Fiscal reaction function in Europe"), is under review for the EconomiX Working Papers series.

3.1 Introduction

The Covid-19 pandemic and its subsequent economic consequences have put a strain on public finances of European countries. In response to the unprecedented scale and the asymmetric effects of the Covid-19 crisis, EU policymakers have deployed a broad set of measures at country-level, that have resulted overall in a drastic increase in the public debt.¹ These emergency policies have led to a situation that threaten the fiscal sustainability of European countries, some of which were already in dire straits.

The question of fiscal sustainability is particularly important in Europe, in light of the economic European integration and the financial and economic precedents. But the crisis has also highlighted the obsolescence of the European fiscal rules and their inadequacy with the actual macroeconomic conditions. New proposals have been put forward for an alternative European fiscal framework such as the adoption of fiscal standards rather than fiscal rules ([Blanchard et al. \(February 2021\)](#)), a European central fiscal capacity ([European Fiscal Board \(2020\)](#)),

1. In the Euro Area, the government deficit to GDP ratio dramatically increased to a historic high, going from 0.6% in 2019 to 7.2% in 2020 (Eurostat).

or country-specific fiscal targets rather than uniform numerical criteria (Martin et al. (2021)). These recommendations focus on the framework in which the fiscal policy is possible, defining the boundaries that are not to be overstepped, and constitute a substantial aspect for sustainable public finances. However, they are not sufficient to ensure sound fiscal behaviours, as reflect for example the track records of compliance with the fiscal rules (Larch and Santacroce (2020)). Discretionary fiscal policies adopted these last decades have been associated to significant increases of the debt level in European countries. Their ability to stabilize the economy and to cope with fluctuations of the business cycle, which is a key role of fiscal policies, seems consequently to be limited. Along with these researches aforementioned, a closer look at the fiscal behaviour itself is then necessary to improve the fiscal discipline of EU countries. Our chapter is in line with this approach and expands on the existing literature by investigating the variables at play in the fiscal policy-making process.

In that way, Bohn (1998) proposes an attractive and interesting approach to study fiscal behaviours: he defines a *fiscal reaction function* (henceforth, FRF) linking, the primary balance² and the outstanding debt of a country. The FRF constitutes a good test for the fiscal solvency as well: a positive and significant coefficient connecting the primary balance and the debt-to-GDP ratio is a sufficient, but weak (Ghosh et al. (2013)), condition to conclude to a sustainable debt. The FRF has been since widely used to study the fiscal policies adopted and their sustainability, and several factors and forms have been adopted to make it more realistic.

Part of these new factors are motivated by political considerations. Indeed, policymakers face conflicting pressures between ensuring reelection, satisfying group interests and leading economically sound and socially fair policies. Talvi and Végh (2005) have developed a model of optimal fiscal policy to understand procyclicality of fiscal policies incorporating the possibility of a “political distortion”. While economic booms should be an opportunity for fiscal authorities to build up surpluses, they tend to lower the tax and/or increase the spending due to that political aspect. This conclusion is supported empirically by Larch et al. (2019), who interpret this result

2. Thereafter, numerous studies have privileged the cyclically adjusted primary balance as the dependent variable. Checherita-Westphal and Žďárek (2017a) discuss the difference between the primary balance and its cyclically adjusted version.

as an aversion to unpopular tax increases and/or expenditures cuts. The institutional setting or the number of power blocs in competition for funds can also impact the fiscal policies (Lane (2003)), as well as particular phenomenon proper to the policymaker. For example, Alesina and Tabellini (2005) and Sugata and Neanidis (2017) deal with the impact of corruption on fiscal policy orientations. Specifically, the former establish a link between corruption and procyclicality of the fiscal policy - the higher the level of corruption, the higher the procyclicality - while Sugata and Neanidis (2017) conclude to a dissociation between public spending and expenditures when corruption occurs, with higher tax and lower spending. Eventually, political influences can also be time-varying, and take the form of a cycle, as theorized in the Political budget cycle theory (Nordhaus (1975)). The presence of a political budget cycle has been repeatedly noticed, notably through a negative impact of election years on the primary balance (Checherita-Westphal and Žďárek (2017a); Larch et al. (2021)). We include in our model election dates, but contrary to previous works, vary the time distance to study the variations of the primary balance *ante* and *post* election years. We also include in our model a dummy variable for the type of government, differentiating between single-party majority government and coalition, in the vein of Lane (2003). Since coalition governments are the product of negotiations between different political forces, we expect a more neutral fiscal policies in countries lead by coalition governments.

The link between fiscal behaviour and financial markets has been explored too. Financial markets are particularly sensible to the fiscal sustainability of governments since sovereign debts are financed in the bond markets by sovereign and private investors. Based on a large set of variables going from macroeconomic to market-based indicators, the sovereign debt pricing indicates a "market's sentiment" (Dufrénot et al. (2016)) that policymakers include in their policy-making process. Indeed, the financing conditions - and specifically the level of interest payments - impact the fiscal situation and sustainability of countries (Fincke and Greiner (2012); Checherita-Westphal and Domingues Semeano (2020)). Maltritz and Wüste (2015) and Barbier-Gauchard and Mazuy (2018), using both fiscal reaction function, adopt the ten-year government bonds as a proxy for the above-mentioned "markets' sentiment" and find no evidence of financial market pressure. Legrenzi and Milas (2013) reach the same conclusion using the spread between

the 10-year yield on a set of European countries and the 10-year yield on German bonds, but find significant effect when considering a composite indicator of financial pressure. [Tamborini and Tomaselli \(2020\)](#) are closer to our approach since they adopt ratings of sovereign bonds by Standard and Poor's as a proxy of market pressure (among others) to study measures of austerity in the European Union. We believe that adopting index such as credit ratings constitutes a good alternative to the credit spreads or interest rates for two reasons: (i) the credit rating and the policy-making process have closer (low) frequencies than the latter and interest spread (high frequency) one, and (ii) the publicity - ultimately the impact - of credit ratings is more important in mainstream medias than the one of interest variations and credit spreads. Being sensible to public opinion and big signals from markets, policymakers may be more keen to incorporate credit ratings variation in their policy-making process. We innovate by including in our FRF the annual average of foreign currency long-term sovereign debt ratings by Moody's, Standard & Poor's, and Fitch Ratings ([Kose et al. \(2017\)](#)).

At last, a crucial aspect of the FRF is the functional form adopted, especially the relationship between the fiscal policy variable and the debt. The seminal paper by [Ghosh et al. \(2013\)](#) introduces the *non-linear* fiscal reaction function to take into account the empirical observed cubic relationship between the primary balance and the lagged debt ratios, reflecting a "fiscal fatigue"; a phenomenon that [Checherita-Westphal and Žďárek \(2017a\)](#) do not observe when adopting the strategy of [Ghosh et al. \(2013\)](#) for Euro area countries. [Mendoza and Ostry \(2008\)](#) and [Theofilakou and Stournaras \(2012\)](#) fail to find any non-linearity under the form of a cubic relationship, but find evidence of a threshold effect of debt on public spendings. [Legrenzi and Milas \(2013\)](#) share this conclusion when allowing the threshold to vary in response to economic conditions. The evidence of a non-linearity of the FRF is, nevertheless, being dashed once we correct our estimation of the panel structure and allow country-specific coefficients ([Everaert and Pozzi \(2007\)](#)). [Larch et al. \(2021\)](#) adopt also a non-linear approach by incorporating interaction terms in the FRF. They create a dummy variable that interact with the change business cycle variable and test several possible factors. While the change in the sign of the output gap significantly impacts the fiscal policy, the level of debt does not influence the relationship between

the business cycle and the primary balance. Building on their approach, we adopt a non-linear FRF by incorporating an interaction term to study the impact of the level of the debt-to-GDP ratio on the relationship between the change in primary balance and the change in the output gap.

The rest of the chapter is organized as follows: Section 3.2 presents the data and the method employed to estimate our model. Section 3.3 displays the results we obtain. Finally, Section 3.4 concludes.

3.2 Data and Methodology

3.2.1 Data

Our panel is composed of 19 European countries, namely Austria, Belgium, Cyprus, Germany, Spain, Estonia, Finland, France, Greece, Ireland, Italy, Lithuania, Luxembourg, Latvia, Malta, Netherlands, Portugal, Slovakia and Slovenia, over the period 1991-2019 (29 years). We end up with 551 country-time observations (annual frequency) and a strongly balanced panel. All of the above-mentioned countries are members of the euro area. The main data source is the World Bank Cross-Country Database of Fiscal Space ([Kose et al. \(2017\)](#)). Data on election date and the type of government derive from the Comparative Political Data Set ([Armingeon et al. \(2020\)](#)), and GDP time series come from the World Bank Database. Finally, data on the Shadow Short Rate come from the Leo Krippner website. Table 3.1 presents a detailed description of the variables.

General government gross debt, current account balance of payments and GDP cyclical component are classical components of fiscal reaction functions. The general government gross debt represents the budget constraint policymakers face when defining fiscal policies, the current account balance of payments aims at incorporating possible cross-country spillovers, and the GDP cyclical components the cyclical conditions. In line with a large strand of the literature, we included political economy variables as election dates (in the form of a dummy variable), and a market perception of the fiscal policy with the foreign currency long-term sovereign debt

ratings.

We also conducted tests for unit roots developed by [Im et al. \(2003\)](#) and [Choi \(2001\)](#), adapted to our type of panel structure.³ Statistics and *p-values* obtained are presented in Table 3.2. Results concerning variables such as the business cycle (Hodrick-Prescott (HP) and Christiano-Fitzgerald (CF) filters), the primary balance, the cyclically-adjusted balance and the fiscal balance converge to the absence of unit roots, and consequently these variables are usable in level.⁴ We are in a grey zone for two variables, that is the foreign currency long-term sovereign debt ratings and the General government gross debt: the Im-Pesaran-Shin test allows us to reject the null that all series contain a unit root, while we cannot reach this conclusion with the Fisher-type test. Lastly, we are unable to reject the null hypothesis for current account balance of payments and the shadow short rate. Table 3.3 presents the results of the same tests applied to the variables in difference. None of the series seems to be characterised by the presence a unit-root (our variables are then $I(1)$). Unfortunately, results for the 5-year sovereign CDS spreads and the shadow short rate are not presented because the number of time periods is insufficient to compute the statistics. These results encourage us to adopt a model in difference, to avoid any problems related to non-stationarity.

3.2.2 Methodology

Building on the approach of [Bohn \(1998\)](#) and [Ghosh et al. \(2013\)](#), the main FRF adopts the following form :

$$pb_{i,t} = \alpha + \beta_1 pb_{i,t-1} + \beta_2 debt_{i,t} + \beta_3 debt_{i,t}^2 + \beta_4 debt_{i,t}^3 + \sum_{c=1}^n \beta_c X_{c,i,t} + \delta_i + \epsilon_{i,t} \quad (3.1)$$

with $pb_{i,t}$ the primary balance of the country i at time t , $pb_{i,t-1}$ its lagged value, $debt_{i,t}$ is the debt-to-GDP ratio of the country i at time t , $debt_{i,t}^2$ and $debt_{i,t}^3$ the square and cubic values

3. Both tests are based on a heterogeneous specification of the alternative hypothesis, to be considered here since we have a heterogeneous panel of countries.

4. The null hypothesis for both tests is that all the panels contain a unit root.

Table 3.1 – Descriptive statistics

<i>Variable</i>		<i>Mean</i>	<i>Std. Dev.</i>	<i>Min</i>	<i>Max</i>	<i>Observations</i>
Foreign currency long-term sovereign debt ratings, index from 1-21	overall	17.48403	3.658737	2.842441	21	$N = 520$
	between		3.010183	11.49811	21	$n = 19$
	within		2.17317	8.020574	22.93036	$\bar{T} = 27.3684$
5-year sovereign CDS spreads, basis points	overall	347.0739	3253.789	2	50990.61	$N = 246$
	between		750.2741	22.91661	3181.932	$n = 17$
	within		3147.108	-2826.858	48155.76	$\bar{T} = 14.4706$
Fiscal balance, % of average tax revenues	overall	-11.75153	15.75715	-130.5527	21.55893	$N = 518$
	between		8.731489	-29.63211	7.098908	$n = 19$
	within		13.19512	-131.0886	22.69317	$\bar{T} = 27.2632$
Primary balance, % of GDP	overall	-2737852	3.23735	-29.812	7.616	$N = 517$
	between		1.319529	-2.99788	2.395172	$n = 19$
	within		2.97127	-30.08614	7.565077	$\bar{T} = 27.2105$
Cyclically-adjusted balance, % of potential GDP	overall	-2.700526	3.393461	-27.48857	5.448505	$N = 511$
	between		1.988638	-6.34828	2.086433	$n = 19$
	within		2.787387	-27.82035	5.661124	$\bar{T} = 26.8947$
General government gross debt, % of GDP	overall	63.10071	36.79731	3.766	189.886	$N = 519$
	between		32.83244	6.93004	127.9493	$n = 19$
	within		18.34719	10.46943	125.0374	$\bar{T} = 27.3158$
Gross Domestic Product (GDP)	overall	6.32e+11	9.44e+11	4.51e+09	3.94e+12	$N = 540$
	between		9.53e+11	8.32e+09	3.27e+12	$n = 19$
	within		1.35e+11	6.54e+10	1.30e+12	$\bar{T} = 28.4211$
Current account balance of payments, % of GDP	overall	-.3849814	5.589949	-20.84025	12.58237	$N = 370$
	between		4.231222	-6.637716	8.187112	$n = 17$
	within		3.883695	-16.21171	12.81545	$\bar{T} = 21.7647$
GDP cyclical component (HP filter)	overall	.1443274	131.5148	-1353.307	846.6428	$N = 540$
	between		4.848777	-4.800328	18.97102	$n = 19$
	within		131.4282	-1372.133	827.8161	$\bar{T} = 28.4211$
GDP cyclical component (CF filter)	overall	.6929892	118.6272	-1372.947	736.8346	$N = 540$
	between		1.586334	-7.553701	6.902918	$n = 19$
	within		118.6169	-1379.157	730.6247	$\bar{T} = 28.4211$
Shadow Short Rate (SSR)	overall	1.2252	2.369624	-3.01	4.39	$N = 475$
	between		0	1.2252	1.2252	$n = 19$
	within		2.369624	-3.01	4.39	$T = 25$

Note : “overall” corresponds to the whole sample without taking into account the panel structure, “between” is the statistics at the country-level, “within” can be seen as the average statistics at the panel-level. N refers to the total number of observations, n the number of observations at the panel-level and \bar{T} the number of observations at the country-level.

Table 3.2 – Unit-root tests results (level)

<i>Variables</i>	<i>Im-Pesaran-Shin</i>		<i>Fisher-type</i>	
	Statistic	<i>p-value</i>	Statistic	<i>p-value</i>
Foreign currency long-term sovereign debt ratings	-1.6456	0.0499	0.5612	0.7127
General government gross debt	-2.3475	0.0094	-0.6220	0.2670
Business cycles (HP filter)	-18.3564	0.0000	-13.4946	0.0000
Business cycles (CF filter)	-22.4088	0.0000	-23.8239	0.0000
Primary balance	-4.3317	0.000	-5.0544	0.0000
Cyclically-adjusted balance	-5.5327	0.0000	-7.1862	0.0000
Current account balance of payments	-0.5955	0.2758	-0.2256	0.4108
Fiscal balance	-4.1164	0.0000	-5.7333	0.0000
Shadow Short Rate (SSR)	3.6076	0.9998	4.8830	1.0000

Note : The statistic of the Im-Pesaran-Shin test is the W_{t-bar} statistic, while the one used in the Fisher-type test is the inverse normal Z statistic, recommended in application (Choi (2001)). The 5-year sovereign CDS spreads is not included in the table since the number of time periods to compute the statistics is insufficient.

Table 3.3 – Unit-root tests results (difference)

<i>Variables</i>	<i>Im-Pesaran-Shin</i>		<i>Fisher-type</i>	
	Statistic	<i>p-value</i>	Statistic	<i>p-value</i>
Δ Foreign currency long-term sovereign debt ratings	-7.4778	0.0000	-6.7924	0.0000
Δ General government gross debt	-9.4255	0.0000	-11.8310	0.0000
Δ Business cycles (HP filter)	-19.7276	0.0000	-22.5829	0.0000
Δ Business cycles (CF filter)	-18.5895	0.0000	-31.0836	0.0000
Δ Primary balance	-17.3537	0.000	-23.6618	0.0000
Δ Cyclically-adjusted balance	-16.9740	0.0000	-22.7662	0.0000
Δ Current account balance of payments	-12.4470	0.0000	-11.6871	0.0000
Δ Fiscal balance	-18.1777	0.0000	-22.0158	0.0000

Note : The statistic of the Im-Pesaran-Shin test is the W_{t-bar} statistic, while the one used in the Fisher-type test is the inverse normal Z statistic, recommended in application (Choi (2001)). The 5-year sovereign CDS spreads and the shadow short rate are not included in the table since the number of time periods to compute the statistics is insufficient.

of the latter, $X_{c,i,t}$ is a set a n control variables for every country i at time t , δ_i a country fixed effect and $\epsilon_{i,t}$ the error term.

A large variety of FRF specifications has been explored in the literature, regarding its *dynamic* nature or the *linearity* of the relationship with the debt-to-GDP ratio.⁵ However, few have focused on the lead-lag structure, usually considering the $t - 1$ values of the explaining variables. This approach is understandable since (i) the fiscal policy is defined and implemented following a legislative process that does not allow a quick adjustment, and (ii) because the set of available information necessary for the decision-making is incomplete at time t .⁶ The policymaker relies then on the information available at $t - 1$ to establish the fiscal policy at t . We believe that a more subtle approach is to take into account lagged variables ($t - 1$) such as the debt-to-GDP ratio, but also lead variables ($t + 1$), as election dates are predictable and influence upstream economic policies (Alesina and Passalacqua (2016)), and variables in t that fiscal authority can be notified of when happening, such as sovereign debt ratings. Our FRF is then designed to taking into account the forward-, backward- and contemporary-looking ability of the policymaker. Accordingly, our specification takes the following form :

$$\Delta \text{pb}_{i,t} = \alpha + \beta_1 \Delta \text{pb}_{i,t-1} + \sum_{a=2}^l \beta_a W_{(a,i,t+1)} + \sum_{b=l+1}^m \beta_b X_{(b,i,t)} + \sum_{c=m+1}^n \beta_c Y_{(c,i,t-1)} + \delta_i + \epsilon_{i,t} \quad (3.2)$$

with $W_{(a,i,t+1)}$, $X_{(b,i,t)}$ and $Y_{(c,i,t-1)}$ different sets of variables at $t + 1$, t and $t - 1$, respectively.

We also take into account the persistence in the primary balance series by incorporating the lagged values of the dependent variable ($\Delta \text{pb}_{i,t-1}$). The next step consists into defining the variables that make up each set. Our first configuration is as follow: $W_{(a,i,t+1)} = (\text{election date}_{(i,t+1)})$,

$X_{(b,i,t)} = (\Delta \text{sovereign rate}_{(i,t)})$ and $Y_{(b,i,t)} = (\Delta \text{General government gross debt}_{(i,t)}, \Delta \text{Business cycles}_{(i,t-1)},$

$\Delta \text{Primary balance}_{(i,t-1)}, \Delta \text{Cyclically - adjusted balance}_{(i,t-1)}, \Delta \text{Current account balance of}$

$\text{payments}_{(i,t-1)}, \Delta \text{Fiscal balance}_{(i,t-1)})$. We vary the composition of the sets of variables to control for longer, or not, forward- and contemporary-looking effects.

5. A more comprehensive presentation of the specification issues is made by Everaert and Jansen (2018).

6. To circumvent this problem, Larch and Santacroce (2020) explore alternative measurements of the cyclical component such as the change in the unemployment rate, industrial production index and OECD composite leading indicator.

Our approach consists in a *non linear* FRF, since we include in our model an interaction term for the reaction of the primary balance to the debt ratio. By that, we aim at taking into account the possibility of a fiscal fatigue (Ghosh et al. (2013)), i.e., the possible exhaustion of the fiscal capacities of a country after reaching a certain amount of debt. Our approach is then similar to the one adopted by Larch et al. (2021), who also include an interaction term. But we differ by interacting two different variables between them, and not a factor with an existing variable. Our interaction variable is defined as follow: $FF_{i,t-1} = \Delta\text{output}_{i,t-1} \cdot \text{debt}_{i,t}$. We justify this variable by the importance of the debt-level effect in the reaction of the primary balance to the business cycles: a country can adopt a counter-cyclical fiscal policy when fiscal space is still available, roughly when the debt level is moderate. However, countries have no room when the debt level is very high. The marginal effect is then:

$$\frac{\partial \Delta \text{PB}_{i,t}}{\partial \Delta \text{output}_{i,t}} = \beta_{c1} + \beta_{c2} \text{debt}_{i,t-1} \quad (3.3)$$

with $\text{PB}_{i,t}$ the primary balance of country i at time t , β_{c1} the coefficient associated to the change in output and β_{c2} the coefficient associated to the interaction variable. We expect β_{c2} to be negative and $\beta_{c2} \text{debt}_{i,t-1}$ to overcome the effect of β_{c1} at a certain level of $\text{debt}_{i,t-1}$.

On the endogeneity issue

We may face several estimation issues by choosing the theoretical model (3.2). Indeed, two sources of endogeneity are identifiable: (i) one relates to the dynamic nature of our model, and (ii) one to its simultaneous nature. Regarding the former, Checherita-Westphal and Žďárek (2017b) remind that the Nickell's bias is negligible for panels with a time dimension greater than 20, even though Judson and Owen (1999) pointed out that "even with a time dimension T as large as 30, we find that the bias may be equal to as much 20% of the true value of the coefficient of interest". To meet this risk, we estimate our model with the bias-corrected least-square dummy variable (LSDVC) developed by Bruno (2005) and which is usually used in the literature. Performance of the LSDVC can be limited by the time dimension of our panel,

we then also use the bootstrap-corrected fixed-effects estimator for dynamic panel-data models (BCFE) by [Everaert and Jansen \(2018\)](#) which is appropriate for medium size panels. The GMM estimator is often used in case of dynamic model, rightly or wrongly, but might present poor performances and mixed results when the cross-section dimension is rather small, which is our case here. Since the Nickell's bias may be negligible thanks to the time dimension of our dataset, we also estimate our model with the fixed effect (FE) estimator.

The simultaneity of our model is the second challenge we face. Several of our explanatory variables, such as the cyclical component, the current account balance of payments and the level of debt, are impacted by our dependent variables, i.e. the primary balance. To tackle this problem, much of the literature has employed instrumental variables techniques, principally two-stage least square methods, which required the selection of relevant instruments, and open the door to new concerns. An alternative solution is to lag the suspected endogenous variables. This strategy is adopted by [Cimadomo \(2008\)](#), who uses the lagged output gap to study cyclically-adjusted primary balance precisely to avoid endogeneity problems.⁷ It is the strategy we adopt in this chapter, (i) because the additional data requirements are limited, and it is intuitively appealing, and (ii) because this approach is economically grounded. In our particular case, the simultaneous hypothesis would mean that, in the span of a year, the fiscal policy implemented at year t impacts the other endogenous variables the same year, while the latter also influence the fiscal policy implemented at year t .⁸ In our view, this is a debatable assumption if we look at the timescale of the fiscal policy. National parliaments indeed usually enact budget law for year t in year $t - 1$, based on a set of economic indicators available at the time of budgeting ($t - 1$), such as the GDP or the output gap. However, estimations and projections may severely diverge from what is observed *ex post* ([Orphanides and van Norden \(2002\)](#)), and lead to inadequate fiscal stance.⁹ Therefore, We decide not to incorporate the observed *ex post* variables at time t but the observed *ex post* variables at time $t - 1$, which present the optimal combination of reliability and

7. [Checherita-Westphal and Žďárek \(2017a\)](#) prefer considering all their explanatory variables (except the debt-to-GDP ratio) contemporaneously, while [Larch and Santacroce \(2020\)](#) propose a mixed model.

8. The simultaneous nature of a model may rest on the inability or the impossibility to observe used variables at a high(er) frequency. In other words, the time window selected as unit of frequency conceals a dynamic system.

9. To overcome this problem, [Cimadomo \(2008\)](#) includes official projections in the fiscal reaction function.

time-proximity for policy-makers. Eventually, the time of application, of transmission and of tax collection of the fiscal policy should also be taken into account when estimating fiscal reaction function. For these reasons, we believe that that we should not worry about the simultaneous nature of our model, and the resulting endogeneity issue.

3.3 Results

Results from the LSDVC, the FE and the BFCE estimators are presented in Tables 3.4, 3.5 and 3.6, respectively. Unsurprisingly, the lagged dependent variable ($\Delta pb_{i,t-1}$) is found highly statistically significant in almost all the specifications, with an expected positive sign. This result underpins the idea of a persistence in fiscal policy, and our estimates are very similar to the ones found by [Larch et al. \(2021\)](#) in terms of magnitude. In contrast, the coefficient of our lagged output gap variables $\Delta output_{(i,t-1)}$ is positive but not statistically significant. This result may seem puzzling as it is theoretically counter-intuitive, but it corresponds to an empirical observation we share with [Checherita-Westphal and Žďárek \(2017a\)](#) and partially with [Larch et al. \(2021\)](#). To take into account a possible non-linear effect that would explain this outcome, we introduced the interaction term $(\Delta output * debt - level)_{(i,t-1)}$. However, the latter is globally not statistically significant. The twin deficit hypothesis is verified with all the estimators and within all the different specifications employed. Indeed, a 1 point increase in the change of the current account leads to an average increase of the change in the primary balance of 0.17.

We would expect, regardless of the cyclical conditions, that the debt-to-GDP ratio would have a negative impact on the primary balance as the fiscal authority tends to reduce the fiscal deficit when getting close to an unsustainable situation. In contrast with this expectation, our estimates present a positive and statistically significant coefficient between the change in the primary balance in t and the change in debt-to-GDP ratio in $t - 1$, with an average coefficient of 0.85. This is a counter-intuitive result, especially within the studied time-frame and accounting for the role this indicator plays in fiscal policies. Particularly startling since we also included

a crisis dummy in our estimate (crisis_t) to take into account the specific response of fiscal authorities at this period. Our crisis variable appears as significantly negative (on average, -3.5), an outcome that meets our expectations.

Second and third columns of each table have been used as control estimates, the remaining estimates introduce our set of variables of interest, and proceed by adding one variable at a time. Our variables of interest set includes the change of the sovereign debt rating ($\Delta\text{sovereign rate}_{(i,t)}$), the type of government ($\text{Gov. type}_{(i,t-1)}$), the fiscal balance in percent of the tax revenues ($\Delta\text{Fiscal space}_{(i,t-1)}$), the date of election (at $t-2$, $t-1$, t , $t+1$ and $t+2$), the shadow short rate (SSR) in t and $t-1$, and eventually the date of adoption of the euro ($\text{euro}_{(i,t)}$). As it can be seen in the tables, the above-mentioned comments on the sign and significance of control variables still stand through the inclusion and exclusion of our variables of interest.

An interesting result comes from the inclusion of the sovereign debt rating. Indeed, The coefficient associated to this variable is negative and statistically significant in 2 out of 3 estimates, i.e. the LSDVC and the FE estimators (-0.161 and -0.184 , respectively). This outcome is in line with what we would expect: when the sovereign debt ratings of a country decreases, fiscal policy makers tend to reduce their fiscal deficit and adopt measures to improve the fiscal balance in order to reassure markets, hence the increase of the primary balance. This result is important since it shows that market signals are important to understand the fiscal stance and extends the work of [Hanusch and Vaaler \(2015\)](#).

We include political factors to take into account the well-documented political cycle. To this aim, we consider 6 different variables : the type of government and the election date at different time perspective. The coefficient associated to the type of government is positive but not significant, implying that the type of constitution of government (majority by a party or coalition) has no impact on the fiscal stance of the country. The choice to adopt different time perspective rely on the will to identify the length and the form of the political cycle. In contrast with the literature, we identify a significant coefficient associated only with the variable election date $_{(i,t+1)}$ (in average, -0.544). This coefficient is negative, inducing an increase of the deficit in the period

prior the election. This result is in line with what the literature indicate and the tendency to attract votes to the detriment of fiscal sustainability. We do not observe, however, other significant coefficient associated to other time configuration of the date of election.

Finally, the coefficient associated to the shadow short rate (SSR), our proxy of the monetary policy adopted by the ECB, is significant in the three estimates we computed with a positive sign (in average, 0.446). We expected this result, which highlight an interesting relationship between the fiscal and the monetary policy. Indeed, since a decrease of the interest rate allows a lower effective funding cost, it can be an appealing trend for countries to borrow through bond markets. Inversely, a tightening of the monetary policy may have a signal effect on fiscal policy makers and act as a threat for future fiscal sustainability. Fiscal authorities, therefore, would tend to reduce the fiscal deficit to face an upcoming tightening of financial conditions. If the monetary policy implemented has a noticeable impact, the adoption of the euro has a more tenuous effect that our specifications are poorly getting. Only one of our estimators (BFCE) finds a significant effect. The coefficient associated is negative, in line with what we expect: the integration into the euro zone was accompanied with a reduction of public deficits.

3.4 Conclusion

This chapter contributes to the literature on fiscal policy and its determinants, examining new variables that might be at play as well as proposing a novel approach of the fiscal reaction function. Hitherto, several forms of fiscal reaction functions have been investigated to explain the observed fiscal span in Europe, but to our knowledge none have investigated the potential leads and lags in the fiscal policy reaction. Our approach mixed a forward-, backward- and contemporary-looking ability, allowing different response time of the policy makers.

We also incorporate in our FRF new variables such as the sovereign credit rating and the shadow short rate. The former had been very rarely used to study countries fiscal behavior, despite the significant importance it can have on markets and its relative stability. The latter allows to link the monetary policy and the fiscal policy, and has surprisingly not been extensively

studied in this context.

We estimate our model with three different estimators adapted to the specificity of our data set: the bias-corrected LSDV estimator, a bootstrap corrected fixed-effects estimator for dynamic panel-data and the fixed-effect estimator. We used a sample of 19 European countries over the period 1991-2019, all members of the Euro zone and members of the European Union. The time-frame covers important moments of the European integration as well as global and regional crises.

Our findings corroborate our initial hypothesis: a fiscal reaction function should mix lagged and lead elements to take into account the backward- and forward-looking ability of policy makers. Taking into account this aspect, we notice that the political cycle is present in European countries and impacts fiscal policies upstream. It has also allowed us to limit the impact of monetary policy on fiscal policy, which reacts swiftly to changes in the ECB decision or direction. With a positive impact of the shadow short rate on the primary balance, expansionary monetary policy seems to give more flexibility to the fiscal policy by allowing broader fiscal deficits for a reduced borrowing cost.

Finally, some policy guidelines can be deduced from our chapter. In a time of uncertainty vis-à-vis the fiscal sustainability of some EU countries, monetary policy makers can have an active role by tightening the financing conditions on the markets and suggesting an increase of the interest rate in the upcoming years. Ratings agencies have also a substantial part to play in maintaining sound fiscal practice.

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CONCLUSION ET PERSPECTIVES

La crise que nous vivons actuellement est révélatrice des disparités et singularités qui composent l'économie européenne, et plus particulièrement la zone euro. Cette crise vient se rajouter à la série de crises¹⁰ que connaît le continent européen. Qu'il s'agisse de la politique monétaire à adopter, de la nature des plans de relance ou encore des règles de gouvernance, les désaccords entre pays qu'elle a soulevés sont profonds. Elle met ainsi en avant les lacunes et les faiblesses du processus d'intégration et de convergence des économies européennes depuis ces dernières années, causées notamment par des configurations institutionnelles et des structures économiques particulières. Elle a permis également de rappeler l'importance d'une convergence des économies européennes, pour que les outils communs soient les plus efficaces, si ce n'est simplement pour éviter qu'ils produisent l'effet inverse. Ainsi, la question de la convergence économique des pays européens est une question centrale pour la survie de l'union monétaire et économique européenne, *in fine* de l'Union Européenne. C'est ce constat qui nous a conduit à étudier **la convergence économique européenne, en nous intéressant plus particulièrement à trois aspects de celle-ci : la mobilité du travail, la synchronisation des cycles économiques et les déterminants des politiques budgétaires.**

Si notre apport à la littérature sur la construction d'un espace économique européen cohérent n'est pas négligeable, des prolongements et approfondissements sont possibles. Le premier chapitre de cette thèse s'intéresse à la relation entre les structures académiques — plus particulièrement la tendance, au travers du processus de Bologne, à leur harmonisation — et les migrations intra-européennes. Nous n'observons pas d'effet notable du processus de Bologne

10. Série qui, la plupart du temps, se caractérisera par ce que Jean-Claude Juncker a qualifié de période de "polycrises".

sur la mobilité des européens. Nous avons cependant noté que des variables comme l'adhésion à l'Union Européenne ou l'adoption de l'euro comme monnaie ont un impact sur les flux de personnes entre pays. C'est un résultat qui mériterait plus de recherche et d'attention, notamment parce que l'euro a eu un impact négatif. Ce résultat, qui est contre-intuitif, soulève un problème qui intéresserait certainement les théoriciens des zones monétaires optimales (ZMO). D'un point de vue plus technique, l'indicateur que nous utilisons pour la mise en place du processus de Bologne est imparfait : la mesure est dépendante des déclarations des pays, de basse fréquence et ne permet pas une catégorisation fine. Il serait intéressant d'étendre notre base de données sur une période plus longue pour pouvoir constater des effets plus saillants.

Le chapitre 2 a permis de mettre en évidence une relation entre la politique monétaire et la synchronisation des cycles. Si l'impact de la politique monétaire sur un cycle économique particulier est bien documenté, son effet sur un ensemble hétérogène d'économies et la synchronisation qui en découlait a été très peu, voire pas du tout, exploré. Nous avons pallié ce manque et mis en évidence la relation décroissante entre le taux d'intérêt et la synchronisation: plus la politique monétaire est expansionniste, plus la synchronisation des cycles semble importante. C'est un résultat également important pour la théorie des zones monétaires optimales et qui va dans le sens d'une endogénéité des ZMO. Cependant, notre résultat gagnerait à être complété par un fondement théorique en amont : une démonstration théorique de l'impact de la politique monétaire sur un ensemble de cycles économiques et la synchronisation qui en résulterait, peut être même la mise en évidence d'une "direction" ("*a path*") à adopter pour une plus grande synchronisation, permettrait d'appuyer nos résultats. Ensuite, d'autres techniques d'estimations pourraient être appliquées à notre modèle, qui prendraient en compte l'endogénéité et la dynamique de notre spécification tout en tenant compte des dimensions propres à notre panel.

Enfin, le chapitre 3 a mis en avant l'importance des signaux provenant des marchés pour comprendre la politique budgétaire des pays européens. Nous soulignons également le lien qui existe entre la politique budgétaire et la politique monétaire en étudiant comment la première

réagit aux évolutions de la seconde. Nous avons enfin constaté la présence d'un cycle politique (une augmentation des dépenses publiques et/ou réduction des prélèvements en prévision d'une élection) en Europe. Il serait intéressant d'adopter une variable dépendante prenant en compte le cycle comme la *balance primaire ajustée du cycle*, ce que font certains travaux, et qui permettrait de traiter plus spécifiquement la partie discrétionnaire de la politique budgétaire. Nous avons tenu compte de l'interconnexion entre pays en incluant dans notre modèle le compte courant. D'autres techniques plus élaborées permettant de modéliser cette dépendance et les canaux de transmission des politiques budgétaires entre pays seraient intéressantes. Elles permettraient d'adopter un cadre plus large et plus complexe, comme ce que permettent les modèles structurels dynamiques (tels que les modèles VAR).

Par ces trois chapitres, nous avons souhaité contribuer à l'étude et la compréhension de la zone euro, et plus globalement de l'économie européenne. Les résultats obtenus apportent des constats empiriques non-négligeables, mais posent aussi de nouvelles questions sur la définition de la convergence économique, et des critères de celle-ci. Nous espérons que cette thèse contribuera à l'élaboration d'une théorie de la convergence plus large, voire d'un domaine propre à ce phénomène, comme a pu se développer une *Transition Economics* pour étudier le passage d'une économie planifiée à une économie de marché. D'autres zones monétaires feront leur apparition dans les années avenir, notamment en Afrique de l'Ouest¹¹, ou sont appelées à apparaître¹². Une demande de plus en plus grande est à venir pour comprendre ce qu'est la convergence économique.

11. projet d'unité monétaire "Eco"

12. Voir notamment la proposition du Premier Ministre Malaisien Mahathir Mohamad d'une monnaie commune en Asie de l'Est.