Economic, financial and banking integration in the Eurozone : a cyclical approach

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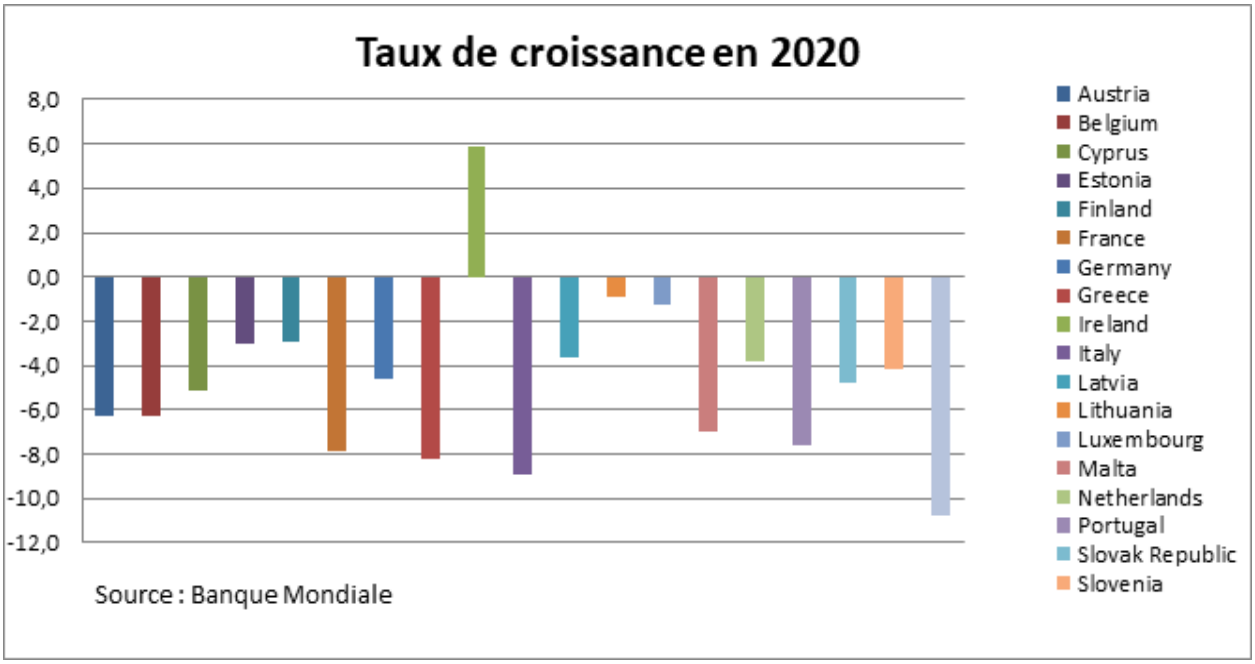
Introduction Générale

Eléments de contexte

Le taux de croissance moyen de la zone euro a fortement reculé en 2020 suite à la crise de la COVID-19 en atteignant -6,7%[1]. Face à cette contraction spectaculaire, la réponse des institutions européennes a été coordonnée, et a permis de diminuer l'impact de cette crise sur les économies de la zone euro. Bien que cette réponse s'est avérée efficace à court terme, elle n'a pas effacé les disparités structurelles présentes dans la zone euro entre les Etats membres et au sein des Etats membres, ni fait disparaitre les défaillances de la construction européenne. Au contraire, comme le montre la Figure 1, la pandémie a d'autant plus souligné l'incomplétude de la zone euro et les hétérogénéités, et par conséquent la nécessité de les corriger.

[1]Source : Base de données de la Banque Mondiale.

Figure 1: Taux de croissance des pays de la zone euro



Cette incomplétude résulte de trois insuffisances économiques majeures. La première repose sur la prétendue convergence qu'auraient facilitée les critères de Maastricht. La seconde est issue de l'ampleur de la crise financière permise par le fonctionnement même de la monnaie unique. La troisième réside dans l'absence totale de mécanismes bancaires homogènes, alors même que les marchés financiers de la zone euro sont majoritairement basés sur le secteur bancaire. Cette thèse s'accorde à présenter et analyser certains moyens d'atteindre une zone euro plus complète, moins perméable aux divergences internes, plus robuste aux chocs extérieurs afin de permettre une applicabilité efficiente de sa politique monétaire unique.

En effet, alors que l'intégration monétaire et financière devait être le point d'aboutissement du projet de monnaie unique, l'absence de mécanismes de gestion de cette intégration tend

finalement à accentuer les crises et les divergences entre les Etats membres de l'Union monétaire européenne. Comme le souligne Obstfeld (2013), le trilemme propre aux unions monétaires réside dans leur incapacité à atteindre simultanément, (i) l'intégration financière transfrontière, (ii) la stabilité financière et (iii) l'indépendance budgétaire domestique, lorsque le niveau de développement financier est très important.

Plus précisément, il est généralement admis que les divergences économiques ont un impact sur les réactions asymétriques aux chocs communs que subissent les économies de l'Union Européenne, et en particulier de la zone euro. Cependant, les mécanismes permettant l'ajustement des politiques aux divergences présentes au sein de la zone euro, et l'introduction de ces hétérogénéités dans les modèles économiques sont deux domaines relativement peu explorés dans la littérature. Dans cette perspective, cette thèse questionne l'évaluation et la correction des hétérogénéités des pays de la zone euro compte tenu de leurs divergences structurelles et historiques.

Ainsi, nous étudierons le cadre dans lequel une politique monétaire unique peut être efficiente ce qui implique l'étude des secteurs économiques et financiers dans leur globalité. Par ce biais, nous pouvons (i) analyser l'application de la politique monétaire en prenant en compte les interdépendances qui existent entre les secteurs économiques et financiers dans la zone euro (Borio, 2014 ; Claessens et al., 2012 ; Mian et al., 2017) ; (ii) étudier les facteurs d'aggravation de la crise financière liés à la structure de la zone euro ; (iii) souligner de

quelle façon ces interdépendances intra Etat membres et inter Etat membres ont conduit à la crise des dettes souveraines en zone euro. En d'autres termes, s'il apparaît que suite à ces crises, la conception de la zone euro et les conditions sous lesquelles la politique monétaire s'exprime ont considérablement été modifiées, il n'en reste pas moins que ces défaillances avaient été, au préalable, soulignées par certains économistes américains dès les années 1990 (Einchengreen, 1992).

Ces défaillances reposent sur trois fondements principaux mis en avant dans une importante littérature majoritairement outre-Atlantique qui a marqué les années 1990. En premier lieu, les pays membres de l'Union monétaire ont perdu un mécanisme d'ajustement - le taux de change - en cas de chocs macroéconomiques négatifs. Dans un environnement marqué par des rigidités nominales, les économies sont alors confrontées à un problème d'ajustement. En deuxième lieu, ce problème d'ajustement est accentué par le fait que l'Union monétaire est incomplète : elle a défini une politique monétaire unique sans construire parallèlement une union budgétaire capable de se doter de mécanismes de redistribution et de stabilisation à l'échelle de la zone monétaire. En troisième lieu, le processus d'unification monétaire n'a pas considéré comme centrale la question de l'hétérogénéité structurelle entre les pays membres. La vision dominante était alors que la convergence nominale liée à la politique monétaire unique devait conduire à des modifications structurelles des économies - plus particulièrement en ce qui concerne les marchés du travail - dans le sens d'une plus grande flexibilité.

L'Union monétaire européenne, qui devait répondre aux critères de la théorie des Zones Monétaires Optimales de Mundell (1961), a finalement démontré les limites de l'application d'une telle théorie dans une zone dont les structures économiques et financières sont hétérogènes. Le fonctionnement de la zone euro ou, la « maison sans toit » (De Grauwe, 2013), a été avant la crise financière de 2007, une des conditions par lesquelles la crise financière s'est propagée et a mené à une crise des dettes souveraines. Pour mieux comprendre l'occurrence de ces crises, nous allons successivement nous concentrer sur : (i) la théorie des Zones Monétaires Optimales de Mundell (1961) ; (ii) la manière dont la crise financière s'est propagée au sein de la zone euro ; (iii) et enfin l'émergence la crise des dettes souveraines.

La théorie des Zones Monétaires Optimales de Mundell (1961) avance l'idée selon laquelle une zone géographique gagne à adopter une monnaie commune sous certaines conditions. Dans le cas de la zone euro, l'une des conditions d'adoption de la monnaie commune est la perte de l'indépendance de la politique monétaire. En échange de cette perte, les pays membres bénéficient : (i) d'une forte réduction des coûts de transaction (Ott and Vignolles, 2012) car le risque de change n'existe plus ; (ii) d'une augmentation des échanges de biens et de capitaux car les coûts fixes diminuent et donc la compétitivité augmente (Rose, 2000) ; (iii) et d'un taux de chômage qui n'augmente plus du fait de la mobilité des facteurs de production. Ces trois avantages ne sont possibles que si les pays membres sont structurellement similaires et que des mécanismes d'ajustement existent en cas de chocs systémiques importants.

Or, en 2007, les pays membres – désormais dépourvus de leurs instruments d'ajustements monétaires – disposaient de très peu de mécanismes d'ajustement pour répondre aux chocs. De plus, une réponse commune aux chocs était difficilement envisageable du fait de l'hétérogénéité présente en zone euro.

Spécifiquement, les économies européennes avant la crise financières de 2007 avaient une croissance positive et un faible taux d'inflation ainsi que des dettes publiques soutenables – bien qu'élevées – compte tenu de la tendance positive enregistrée au niveau de leurs taux de croissance. Les marchés et les investisseurs supposaient alors qu'avec le soutien de tous les pays membres de la zone euro, il y avait une garantie implicite que la dette serait sans risque de défaut. En conséquence, les investisseurs étaient disposés à détenir de la dette à des taux d'intérêt bas même si certains pays -comme la Grèce- avaient des niveaux d'endettement assez élevés. La crise des *subprimes* a remis en cause cette idée en accroissant le scepticisme des investisseurs face aux finances européennes. Par exemple, en Grèce, la dette était peu soutenable compte tenu de son économie. Ainsi, les ventes d'obligations grecques ont augmenté, ce qui a entrainé une hausse du taux d'intérêt. Est également intervenu un changement de perception des marchés financiers sur la soutenabilité de la dette européenne. Les marchés spéculaient désormais sur la possibilité d'une crise des liquidités en zone euro. Ces effets étaient par ailleurs renforcés par le fait que le traité de Maastricht (1992) ne prévoyait pas de mécanismes permettant de se prémunir contre les conséquences des paniques soudaines sur

les niveaux d'endettement. La crise financière a révélé alors une crise des dettes souveraines sous-jacente contre laquelle aucune stratégie efficace n'existait puisque :

- Les contribuables Allemands refusaient de souscrire à des obligations grecques.
- Il n'existait pas d'union fiscale.
- Il n'y avait pas de prêteur en dernier ressort.

En outre, un pays en crise de dette souveraine n'est généralement pas compétitif et arbore des taux d'inflation et des coûts de main-d'œuvre plus élevés. Cela signifie qu'il y a une demande plus faible pour leurs exportations, un déficit du compte courant plus élevé et une croissance économique atone. Prenons l'exemple de la Grèce où la crise de la dette a été particulièrement importante. Etant Etat membre de la zone euro, la Grèce ne pouvait pas procéder à une dévaluation externe de sa monnaie afin de renforcer sa compétitivité. Elle ne pouvait pas non plus mener une politique monétaire expansionniste puisque c'est la Banque Centrale Européenne qui contrôle la politique monétaire. Par conséquent, elle ne pouvait compter que sur une dévaluation interne qui passe par la mise en place de politiques d'austérité qui se traduisent par des perspectives d'une croissance affaiblie. A l'inverse, l'Allemagne ne connaissait pas une crise de dette souveraine aussi prégnante que celle de la Grèce et avait toujours la confiance des marchés financiers. Autrement dit, la zone euro n'était pas homogène en termes de structures économique et financière et n'avait pas de mécanisme d'ajustement adéquat, ce qui a empêché dès lors une réponse commune aux chocs d'une part ; et la BCE et les états membres de solutionner la crise européenne, d'autre part.

Pourtant, en 1992, le traité de Maastricht envisageait un certain nombre de critères supposés créer des structures économiques et financières homogènes. Les critères de Maastricht énoncent dans l'article 109 J, chapitre 4, titre II du Traité sur l'Union Européenne en date du 1er Mai 1992 que :
« Un degré élevé de convergence durable [. . .] (de) chaque Etat membre satisfait aux conditions suivants :

- La réalisation d'un degré élevé de stabilité des prix.
- Le caractère soutenable de la situation des finances publiques. »

Ces deux points se traduisent par un taux d'inflation par Etat Membre ne devant pas dépasser 1,5 points celui des trois États membres les plus performants en termes de stabilité des prix tandis que des finances publiques soutenables sont caractérisées par un déficit public ne devant pas excéder 3% du PIB et une dette publique inférieure à 60% du PIB.

Par ces trois seuls critères, il était supposé que des structures économiques, complexes, divergentes, multisectorielles, et dont les développements étaient à différents niveaux d'avancement, convergeraient et seraient capables d'accueillir une politique monétaire unique basée sur l'agrégation de ces différentes structures économiques. Comme l'histoire économique moderne de la zone euro l'a démontré, et comme expliqué ci-dessus, la convergence n'avait pas eu lieu et les structures macroéconomiques ainsi que les marchés financiers de la zone euro

n'avaient pour point commun que l'unicité de la politique monétaire.

Ainsi, de par la structure même de la zone euro et des conditions dans lesquelles évoluait la politique monétaire, une crise financière tout d'abord, une crise de dettes souveraines dans un deuxième temps et institutionnelle dans un troisième temps, étaient inévitables.

La crise des dettes souveraines fait alors largement écho à ces arguments (Bergsten, 2012 ; Boone et Johnson, 2012). Cette crise peut en effet être interprétée en partie comme le résultat d'un double problème : celui des divergences structurelles entre les pays membres d'une part ; celui de l'incomplétude institutionnelle d'autre part. Spolaore (2015) explique l'incomplétude de l'architecture institutionnelle européenne en considérant son échec initial. En effet, au début des années 1950, les initiateurs de l'intégration européenne ont défendu une approche ambitieuse fondée sur une intégration politique poussée et la mise en place d'une politique de défense commune. Les difficultés rencontrées pour atteindre ces objectifs ont conduit à une stratégie de fait axée sur une logique selon laquelle une approche gradualiste des réformes serait susceptible de conduire à une réaction en chaine dans le sens de plus d'intégration.

La littérature consacrée à la crise des dettes souveraines a également accordé une place importante, d'une part, à l'étude des interactions entre cette crise et la stabilité bancaire et, d'autre part, à ses conséquences sur le processus d'intégration européenne. Concernant

le premier aspect, les travaux ont clairement identifié la présence d'interactions négatives entre les Etats et les banques privées (Brunnermeier et al., 2016). En termes de réponses de politique économique, la littérature s'est focalisée sur les mécanismes à mettre en œuvre afin de lever la présence de ces interdépendances déstabilisatrices entre banques privées et Etats dont la mise en place de l'Union bancaire européenne est une illustration (Gros, 2012 ; Belke and Gros, 2015; Gelpern and Veron, 2020; Lindner, Soemer and Theobald, 2014). Un objectif lié a porté sur la nécessité de stopper le processus de fragmentation de l'espace monétaire et financier au sein de la zone euro.

Problématique de la thèse et méthodologie

C'est dans un tel contexte que nous questionnons, dans cette thèse, le processus d'intégration économique et financière des pays européens. Trois questions essentielles en découlent: Quel est le degré d'hétérogénéité des structures économiques et financières dans la zone euro ? Les divergences structurelles ont-elles été exacerbées par l'accélérateur financier intra zone euro ou par la transmission internationale des chocs financiers ? Enfin, est ce que l'Union bancaire européenne est un mécanisme d'ajustement permettant l'accroissement de l'intégration financière et économique? Les trois chapitres de cette thèse répondent respectivement à ces questions.

Nous analysons les incomplétudes de la zone euro en nous basant sur l'étude des cycles

économiques et financiers[2]. Merler (2015) et Schüler et al. (2015) sont, à notre connaissance, les rares économistes à avoir abordé la question des hétérogénéités en zone euro sous l'angle des cycles. Pourtant, Claessens et al. (2012) ont montré que les cycles financiers avaient pour spécificité une ampleur très prononcée comparativement à celle des cycles économiques. Les divergences de cycles au sein de la zone euro sont susceptibles de la fragiliser lorsqu'elles deviennent trop importantes. C'est une des leçons importantes de la crise des dettes souveraines. Dans cette perspective, s'interroger sur la pérennité du projet européen doit prendre appui, entre autres, sur l'identification des cycles financiers et économiques, de leurs divergences et des conséquences qu'elles impliquent. Elle doit également prendre appui sur les interactions entre cycles financiers et cycles économiques car elles sont importantes à prendre en compte dans le cas des ajustements au sein de la zone euro.

Il est dès lors nécessaire, dans un premier temps, d'identifier les variables les mieux à même de reproduire les mouvements cycliques. Il s'agit d'une étape indispensable pour mesurer les cycles.

La littérature souligne que les variables les mieux à même de les reproduire sont les prix de l'immobilier et les crédits au secteur privé. Ceci s'explique par la tendance de ces variables à co-varier (Borio, 2014), confirmant l'importance du crédit dans le financement de la construction et l'achat de biens immobiliers ainsi que le poids du secteur immobilier dans

[2]Un cycle financier est selon Borio (2014) une séquence d'interactions qui se renforcent mutuellement entre les perceptions de la valeur et des risques et qui se traduisent régulièrement par des booms suivis par des « busts » (*i.e.* effrondrement).

l'évolution de l'activité économique. C'est aussi l'un des meilleurs moyens d'obtenir le lien entre cycle financier, cycle économique et crise financière. On peut compléter cette approche en distinguant entre le crédit pour le secteur privé et non financier, le ratio crédit sur PIB, les prix des actifs, et les prix des biens immobiliers (commercial, résidentiel), ceci, pour construire le cycle financier.

Considérer le crédit au secteur privé et les prix de l'immobilier afin de définir un cycle financier paraît essentiel. On peut ici rappeler les ressorts traditionnels d'un cycle financier. Tout d'abord, l'économie subit un choc positif augmentant les perspectives de croissance potentielle et induisant un environnement favorable à l'augmentation des octrois de crédits. Les investissements sont perçus comme rentables, et dans un contexte de libéralisation financière (diminution des contraintes notamment en zone euro) et de stabilité monétaire (environnement de faible inflation), les agents ne perçoivent que la plus-value qu'ils peuvent en tirer et accordent une vigilance moindre à l'octroi de crédits, entrainant au moment du retournement du cycle des incapacités de remboursement par les agents insolvables. C'est le cas notamment de l'Espagne, où jusqu'en 2005, la politique monétaire européenne était bien trop accommodante pour le pays et les prêts interbancaires très peu coûteux (du fait de l'intégration financière européenne), qui ont conduit à un excès d'investissement financé principalement par les crédits.

D'autre part, le cycle économique est défini par Burns and Mitchell (1946) comme un type de

fluctuations qu'on retrouve dans l'activité économique globale. Il se compose d'expansions se produisant à des intervalles de temps proches dans de nombreuses branches d'activités économiques, suivies de récessions, de contractions puis de reprises et qui se rejoignent dans la phase d'expansion du cycle suivant (p.3 dans « Measuring Business Cycles »). Ils peuvent être mesurés par un large éventail de variables telles que l'investissement, la consommation, la construction ou encore par le prix des matières premières. Cependant, l'une des variables les plus fréquemment utilisées est le PIB car elle constituerait la meilleure mesure lorsque l'objectif est de mesurer l'activité économique à l'échelle globale comme le souligne le NBER :

"Because a recession must influence the economy broadly and not be confined to one sector, the committee emphasizes economy-wide measures of economic activity. It views real gross domestic product (GDP) as the single best measure of aggregate economic activity"[3].

Enfin, plusieurs techniques peuvent être utilisées pour identifier les cycles. Il est possible par exemple de recourir à une méthode de datation des cycles (Harding et Pagan, 2006) s'appuyant sur le changement en niveau des variables. Une autre approche se fonde sur l'utilisation de filtres (Kalman, 1960 ; Hodrick et Prescott, 1997 ; Baxter et King, 1999) qui permettent de distinguer les fluctuations des variables autour de leur tendance pour ensuite identifier les cycles comme une déviation par rapport à cette dernière. Une dernière approche repose sur l'utilisation de la méthode des ondelettes qui décompose le cycle en termes de fréquence et de temps (Crowley, 2007).

[3]https://www.nber.org/research/business-cycle-dating

Ainsi, dans l'ensemble des chapitres de cette thèse, le secteur économique sera représenté par le cycle économique et le secteur financier par le cycle financier.

Structuration de la thèse

Le **premier chapitre** de cette thèse s'attache à évaluer, dans le cadre de la zone euro, le degré de convergence des cycles économique et financiers intra pays-membres et inter-pays membres au cours du temps et à travers les fréquences. De cette façon, il sera plus aisé de comprendre la manière dont se transmettent les chocs financiers et d'analyser si l'état actuel de l'Union bancaire est un mécanisme d'ajustement suffisant. Effectuer ce type d'analyse est crucial étant donné qu'il est apparu que les économies des Etats membres de la zone euro avaient des fondamentaux divergents (Landmann, 2011). En fait, la convergence observée des revenus dans les années 2000 a largement reposé sur un boom financier – marqué par un emballement du crédit au secteur privé et une bulle immobilière – dans les pays à croissance rapide. En conséquence, la politique monétaire unique rencontre d'importantes difficultés lorsque les pays de la zone monétaire n'ont pas les mêmes réactions face à un choc financier commun et qu'ils montrent de fortes hétérogénéités. C'est pourquoi identifier le plus précisément possible le degré de convergence peut, dans un premier temps, permettre d'améliorer le cadre d'application de la politique monétaire. A cette fin, une méthode de décomposition en ondelettes discrètes dite $MODWT$[4] est utilisée afin d'analyser si les cycles

[4]Une MODWT est une méthode de traitement de signal permettant d'analyser un signal *i.e.* une série temporelle à plusieurs échelles au cours du temps. Ainsi, elle permet de rendre compte de la persistance des

financiers d'une part et les cycles économiques d'autre part sont synchronisés, interconnectés, interdépendants et covariants au cours du temps et à travers les fréquences inter-pays. Dans un deuxième temps, ce chapitre s'attache à vérifier si, au sein des pays, les cycles financiers et économiques sont synchronisés, interconnectés, interdépendants, covariants et en phase au cours du temps et à travers les fréquences intra-pays. Les résultats qui découlent de notre analyse démontrent alors que : (i) la zone euro est majoritairement divergente à court terme ; (ii) la politique monétaire a conduit à une période de boom entre 2002 et 2006 qui a masqué les divergences déjà existantes dans la zone euro ; (iii) les cycles économiques et financiers se sont développés dans un environnement macroéconomique et financier idiosyncratique ce qui a conduit à une aggravation des divergences ; (iv) le manque de synchronisation à toutes les fréquences et dans le temps intra-pays et inter-pays a empêché la politique monétaire de jouer son rôle contracyclique.

Une fois le degré de convergence établi, il est crucial d'évaluer par quels canaux les fluctuations macroéconomiques sont impactées car la divergence en terme d'amplitudes à chaque phase des cycles empêche la politique monétaire d'être efficace.

Dans un **deuxième chapitre**, nous nous demandons comment les chocs financiers et économiques se transmettent d'un pays à l'autre et d'un cycle à l'autre. Cette question est cruciale en particulier pour la zone euro puisque, comme le soulignent Claessens et Kose (2017), les fluc-

cycles (à court terme, moyen terme ou long terme), tout en mettant en évidence à chaque terme la variation locale des phases du cycle.

tuations de divers segments de marché – tels que les marchés des actions, du logement ou du crédit – jouent un rôle important dans le façonnement des récessions et des reprises. D'une part, il est bien connu que les récessions associées à des perturbations financières sont souvent plus longues et plus profondes que les autres récessions et, inversement, les reprises associées à une croissance rapide du crédit et des prix des logements ont tendance à être relativement plus fortes (Claessens et al., 2012). D'un autre côté, les chocs financiers ont des implications mondiales, en particulier ceux provenant des marchés financiers américains. Comme suggéré par Claessens et Kose (2017), il y a eu une propagation rapide des perturbations des marchés financiers américains vers d'autres pays pendant la crise financière mondiale qui ont remis en question la transmission transfrontalière des chocs réels et financiers.

Spécifiquement, dans ce deuxième chapitre, nous identifions les interdépendances entre les pays en développant et estimant un modèle un GVAR (Global Vector AutoRegressive). Le GVAR fournit un cadre de modélisation global général pour l'analyse quantitative des différents chocs et canaux de mécanismes de transmission. Cette méthode combine à la fois des séries temporelles, des données de panels et des techniques d'analyse factorielles afin de traiter d'un large éventail de questions économiques et financières. Cette approche permet en outre de contourner le « curse of dimensionality ». Elle se construit en deux étapes : (i) nous estimons des modèles spécifiques adaptés à une petite économie ouverte; (ii) nous empilons et résolvons simultanément des modèles VARX*[5] de pays individuels en un seul modèle global VAR. Nous générons ensuite des fonctions de réponses impulsionnelles et évaluons si les chocs

[5]Vecteur autorégressif avec bloc exogène.

de variables financières sont une source d'amplification et de propagation des fluctuations macroéconomiques et s'ils se transmettent au niveau international. Nos résultats montrent que : (i) il y a des effets de débordements internationaux importants des chocs de crédit privé aux États-Unis alors que la transmission financière des chocs provenant des régions de la zone euro est essentiellement régionale ; (ii) le cours des actions n'est pas étroitement lié au cycle économique dans le « cœur »[6] de la zone euro ; (iii) il y a un impact global des chocs financiers américains et un impact plus régional des chocs financiers de la zone euro ; (iv) enfin, les mécanismes d'accélérateur financier sont faiblement applicables à la zone euro.

En conséquence, la politique monétaire de la zone euro ne peut pas être efficace car elle doit faire face à des chocs régionaux et internationaux. De ce fait, afin de permettre à la politique monétaire d'être optimale, il faut améliorer la stabilité financière et l'intégration. Cela permettrait d'accroître la similitude entre les fluctuations macroéconomiques de la zone euro et que la politique monétaire soit mieux adaptée aux pays membres. En effet, le marché financier de la zone euro étant basé sur les banques, le règlement sur les exigences de fonds propres a été établi par l'Union bancaire européenne afin de stabiliser le système financier, d'améliorer l'intégration financière et d'éviter que les chocs externes influencent le système financier interne de la zone euro, ce qui, à terme, permettrait à la politique monétaire d'être efficace.

[6]Le « cœur » est composé de l'Autriche, la Belgique, la Finlande, L'allemagne, les Pays-Bas. Ce sont les pays qui n'ont pas connu un boom financier significatif sur la période étudiée.

Ainsi, dans un **troisième chapitre**, nous cherchons à savoir si le règlement sur les exigences de fonds propres fixé par l'Union bancaire européenne améliore l'intégration financière et la stabilité financière dans la zone euro et permettrait ainsi une meilleure absorption des chocs. En effet, en 2012, l'Union Européenne a opéré un changement structurel de sa politique bancaire en créant une Union bancaire. L'Union Européenne a remplacé la supervision décentralisée et la concurrence réglementaire entre pays par une approche plus harmonisée (De Rynck, 2016). Gros et Schoenmaker (2014) décrivent l'Union bancaire comme un transfert au niveau européen des cadres réglementaire et institutionnel afin d'augmenter le degré de stabilité du secteur bancaire. Lors de la crise financière de 2007, ces mécanismes n'existaient pas et la responsabilité de superviser le système bancaire et d'assurer sa stabilité était du ressort des gouvernements nationaux. En particulier, la crise financière a souligné qu'un secteur bancaire intégré ne pouvait pas être optimal sans une Union bancaire. Tout d'abord, laisser la responsabilité de la supervision et de la stabilité aux gouvernements nationaux a montré qu'ils ne prennent en compte et ne préservent que les intérêts nationaux (Schoenmaker, 2013 ; Gros et Schoenmaker ; 2014). Un tel comportement entraîne des effets systémiques des défaillances bancaires au niveau de la zone euro. Deuxièmement, parce qu'il existe une interdépendance entre le risque de crédit gouvernemental et bancaire pendant la crise financière (Alter et Schuler, 2013). La création d'une Union bancaire permettrait alors d'éviter la 'diabolic loop'[7] (Brunnermeier et al., 2016) entre les gouvernements nationaux et les banques. En d'autres termes, une Union bancaire pourrait jouer le rôle d'un important mécanisme d'ajustement aux chocs (Gros, 2012).

[7]Ou « cercle vicieux ».

Ainsi, afin d'évaluer si l'Union bancaire joue bien ce rôle dans la zone euro, nous comparons deux ensembles de fonctions de réponse impulsionnelle (IRF) issus de deux spécifications de vecteurs autorégressifs en panel (PVAR). Dans ces modèles, la stabilité financière est représentée par notre indicateur de cycle financier et par les prêts non productifs; le secteur réel est représenté par le cycle économique ; et l'intégration financière par les positions bancaires transfrontalières dans une première spécification et par les rendements obligataires dans une seconde spécification. Nos résultats démontrent que le règlement sur les exigences de fonds propres de l'Union bancaire améliore l'intégration financière mais n'augmente pas la stabilité financière. Par conséquent, il ne permet pas de répondre à son objectif initial : stabiliser le système financier et corriger la fragmentation financière qui a suivi la crise financière.

Au total, l'objectif de cette thèse est de contribuer à une meilleure compréhension des mécanismes de divergence entre les pays de l'Union Monétaire Européenne afin de proposer des mécanismes d'ajustement adéquats empêchant l'accumulation de déséquilibres pouvant remettre en cause la soutenabilité de la zone euro dans son ensemble.

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Chapter 1

Are the Eurozone financial and business cycles convergent across time and frequency?*

Abstract

This chapter examines the Eurozone (EZ) convergence through Financial and Business cycles frequencies over time. Specifically, I use the Maximum Overlap Discrete Wavelet Transform (MODWT) in order to analyze whether financial cycles on the one hand and business cycles on the other hand are inter-countries synchronized, interconnected, interrelated and co-variant across time and frequencies. I also study if Financial and Business cycles are intra-countries synchronized, interconnected, interrelated, co-variant and phased across time and frequencies. I find that: (i) the EZ is mostly divergent at short term; (ii) the monetary policy led to a boom period between 2002 and 2006 that masked the already existing divergences in the EZ; (iii) that business and financial cycles grew in a case-by-case macroeconomic and financial environment which led to an exacerbation of the divergences; (iv) the lack of synchronization at all frequencies and over time intra-country and inter-country precludes the monetary policy to play its countercyclical role.

Keywords: financial cycles, business cycles, EMU, synchronicity, wavelet analysis.

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1.1 Introduction

The financial crisis of 2007 and the economic crisis of 2008 in the Eurozone (EZ) pointed out the relevance of studying financial disruptions simultaneously with economic recessions. Borio (2014) relates that recessions that coincide with contraction phase of the financial cycle are especially severe. Indeed, GDP tend to drop by around 50% more than otherwise when recessions coincide with the financial cycle's contraction phase (Drehmann et al., 2012; Borio, 2014).

The study of interactions between business cycles (BC) and financial cycles (FC) have thus, been more intensively studied after the occurrence of the 2008 economic crisis. According to Burns and Mitchell (1946), "Business cycles are a type of fluctuations found in the aggregate economic activity of nations that organize their work mainly in business enterprises [...] a cycle consists of expansions occurring at about the same time in many economic activities, followed by similarly general recessions, contractions, and revivals which merge into the expansion phase of the next cycle". On the other hand, FC that will be studied in this chapter are defined according to the definition of Borio (2014):[1] "self-reinforcing interactions between perceptions of value and risk, attitudes towards risk and financing constraints, which translate into booms followed by busts. These interactions can amplify economic fluctuations and possibly lead to serious financial distress and economic dislocations".

In particular, Bernanke and Gertler (1999) and Kiyotaki and Moore (1997), suggested that BC and FCs interact when we consider the presence of financial frictions such as collateral constraints to borrow. Specifically, wealth and substitution effects can be amplified because of changes in access to external financing, including through the financial accelerator and

[1] As there is no consensus on the definition.

related mechanisms (Claessens et al., 2012). Conversely, changes in the supply of external financing can affect corporations and households and thereby aggregate BC (Claessens et al., 2012). Hence, the interactions between BCs and FCs play an important role in shaping recessions and recoveries (Claessens et al., 2012).

Our work relates to the literature studying the interactions between BCs and FCs within the Eurozone. Many studies focus on the BC convergence within the Eurozone (Hugues Hallett and Richter, 2006; Darvas and Szapary, 2008; Koopman, Azevedo, and Rua, 2006). However, only a few of them studies the synchronization of FCs in the Eurozone (Merler, 2015; Schüler, 2015). And even a thinner part of the cycles convergence literature focuses on the synchronization between FCs and BCs within the EZ (Oman, 2019; Hiebert et al., 2018; de Winter et al., 2017).

Overall, in spite of the rich research on cycles, empirical researches lack to understand the synchronicity between BC and FC within and between each country of the Eurozone. It either studies the interaction between BCs and FCs by focusing on whether it is the financial or macroeconomic variables that are leading, coincident or lagging indicators of the real economy excluding the Eurozone context (Helbling et al., 2011); or analyses the synchronicity of business (respectively financial) cycles between countries (Merler, 2015; Schüler, 2015; Coussin and Delatte, 2019). In the previous analysis, they mainly investigate the synchronicity over time without evaluating the differences of synchronicity stemming from the frequency of the cycle. Yet, evaluating at which term cycles are synchronized would drastically improve the implementation of the monetary policy (Wälti, 2009). As noted by Crowley and Mayes (2008), "simply looking at BCs loses much of the detail of the extent of co-movement in different frequency cycles within the euro area". Their study focuses on the growth cycles of the core of the Eurozone in terms of frequency content and phasing of cycles; but it does not

look at the Eurozone (EZ) in terms of frequency content and phasing of BCs and FCs between and within Eurozone state members. Hence, findings suggesting that the Eurozone is synchronous (or not) have some shortcomings as they do not depict the short term, medium term and long term dynamics of BCs and FCs within and between countries. For instance, Aldasoro et al. (2020) distinguish two types of FCs. The Global FC defined by financial asset prices and capital flows and the Domestic Financial Cycle (DFC) characterized by credit and house prices. They found that the DFC is predominantly linked with medium-term cycles.

In the context of the EZ, this is particularly important as the shock of 2007 led to different responses at different terms in the real economy of the EZ's countries and revealed how much the economic and financial structures in the EZ were divergent. They are divergent not only in terms of amplitude but also through frequencies as they do not present the same development path (*e.g.* Greece and Germany). Hence, when the 2007 crisis occurred and was diffused asymmetrically in the EZ, the single monetary policy could not stabilize the economy as it should have. In other words, the symmetric financial shock of 2007 led to different response in the BCs of the EZ's countries revealing how much the economic and financial structures were heterogeneous and unadapted to receive a unique monetary policy.

As highlighted by Eichengreen and Bayoumi (1993), the Eurozone enclosed a core and a periphery group which were divergent. More precisely, if disturbances are distributed asymmetrically across divergent countries, there will be an occasion for an asymmetric policy response. And as the adoption of the euro leads to a loss of the monetary policy sovereignty, governments will no longer have the option of adopting a monetary policy which differs from that of the Union as a whole as a response to a country specific shocks. Insofar as monetary policy is useful for facilitating adjustment to disturbances, adjustment problems grew more persistent and difficult to resolve.

Mundell (1961) preconized to have a high mobility of the production factors as a solution for asymmetric shocks absorption. But because of the language barrier, the strong national preferences and the different social systems, this solution is not applicable. Hence, the main issue for the EZ is its capacity to handle and absorb an asymmetric shock. Indeed, if the shock is symmetric, the European Central Bank (ECB) can intervene by implementing a common monetary policy which will suit all countries. But if a shock occurs in only one country and is not diffused in the others, or is asymmetrically diffused, the monetary policy cannot stabilize the economy as it should do.

This chapter addresses some of these gaps in the literature. I investigate the level of synchronicity of BCs and FCs within and between EZ state members using the wavelet approach[2] Maximum Overlap Discrete Wavelet Transform (MODWT) and Continuous Wavelet Transform (CWT)). The wavelet analysis is a refinement of Fourier analysis and overcomes its shortcoming, as it allows one to take into account, both the frequency and the time variations of a time series simultaneously. More precisely, a cycle is decomposed into its shortest and longest frequencies over the years. Three main shortcomings of the literature are adressed here: (i) the convergence between BCs on the one hand and between FCs on the other hand between nine EZ's state members; (ii) the convergence between BCs and FCs within nine Eurozone country; (iii) the convergence of BCs and FCs within and between state members of the Eurozone over time and across frequencies.[3] I thus address the following question: are the BCs and FCs in the Eurozone co-moving, synchronized and convergent over time and

[2]As noted by Galati et al. (2016), the literature on measuring FCs is still in its infancy but has its roots in a rich literature on systematic boom-bust patterns. However, this literature faces three important issues of methodology: (i) there is no consensus on the most reliable method; (ii) there is no consensus on which financial variables are to be included in the analysis as data limitations are numerous; (iii) there is no consensus either on how to combine multiple variables into a single measure of FC as illustrated by the debate "date-then-average or average-and-date" (Stock and Watson, 2014).

[3]Cycles are decomposed into their short term, medium term and long term length.

through frequencies?

My chapter is the first studying BC and FC's convergence between and within Eurozone state members over time and through frequencies simulteanously. I contribute to the existing literature in several ways. First, I contribute to the very thin EZ's FC literature, as my first objective is to evaluate the Eurozone convergence through FCs and BCs.[4] Hence, I measure the Domestic Financial Cycle[5] in terms of property prices, private credit and credit-to-GDP ratio for the Eurozone (Borio, 2014) and establish the main interactions between FCs in the Eurozone. Secondly, I investigate the FCs and BCs at all frequencies and over time through the MODWT methodology following Crowley (2005, 2007). Thirdly, BCs have been a concern for two centuries and are still a major unsolved question in economy. In this chapter, not only do I look into this issue in the context of economic changes in the Eurozone, but I also connect it to FCs. In other words, I estimate the classical BC of Burns and Mitchell (1946) and the NBER represented by the GDP and look at which term and when BCs are synchronized. Finally, I analyze the BC/FC interrelations within and between state members in order to establish if there is an intercountry and intracountry convergence of the FC/BC interaction.

I find that there are strong divergences between cycles through frequencies at short term and after the occurrence of a crisis. In other words, the link between cycles changes over time but mostly across frequencies. I show that after the occurrence of a crisis, cycles tend to be less convergent in their trough phases during 8 quarters. I also find that there are a common BC and a common FC to the Eurozone state members but with divergent amplitudes. In terms of absorption of asymmetric shocks, it induces that there is structural divergences between

[4]As far as I know, only Merler (2015), Schüler (2015), Stremmel (2015) and Coussin and Delatte (2019) evaluate the Eurozone convergence through FCs.

[5]Which I will call the Financial cycle (FC).

state members and that the monetary policy cannot handle them because of the too strong differences in terms of amplitudes. My results confirm that FCs tend to be more correlated to BCs at medium term (Aldasoro et al., 2020; Drehmann et al., 2012; Borio, 2014).

This chapter is composed of six sections. Section 1.2 stresses the importance of studying cycles within the EZ. Section 1.3 presents the literature review. Section 1.4 develops the methodology. Section 1.5 presents the data used in this study and shows some stylized facts of the Eurozone synchronization by distinguishing BCs and financial cycles. Section 1.6 analyses the empirical results. Finally, Section 1.7 concludes the paper.

1.2 Stressing the importance of studying cycles within the Eurozone

In this section, the linkages between monetary policy and BCs and FCs are going to be presented in the first subsection. While the second one presents why do I study the divergences in the Eurozone through cycles.

1.2.1 On the linkages between monetary policy and financial and economic variables

In the light of the recent global financial crisis and the creation of the EZ, it is necessary to understand the role and linkages between the financial sector, the macroeconomic activity and the monetary policy in order to detect how to improve the EZ stability. In particular, the economic activity of each state member of the EZ is bounded by a single monetary policy.

Initially, the monetary policy primary goal is to ensure price stability. To achieve this goal, three main channels are mobilized (Mishkin, 1995): (i) interest rate; (ii) asset price; (iii) credit channel. Taylor (1995) pointed out that interest rates have important effect on the consumer and companies spending decisions and hence are powerful monetary policies mechanisms . While Mishkin (2001) highlighted that the more developed a country is, the more important the asset price channel will be in the transmission of monetary policy into the economy. On the other hand, Bernanke and Getler (1995) consider that the first channel has failed as a monetary policy mechanism of transmission which led to focusing on the credit channel. Despite the debate on the most effective transmission channels, most economists would agree on the fact that monetary policy is a powerful countercyclical tool.

The state members of the EZ, however, have lost this tool as it is decided at a supranational level: at the European Central Bank (ECB). In period of recession, they can no longer use the monetary policy as a countercyclical tool. This is controversial as de Grauwe (2007) has shown that the interest rate set by the ECB during the pre-crisis period was often unadapted to all EZ state members. Indeed, given the rates of inflation and the output gaps observed in these countries, the interest rates for each country should have been very different from the one fixed by the ECB (de Grauwe, 2007). The second implication is in term of FC. The divergences in real interest rates have important consequences on the housing markets in the Eurozone countries. Generally, low real interest rates stimulate the demand for houses (and real estate in general), which in turn tend to raise house prices (the reverse is likely to happen in countries with high real interest rates). In Ireland and Spain for example, the house price increases were spectacular, they more than doubled in Spain and more than tripled in Ireland whereas countries like Germany saw them decline during the same period (de Grauwe, 2007). Those two implications combined provide a third one, specific to the monetary policy. When the Euro was launched, the low interest rates fueled the housing bubble which spilled over

into the credit markets. Since the nominal interest rates are fixed centrally by the ECB, such a credit expansion can be done at unchanged nominal interest rates. The danger is that when the crash/bust comes, the divergences in the Eurozone get accentuated, fueling, in turn, the divergences in the European countries' structures belonging to the Eurozone. In other words, monetary policy regimes have a pivotal role in determining the economy's vulnerability to boom-bust cycles and its long-run evolution (Rungcharoenkitkul et al., 2019).

1.2.2 On why studying divergences through cycles and what would it tell for the monetary policy?

A better knowledge of the structure and linkages between the economic and financial sector within the EZ will hence allow a more homogeneous transmission of the monetary policy. Indeed, as noted by Roma and Nocera (2017): "it is crucially important to understand the role that house prices played in the past and the linkages between housing, monetary policy and macroeconomic activities in general, in order to detect future housing imbalances and to improve financial stability".

One way to study the structure and linkages between the economic and financial sectors is through BCs and FCs. Both allow to study respectively a large broad of the economic and financial sectors but also to depict each economic and financial phase a country goes through. Once, the BCs and FCs comprehended, it would be easier to materialize the influence that the monetary policy has on BCs *i.e.* real variables through their impact on the FC (Rungcharoenkitkul et al., 2019). Indeed, according to Rungcharoenkitkul et al. (2019): "Many studies have found that strong credit and/or asset prices increases, beyond historical norms, are useful leading indicators of subsequent busts and financial crises (*e.g.*

Borio and Lowe, 2002; Borio and Drehmann, 2009; Reinhart and Rogoff, 2009; Schularick and Taylor, 2012). It has also become increasingly evident that strong credit growth and/or easy financial conditions carry information about subsequent economic slowdowns (Mian et al., 2017; Claessens et al., 2012; Jordà et al., 2016; Drehmann et al., 2017); large negative output gaps or possibly deeper recessions (Borio and Lowe, 2004; Krishnamurthy and Muir, 2017; Jordà et al., 2016; Borio et al., 2018), or downside risks to output (Adrian et al., 2019)".

Not only BCs and FCs embody the economic and financial structure in the EZ, they also indicate (with the help of multiple tools) if and when the European structures are convergent, co-moving and synchronized. Studying the phases of the BCs and FCs will also depict the amplitude of each economic (respectively financial) phase in each country and hence provide scarcer information on the appropriate policies that should be implemented at each phase. For instance, Papademos (2004) shows that a variation of the key interest rates induces a maximal adjustment of the production after one to two years. But what about the BCs and FCs phases? Do their phases fit this amount of time? More importantly, do we really need cycles to be homogeneous within and between countries? And would not it be better to take into account that they are intrinsically divergent (such as in the US where cycles' states do not have the same amplitude) and hence, think about the implementation of other adjustment mechanisms?

Finally, Papademos (2004) among others, highlights the following question: "Given the uncertainty about the extent and timing of a possible disruption, and given our imperfect knowledge of the structure and functioning of the economy, is monetary policy able to effectively dampen movements in the BC or would it accentuate them due to imperfect information or inappropriate or overly ambitious actions?".

I agree with this statement. That is why, the intent of this chapter is to study BCs and FCs co-movement, synchronicity and convergence within and between the EZ state memberss over time but mostly across frequencies. Indeed, as we will see in the next section, most studies focused on the synchronization between cycles over time but only a few of them study them across frequencies (Crowley and Hugues Hallet, 2018; Ardilla and Richter, 2016; Yan and Huang, 2020).

1.3 Literature review

Cyclical convergence is a key consideration for countries deciding whether to join, or to remain in a common currency union (Hugues Hallett and Richter, 2006). The literature on the Eurozone cyclical convergence is mostly focused on BC. Only a few recent studies have focused on the FC convergence in the EZ. However, it is necessary to study both of them as Eurozone countries share a common monetary policy which has a great influence on the BC and the FC. As Furceri and Karras (2008) showed, the impact of the euro on BCs convergence remains an open question. Nonetheless, their results suggest that all the economies studied in their sample have been more similar in terms of BC synchronization after the euro. Nevertheless, it does not imply that the euro has induced greater synchronization as they find that the most synchronized European Monetary Union (EMU) wide income is that of Denmark and the United Kingdom. On the other hand, Beine et al. (2000) suggest a more restrictive definition of optimum currency area for which the short run fluctuations were synchronized by using both a cointegration and a common cyclical feature analysis in a Vector AutoRegressive(p) framework. They confirm the idea of a two-speed Europe and suggest that even a restricted monetary union would still face some stabilization costs. They also highlight the existence of an adjustment delay between EMU countries cycles. Mostly, they find a starting core of European countries composed of Germany, Belgium, the Netherlands

and France. Similarly, Hugues Hallett and Richter (2006) use a time-frequency decomposition by filtering the data through a Kalman filter and deriving it in a frequency domain via a short time Fourier Transform. They find evidence of clustering while measuring the degree of convergence among European BCs. Those results are in line with Artis and Zhang (2002) and Demertzis et al. (1998) who also distinguish the short run convergence from the long run one. They show that in the long run, Germany's BC is more convergent with the Eurozone's BC. Darvas and Szapary (2008) studied the current degree of synchronization in the enlarged European Union (EU) and the evolution of BC synchronization among the Eurozone's countries by extracting them through a Hodrick and Prescott filter and a Baxter and King filter. They find evidence of a core group composed of Austria, Belgium, France, Italy and the Netherlands and a group of countries composed of Finland, Ireland, Portugal and Spain on the periphery. The core group showed a high degree of synchronization not only for the GDP but also for all its components. But the other group had been moving towards a higher level of synchronization since their run-up to EMU.

Contrary to BCs, no consensual FC measure is available. Yet, its understanding and its drivers are essential for the conduct of monetary and macroeconomic policies. The recent literature shares a broad description of FC but struggles to come up with an appropriate indicator. The FC literature can be divided into two strands. The first strand describes indirectly FCs and obtains findings on FCs such as studies on asset prices or credit aggregated to economic activities (Borio et al., 2013; Aizenman et al., 2013; Schularik and Taylor, 2012; Aldaroso et al., 2020). Others such as Borio and Lowe (2002, 2004), Borio and Drehmann (2009), Ng (2011) use financial factors as leading indicators in early warning system. The second strand appears after the global financial crisis and directly studies the FCs characteristics. Drehmann et al. (2012) made a first attempt to construct a synthetic FC measure by combining medium term fluctuations of financial variables for 7 advanced countries. Those

studies show that FCs tend to be longer and to exhibit greater amplitude than BCs, but also that peaks of FCs are linked to systemic banking crisis. Also, this literature exposes that embedding equity prices provide less good results. Many studies are still looking for a proper way to define, measure and explain FCs (Levanon et al., 2015; Stremmel, 2015; Ardila and Sornette, 2016; Galati et al., 2016).

Few studies have focused on the FC's convergence and synchronization among the Eurozone so far. Merler (2015) analyzes the credit cycles, the house prices cycles and the FCs for both the Eurozone as a whole and individually for the eleven member states member states. To estimate those three cycles, she uses the Principal Component Analysis method. She shows that before the crisis, the three cycles diverged significantly in different Eurozone countries. For instance, she finds that Germany and the Netherlands are opposed to Spain and Ireland which are opposed to France and Italy in terms of cycle. Indeed, when the first ones are in a contraction phase, the second ones are in an expansion phase while the third ones display moderate fluctuations after 1999. She argues that the divergence in FCs is deeply rooted in the financial integration that follows the unification of monetary policy. She also presents that the divergence in FCs at the country level is very strongly correlated with cross-border debt flows, and especially with the intra-Eurozone component of these flows. On the other hand, Schüler et al. (2015) introduce a methodology to characterize FCs combining a novel multivariate spectral approach and a time varying aggregation emphasising systemic developments for 13 European Union countries. Their results suggest that the most important FCs are on an average of 12.7 years but with some dispersion across countries.[6] They also show that considerable co-movements of FCs across the countries exist,[7] which suggests a

[6]Denmark, Sweden, Finland are the closest to that average while Ireland, the Netherlands, Spain, Belgium, Italy and France cycles are in the range of 20.5 and 15.5 years. Austria, Portugal and Germany have shorter FC with respectively 9.3 years, 8.8 years and 7.8 years. Finally, the United Kingdom is the most distant one from that average with a FC of 5.4 years.

[7]For instance, the six most synchronised FCs are Belgium, the United Kingdom, Spain, Finland, Swe-

strong need for coordination and reciprocity in the implementation of country-specific measures. In addition, they find that FCs' interaction with BC counterparts –and the potential for divergence – underscored the need for policy specialization, notably across the macroeconomic and macroprudential space. Stremmel (2015) tries to capture the FC in Europe which he estimates by employing a frequency-based filter techniques. According to Stremmel, the best fitted synthetic FC measure for Europe contains the credit-to-GDP ratio, credit growth and house-prices-to-income ratio. He also captured the synchronicity of FCs in Europe and found that FCs were highly correlated during stress times and diverged in boom periods. Finally, few papers have studied the synchronization between and within the Eurozone state members through BCs and FCs. For instance, Oman (2019) used a frequency-based filter to study the synchronization of BCs and FCs in the Eurozone. His paper highlights that: (i) FCs are less synchronized than BC; (ii) BCs synchronization increased ; (iii) FCs are desynchronized more between high-amplitude and low-amplitude countries especially Germany. Finally, as far as I know, only Yan and Huang (2020) stressed out the relationship between the financial and the BCs in the time and frequency domain. However, their empirical analysis is based on the data from the United States. Their results show that the FC is closely related to the BCs especially at medium-term frequencies (8-30 years); that the BC leads the FC with a high positive correlation and that the FC is an important source of the BC fluctuations.

den and Ireland. Germany has the weakest link to cycles of other countries (53% on average in term of concordance).

1.4 Methodology

This section presents the wavelet approach I use in this chapter to estimate BCs and FCs. It also provides information on the reason why I choose to implement this approach rather than the traditional filters such as the band pass or high pass filters, or the turning point method.

1.4.1 The Wavelet Transform: a brief overview

The Wavelet Method is a time-frequency domain filter. The original work on wavelets stems from the research of Mallat (1989) and Daubechies (1992). The Wavelet Transform (WT) is used as an element of filtering allowing a separation between different components of the same signal. Two main approaches are distinguished: the Continuous Wavelet Transform (CWT) on the one hand and the Discrete Wavelet Transform (DWT) on the other hand (see Percival and Walden (2000) and Gençay et al. (2002) for more discussion on the CWT).

The DWT is based on two discrete wavelet filters which are called the mother wavelet $h_l = h_0, \ldots, h_{L-1}$ and the father wavelet $g_l = g_0, \ldots, g_{L-1}$. The mother wavelet is characterized by three basic properties:

$$\sum_{l=0}^{L-1} h_l = 0 \tag{1.4.1}$$

$$\sum_{l=0}^{L-1} h_l^2 = 1 \tag{1.4.2}$$

and

$$\sum_{l=0}^{L-1} h_l \; h_l h_{l+2n} = 0 \;\; \text{for all integers } n \neq 0 \tag{1.4.3}$$

They respectively ensure that: (i) the mother wavelet is associated with a difference operator; (ii) the wavelet transform preserves the variance (Byers et al., 2002) of the original data; (iii) a multiresolution analysis can be performed on a finite variance data series. The first property implies that the mother wavelet (also called "differencing function") is a high-pass filter as it measures the deviations from the smooth[8] components. The father wavelet (*e.g.* "scaling function") aims at capturing long scale (*i.e.* low frequency) components of the series and generates the scaling coefficients. Their application allows separating the low frequency components from the high frequency components of a time series.[9]

However, the DWT has three main drawbacks. First, the DWT requires a specific sample size and a dyadic[10] length while most macroeconomic and financial time series do not.[11] Secondly, the DWT is non-shift time invariant, which means that the MRD (Multiresolution Decomposition)[12] will change with a circular shift, *i.e.* if one shifts the series one period to the right, the multiresolution coefficients will be different. Third, it may introduce phase shifts in the wavelet coefficients: peaks or troughs in the original series may not be correctly aligned with similar events in the multiresolution analysis. That is why I choose the MODWT rather than the DWT to estimate BCs and FCs.

[8]The smooth is the trend component of the wavelet.

[9]See Crowley (2007), Constantine and Percival (2003), Gençay et al. (2002), Whitcher et al. (2000), Daubechies (1992), Mallat (1989), for further details on the method.

[10]Power of two such as 4 which is equal to 2^2.

[11]For example, if a time series has 126 data points instead of 128, we will have to lose 62 data points in order to get a dyadic length of 64 or to find two more ones in order to get 128 data points. If not, the DWT is not enforceable.

[12]MRD is the action of decomposing a time series into multiple frequencies in function of time.

1.4.2 The Maximum Overlap Discrete Wavelet Transform (MODWT)

The MODWT, introduced by Shensa (1992), overcomes the previous aforementioned drawbacks. Besides its intuitive approach, the MODWT is very popular for its features.[13] It gives up the orthogonality property to provide: (i) the capacity to handle any type of sample size without being forced to be dyadic; (ii) the increase of the resolution at coarser scales as it oversamples the data; (iii) the MODWT crystal coefficients that are time invariant, *i.e.* it is invariant to translation; (iv) the wavelet variance estimator that is more asymptotically efficient than the DWT one (Percival and Mofjeld, 1997). In other words, all integer translations are taken into account u=k whereas with the DWT, the integer translations are specific as u and s are defined by $u = k2^{-j}$ and $s = 2^{-j}$. Thus, each scale will be properly shifted and each coefficient approximately aligned with the original data. This action of decomposing is called a Multiresolution decomposition (MRD, Masset 2008, Percival and Walden 2000). In the next subsection, I am going to explain how they are set.

1.4.3 Shifts, Scales and Wavelets

In the process of MODWT, choosing the scale and the wavelet is important. Indeed, the scale depends on the number of observations – the more they are, the coarser the scale would be preferred – but also on the associated mother and father wavelets as their position in their equation is variant.[14] On the other hand, the choice of the wavelet highly depends on the type of frequency chosen but also on the type of series chosen.[15] On the contrary,

[13]It can also be called non decimated DWT, time invariant DWT, undecimated DWT, translation-invariant DWT. Its "MO" part came from its relationship with the literature on the Allan Variance (See Greenhall, 1991; Percival and Walden, 2000).

[14]The Symmlet will not have the same scale than a Haar Wavelet for example.

[15]For example, a Haar wavelet will not be adapted to financial or economic time series as its waveform is discontinuous.

the shift is not chosen but determined in the mother and father wavelets functions.[16] One must add the importance of a wavelet's length. As noted by Crowley (2007) for financial and volatile economic series, a wavelet tap of length 8 is probably most appropriate but with macroeconomic data that possesses less volatility, a wavelet of tap length 4 is likely more advantageous with relatively short datasets, as the number of possible scale resolutions will likely increase over the tap 8 equivalent. Seeing the structure of our series, I chose to apply the previous suggestion formulated by Crowley (2007) to our financial and macroeconomic data. Indeed, basing our analysis on Crowley (2005, 2007), Crowley and Schultz (2010), Masset (2008) and Whitcher et al. (2002), I apply the Daubechies wavelet as it has the best response whatever the length is.[17] Masset (2015) presents[18] the frequency responses of the Haar, D4 (Daubechies, length 4), D8 (Daubechies, length 8) and LA8 (Least-Asymmetric, length 8). He found that the D8 captures much better the components at j=5, *i.e.* 5 scales. For all those reasons and based on Crowley (2007), I choose a Daubechies wavelet filter of a length's tap of 4 for the macroeconomic data whereas financial data necessitate a D8 wavelet filter.

1.4.4 A static perspective of cycles

In the previous section, I presented the MODWT concept. In those sections, I explain how I explore FCs and BCs relationships in the EZ. Three types of analysis are provided here. First, I study cycles through their crystal scales as the MODWT MRD displays significant features such as asymmetry, volatility and frequency. Secondly, cycles are investigated using a static approach which involves wave correlations and cross-correlations analyses. In a third

[16] As a reminder, the shift is simply the number of translations of the wavelet for any scale but is not assumed to be dyadic here because the MODWT does not require it.

[17] This wavelet has also been found suitable for the EZ economic policy simulations (Crowley and Hudgins, 2017).

[18] In "Analysis of Financial Time-Series Using Fourier and Wavelet Methods", page 24.

step, I examine cycles through a dynamic approach[19] which encompass a wavelet coherence analysis.

1.4.4.1 Analysis of crystal scale through MRD analysis: volatilities, amplitudes and frequencies

Crystal scales are the first step of a wavelet analysis. They are composed of S_j the set of convolved father wavelet coefficients (generally called the smooth scale) and D_j the set of convolved mother wavelet coefficients (details crystals). A crystal scale is the set of coefficients for each scale. In other words, it is the decomposition of each country's cycle by their long, medium and short term frequencies. During the interpretation of the MRD, crystal scales provides information on the frequencies and the volatility of a time series. Table 1.4.1 shows the frequencies captured by each scale crystal (see Crowley, 2005). Crystal scales also provide information on the evolution of volatility at its different scales. They give information on the amplitude of the cycle at each frequency. Last but not least, scale crystals determine at which scale economic activity is the most intense and then, identify the relevant cycle length from an economic standpoint.

Table 1.4.1 Frequency interpretation of MRD scale levels

Scale Crystals	Quarterly Frequency Resolution
d1	1-2
d2	2-4
d3	4-8 = 1-2 years
d4	8-16 = 2-4 years
d5	16-32 = 4-8 years
d6	32-64 = 8-16 years
d7	64-128 = 16-32 years
d8	etc.

[19]Contrary to the continuous approach, the static approach permits to focus on the behavior of the time series at each point of time.

1.4.4.2 Wavelet correlation

The wavelet correlation between two time series is defined as the ratio of the wavelet covariance and the square root of the wavelet variances (Whitcher et al., 1999; Whitcher et al., 2000).[20] I can analyze the correlation between two time series at a multiscale level. In other words, once covariance by scale has been obtained, the wavelet variances and covariance can be used to obtain scale correlations between series. Confidence intervals can be derived for the correlation coefficients by scale (Whitcher et al., 2000; Constantine and Percival, 2003). When the presence of biased estimators is rejected, I check their significance at the 95% (Crowley et al., 2006). Then, I analyze the correlation between each pair of series at all scales. However, not all scales can be analyzed in the static approach. Indeed, due to the lack of data (1995Q1-2016Q3),[21] only d1 to d4 crystal scales can be analyzed. Globally, the static approach allows to identify: (i) the correlation at each scale between two cycles (FC/FC, BC/BC, BC/FC); (ii) if some countries share more common characteristics with each other; (iii) at which term they mostly do.

1.4.4.3 Analyzing inter-cycles' countries and intra-countries' cycles through wave cross-correlation

To complete our static analysis, cross-correlations are plotted for each of these variables to identify the presence of synchronization at different frequencies. It is important to keep in mind that it is not possible to analyze cross-correlations after d4 owing to the lack of data. In my estimation, I observe the set of coefficients provided by the cross-correlations in absolute values. The highest coefficient allows to detect leads and lags among studied variables and

[20]The estimators of the standard deviation must be bias free to obtain a wavelet correlation estimator without scale bias. Thus, from that estimator and the spectra of the wavelet scale coefficient, we could determine the wavelet variance or covariance asymptotically and thus construct a confidence interval (Whitcher et al., 2000).

[21]It is worth noting that our study period spans from the first quarter of 1995 to the third quarter of 2016.

the level of the cross-correlations.

1.4.5 Dynamic perspective of cycles: Wavelet coherence and Phasing

The dynamic approach[22] consists in studying continuously the relationship between cycles. I explore their degree of dependence, of co-movement through a power spectrum coherence analysis. In other words, do cycles move closer together over time and frequency? To apply a wavelet coherence analysis, I had to switch from the MODWT to the CWT. [23] [24] The wavelet coherence analysis is a multivariate spectral analysis combining the spectra dedicated to the frequency content of series' pairs for a specific frequency. It shows a magnitude squared coherency for one country cycle against another country cycle. There are confidence intervals for the null hypothesis, which is "coherency is zero". Specifically, as I work in time-frequency domain, I have information on the coherence (dependence and co-movement) through time. Thus, the two series can be coherent at some periods but not at others. They can be coherent at the same period only on certain frequencies. More precisely, when two cycles are coherent, it means that they are dependent and co-moving. Indeed, two cycles could be interrelated without co-moving in the same way. In contrast, two cycles could be co-moving after a similar shock at a certain period, but not inter-dependent. Visually, when the color displayed at a certain period on the coherence graph is "warm" (orange, yellow, etc.), cycles

[22]Contrary to the static approach, the dynamic approach allows to study the time series behavior continuously over time. Overall, I maintain my attention on the possible modification of the BC or FC behavior on and between each point of time.

[23]Similarly to the Fourier Transform, the Wavelet Transform has a continuous form. The continuous wavelet transform is a function of two variables $W(u, s)$ and obtained by simply projecting the function of interest $x(t)$ onto a particular wavelet ψ. The resulting wavelet coefficients are a function of these two parameters, location and scale, even though the original function was only a function of one parameter, time t for instance.

[24]Contrary to the MODWT method, the parameters in the continuous method are sensitive to the number of data. Hence, different parameters of wavelet length have been tested in order to check the robustness of the results. No main differences have been found.

are highly coherent (*i.e.* highly moving closer together) or just coherent. On the other hand, when the color displayed at a certain period on the coherence graph is "cold" (blue, green, etc.), cycles are weakly coherent (*i.e.* weakly moving closer together). It depends on the intensity of the warm or cold color: the more intense a color, the stronger the coherence (or incoherence). For example, Spain and Ireland could be not coherent during the latest years but highly coherent during the 1990s. It would be visualized as a dark blue region between 2010 and 2012 and an orange region between 1995 and 2000. Finally, if two countries' FCs or BCs are predominantly not in coherence, it would imply that a single monetary policy, an economic or a financial event will not have the same effect on both. All combinations are possible.

1.5 Stylized Facts: Why does divergence matter?

Before presenting the stylized facts of the nine countries analyzed in this chapter, I introduce the data and the nature of the variables used in this study.

1.5.1 Data and variables

In order to investigate both the features and the synchronization of BCs and FCs in the Eurozone, two datasets have been built. Both sets encompasses nine countries (Belgium, Finland, France, Germany, Ireland, Italy, the Netherlands, Portugal, Spain) spanning the 1995-2016 period. The first dataset is composed of inflation growth rate[25], the domestic credit to private sector growth rate[26] and the GDP[27] growth rate. I use annual data. It allows us to highlight some stylized facts in Section 1.5.2.

[25]Source: UNCTAD
[26]Source: BIS
[27]Source : IMF IFS database

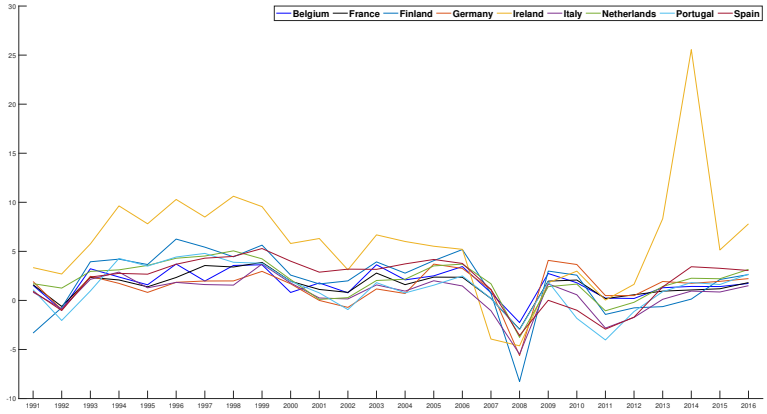
The second datasets allows to compare the EZ state members' features of BCs and FCs in an intra-country and inter-country analysis.The list of countries and the detail coverage of the variable are listed in **Appendix A.** I use quarterly data in logarithm to estimate the FCs and BCs. In line with the business fluctuations literature (Burns and Mitchell, 1946) and the NBER definition of BCs, I use GDP as a measure of the economic activity. As noted on the NBER website: "Because a recession must influence the economy broadly and not be confined to one sector, the committee emphasizes economy-wide measures of economic activity. It views real gross domestic product (GDP) as the single best measure of aggregate economic activity".

Following Borio (2014), FCs are measured using real property prices, credit to the private sector and credit-to-GDP ratio. As FCs includes several indicators, I extract their cyclical components. These cyclical components are then averaged as in Borio (2014) to be applied in a static approach. On the other hand, in the continuous approach, I first take the mean of the three time series and then study their cyclical component.

1.5.2 Why does divergence matter?

Why does divergence matter? Divergence matters because it leads to an accumulation of imbalances within the Eurozone making the common monetary policy less effective. It entails that some Eurozone countries are less resilient to exogenous shocks necessitating assistance from others to prevent a catastrophic collapse. It is addressed by sometimes painful adjustments such as internal devaluation which can have political consequences threatening the existence of the euro by populists who plead for the euro abolishment as an easy way out of domestic problems (Zuleeg, EMU forum, 2016). A significant divergence is found in the

Figure 1.5.1: GDP growth

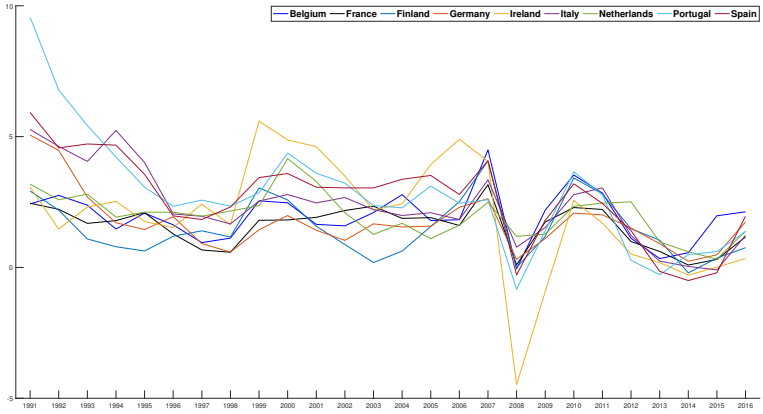


Source: IMF

growth rates of GDP (Landmann, 2011) where, as showed by Figure 1.5.1, some substantial gaps exist between the state members. For instance, their GDP growth move simultaneously but not in the same proportion. Ireland in particular is outgrowing all countries while Germany has one of the weakest GDP growth on the same period. Despite those divergences in the economic growth structure, there is a unique monetary policy that is applied to all of them. Hence, even if the Maastricht criteria such as the inflation rate were converging (Figure 1.5.2) through the period, the economic outcomes such as the growth rates and the financial outcomes such as the domestic credit to the private sector (Figure 1.5.3) were still divergent. As a consequence, convergence which often refers to BC synchronization within an Optimum Currency Area could not exist. The Eurozone does not seem synchronized or convergent from the three graphs presented implying a need for capital or labour flows to balance out activity or some form of equalization system.

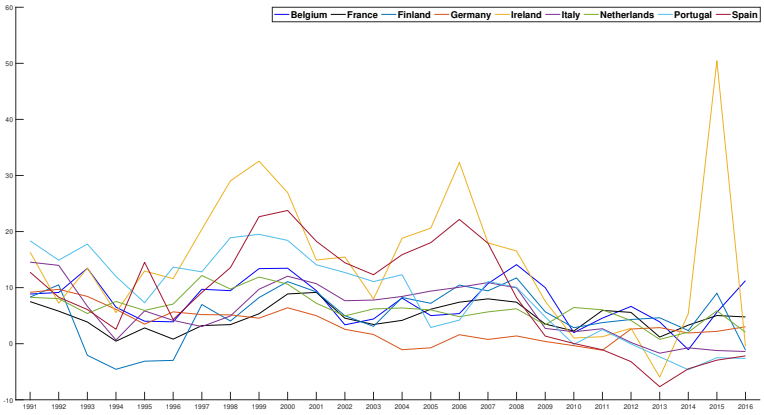
Indeed, the lack of synchronization in the EZ empowered by the structural divergences led to an impossibility of adjustment even for symmetric shocks – whether it was the financial crisis

Figure 1.5.2: Inflation rate



Source: UNCTAD

Figure 1.5.3: Domestic credit to private sector growth rate



Source: BIS

of 2007 or the sovereign debt crisis of 2010 (De Grauwe, 2011; De Grauwe and Ji, 2012). In particular, those crises were related to: (i) an excess of spending over income, an excess of investment over savings and an excess of imports over exports in the PIGS (Greece, Ireland, Portugal, Spain) countries; (ii) current account deficit and surplus in the financial account (De Grauwe, 2007). Hence, a growing disequilibrium caused by the divergence in unit costs and price levels and by the common currency – because of the effect of relative prices on trade flows – impacted the trade balances and the international competitiveness (Landmann, 2011). In some countries, such as Germany, wages should have grown much more than they actually did to erase the shifts in international competitiveness. In other words, by fixing the inflation rate and requiring more growth of the domestic productivity, there was an increase of the average level of prices. Thus, instead of preventing the divergences, the exact opposite happened because the equilibrating response of relative prices was abolished creating shifts in the distribution of supply and demand across the EMU (Holm-Hadulla et al., 2010; Felipe and Kumar, 2011). Based on the shape of the graph above, one can deduce that there are undeniable realities in the Eurozone: asymmetries, unsynchronization, and divergences. They are analyzed below.

1.6 Is the Eurozone convergent in cyclical terms?

First, I study the BC/FC relationship in the Eurozone. Secondly, I investigate the inter-relationship between the EZ's BCs. In a last subsection, I explore the inter-relationship of FCs within the EZ.

1.6.1 Lessons from a BC/FC analysis since the Eurozone creation

Recent empirical studies have found that: (i) the FCs when measured using credit or house prices has a much lower frequency than the BCs (see *e.g.* Strohsal et al., 2015; Claessens et al., 2012; Borio, 2014); (ii) FC duration has increased considerably, especially in the course of the Great Moderation starting in the mid-1980s. (Filardo et al., 2018); (iii) the amplitude of the FC varies more than the BC; (iv) the synchronicity of FC and BC appears fairly low; (v) their duration and amplitude changes over time (Filardo et al., 2018); (vi) the average years of BC and FC across the European Union is estimated to be 13 years in average for credit and house price cycles and that cycles in real GDP are closely related to those in house prices and credit at medium-term frequencies of 8 to 15 years.[28] In other words, the medium-term fluctuations are shared by those in house prices and credit with major turning points being closely aligned.

In this study, I find that there is a homogeneous BC/FC relationship among the EZ's countries as presented by the MRD plots (Figure 1.6.1). I confirm points (i) to (v) stressed out by the literature. However, I add through a wavelet cross country analysis that the divergences stemmed from the eruption of financial disruptions. Indeed, as we can see on Figure 1.6.1, BCs and FCs seem to move in the same direction but in divergent amplitude;

[28] According to the occasional paper series published by the ECB in january 2018 "Real and FCs in EU countries: Stylised facts and modelling implications".

and FCs in particular present longer duration especially in the long run (D6)[29] where FCs may present even longer cycles. The latter confirms the results suggested by Crowley and Hudgins (2016).[30] As predicted by the previous stylized facts, I find that Germany and Ireland are the exception. Indeed, Ireland cycles present the greatest amplitude among the EZ while Germany does not show a lot of amplitudes in its cycles. I also find that cycles in real GDP are strongly correlated and synchronized[31] (Table 1.6.1).

I finally confirm the result found by Jordá et al. (2015, 2016) and by Claessens et al. (2012): financial disruptions have been an important trigger of cycles' desynchronization across the Eurozone economies even at medium terms. The relationship between BCs and FCs presented in the Figure 1.6.1 shows that major recessions in economic activity are preceded by financial booms in all the countries under analysis. Hence, the presence of booms in the FCs tend to emphasize BCs fluctuations which would have been missed otherwise.

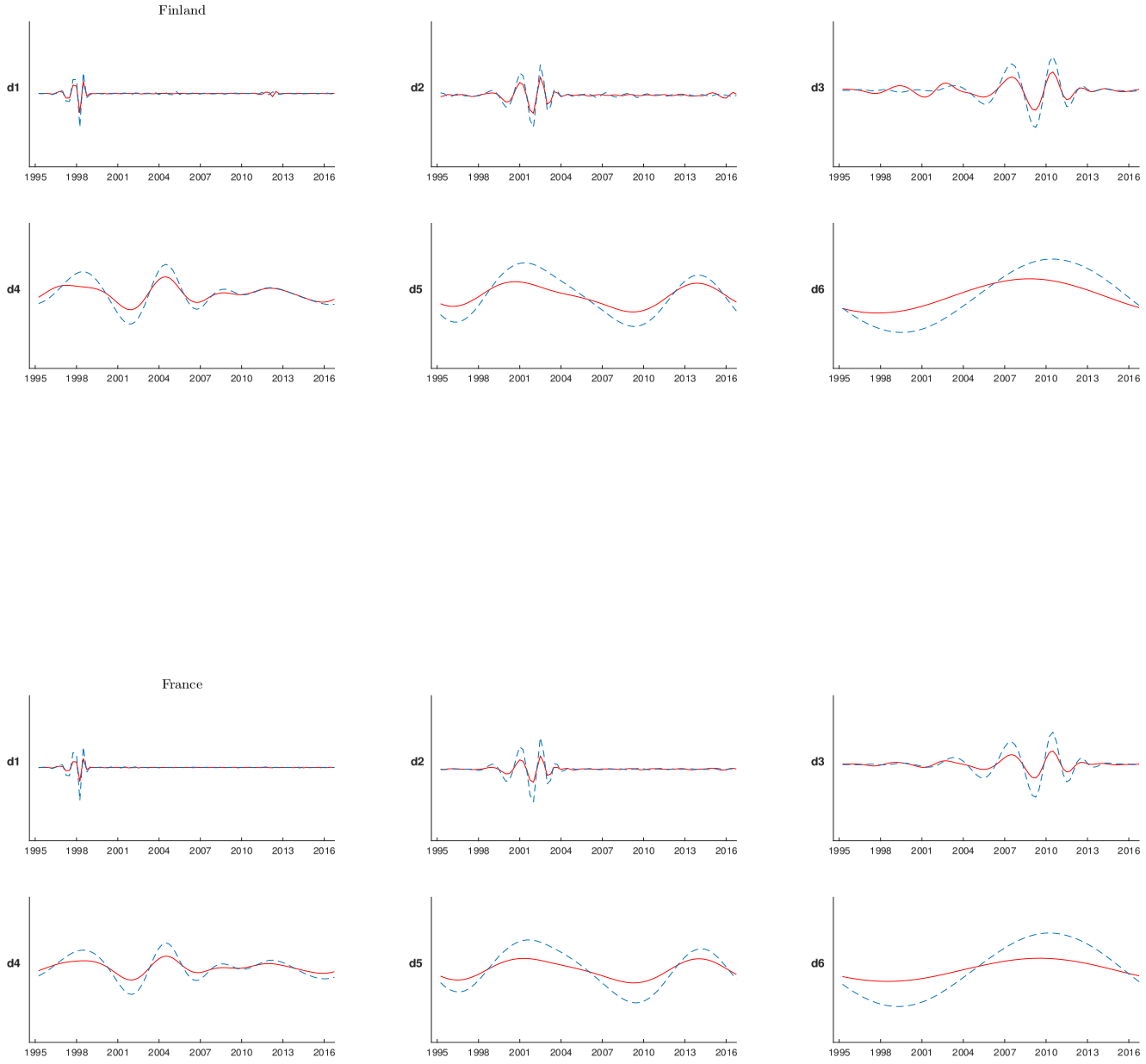
[29] When cycles's length are between 32 and 64 quarters.
[30] More MRD plots can be presented on demand.
[31] They are all synchronized. Results are available on demand.

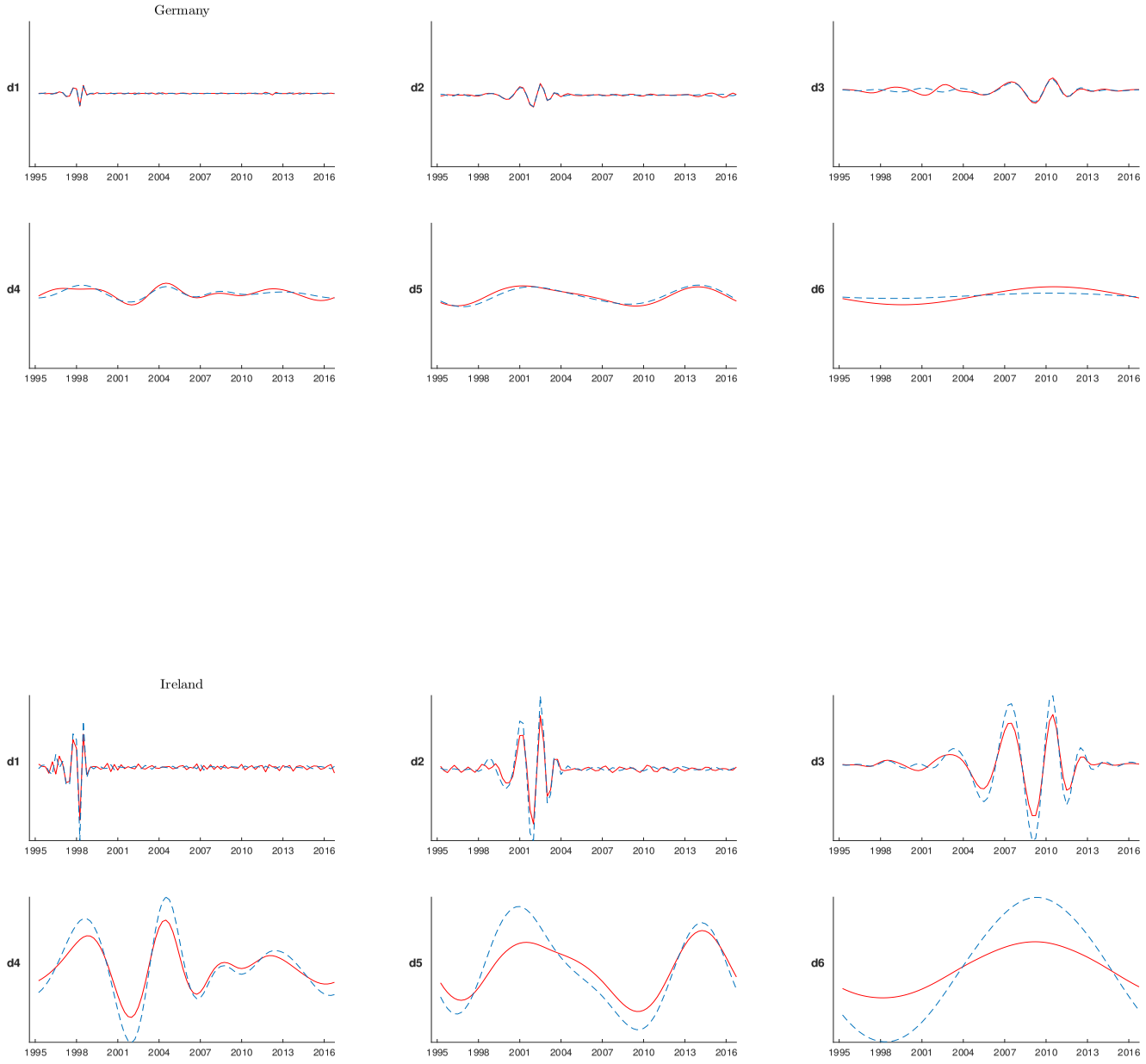
Table 1.6.1 Wavelet correlation BC/FC between 1995-2016

Do business cycles lead financial cycles?	D1	D2	D3	D4
Belgium	0.99***	0.98***	0.95***	0.98***
Finland	0.97***	0.97***	0.93***	0.97***
France	0.99***	0.99***	0.97***	0.99***
Germany	0.95***	0.93***	0.82***	0.92**
Ireland	0.90***	0.97***	0.98***	0.98***
italy	0.94***	0.87***	0.71**	0.87**
The Netherlands	0.98***	0.98***	0.98***	0.98***
Portugal	0.97***	0.96***	0.93***	0.97***
Spain	0.99***	0.98***	0.98***	0.98***

Note: *** and ** respectively denote significance at the 1% and 5% levels.

Figure 1.6.1: Business cycles and Financial cycles MRD 1995-2016





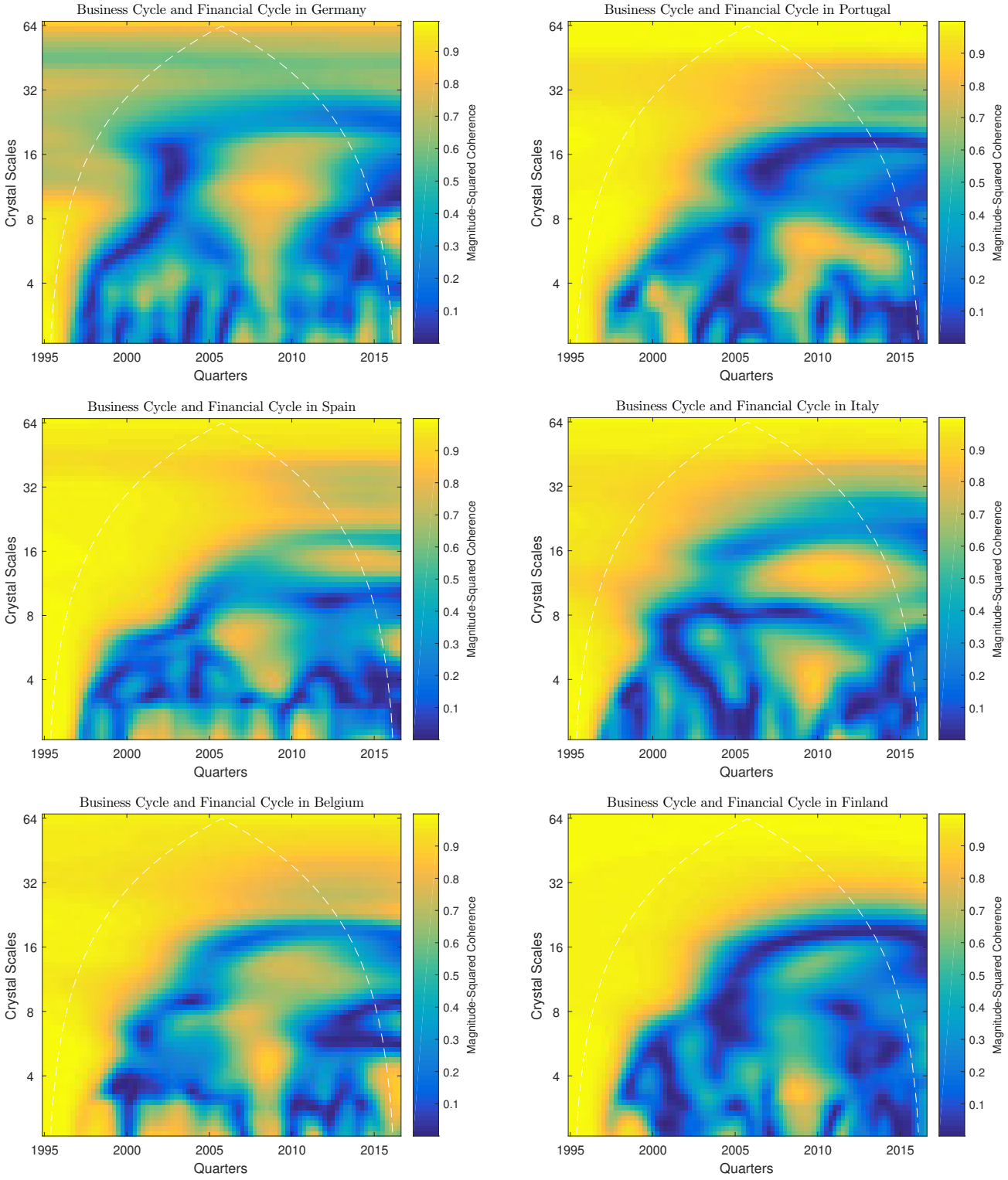
Note: The full red line and the blue dotted line respectively represent the BC and the FC.

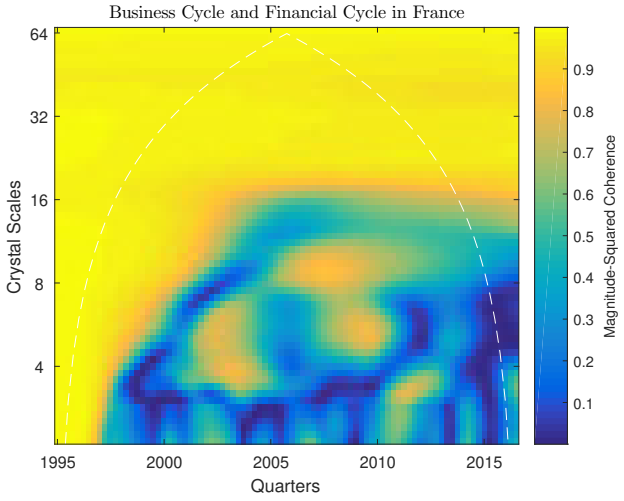
This result must be however decomposed into its different behavior according to the frequency studied. Until medium term (D4 crystal scale), I find a strong and positive correlation and synchronization between BCs and FCs in the Eurozone which is concordant with the fact that there is a strong relationship between the FCs and the BCs until medium term. Nonetheless, this strong relationship fades away after a financial shock. Indeed, one of the key result of this chapter is that divergences between cycles appear after each financial burst and lasts during at least 4 years in average. As we can see from Figure 1.6.2, there is a high level of coherence[32] between BCs and FCs from short to medium term out of post period of crisis.[33] But after each negative shock – 2000 with the internet bubble burst and 2007 with the subprime crisis – divergences between FCs and BCs last four years minimum (d1 to d3). Finally, before the adoption of the Euro, BC and FC were in coherence *i.e.* moving closer together. It suggests that the adoption of the euro and the unique monetary policy were not able to stabilize the consequences stemming from financial shocks. Hence, the transmission of the monetary policy is not efficient. In other words, the design of the euro exacerbated the divergences between cycles in the EZ. For instance, the nine spectra presented in Figure 1.6.2 indicate that most cold regions *i.e.* low dependence and comovement between cycles are observed in the aftermath of the 2000 and 2007 crises at short and medium term.

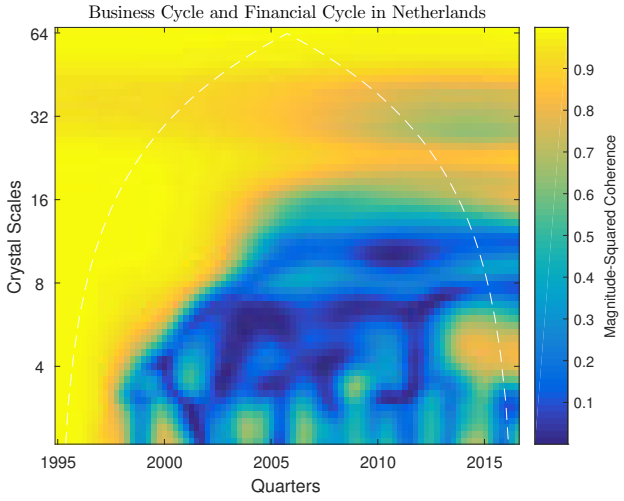
[32]Coherence measures the degree of convergence between the BCs and FCs. Specifically, it measures how cycles move closer together while a simple correlation only shows that cycles move together.

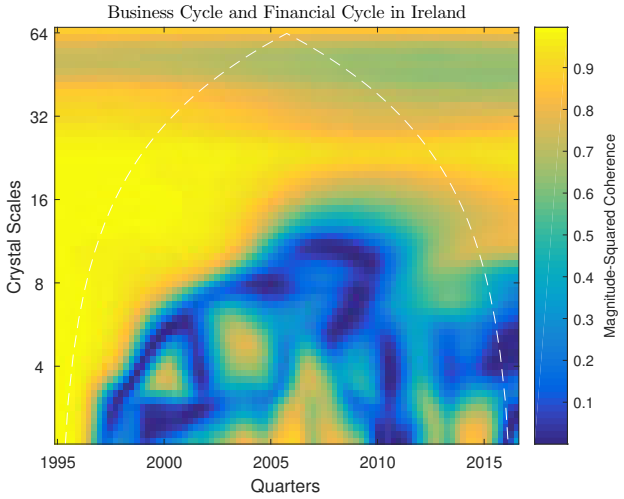
[33]Hiebert et al. (2016) used a spectral analysis and also found a high level of coherence between GDP and credit and house prices but they did not pointed out that this high level of coherence is highly tempered after a burst nor did they present the amount of divergence period as I do here.

Figure 1.6.2: Wavelet coherence spectrum between BC and FC 1995-2016




Business Cycle and Financial Cycle in France
Crystal Scales
64
32
16
8
4
1995
2000
2005
2010
2015
Quarters
Magnitude-Squared Coherence
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1


Business Cycle and Financial Cycle in Netherlands
Crystal Scales
64
32
16
8
4
1995
2000
2005
2010
2015
Quarters
Magnitude-Squared Coherence
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1


Business Cycle and Financial Cycle in Ireland
Crystal Scales
64
32
16
8
4
1995
2000
2005
2010
2015
Quarters
Magnitude-Squared Coherence
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1

1.6.2 Are BCs convergent in the EZ?

After 1995, there is an increasing trend in the degree of synchronization which confirm the results of Oman (2019). I add that after 2000, the regions of high coherency (regions where the BCs of state members are moving closer together) extend across all frequencies which confirm the result found by Aguiar-Conraria and Soares (2011). According to Camacho et al. (2004), there is no "empirical evidence supporting the core and periphery distinction". My results complete those conclusions by adding that there is a strong and positive correlation from short to medium term *i.e.* D1-D4 frequencies (see Table 1.6.2 and 1.6.3) and by confirming that I did not find an empirical evidence of a core-periphery distinction as stressed by Eichengreen and Bayoumi (1993), Beine et al. (2000) and Merler (2015); nor did I find an evidence of a German leading/more synchronized cycle as pointed out by Artis and Zhang (2002) and Demertzis et al. (1998). Those correlations as highlighted by Billio et al. (2016) remain essentially the same during all period indicating a stable relationship whereas discrepancies and thus lack of synchronization appear significantly during recession periods and the subsequent recovery periods.

Table 1.6.2 Wavelet correlation BC between 1995-2016

	Belgium	Finland	France	Germany	Ireland	Italy	Netherlands	Portugal	Spain
				D1					
Belgium	-								
Finland	0.98***	-							
France	0.99***	0.98***	-						
Germany	0.98***	0.98***	0.98***	-					
Ireland	0.95***	0.94***	0.94***	0.94***	-				
Italy	0.95***	0.96***	0.96***	0.95***	0.88***	-			
Netherlands	0.99***	0.98***	0.99***	0.98***	0.95***	0.95***	-		
Portugal	0.98***	0.97***	0.97***	0.96***	0.93***	0.94	0.98***	-	
Spain	0.99***	0.98***	0.99***	0.97***	0.95***	0.95***	0.99***	0.97***	-
				D2					
Belgium	-								
Finland	0.98***	-							
France	0.99***	0.99***	-						
Germany	0.98***	0.98***	0.97***	-					
Ireland	0.96***	0.96***	0.97***	0.94***	-				
Italy	0.94***	0.92***	0.92***	0.93***	0.87***	-			
Netherlands	0.99***	0.98***	0.99***	0.98***	0.97***	0.91***	-		
Portugal	0.97***	0.98***	0.98***	0.97***	0.96***	0.91	0.98***	-	
Spain	0.98***	0.98***	0.99***	0.97***	0.97***	0.90***	0.99***	0.97***	-
				D3					
Belgium	-								
Finland	0.98***	-							
France	0.99***	0.98***	-						
Germany	0.98***	0.99***	0.98***	-					
Ireland	0.98***	0.94***	0.97***	0.94***	-				
Italy	0.84***	0.89***	0.83***	0.91***	0.75**	-			
Netherlands	0.99***	0.98***	0.99***	0.98***	0.97***	0.83***	-		
Portugal	0.97***	0.97***	0.97***	0.97***	0.95***	0.86	0.97***	-	
Spain	0.99***	0.97***	0.99***	0.96***	0.98***	0.79***	0.99***	0.96***	-
				D4					
Belgium	-								
Finland	0.99***	-							
France	0.99***	0.98***	-						
Germany	0.97***	0.97***	0.98***	-					
Ireland	0.99***	0.97***	0.98***	0.95**	-				
Italy	0.89**	0.89**	0.92**	0.95**	0.87**	-			
Netherlands	0.99***	0.98***	0.99***	0.98***	0.98***	0.91**	-		
Portugal	0.98***	0.96***	0.97***	0.95**	0.98***	0.88	0.98***		
Spain	0.98***	0.96***	0.98***	0.97***	0.98***	0.91**	0.99***	0.98***	-

Note : * denotes significance at the 1% level.**

Table 1.6.3 Wave cross correlation BC

	Belgium	Finland	France	Germany	Ireland	Italy	The Netherlands	Portugal	Spain
					D1				
Belgium	-	synchronized	synchronized	synchronized	synchronized	synchronized	synchronized	synchronized	synchronized
Finland		-	synchronized	synchronized	synchronized	synchronized	synchronized	synchronized	synchronized
France			-	synchronized	synchronized	synchronized	synchronized	synchronized	synchronized
Germany				-	synchronized	synchronized	synchronized	synchronized	synchronized
Ireland					-	synchronized	synchronized	synchronized	synchronized
Italy						-	synchronized	synchronized	synchronized
The Netherlands							-	synchronized	synchronized
Portugal								-	synchronized
Spain									-
					D2				
Belgium	-	synchronized	synchronized	synchronized	synchronized	synchronized	synchronized	synchronized	synchronized
Finland		-	synchronized	synchronized	synchronized	synchronized	synchronized	synchronized	synchronized
France			-	synchronized	synchronized	synchronized	synchronized	synchronized	synchronized
Germany				-	synchronized	synchronized	synchronized	synchronized	synchronized
Ireland					-	synchronized	synchronized	synchronized	synchronized
Italy						-	synchronized	synchronized	synchronized
The Netherlands							-	synchronized	synchronized
Portugal								-	synchronized
Spain									-
					D3				
Belgium	-	synchronized	synchronized	synchronized	synchronized	synchronized	synchronized	synchronized	synchronized
Finland		-	synchronized	synchronized	synchronized	synchronized	synchronized	synchronized	synchronized
France			-	synchronized	synchronized	synchronized	synchronized	synchronized	synchronized
Germany				-	synchronized	synchronized	synchronized	synchronized	synchronized
Ireland					-	synchronized	synchronized	synchronized	synchronized
Italy						-	synchronized	synchronized	synchronized
The Netherlands							-	synchronized	synchronized
Portugal								-	synchronized
Spain									-
					D4				
Belgium	-	synchronized	synchronized	synchronized	synchronized	synchronized	synchronized	synchronized	synchronized
Finland		-	synchronized	synchronized	synchronized	**Not synchronized**	synchronized	synchronized	synchronized
France			-	synchronized	synchronized	**Not synchronized**	synchronized	synchronized	synchronized
Germany				-	synchronized	synchronized	synchronized	synchronized	synchronized
Ireland					-	synchronized	**Not synchronized**	synchronized	synchronized
Italy						-	**Not synchronized**	**Not synchronized**	synchronized
The Netherlands							-	synchronized	synchronized
Portugal								-	synchronized
Spain									-

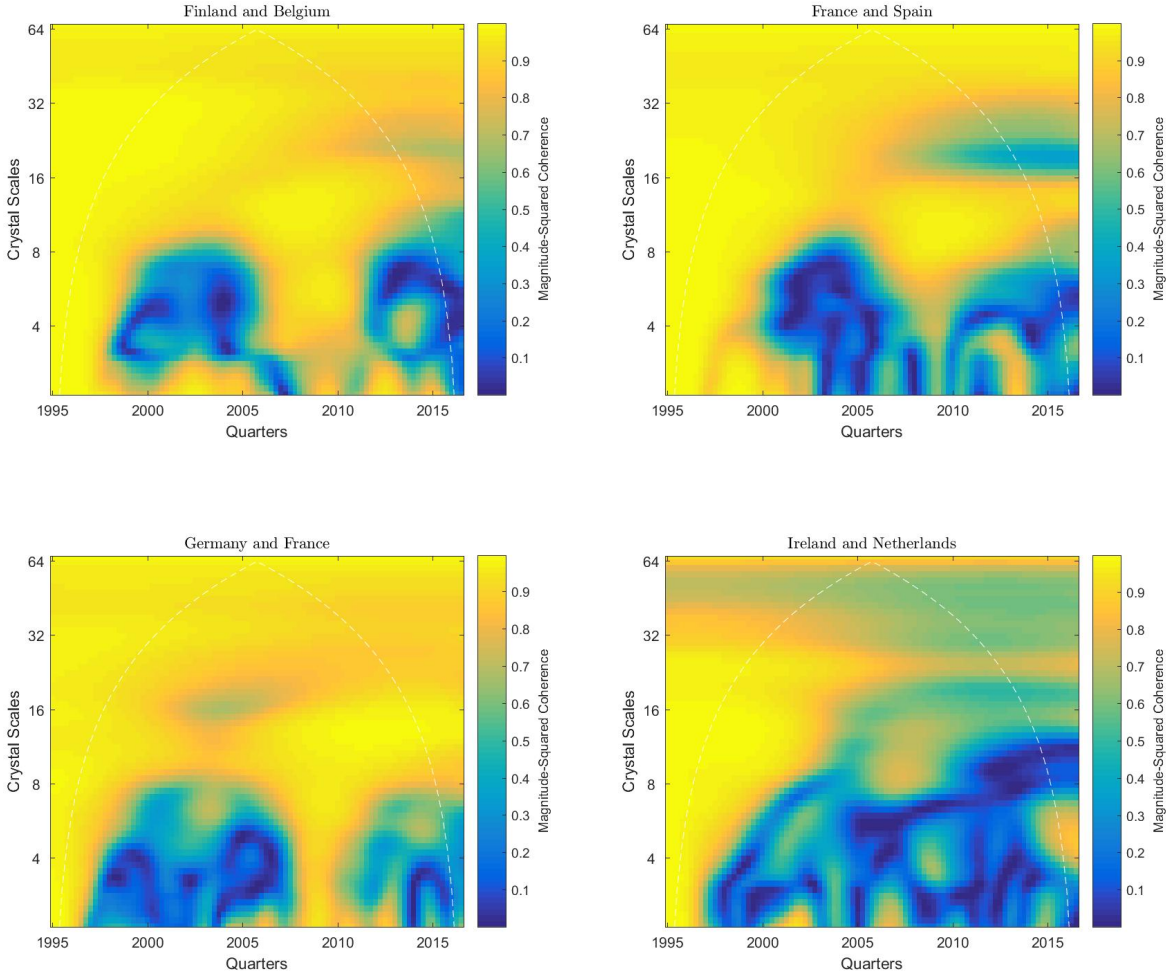
I also find that there is less synchronization after the occurrence of a crisis – whether it is the bubble crisis of 2000, the financial crisis of 2007 or the economic crisis of 2008 – especially at lower frequencies (from D4). As presented in Table 1.6.3, there are more divergences at lower frequencies especially between the Italian and French BCs where the Italian BC is led by the French one (Aguiar-Conraria and Soares, 2011). Plus, between D4-D6, the BC activity is more intense (Crowley and Lee, 2005), suggests that even longer cycles might be at work here and divergences tend to appear in terms of amplitude between cycles as we can see in the Figure 1.6.1. This phenomenon happens particularly after the occurrence of a crisis. Except from Ireland, BCs behave as if they were highly synchronized at high frequencies, but at medium frequencies (after 4 quarters) the divergences appear and tend to decrease at low frequencies.

For instance, on the wavelet coherence spectrum (Figure 1.6.3), I show that at very short term (less than 2-4 quarters) after a crisis, BCs are convergent while they diverge at lower frequencies (D3 and D4). More specifically, on the four examples displayed, after the 2007 crisis and the 2000 crisis, I depict an absence of coherence (*i.e.* BCs are not moving closely together after a crisis) as an immediate response to the negative shocks. For the four of them, the divergence lasts at least 4 quarters after the occurrence of the crisis. In other words, the year that follows a major negative shock, BCs tend to diverge for 4 quarters in the Eurozone. Overall, except for the case of Ireland and the Netherlands which is very specific due to the Irish unique situation in the Eurozone[34] all the figures demonstrates an evolvement towards more coherence. More precisely, from 8 quarters (2 years) to above, we can see that BCs are mostly convergent. This result is in contradiction with the static analysis made above. The latter does not consider the dynamic happening between each point of time. In other

[34]Ireland was intensively affected by the financial crisis. Its economy was more involved with the American one and hence, the subprime crisis has hit more hardly the Irish economy compared to any other country in the Eurozone.

words, some may point out that comparing to the dynamic analysis provided by the wavelet coherence, the static one may avoid some of the BCs' realisms. Hence, the literature on the subject may benefit from the insight of this methodology.

Figure 1.6.3: Wavelet coherence spectrum between Business Cycles 1995-2016



I confirm that there is more synchronization between BCs in the Eurozone as presented in the literature but this one is altered by the crisis. I find that the amplitude of BCs in the Eurozone differs from country to country (see Figure 1.6.1) as suggested by Belke et al. (2016). Hence, the amplitude of BCs differs across countries so that even if synchronicity

is perfect, one size does not fit all.[35] More precisely, the monetary policy could be suitable in terms of the needed direction of policy moves but not in terms of the required amplitude of these moves. Thus, when the state members are affected by asymmetric shocks, the dynamics of their BCs will differ. This is why, our wavelet coherencies are not identical *i.e.* the amplitude of their cycles and hence the durability of the shock is different from a state member to another. Plus, even though, business cycles seem to be more convergent, given the amplitude of the business cycles, the monetary policy thrust will be different from a state member to another. As a consequence, other open macroeconomic models may be utilized in order to determine the suggested amplitude for the monetary policy implementation. One of the idea advanced is that further financial integration would erase or ease the application of the single monetary policy (ECB, 2020). For instance, the two major shock dates 2007 and 2010 perceived in Figure 1.6.3[36] led to strong divergences between D3 and D4 (1 year to 4 years of divergences depending on the countries studied) that could have been avoided if there had been a deep financial integration in the Eurozone. Having further financial integration dampens the financial cycle amplitudes and increases the level of convergence in the Eurozone (Draghi, 2012). One of the ways to deep the financial integration is to implement a banking union in order to provide more banking and financial integration and hence increase the level of financial stability and avoid the financial instability to create divergences between business cycles.[37] Finally, the short-term divergence (2 years) might be explained by changes in productivity and unemployment. As Gallegati et al. (2016) suggested, policies that aimed at increasing productivity can have negative effects on employment growth in the short-run.

[35] As precised by Wälti (2009): strong synchronicity does not mean that all the countries demand moves of the same magnitude.

[36] Other figures are available on demand.

[37] In the third chapter of this PhD dissertation, I analyze, how to implement a fully functional banking union in order to have deeper financial integration allowing for more convergence.

Another way to smooth those divergences would be to have more intense trade relations and stronger bilateral financial integration to make BCs amplitude more similar and having more similar economic structures to decrease the output gaps divergences between countries. Indeed, the 2007 and 2010 crisis revealed the already existing divergences between countries as each member state has been affected in different ways by these shocks. In response, countries have adopted policies that vary according to their domestic circumstances while having a unique unadapted monetary policy. The latter instead of stabilizing economies, strengthened the divergences which may explain why divergent amplitude kept growing at lower frequencies.

1.6.3 Are FCs convergent in the EZ?

"What happens in the Financial cycles?". This question presupposes that FCs share commonalities across time and frequencies that make them all look alike. Yet, Meller and Metiu, (2015) and Aikman et al., (2014), highlighted that credit cycles in Europe were asynchronous across countries. Whether FCs would be synchronous or asynchronous, their degree of co-movements across the Eurozone has implications for policy coordination such as which policy to apply across all the state members or which macroprudential national policy to apply (Hubrich et al., 2013). The key results of this analysis is that the synchronization between FCs depends on the period and the frequency under consideration and that divergences exist between FCs, which are, the reflection of the financial conditions needed by a country's economy.

In line with Drehman et al. (2012): FCs are very long. Filardo et al. (2018) show that in duration a FC varies from more than 8 years to 20 or more. However, contrary to what those authors suggest, BC and FC seem to exhibit similar length in the EZ. Indeed, Figure 1.6.1 shows that most activity is contained at lower frequencies[38] (Crowley and Lee, 2005). Plus, there is a high degree of FC convergence during the boom period. It is probably due to the process occurring before the financial crisis which has a great impact on the understanding of FCs and on the EZ convergence. In other words, there is an increase in heterogeneity within the Eurozone in the aftermath of the global financial crisis and, above all, the sovereign debt crisis.

The results also show a strong and positive correlation (see Table 1.6.4) and synchronization[39] until 4 years between FCs. But they also show that FCs move simultaneously with only disparities in terms of amplitude and length as presented in the MRD analysis. For example, we can see in the Figure 1.6.1 that the Irish FC displays the greatest amplitude at all terms. This result is justified by the sizeable financial boom, in terms of private credit and increase of house prices that Ireland experienced and was one of the most important in the Eurozone. Overall, the FCs expansions and contractions comprise the financial conditions rather than the real side of the economy.

[38] D5 and D6.

[39] They are all synchronized at all terms. Results are available on demand.

Table 1.6.4 Wavelet correlation FC between 1995-2016

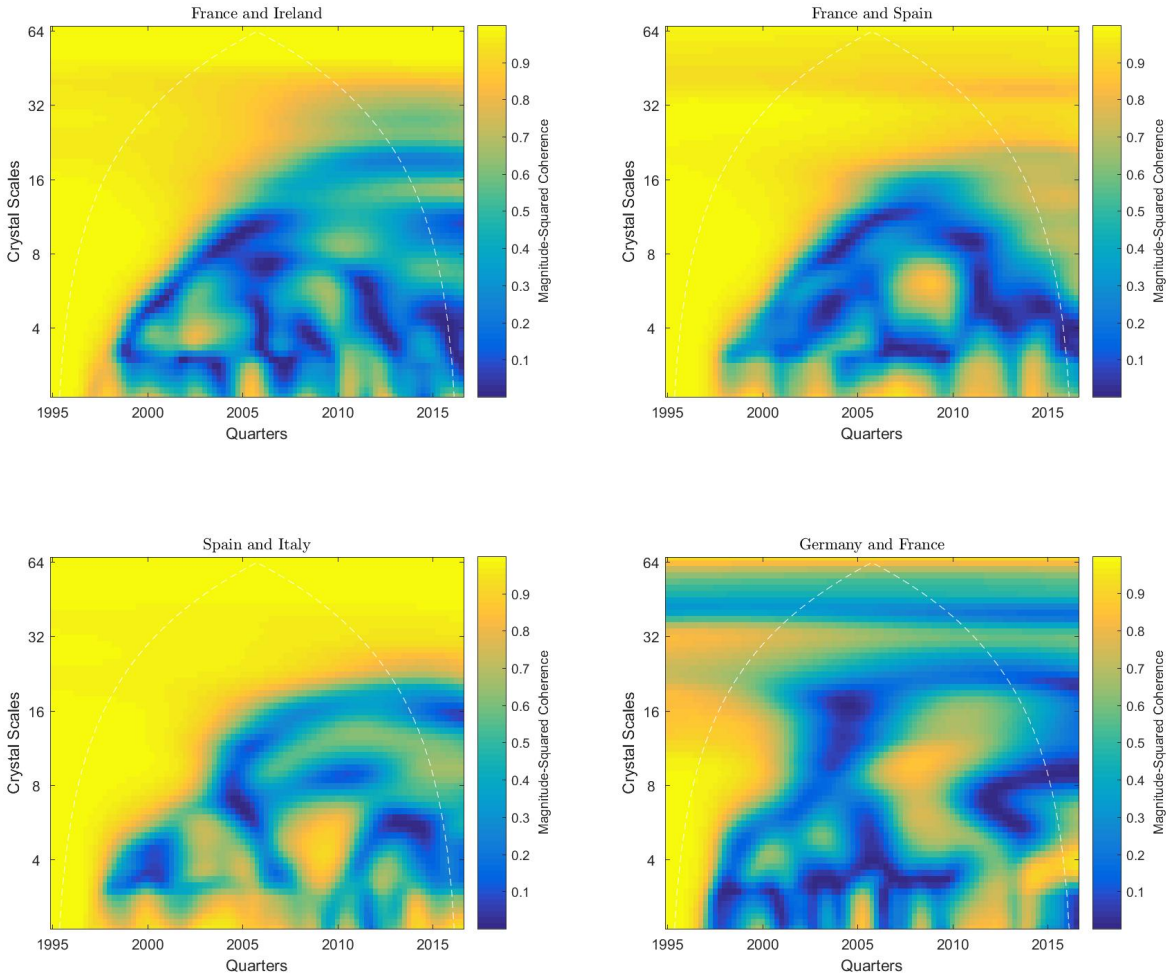
	Belgium	Finland	France	Germany	Ireland	Italy	Netherlands	Portugal	Spain
D1									
Belgium	-	0.99***	0.99***	0.98***	0.98***	0.99***	0.99***	0.98***	0.99***
Finland		-	0.99***	0.97***	0.97***	0.98***	0.99***	0.98***	0.99***
France			-	0.98***	0.98***	0.99***	0.99***	0.99***	0.99***
Germany				-	0.97***	0.98***	0.97***	0.97***	0.98***
Ireland					-	0.97***	0.97***	0.96***	0.98***
Italy						-	0.98***	0.98***	0.99***
Netherlands							-	0.99***	0.99***
Portugal								-	0.98***
Spain									-
D2									
Belgium	-	0.99***	0.99***	0.98***	0.99***	0.99***	0.99***	0.98***	0.99***
Finland		-	0.98***	0.98***	0.98***	0.98***	0.99***	0.98***	0.99***
France			-	0.98***	0.98***	0.99***	0.99***	0.99	0.99***
Germany				-	0.97***	0.98***	0.98***	0.97***	0.98***
Ireland					-	0.98***	0.98***	0.98***	0.98***
Italy						-	0.98***	0.99***	0.99***
Netherlands							-	0.98***	0.99***
Portugal								-	0.99***
Spain									-
D3									
Belgium	-	0.99***	0.99***	0.97***	0.98***	0.99***	0.98***	0.99***	0.98***
Finland		-	0.98***	0.97***	0.97***	0.98***	0.98***	0.98***	0.98***
France			-	0.95***	0.98***	0.99***	0.99***	0.99***	0.99***
Germany				-	0.95***	0.96***	0.95***	0.97***	0.96***
Ireland					-	0.98***	0.98***	0.98***	0.98***
Italy						-	0.99***	0.99***	0.99***
Netherlands							-	0.99***	0.99***
Portugal								-	0.99***
Spain									-
D4									
Belgium	-	0.99***	0.98***	0.97***	0.99***	0.99***	0.99***	0.99***	0.99***
Finland		-	0.99***	0.97***	0.98***	0.99***	0.99***	0.99***	0.99***
France			-	0.97***	0.98***	0.99***	0.99***	0.97***	0.99***
Germany				-	0.96***	0.98***	0.97***	0.97***	0.96***
Ireland					-	0.99***	0.99***	0.97***	0.99***
Italy						-	0.99***	0.98***	0.99***
Netherlands							-	0.98***	0.99***
Portugal								-	0.98***
Spain									-

Note: * denotes significance at the 1% level**

Those results are tempered by the dynamic analysis which confirms the study of Verona (2016) suggesting that most variability of house prices occurs at frequencies of periods longer than 8 years. Indeed, the results show that FCs in the EZ are less in coherence (*i.e.* FCs tend to not move closer together) after 4 quarters and stronger and longer in duration after 16 quarters (4 years to 16 years). More precisely, the dynamic analysis pinpoints cold areas – which are periods of low co-movement and dependence – that appear on the three spectrograms (France/Ireland, Spain/France, Italy/Spain) in Figure 1.6.4 after the collapse of the Dot-com crisis in 2001 and after the global financial crisis in 2007. There is less inter-FCs co-movements and dependence during post crisis periods, as presented in the spectrograms. The boom masked the divergences and the crisis highlighted them. In other words, the accumulation of divergent macroeconomic structures, macroeconomic policies and asymmetric shocks exacerbated already existing divergences that have been masked by the boom period.

The result of the dynamic analysis provides more details about the asynchronous European FCs. As I highlighted, FCs are not smoothly synchronous over the period 1995-2016. On the contrary, the formation of bubbles, the rise of crisis imply different responses from each country. For instance, while I show that there is a strong and positive correlation until 4 years in the static analysis, the dynamic one sheds light on the fact that FCs in the Eurozone may be less convergent after 4 quarters. More than that, it highlights that the strong correlation exists in reality only after 4 years. Those results seem in contradiction with each other as one suggests that the strongest correlation exists during the four first years and the other suggests it is only after 4 years. In reality, those results are not in contradiction. Indeed, there is a notion that is included in the dynamic analysis which is not in the static one: the time. The correlation in the static analysis is only understood throughout the frequencies. There is no room for the time it takes to be in correlation or any nuances on when the FCs of each country are moving closer together in each frequency. For instance, we

Figure 1.6.4: Wavelet coherence spectrum between FCs 1995-2016



can see that the Italian and Spanish FCs are in correlation at a very high level of frequency (D2) – which is accurate – but not on the whole period. As we can notice on Figure 1.6.4, the Spanish and Italian FCs are mostly in coherence but at different dates in time at the scale D2 which corroborates the result of the static analysis and adds that they move closely together, however not smoothly over time. This result expands the research on the degree of synchronization of FCs within the Eurozone and is in line with Aldasoro et al. (2020). They found that cross-country pairwise correlations of the domestic FCs are not very high. I add that they are high but not smoothly over time and across frequencies.

Finally, the French, Spanish and Italian FCs are similar while the German FC is weakly co-moving and displays low dependence with most countries (Figure 1.6.4). The most striking dissimilarity between the German cycle and the Eurozone state member in terms of FC is the stability of property prices in Germany *i.e* decreasing in period of boom and increasing in period of bust. For instance, in fifteen years, the German property prices have almost not risen at all contrary to the French or the Spanish ones which were multiplied by at least 2.5 within the same period.[40] As property prices are one of the determinant of the FCs and as they did not surge in Germany, its FC is less convergent with other state members.

1.7 Conclusion

This chapter contributes to the debates on the sustainability of the European monetary union. I investigate to what extent the Eurozone is heterogeneous and at what terms through the relationship between financial and BCs. I find that, BCs and FCs are co-moving, synchronized and correlated at medium term in boom/expansion phase but not at any term after a bust/recession phase. I also find that BCs between the EZ countries are mostly co-moving, synchronized and correlated but they diverge in term of amplitudes. However, FCs between the EZ countries do not share a lot of commonalities are they are irregularly co-moving, synchronized and correlated over time and across frequencies.[41]

More precisely, I confirm the recent empirical results (Strohsal et al. 2015; Claessens et al., 2012; Borio, 2014; Filardo et al., 2018) on BCs and FCs interactions: (i) FCs have lower frequencies than BCs ; (ii) that the amplitude of FCs varies more than the BC; (iii) that

[40] This observation is based on the calculation of a rate of change of property prices data used to estimate FCs and can be provided on demand.

[41] I mostly relied on a D4 wavelet. I will rely on a LA8 wavelet in further research following Hudgins and Crowley (2019).

the duration and amplitude of BC and FC varies over time and that financial disruptions have been an important trigger of cycles desynchronization across the Eurozone economies even at medium term; (iv) and that FC are predominantly linked with medium term BC. I add that after a financial burst, FCs are not predominantly linked with medium-term BC. Those results suggest that the interactions between BCs and FCs in the EZ are similar to the interactions between BCs and FCs outside the EZ. Plus, contrary to the non EZ countries, the single monetary policy is not able to stabilize the desynchronization stemming from the financial disruptions.

Secondly, I also confirm that after the adoption of the euro, BCs are moving closer together at all frequencies. However, I do not find any empirical evidence of a core-periphery distinction contrary to Eichengreen and Bayoumi (1993), Beine et al. (2000) and Merler (2015) or any evidence of a German leading cycle as suggested by Artis and Zhang (2002) and Demertzis et al (1998). Finally, BC activity is more intense at lower frequencies and divergences appear in term of amplitudes (but not in term of phases which are aligned) as demonstrated by Crowley and Lee (2005). I add that signs of desynchronization appear between BCs after the occurrence of a crisis at medium and long term but not at short term. In other words, BCs are not desynchronized at short term even after a positive or negative shock. A deeper financial integration would have eased the application of the single monetary policy which would have in turn been able to be countercyclical and hence avoid this desynchronization. Indeed, as shown by de Grauwe and Ji (2014), the one-size-fits-all monetary policy conducted by the ECB led to a stronger boom in booming countries and stronger recession in recession countries, thereby exacerbating the divergences. Another more effective way to smooth BCs divergences between state members would be to have a more intense trade relations and stronger bilateral financial integration.

Thirdly, in line with Filardo et al. (2011) and Drehman et al. (2012), I find that FCs are very long with most activity happening at low frequencies. However, I also found that contrary to the FC measured for non EZ countries, the EZ FCs do not share commonalities. On the one hand, FCs contrary to BCs do not present a smooth synchronization on a particular period or frequency. Their synchronization depends on the time and frequency under consideration. But also that those divergences are not regular over time and across frequencies because they are the reflection of the financial condition needed by a country's economy. Plus, FCs do not move closer together after a negative shock. But also that FCs before the crisis presented some forms of convergence because the boom masked the underlying divergences while the crisis highlighted them. Specifically, this boom was driven by an unadapted key interest rates *i.e.* set by a common monetary policy. On the other hand, the dynamic wavelet method brings important insights especially when it estimates the degree of correlation/cross correlation. Indeed, this methodology does not take into account only the number of lags/leads and if cycles are correlated as it decomposes cycles into their short, medium and long term length over time. Hence, it verifies if they are correlated, and cross correlated at each length and over time. In particular, I found that FCs are mostly correlated after a crisis but only at medium term *i.e.* four years after a crisis. Hence, contrary to what Aldasoro et al. (2020) suggested, FC present high cross country correlation but not smoothly over time and across frequency.

To sum up, our main striking result is an increase in heterogeneity within the Eurozone in the aftermath of the global financial crisis and, above all, the sovereign debt crisis at medium to long term. Interestingly, during the expansion period, I show that the EZ presents homogeneous FCs and BCs. As a matter of fact, the subprime crisis, the sovereign debt crisis and the risk of deflation highlighted the lack of financial cohesion in the EZ. However, these crises are not the main culprits explaining the growing heterogeneity within the Eurozone but

they reveal the incompleteness of the monetary union, and in turn, the asymmetric impact of shocks. More precisely, the successive crises revealed the need of adjustment mechanisms within the Eurozone. On the other hand, those crises emphasized the difficulties encountered by the Eurozone to finance the public debts without strains. Indeed, as de Grauwe and Ji (2014) suggested in their analysis of fiscal sustainability in Spain and the United Kingdom, while the former does not have control over the currency in which its debt is issued, the latter was in the opposite situation allowing the Bank of England to act as a lender of last resort by monetarizing the public debt. Finally, macroeconomic policies in the Eurozone have been largely driven by financial markets expectations. Indeed, as noted by Schularick (2012) and de Grauwe (2013), most of the financial crises of the last century in the industrialized world were caused by excessive private debt accumulation and not by excessive accumulation of government debt. Hence, financial markets have been an important engine to fragment the Eurozone, forcing some – the less homogeneous countries of our samples – into bad equilibria and others – the most homogeneous countries of our samples – into good equilibria. Indeed, the less homogeneous countries – such as Spain or Ireland – are also the countries that have accumulated current account deficits while others such as Germany or the Netherlands have built up current account surpluses.

Our chapter has several policies implications. It could be interesting to provide more common instruments of adjustment mechanism as the monetary policy is not effective. For example, De Grauwe and Moesen (2009) suggested an internal transfer mechanism between the members of the core that would ensure the less creditworthy countries to compensate the more creditworthy ones. Another remedy to those divergences could be to gradually lose the national budgetary policies over a European one. It is important to gradually start this step as the citizens of the Eurozone countries are still mostly against the loss of national sovereignty. A final proposal could be to allow limited flexibility on a case-by-case basis to

use the macroprudential policies. This proposal would be based on the lessons obtained from the time-frequency analysis *i.e.* most divergences are located at short term and the impacts of a negative shock begin 4 quarters after the shocks and last at least 24 quarters. This duration can be anticipated by monitoring the intensity of the shock at high frequencies. The greater it is, the longer it lasts.

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Appendix

Appendix A.

Table 1..1 Data information

Country/Variable	Real GDP			Credit to private sector			Real property prices		
	Source	period	Precision	Source	period	Precision	Source	period	Precision
Belgium	IMF	1995Q1-2016Q3	-	BIS	1995Q1-2016Q3	-	OCDE	1995Q1-2016Q3	-
Finland	IMF	1995Q1-2016Q3	-	BIS	1995Q1-2016Q3	-	OCDE	1995Q1-2016Q3	-
France	IMF	1995Q1-2016Q3	-	BIS	1995Q1-2016Q3	-	OCDE	1995Q1-2016Q3	-
Germany	IMF	1995Q1-2016Q3	-	BIS	1995Q1-2016Q3	-	OCDE	1995Q1-2016Q3	-
Ireland	IMF	1995Q1-2016Q3	Composed of two series, both extracted from the IMF-IFS. The first one is in quarter (1997Q1-2016Q3). The second one was used to extract the 8 missing quarters (1995Q1-1996Q3) by putting into quarter an annual series and filling the missing points with it.	BIS	1995Q1-2016Q3	-	OCDE	1995Q1-2016Q3	-
Italy	IMF	1995Q1-2016Q3	-	BIS	1995Q1-2016Q3	-	OCDE	1995Q1-2016Q3	-
Netherlands	IMF	1995Q1-2016Q3	-	BIS	1995Q1-2016Q3	-	OCDE	1995Q1-2016Q3	-
Portugal	IMF	1995Q1-2016Q3	-	BIS	1995Q1-2016Q3	-	OCDE	1995Q1-2016Q3	-
Spain	IMF	1995Q1-2016Q3	-	BIS	1995Q1-2016Q3	-	OCDE	1995Q1-2016Q3	-

Chapter 2

Are financial shocks a source of amplification and propagation of macroeconomic fluctuations?*

Abstract

In this chapter, we assess whether financial variables shocks are a source of amplification and propagation of macroeconomic fluctuations and whether they are transmitted internationally. We find that: (i) there is a more sizeable international spillover effect from the US private credit shocks than transmission ones from the Eurozone subregions; (ii) equity prices are not closely connected to the business cycle in the core Eurozone subregions; (iii) there is a global impact of the US financial shocks and a more regional one of the Eurozone. In addition, the results suggest that the financial accelerator mechanisms are not very significant within the Eurozone.

Keywords: Financial Accelerator mechanism; Eurozone; International transmission of shocks; Financial cycle; Business cycle; GVAR model.

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2.1 Introduction

The Global financial crisis has sparked a renewed interest in the relationship between the financial cycles and the business cycles. More precisely, understanding the role of financial variables in real economic fluctuations has become more squeezing. In addition, given the importance of the financial shocks and their impact on the real economy, it is even more pressing to study their international transmission and their interaction with the business cycle. As highlighted by Claessens and Kose (2017), over the past three decades, many empirical and theoretical models have investigated the linkages between financial imperfections and the real economy. The first strand of the literature focuses on the demand side of financial transactions by considering the borrower balance sheet channel. Such literature highlights different versions of the financial accelerator mechanism (Bernanke and Gertler, 1995; Carlstrom and Fuerst, 1997; Kiyotaki and Moore, 1997; Bernanke et al., 1999). The second strand studies the supply side (Brunnermeier and Pedersen, 2009; Adrian and Shin, 2008; and Geanakoplos, 2008). Credit fluctuations and their macroeconomic impacts are analyzed by investigating the implications of changes in financial intermediaries' balance sheets. More recently, a new generation of models includes both demand and supply types of macrofinancial linkages (Brunnermeier and Sannikov, 2014; Gertler and Kiyotaki, 2011; Williamson, 2012; Dávila and Korinek, 2018).

In this chapter, we contribute to the ongoing debate about the quantitative importance of the financial accelerator. Specifically, we assess whether financial variables shocks are a source of amplification and propagation of macroeconomic fluctuations and whether they are transmitted internationally. As underlined by Claessens and Kose (2017), fluctuations in various market segments – such as equity, housing, or credit markets – play an essential role in shaping recessions and recoveries. On the one hand, it is well known that recessions

associated with financial disruptions are often longer and deeper than other recessions, and inversely, recoveries associated with rapid growth in credit and house prices tend to be relatively stronger (Claessens et al., 2012). On the other hand, financial shocks have global implications, especially those stemming from the US financial markets. Claessens and Kose (2017) suggested that there is a rapid spread of disruptions from US financial markets to other countries during the global financial crisis, which have questioned the cross-border transmission of real and financial shocks. Not only the global financial crisis led to question the cross-border transmission of real and financial shocks, but it also shed light on the economic issue rising from the lack of research on the linkages between the financial market imperfections in explaining the macroeconomic fluctuations and on the global dimension of financial cycles (Rey, 2015; Cerutti et al., 2017; Ha et al., 2020).

We rely on the Global Vector AutoRegressive (GVAR) approach introduced by Pesaran et al. (2004), which accounts for trade and financial interdependencies between countries — which is a key condition to correctly analyze international shocks transmission. After the introduction of the GVAR, several papers have analyzed various topics such as the role of the United States as an engine of global economy growth (Dées and Saint-Guilhem, 2011), the dynamics of global trade flows, and global imbalances (Dées et al., 2007a; Bussière et al., 2012), and the global impact of oil price shocks (Cashin et al., 2014; Allegret et al., 2015). GVAR models have been used to investigate interdependencies across European Union countries such as macroeconomic and financial spillovers for Eurozone to Central and Southeastern European Economies (Backé et al., 2013; Koukouritakis et al., 2015; Feldkircher, 2015; Hájek and Horváth, 2016), banking vulnerabilities in the Eurozone (Bicu and Candelon, 2013), and monetary policy transmission in the Eurozone (Georgiadis, 2015).

In line with Dées (2016) and Eickemeier and Ng (2015), we assess the international propaga-

tion of positive credit shocks, share price shocks, and house price shocks by considering five regions: the United States, the Eurozone (subdivided into three groups) and some North European countries over the 1995Q1-2016Q4 period. In order to investigate the respective influence of the United States and Eurozone economies, our regions are both the source of the shocks and their destination, except for North European countries.

This chapter extends previous research in four dimensions. First, the GVAR model considers the Eurozone as three main regions following their credit growth, their house prices and stock prices and not as a single country as done in the literature. Second, the analysis revolves around the impact of financial shocks on the Eurozone and if international transmission from the US influences more the Eurozone than the Eurozone itself. Third, through the inclusion of PIGS (Portugal, Ireland, Greece, Spain) countries as a peripheral region, we are able to depict whether this region is particularly sensitive to US financial shocks or to the Eurozone regions or Enorth financial shocks. Finally, in the GVAR model, we assess the role of financial variables in macroeconomic fluctuations in view of analyzing the link between the Eurozone financial and business cycles. The latter is particularly relevant as disruption in the financial sector leads to longer recoveries phase in the real economy.

Our main findings are twofold. On the one hand, the results suggest that macroeconomic fluctuations explained by the financial accelerator mechanism are particularly significant in the United States, while we do not find any support for this assumption in the Eurozone. On the other hand, the international propagation of financial shocks is primarily explained by the United States including within the Eurozone regions.

The rest of this chapter is organized as follows. Section 2.2 situates our approach in the relevant literature. Section 2.3 outlines our estimation methodology and Section 2.4 presents

the data. Results and related comments are reported in Sections 2.5 and 2.6, while Section 2.7 concludes the chapter.

2.2 Literature Review

This chapter draws on two different strands of literature. The first investigates interactions between the real economy and the financial sector by focusing on the demand side of finance that operates through the presence in the economy of financial imperfections.[1] Specifically, the financial accelerator approach (see Bernanke et al., 1999) suggests that changes in borrowers' balance sheets influence their access to finance. For instance, higher house prices can ease household credit constraints as the value of their collateral increases. In turn, this ease of credit constraint tends to favor the acquisition of real estate, which leads to further increase in house prices and thereby to rising collateral and so on. In other words, the financial accelerator mechanism highlights how economic and financial shocks are magnified and spread in the economy. Considering a sample of 21 advanced OECD countries (spanning the period 1960Q1Q1–2010Q4) and 23 emerging market countries (over the period 1978Q1–2010Q4), Claessens et al. (2012) examine the interactions between financial and business cycles. They find that: (i) interactions between business cycles and financial cycles matter in shaping recessions and recoveries; (ii) recessions associated with financial disruptions tend to be longer and deeper than other recessions, in particular when financial disruptions are based on house prices busts; (iii) and recessions accompanied by larger drops in output and greater cumulative output loss tend to rest on both credit crunches and house price busts.

In a similar vein, Mian and Sufi (2018a) stress the close connection between the credit cycle

[1] For an overview, see Claessens and Kose (2017a).

and the business cycle. However, they stand out from the literature by highlighting the role of credit supply shocks interpreted as an increase in the quantity of credit or a decrease in the interest rate on credit "for reasons unrelated to changes in income or productivity of borrowers" (Mian and Sufi, 2018b:4). Specifically, they show that an expansion in credit supply – in particular when operating through household demand – is critical to generating macroeconomic fluctuations. For instance, during the expansionary phase of the credit cycle, economic activity is affected mainly through boosting household demand rather than through an increase in the productive capacity of firms. Such an approach rests on the following empirical regularity: the larger the increase in household debt to GDP ratio prior to the recession, the more severe the subsequent recession. A specific episode of credit supply shock is the launch of the euro in 1999 (Mian et al., 2017a). Indeed, the years preceding the global financial crisis were marked by significant drops in currency and risk premia in the Eurozone – especially in peripheral countries – fueling a dramatic boom in household debt and economic activity. Thus, when the credit expansion phase ended, Eurozone experienced a particularly severe economic contraction. In addition, as stressed by Mian et al. (2017b) in the US case, a positive credit supply shock adds an extra channel of transmission on the real economy by boosting new residential construction. More generally, the authors observe that the shock is followed by an increase in the relative price of non-tradable goods – including residential housing – and non-tradable employment while tradable sector employment is not affected. Using annual data for the period 1999–2016 and 39 European countries with a Generalized Method of Moments (GMM) estimator, Antoshin et al. (2017) confirm results of Mian et al. (2017b) by showing, on the one hand, that bank credit is a key to economic growth as it grew rapidly in the run-up to the crisis in many European countries; and, on the other hand that recoveries in the aftermath of a financial crisis are especially weak and sluggish when the financial collapse is preceded by a credit boom.

Our chapter is also related to a second strand of the literature dedicated to the international transmission of credit and asset prices shocks. An extensive literature suggests that global factors play an essential role in determining and explaining movements in asset prices and output (Claessens and Kose, 2017b). Recent evidence shows that not only cross-country correlations of equity prices increase, but house prices tend to be more and more driven by real and financial global factors leading to the presence of co-movements across major cities (Cesa-Bianchi, 2013; IMF, 2018). A large part of this literature underlines the dominance of the United States as a driver of foreign asset prices. Ehrmann et al. (2011) estimate a multifactor model to assess the two-way international financial transmission between the United States and the Eurozone for seven asset prices over the period 1989-2008.[2] They find that US financial markets explain a significantly larger part of Eurozone prices changes (on average, 30%) than the influence exerted by Eurozone financial markets on US ones (6%). Miranda-Agrippino and Rey (2015) develop a dynamic factor model covering the period January 1990-December 2012 and find the existence of a global factor in risky asset prices. In line with Rey (2013), they show the strong influence of the US monetary policy on credit conditions worldwide. Spillovers across European Union economies have also been investigated in the literature. Galesi and Sgherri (2009) investigate regional financial spillovers across Europe with a GVAR model estimated for 26 European countries (grouped into 5 regions plus the United States) using real GDP growth, real interest rates, and real growth in credit to the corporate sector and equity prices, from June 1999 to April 2008. Three results are particularly relevant for our chapter. On the one hand, co-movements of equity prices are sizeable, especially for mature financial markets. On the other hand, the effects on credit growth tend to be country-specific. Lastly, while short-run financial shocks spillovers are mainly explained by asset prices, the influence of the cost and quantity of credit increases over longer horizons. Sun et al. (2013) estimate a Global VAR model (from 2000Q2 to

[2]Ehrmann et al. (2011) use two-daily returns for short-term interest rates, bond yields, and equity market returns, as well as the exchange rate.

2011Q4) to assess co-movements between output growth, inflation, real credit growth, and long-term interest rates across European countries, including Nordic economies and CESEE countries. They show the presence of strong co-movements in output growth, interest rates, whereas co-movements in inflation and credit growth are weaker. Several studies analyze financial transmission across Eurozone countries. MacDonald et al. (2015) construct financial stress indices (country-specific and one Eurozone indices, specific-indices for the banking sector, the money market, the equity market, and the bond market) for Eurozone economies over the period from January 2004 until August 2011. Estimating VAR models, they find that countries tend to respond to their own financial shocks. In addition, countries are more responsive to the increasing financial stress of the same group, suggesting a form of regionalism. Vansteenkiste and Hiebert (2011) investigate house prices shock spillovers in the Eurozone. They examine seven countries (Belgium, France, Germany, Ireland, Italy, the Netherlands, and Spain) using quarterly data ranging from 1971 to 2009 with a Global VAR model including the following variables: the real house prices, the real per capita income, and the cost of borrowing (proxied by the real long-term interest rates). They find weak evidence of house price spillovers in the Eurozone with some overshooting in the first year after the shock.

Two papers are particularly related to our approach. First, Dées (2016) assesses the influence of financial variables on business cycles fluctuations at the global level for a sample of 38 countries estimated over 1987Q1-2013Q1. The Global VAR includes three financial variables (credit to the private non-financial sector in real terms, real house prices, and real property prices) and four other macroeconomic variables (real output, consumer prices, real interest rates, and the real exchange rate). This paper has several interesting assumptions. First, it assumes that country-specific factors primarily influence housing markets. As a consequence, country-specific models exclude housing-related foreign variables. Second, the US

model does not include US-specific foreign financial variables. This choice is justified by the dominant influence of US financial variables on the global economy, implying that foreign financial variables do not drive US domestic financial variables. However, since external shocks can have second-round effects on the US economy, the US model includes US-specific foreign output and inflation variables. Third, financial shocks are identified through sign restrictions. Dées (2016) finds that credit and asset prices variables matter to explain real economic fluctuations. However, results suggest that their influence has not significantly increased since the global financial crisis. In addition, an important finding is that the international transmission of financial shocks on macroeconomic fluctuations tends to be large and persistent.

Finally, Eickemeier and Ng (2015) assess the international propagation of negative credit supply shocks to the private sector from the United States, the Eurozone and Japan. Specifically, they estimate a Global VAR model consisting of quarterly macroeconomic and financial variables from 33 advanced and emerging countries over the period 1983Q4 to 2009Q4.[3] To distinguish negative credit supply shock from other macroeconomic shocks such as aggregate demand and supply shocks, they use the sign restrictions approach on the short run impulse responses to the shock, assuming that in the aftermath of a negative credit supply shock, the volume of credit and GDP are restricted to decline. Restrictions imply that the corporate bond rate, the spread between the corporate bond rate and the long-term government bond yield, and the spread between the corporate bond rate and the short-term interest rate increase. A striking result is that the US credit supply shocks exert a stronger negative effect on foreign GDP than those from the Eurozone and Japan. The international propagation channels through foreign credit and equity markets suggest the existence of an international

[3]The macroeconomic and financial variables considered by the authors are the following: GDP, inflation, short-term interest rates, government and corporate bond yields, credit to the non-financial private sector, equity prices, and exchange rates.

financial cycle.

2.3 Methodology

This section introduces the GVAR model used in this chapter and provides information on the previous necessary steps of its estimation.

Consider a set of N+1 countries/regions indexed by i=0, 1, 2,.., N, with country 0 denoting the reference one. The GVAR model consists of a number of VAR models for each individual country that are linked to each other via a "linkage matrix". For ease of exposition, and without loss of generality, consider VARX(1,1) specifications (for generalization see Pesaran et al., 2004 and Dées et al., 2007). Those individual VARX models, that account for common global variables, are given by:

$$x_{i,t} = a_{i,0} + a_{i,1t} + \sum_{j=1}^{p_i} \phi_{i,j} x_{i,t-j} + \sum_{j=0}^{q_i} \psi_{i,j} x^*_{i,t-j} + \sum_{j=0}^{q_i} \tau_{i,j} d_{t-j} + \epsilon_{i,t} \tag{2.3.1}$$

for $t = 1, 2, \ldots, T$ and $i = 0, 1, \ldots, N$. $x_{i,t}$ is a $(k_i \times 1)$ vector containing country specific domestic variables, $x^*_{i,t}$ is a $(k^*_i \times 1)$ vector containing country specific foreign variables and d_t is a m-dimensional vector of observed global variables assumed to be weakly exogenous to the global economy. $\phi_{i,j}$, $\psi_{i,j}$ and $\tau_{i,j}$ are of dimension $(k_i \times k_i)$, $(k_i \times k^*_i)$ and $(k_i \times m)$ respectively. The vectors of fixed intercepts and of deterministic time trend coefficients are both $(k_i \times 1)$. $\epsilon_{i,t}$ is a $(k_i \times 1)$ vector of idiosyncratic country-specific shocks and is assumed to be serially uncorrelated with zero mean and non-singular covariance matrix:

$$\epsilon_{i,t} \sim i.i.d(0, \sum{}_{ii}) \tag{2.3.2}$$

Following Galesi and Sgherri (2009), Backé et al. (2013), and Eickmeier and Ng (2015), we build the weights by using bilateral trade and financial flows. Our objective is to capture both spillovers via the trade channel and the financial channel. Bilateral trade weights are used for real variables and financial trade weights for financial ones.

Using bilateral trade weights, the foreign variables specific to country i, $x^*_{i,t}$, are constructed as a weighted sum of the corresponding variables of the other countries. More specifically, for each country i, bilateral annual trade flows (including both exports and imports) with its trading partners are collected. These weights reflect the specific geographical trade composition of each country. The choice of trade weights rests on the fact that bilateral trade has a strong influence on inter-country business cycle linkages (see, among others, Forbes and Chinn, 2004; Imbs, 2004; Baxter and Kouparitsas, 2005). The construction of foreign variables is as follows:

$$x^*_{i,t} = \sum_{j=1}^{N} w_{ij} x_{j,t} \tag{2.3.3}$$

where w_{ij} stands for the share of country j in the total trade of country i (measured in US dollars), i $\neq$ j. We have

$$\sum_{j=1}^{N} w_{ij} = 1 \tag{2.3.4}$$

for all i, j= 1,..., N and w_{ii}=0 for all i=1,..., N.

For the construction of financial weights, we use the external positions of international banks published in the Bank of International Settlements locational banking statistics.[4] Due to

[4]Eickmeier and Ng (2015) use alternative financial weights in their GVAR: (i) outward portfolio in-

data availability, weights are calculated for 2017. The weights are calculated as the loans of a country i vis-à-vis j of the country j over all the loans of country i vis-à-vis the N countries in order to mirror the relative importance of each country's financial partner.

Regarding the estimation strategy, we follow the procedure suggested by Pesaran et al. (2004) and Dées et al. (2007b). We first check that foreign and common global variables are weakly exogenous to ensure that equation (2.3.1) can be independently estimated on a country by country basis. We then stack the country-specific domestic and foreign variables, to study the dynamic for all the variables and all the considered countries simultaneously. More specifically, equation (2.3.1) is rewritten as follows:

$$A_i z_{i,t} = a_{i,0} + a_{i,1t} + B_i z_{i,t-1} + \tau_{i,0} d_t + \tau_{i,1} d_{t-1} + \epsilon_{i,t} \tag{2.3.5}$$

Where $z_{i,t}$=($x_{i,t}^{'}$,$x_{i,t}^{*'}$), A_i=(I,-$\psi_{i,0}$) and B_i=(ϕ_i,-$\psi_{i,1}$). A_i and B_i are of dimension k_i=(k_i+k_i^*) and the rank of (A_i–B_i) gives the number of long run relationships that exist among $x_{i,t}$ and $x_{i,t}^*$.

In a last step, we combine the country-specific models into an overall representation. To this aim, we collect all country-specific variables in a $(k \times 1)$ vector x_t=$x_{0,t}^{'}$, $x_{1,t}^{'}$,...,$x_{N,t}^{'}$ with k= $\sum_{j=0}^{N} k_i$. Country-specific variables in terms of x_t are given by:

$$z_{i,t} = W_i x_t \tag{2.3.6}$$

for all i=1,...,N, where W_i is a $(k_i + k_i^*) \times k$ matrix of fixed constants defined in terms of

vestment; (ii) inward portfolio investment; (iii) outward foreign direct investment; (iv)inward foreign direct investment; (v) outward claims of domestically headquartered banks; and (vi) inward claims of foreign-headquartered banks.

country-specific weights w_{ij}. Then, stacking all country-specific equations, we get:

$$\Gamma x_t = a_0 + a_{1t} + Cx_{t-1} + \tau_0 d_t + \tau_1 d_{t-1} + \epsilon_t \tag{2.3.7}$$

Where:

$$a_0 = \begin{bmatrix} a_{0,0} \\ a_{1,0} \\ . \\ . \\ . \\ a_{N,0}, \end{bmatrix}, \quad a_1 = \begin{bmatrix} a_{0,1} \\ a_{1,1} \\ . \\ . \\ . \\ a_{N,1} \end{bmatrix}, \quad \epsilon_t = \begin{bmatrix} \epsilon_{0,t} \\ \epsilon_{1,t} \\ . \\ . \\ . \\ \epsilon_{N,t} \end{bmatrix}, \quad \Gamma = \begin{bmatrix} A_0 W_0 \\ A_1 W_1 \\ . \\ . \\ . \\ A_N W_N \end{bmatrix}, \quad C = \begin{bmatrix} B_0 W_0 \\ B_1 W_1 \\ . \\ . \\ . \\ B_N W_N \end{bmatrix},$$

$$\tau_0 = \begin{bmatrix} \tau_{0,0} \\ \tau_{1,0} \\ . \\ . \\ . \\ \tau_{N,0} \end{bmatrix} \text{ and } \quad \tau_1 = \begin{bmatrix} \tau_{0,1} \\ \tau_{1,1} \\ . \\ . \\ . \\ \tau_{N,1} \end{bmatrix}.$$

Assuming that the $(k \times k)$ matrix Γ is non singular, we can deduce the GVAR model in its reduced form and solve it recursively so as to predict the future values of x_t:

$$x_t = \Gamma^{-1}(a_0 + a_{1t} + Cx_{t-1} + \tau_0 d_t + \tau_1 d_{t-1}) + \epsilon_t \tag{2.3.8}$$

2.4 Estimation methodology

In this section, we present the data used, the result of the weak exogeneity tests and the persistent profiles.

2.4.1 Data and methodology

We estimate a GVAR model including eleven Eurozone countries (Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, the Netherlands, Portugal, and Spain), five other European economies (Denmark, Norway, Sweden, Switzerland, and the United Kingdom), and the United States. We consider quarterly data over the 1995Q1-2016Q4 period. The choice of this time period relies on the tradeoff between data availability and a sufficient length of time to estimate our model.

Our country sample is decomposed into five subregions used in our GVAR baseline estimates. The first one, denoted ENORTH, includes the five other European economies (Denmark, Norway, Sweden, Switzerland, and the United Kingdom). The second subregion is related to the United States. The other three subregions concern the euro-zone countries, which are distinguished according to the magnitude of credit growth to the private sector, house prices, and stock prices (see also Merler, 2015). They are composed as follow:

- Austria, Belgium, Finland, Germany, and the Netherlands are countries exhibiting no significant financial boom over the studied period. This subregion is denoted CORE;

- France and Italy experienced a moderate financial boom. We name this subregion INTERMED (or MID);

- Greece, Ireland, Portugal, and Spain are countries with the strongest financial boom-bust cycle. Interestingly, we see also that they experienced the strongest GDP fluctuations. Specifically, during the pre-crisis period, increase in GDP has been particularly sizeable, followed by a sharp contraction in the aftermath. This last subregion is denoted PERIPHERAL.

In the spirit of the financial accelerator approach, we select data allowing us to emphasize the roles played by movements in credit and asset (composed of house and equity) prices denoted respectively by cp, hp, and ep in shaping the evolution of macroeconomic aggregates at an international level (see Figure 2.4.1). As the credit variable, we use the credit to households and NPISHs[5] except for Austria, Ireland, and Switzerland, for which we use the credit to the private sector. These data are extracted from the BIS database and expressed considering 2015 as the reference year. To consider the relationship between the collateral constraint and aggregate credit, we include two asset price variables in our analysis.

An extensive literature stresses the interactions between house prices dynamics and macroeconomic and financial stability (Claessens et al., 2012). From this perspective, our GVAR model includes real house prices indices. The second asset price variable is equity prices as they co-move with business cycles (Claessens and Kose, 2017; Ha et al., 2020). These two variables are extracted from the OECD database.

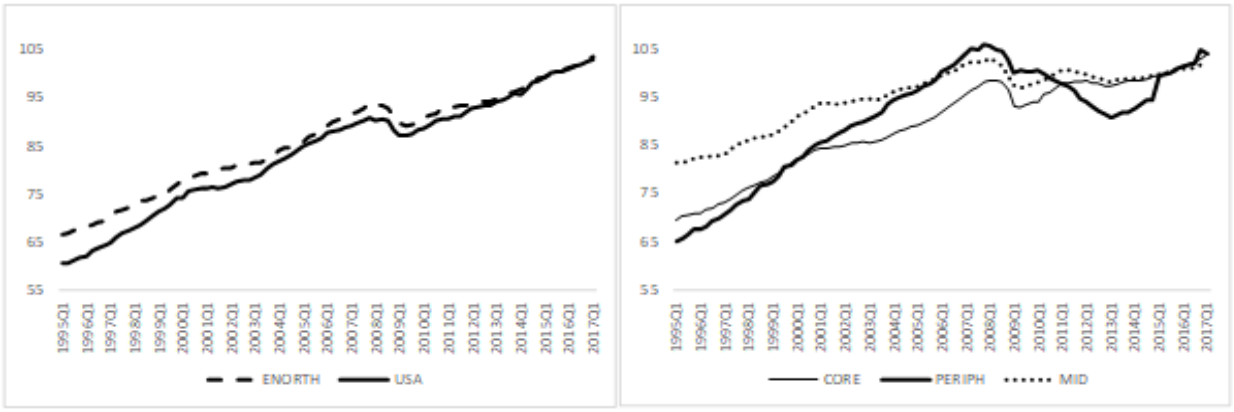
As macroeconomic variables, we consider the consumer price index (CPI), the gross domestic product (GDP) in constant prices, the private final consumption expenditure in constant prices (CP), and the long-term interest rates (LIR). CPI, GDP, and private consumption

[5]Non-Profit Institutions Serving Households.

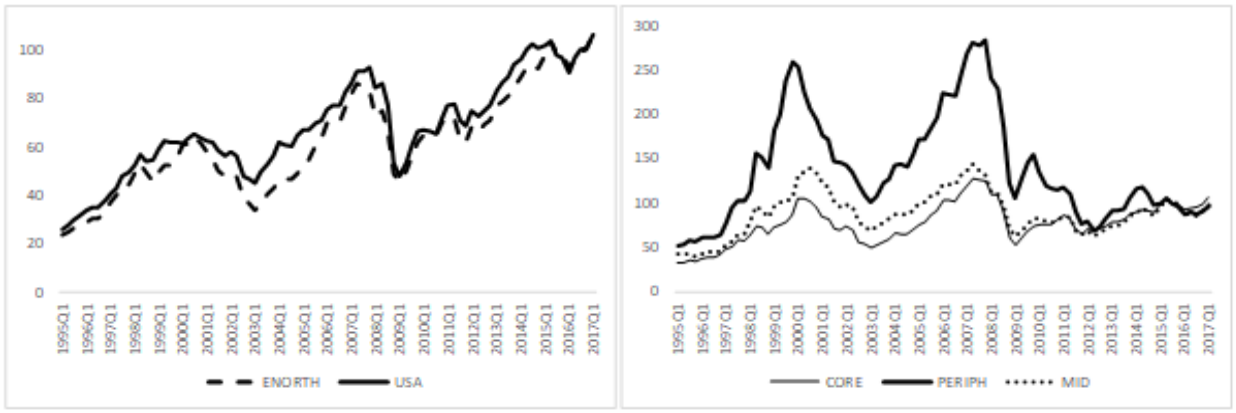
are extracted from OECD databases. Long-term interest rates are from Eurostat except for Norway, for which we use Norges Bank data. These macroeconomic variables characterize the business cycle. Our last macroeconomic variable represents the exogenous global one captured by the oil price index (100=2015; IMF database).

Figure 2.4.1: Credit and assets movements

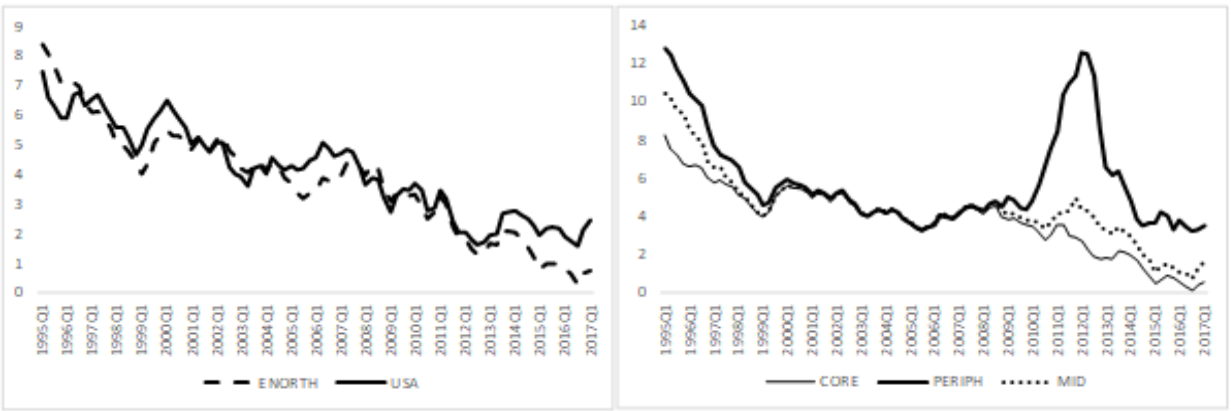
Credit to the private sector



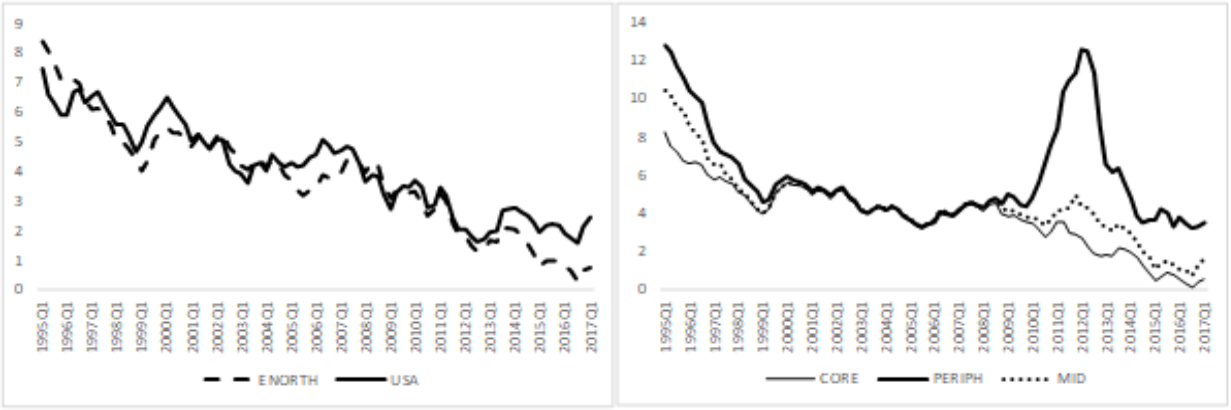
House prices index



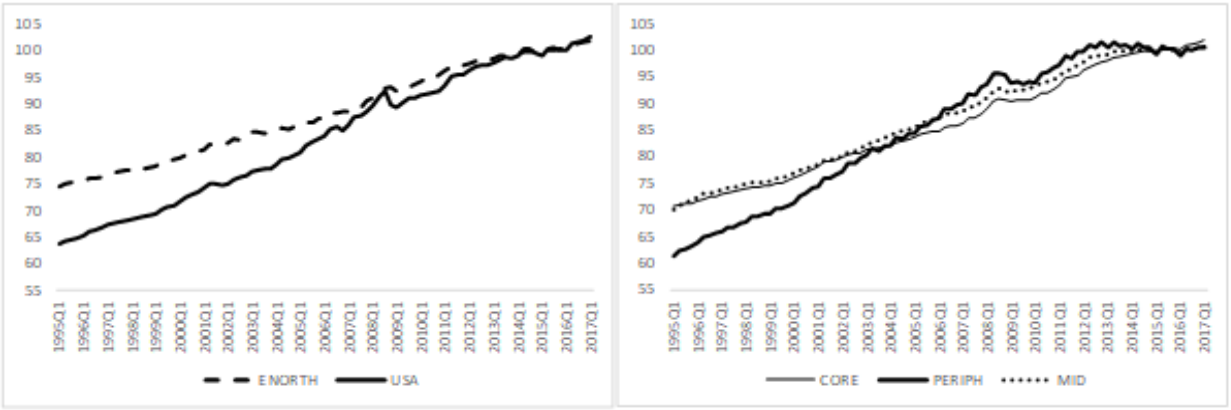
Equity prices index



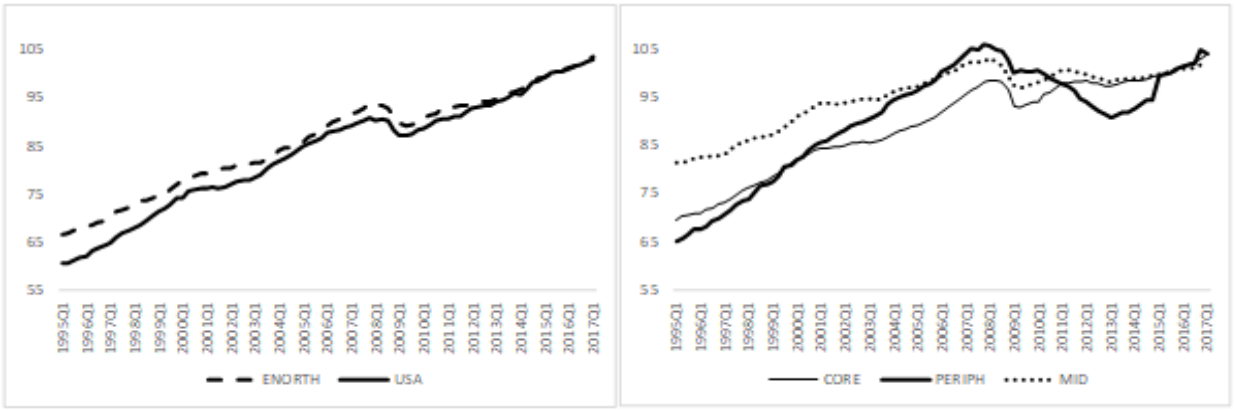
Long-term interest rates



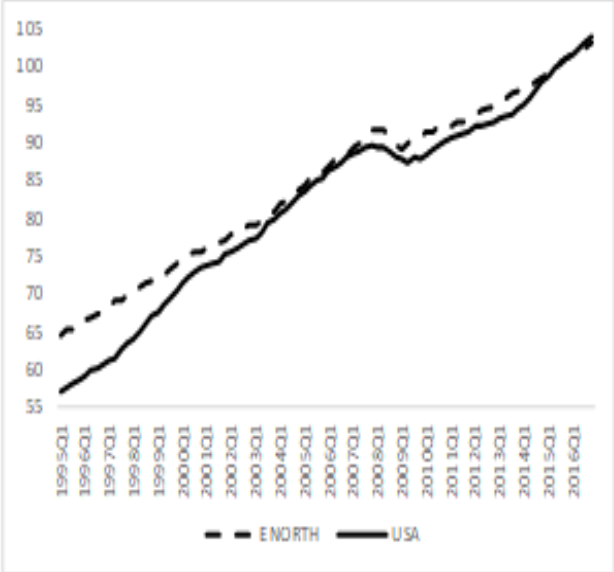
Consumption price index

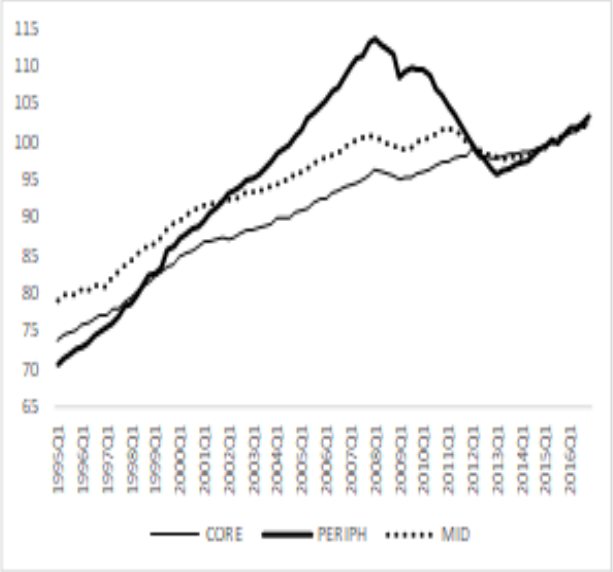


Gross domestic product in constant prices



Private final consumption expenditure in constant prices





Oil price index

Our country-specific *VARX** models include seven variables and a global variable given by the oil price. More specifically, the country specific vector of domestic variable is:

$$x_{it} = (pc_{it}, cpi_{it}, gdp_{it}, lir_{it}, hp_{it}, ep_{it}, cp_{it})' \tag{2.4.1}$$

for i $\in \{0, \ldots, N\}$. We follow Dées et al. (2007a), as we include the oil price as endogenous variable in the US model. The US model is set for i=0, we have:

$$x_{0t} = (pc_{0t}, cpi_{0t}, gdp_{0t}, lir_{0t}, hp_{0t}, ep_{0t}, cp_{0t}, oil_{0t})' \tag{2.4.2}$$

where oil_{0t} is the oil price index (in logarithm). The foreign counterpart of these vectors of variables are respectively given by:

$$x^*_{it} = (pc^*_{it}, cpi^*_{it}, gdp^*_{it}, lir^*_{it}, hp^*_{it}, ep^*_{it}, cp^*_{it})' \tag{2.4.3}$$

for i $\in \{0,\ldots,$N-1$\}$, and

$$x^*_{0t} = (cpi^*_{0t}, gdp^*_{0t}, lir^*_{0t}, cp^*_{0t})' \tag{2.4.4}$$

The country-specific foreign real variables cpi^*_{it}, gdp^*_{it}, lir^*_{it}, cp^*_{it} are constructed using fixed trade weights based on the year 2015 (see Table 2.A.1 in the Appendix). Turning to country-specific foreign financial variables pc^*_{it}, hp^*_{it}, ep^*_{it}, we use the financial weight matrix based on 2017 (see Table 2.A.2 in the Appendix).

Given the importance of the US financial variables in the global economy, the US specific foreign financial variables, pc^*_{it}, hp^*_{it}, ep^*_{it} are not included in the US model as they are un-

likely to be long run forcing with respect to the US domestic financial variables.

Parameter stability tests

To test for parameter stability, we perform various tests based on the residuals of the individual equations of the country-specific error correction models.

We consider various tests for structural breaks. In particular we consider the Ploberger and Kramer (1992) maximal OLS cumulative sum (CUSUM) statistic denoted by PK_{sup} and its mean square variant PK_{msq}. We also implement tests for parameter constancy against non-stationarity alternatives proposed by Nyblom (1989) denoted by R as well as sequential Wald-type tests of one-time structural change at an unknown change point (*i.e.* the Wald form of Quandt (1960) likelihood ratio statistic (QLR), the mean Wald statistic (MW) of Hansen (2002) and the Andrews and Ploberger (1994) Wald statistic based on the exponential average (APW). Statistics with the prefix "robust" denote the heteroskedasticity-robust version of the tests. The critical values of the tests, computed under the null hypothesis of parameter stability, are computing using the bootstrap samples obtained from the solution of the GVAR model.

Table 2.4.1 shows the percentage of rejections under the null hypothesis of parameter stability per variable across the country specific models at 5% level. Given that the sample period covers severe crisis during which our economic variables have undergone significant fluctuations, results are quite encouraging as we globally do not strongly reject the structural stability. The percentage of rejections does not exceed 21, with two exceptions for the QLR and APW tests where the number of rejections is slightly higher.

Table 2.4.1 Number of rejections of the null hypothesis of parameter constancy per variable across the country specific models at the 5% percent level.

Test stats	Pc	Cpi	Gdp	Lir	Hp	Ep	cp	Nbs(%)
PK_{SUP}	3(17.64)	1(5.88)	0(0.00)	3(17.64)	6(35.29)	2(11.76)	0(0.00)	15
PK_{MSK}	3(17.64)	2(11.76)	0(0.00)	1(5.88)	5(29.41)	0(0.00)	0(0.00)	11
Nyblom	2(11.76)	2(11.76)	0(0.00)	1(5.88)	4(23.52)	3(17.64)	0(0.00)	12
$Robust_{Nyblom}$	3(17.64)	2(11.76)	0(0.00)	5(29.41)	4(23.52)	0(0.00)	1(5.88)	15
QLR	4(23.52)	4(23.52)	2(11.76)	5(29.41)	4(23.52)	8(47.05)	1(5.88)	28
$Robust_{QLR}$	3(17.64)	3(17.64)	0(0.00)	5(29.41)	3(17.64)	1(5.88)	1(5.88)	16
MW	3(17.64)	3(17.64)	2(11.76)	3(17.64)	5(29.41)	5(29.41)	0(0.00)	21
$Robust_{MW}$	3(17.64)	3(17.64)	0(0.00)	4(23.52)	3(17.64)	0(0.00)	0(0.00)	13
APW	4(23.52)	4(23.52)	3(17.64)	5(29.41)	4(23.52)	7(41.17)	1(5.88)	28
$Robust_{APW}$	4(23.52)	4(23.52)	0(0.00)	4(23.52)	2(11.76)	2(11.76)	2(11.76)	18

Note: All tests are implemented at the 5% significance level. The numbers in brackets are the percentage rejection rates. The numbers outside the brackets are the number of cases rejected. Nbs (%) is the percentage of countries for which the null hypothesis is rejected.

2.4.2 Weak exogeneity test

One of the main assumptions underlying the global VAR states that foreign and global variables are considered as weakly exogeneous. In a cointegration framework, it implies that there is no long-term feedback of x_{it}^{*} to x_{it}. Weakly assumption is quite realistic for a large enough N and if each economy is relatively small compared to the rest of the world.

Denoting ϵ_t the vector of idiosyncratic shocks of each country/region supposed to be non-correlated, of zero mean, and a non-singular covariance matrix, the assumption of weaken correlation can be written as:

$$E(\epsilon_t, \epsilon_{jt}^{'}) = \begin{cases} \sum_{ij}, t = t^{'} \\ 0, t \neq t^{'} \end{cases}$$

By construction, the model allows for interactions among the different economies through potential contemporaneous dependence between shocks in countries i and j. Considering that the variance/covariance matrix is constant across time is not a too restrictive assump-

tion for quarterly data. Also, the assumption of weakling correlation between error terms is not strong when N is large and when foreign variables are included. The second property we need to validate is the weak exogeneity assumption (Richard, 1980; Engel et al., 1983).

Indeed, weak exogeneity is one of the main assumptions underlying the GVAR. According to Engel et al. (1983), a set of variables are defined as weakly exogenous if the statistical inference of each parameter conditionally on these variables does not involve a loss of information. In other words, following Granger and Lin (1995), the weak exogeneity assumption implies no long run feedback from x^*_{it} to x_{it} without necessarily ruling out lagged short run feedback between the two sets of variables. In this case, x^*_{it} is said to be long run forcing for x_{it} that implies that the error correction term of the individual VECMX models do not enter in the marginal model of x^*_{it}.

Here, we follow the methodology of Harbo et al. (1998), according to whom we test the joint significativity of the error correction terms in auxiliary equations for the country specific foreign variables x^*_{it}. Formally, for each l^{th} element of x^*_{it} the following regression is carried out:

$$\Delta x^*_{it,l} = a_{il} + \sum_{j=1}^{r_i} \zeta_{ij,l} \widehat{ECM}_{ij,t-1} + \sum_{k=1}^{s_i} \phi^{'}_{ik,l} \Delta x_{i,t-k} + \sum_{m=1}^{n_i} \phi^{'}_{im,l} \Delta \tilde{x}^*_{i,t-n} + \eta_{it,l} \qquad (2.4.5)$$

where $\widehat{ECM}_{ij,t-1}$, j=1,2,. . . , i are the estimated error correction terms corresponding to the r_i cointegration relations found for the i^{th} country model, and s_i and n_i are the lag orders of the lagged changes for the domestic and foreign variables respectively. Then the test for weak exogeneity is an F test on the joint null hypothesis that $\zeta_{ij,l}$=0, j=1,2,. . . ,r_i in the above regression.

The weak exogeneity test for both estimated GVAR models are reported in Table 2.4.2. The weak exogeneity hypothesis is never rejected for each of the foreign variables.[6]

Table 2.4.2 Exogeneity test

Country	F-crit	Pc	Cpi	gdp	lir	Hp	ep	cp	oil
Austria	4	0.34	0.2	0.21	0.01	1.99	0.38	0.24	0.05
Belgium	4	2.31	0.45	0.31	0.76	0.01	1.77	0.07	0.18
Denmark	4	0.27	0.78	0.29	0.06	1.55	1.49	0.39	3.28
Finland	4	0.05	0.14	0.05	0	0.01	1.01	0.41	0.71
France	4	1.88	3.96	0.3	1.62	1.99	2.66	0.67	0.74
Germany	4.03	0.41	0	0.74	1.11	0.26	2.51	0.01	0.03
Greece	4	0.37	0.17	0.02	1.6	1.73	0.03	0.09	0.04
Ireland	4	0.37	4.09	0	0.3	4	0.77	0.42	1.87
Italy	4	0.09	2.21	2.83	0.03	0.05	0.39	0.41	0.44
Netherlands	4.03	1.82	0.23	1.63	1.59	0.39	0.45	0.02	0.57
Norway	4	0.08	0.72	1.26	0.16	0.33	0.59	0.18	3.89
Portugal	4.03	2.33	0.66	1.44	0.07	0.7	0.18	0	0.11
Spain	4	0	2.73	0.67	0.03	0.36	0.06	0.01	0.16
Sweden	4	0.14	2.02	0.8	0	0.05	1.63	0.96	3.95
Switzerland	4	0	0.25	0	3.29	0.49	0	0	0.05
UK	4	1.3	1.05	0.26	0.14	0.35	0.27	1.25	0.28
USA	3.97		14.77	1.72	1.84			0.18	

Note: F-statistics test zero restrictions on the coefficients of error correction term in the error correction regression for the country specific foreign variables. The statistical significance level is 5%. F-crit denotes the critical value.

2.4.3 Persistence profile

Persistence profile refers to the time profiles of the effects of system or variable-specific shocks on the cointegration relationships in the GVAR model (Pesaran and Shin, 1998). More precisely, they provide information on the speed with which the cointegrating relationships

[6]Except for Ireland and the USA CPIs.

return to their equilibrium states. We set the value of unity on impact and expect that it should tend to zero as the horizon tends to infinity, *i.e.* n $\rightarrow \infty$ if the vector under consideration is a valid one. Derivation of persistence profile is based on the moving average representation of the GVAR model given by:

$$x_t = b_0 + b_{1t} + F_1 x_{t-1} + F_2 x_{t-2} + ... + F_p x_{t-p} + \epsilon_t \tag{2.4.6}$$

The moving average form of equation (2.4.6) is given by:

$$x_t = d_t + \sum_{s=0}^{\infty} A_s \epsilon_{t-s} \tag{2.4.7}$$

Where d_t represent the deterministic component of x_t and A_t is derived recursively as $A_s = F_1 A_{s-1} + F_2 A_{s-2} + ... + F_p A_{s-p}$ for s =1, 2,. . . ,p cointegrating relationships by country are given by $\Pi_i z_{it}$ while the GVAR counterpart of it is z_{it}. Using the fact that $z_{it} = W_i d_{it} + W_i A_0 \epsilon_t + \sum_{s=1}^{\infty} W_i A_s \epsilon_{t-s}$ we can now deduce the persistence profile of $\Pi_{ji}^{'} z_{it}$ with respect to a wide-system shock on ϵ_t as:

$$PP = \frac{\Pi_{ji}^{'} W_i A_n \sum_{\varepsilon} A_n^{'} W_i^{'} \Pi_{ji}}{\Pi_{ji}^{'} W_i A_0 \sum_{\varepsilon} A_0^{'} W_i^{'} \Pi_{ji}} \tag{2.4.8}$$

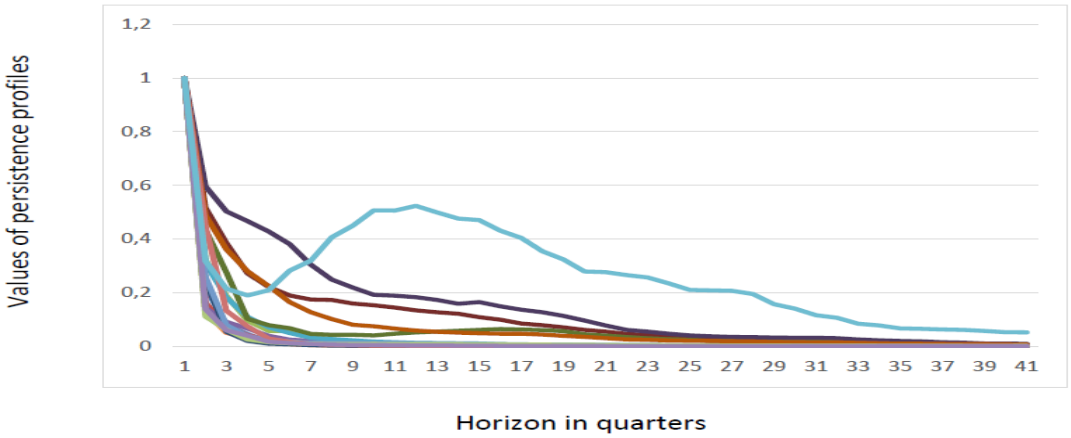
Where $\Pi_{ji}^{'}$ is the j^{th} cointegration relation in the i^{th} country, n being the time horizon, $\sum_{\varepsilon}$ the covariance matrix of ϵ_t. The persistence profile of $\pi_i z_{it}$ with respect to a variable specific shock is given by:

$$PP = \frac{\Pi_{ji}^{'} W_i A_n \sum_{\varepsilon} e_l}{\sqrt{\sigma_u}} \tag{2.4.9}$$

Where e_l is the $(k \times 1)$ vector that corresponds to the l^{th} variable in x_t and σ_u the l^{th} diagonal element of $\sum_{\varepsilon}$. Persistence profiles are reported in Figure 2.4.4 below. We find that our

model returns to equilibrium within 5 years.

Figure 2.4.4: Persistence profiles



2.5 Results

As we are interested in credit-driven and financial asset-driven fluctuations, we successively consider three types of shocks: credit, house prices, and share prices. For each of them, we analyze their impact in each region and their international transmission.

2.5.1 Credit to the private sector shock

In a first step, we assess the responses of our selected variables focusing our attention on the Eurozone and the United States. The following figures display the response of our variables to a one standard error positive shock to the credit to the private sector.

In the Eurozone subgroups, as portrayed in Figures 2.5.1 to 2.5.3, a one standard error positive shock to the credit to the private sector[7] lasts 15-16 quarters, exhibiting a higher

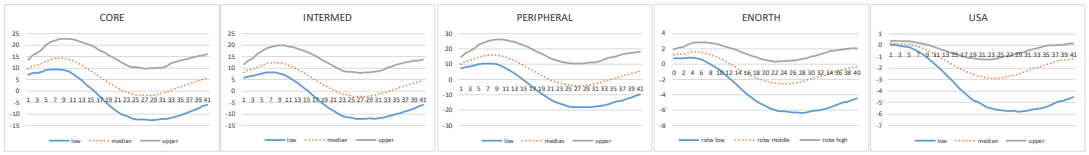
[7]Recall that we use credit to households and NPISHs except for Austria, Ireland, and Switzerland, for which we use the credit to the private sector.

persistence than in the United States (7 quarters). In all Eurozone subgroups and the United States, we observe the expected positive responses for the CPI, but these responses are significant over two quarters in the peripheral Eurozone subgroup. In other words, our private credit shock does not exert an influence on the inflation dynamics. Interestingly, the shock shows higher persistence in the Eurozone economies (through the GDP) than in the United States, except in peripheral countries where the response of GDP is insignificant. This finding is related to the stronger weight of bank funding in the Eurozone. As expected, an increase in the private credit to the private sector exerts a positive influence on the US private consumption, but the response is short-lived (one year). A higher persistence is observed in the INTERMED Eurozone subgroup (7 quarters) while responses – even if positive – are insignificant for CORE and PERIPHERAL subregions. The US long-term interest rate response to the shock is not significantly different from zero at all horizons. We obtain similar results in peripheral Eurozone countries. By contrast, in CORE and INTERMED Eurozone economies, the private credit shock exerts a lasting positive impact (12-13 quarters) with a lag of 3-4 quarters.

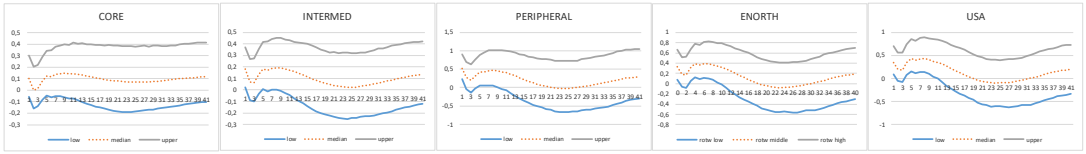
If we consider asset prices responses, the results obtained are mixed. For house prices, responses are either insignificant but positive as expected (CORE and PERIPHERAL Eurozone), or positive only at a short term (4 quarters in INTERMED subgroup), or counter-intuitive as in the United States where house prices persistently fall after a positive credit shock. For share prices, Figures 2.5.1 to 2.5.4 exhibit positive but insignificant responses except for the United States and PERIPHERAL at the impact.

Figure 2.5.1: CORE Eurozone private credit shock

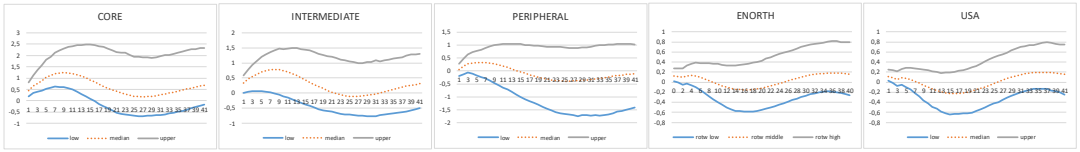
Responses of private credit shock



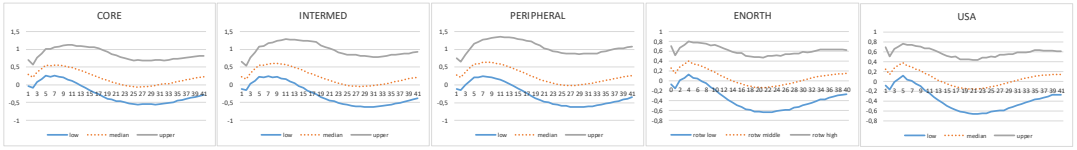
Responses of CPI



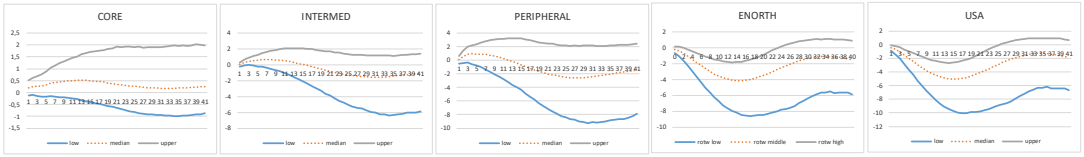
Responses of GDP



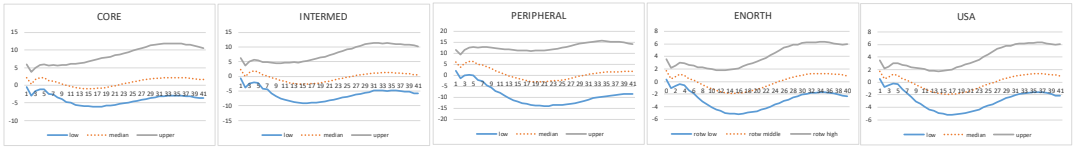
Responses of long-term interest rate



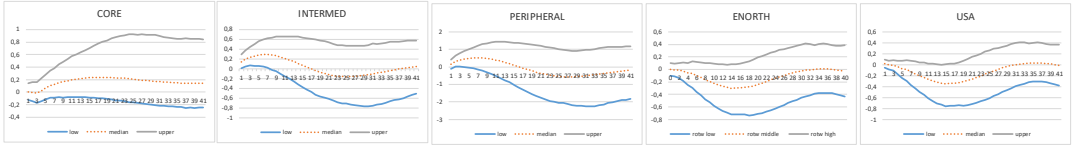
Responses of house prices



Responses of equity prices



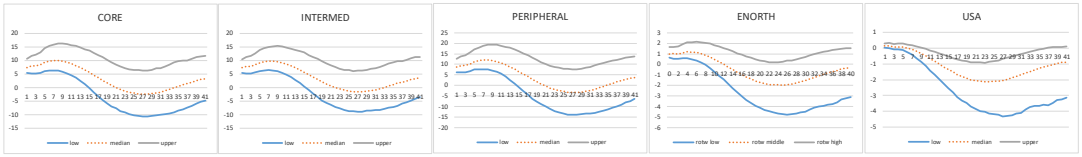
Responses of private consumption



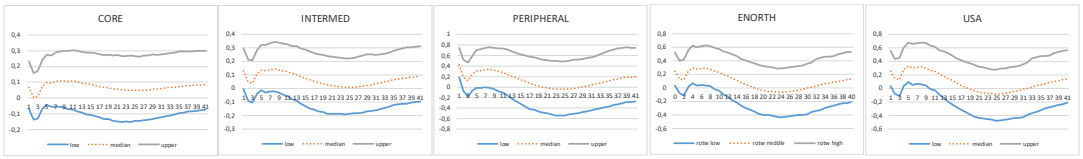
Note: The full lines represent the intervals of confidence at the 95 % level.
The dotted line denotes the response to CORE Eurozone private credit shock.

Figure 2.5.2: INTERMED Eurozone private credit shock

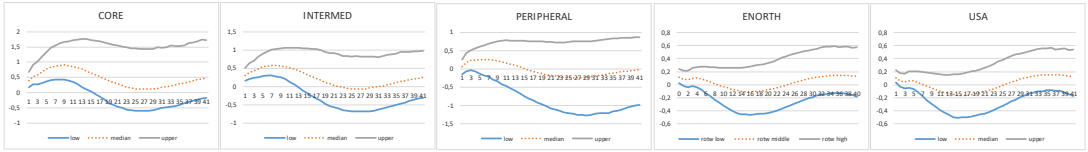
Responses of private credit



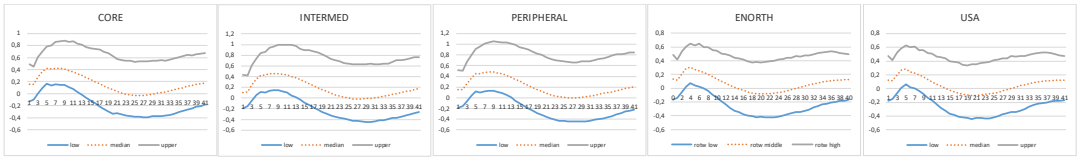
Responses of CPI



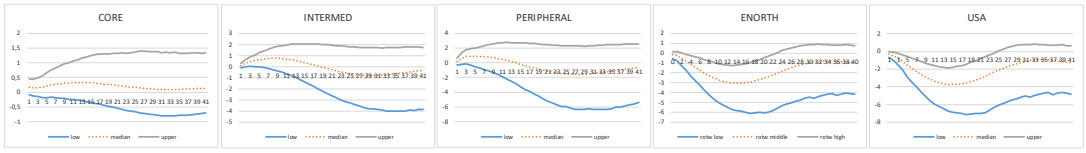
Responses of GDP



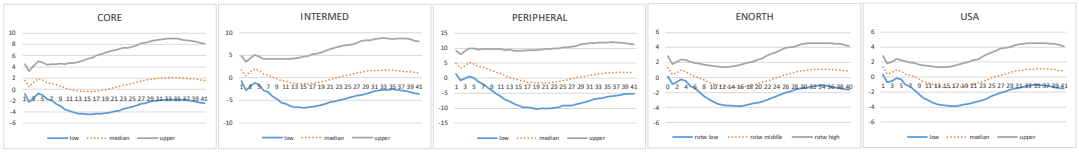
Responses of long-term interest rates



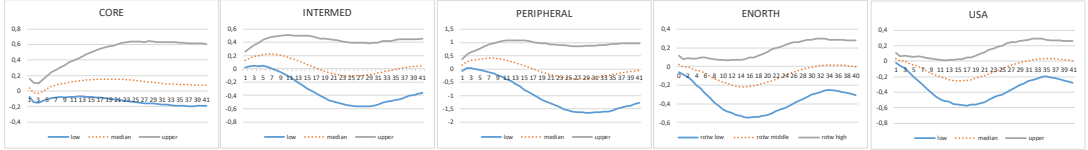
Responses of house prices



Responses of equity prices



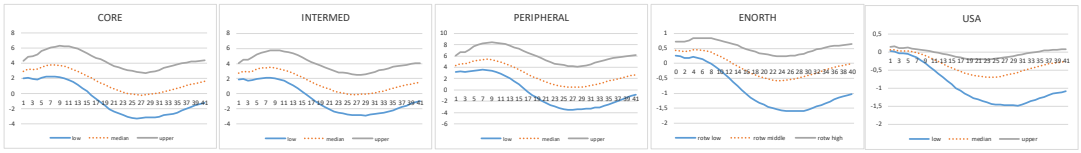
Responses of private consumption



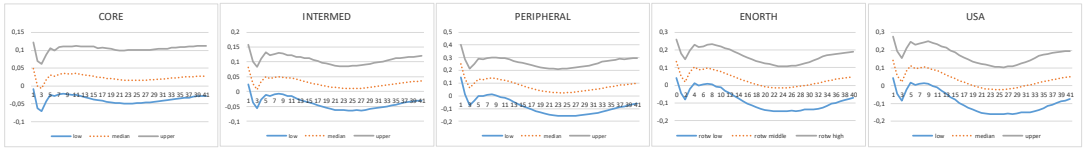
Note: The full lines represent the intervals of confidence at the 95 % level.
The dotted line denotes the response to INTERMED Eurozone private credit shock.

Figure 2.5.3: PERIPHERAL Eurozone private credit shock

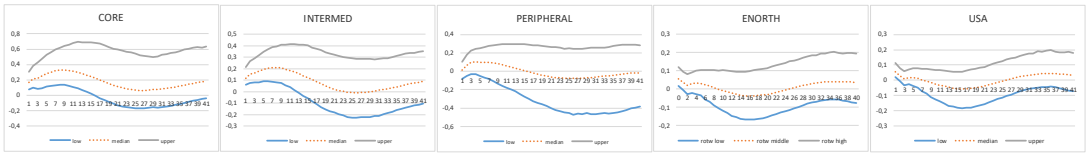
Responses of private credit



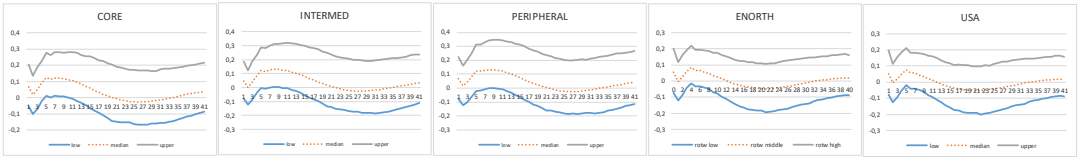
Responses of CPI



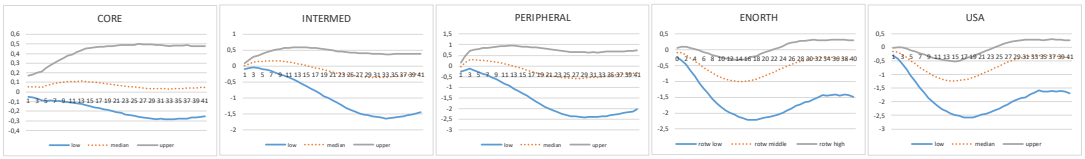
Responses of GDP



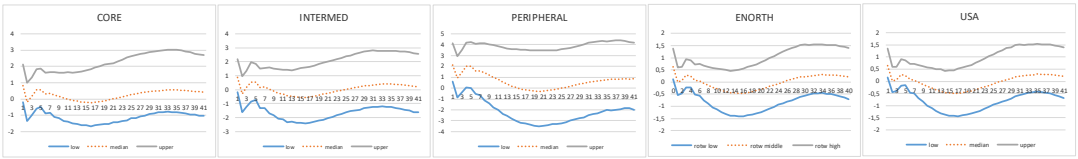
Responses of long-term interest rates



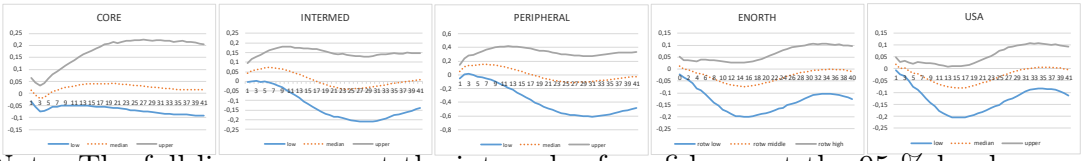
Responses of house prices



Responses of equity prices



Responses of private consumption



Note: The full lines represent the intervals of confidence at the 95 % level.

The dotted line denotes the response to PERIPHERAL Eurozone private credit shock.

In a second step, we investigate the international transmission of the respective positive US private credit shock. Figure 2.5.4 displays the variables' responses of the different Eurozone subgroups to a one standard error positive shock to the US credit to the private sector. Several aspects are noteworthy.

A positive private credit shock in the United States exhibits sizeable spillover effects, in particular for our three euro are subregions (12 quarters) and to a lesser extent in the ENORTH region (8 quarters). In all regions and subregions, except for PERIPHERAL at the impact of the shock, responses of CPI are positive but insignificant. In the aftermath of the US shock, GDP increases in CORE and INTERMED over 11-12 quarters while the response is short-lived in ENORTH. For the PERIPHERAL Eurozone subregion, the GDP response is positive but insignificant. As for the CPI and the long-term interest rates, the US credit shock leads to their increase in other areas, but all responses are not statistically different from zero.

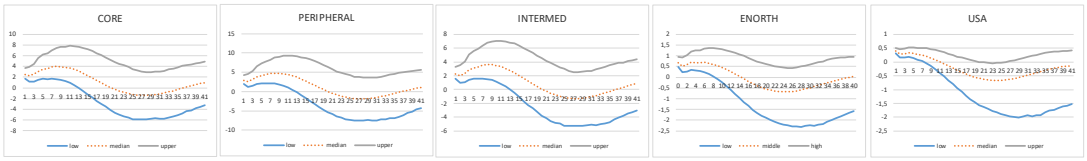
Interestingly, our results suggest that a positive US credit shock does not significantly influence asset prices in other regions or subregions. Specifically, responses are either insignificant (house prices) or short-lived (PERIPHERAL and ENORTH for share prices).

Private consumption increases in the aftermath of the US credit shock. However, responses are insignificant in CORE and PERIPHERAL subgroups. For INTERMED Eurozone and ENORTH, responses last less than 4 quarters.

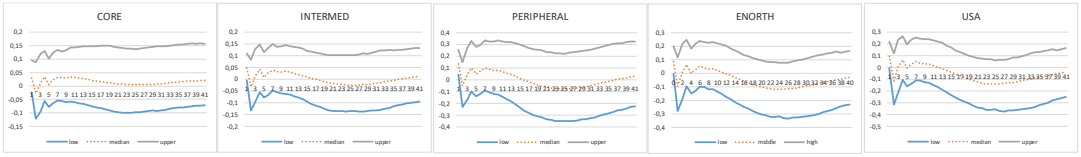
For the Eurozone as a whole, we find that spillover effects remain largely confined to a regional dimension. Specifically, except for the private credit, when responses are positive and

Figure 2.5.4: US private credit shock

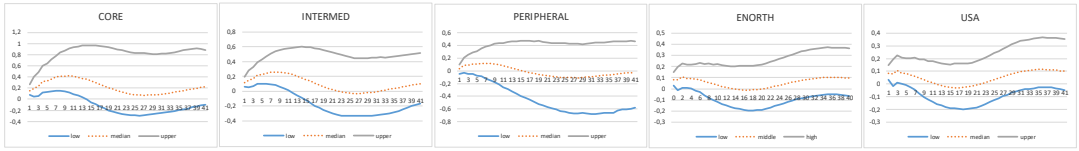
Responses of private credit



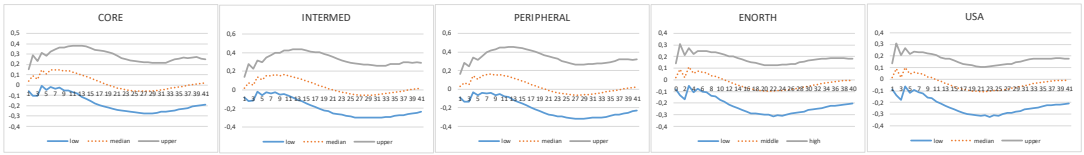
Responses of CPI



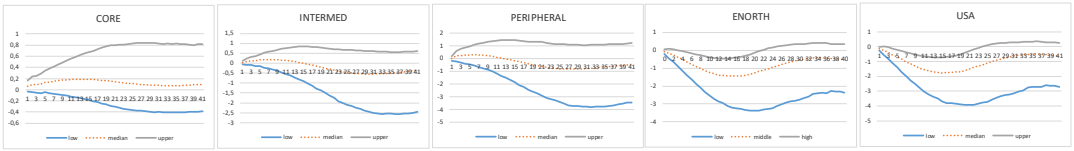
Responses of GDP



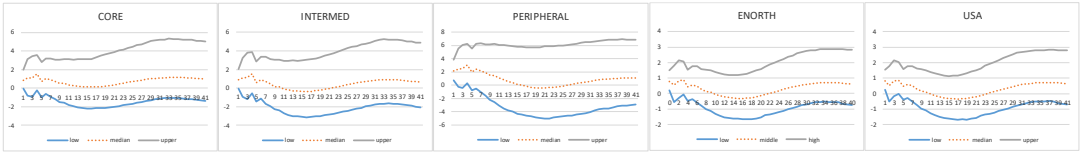
Responses of long-term interest rates



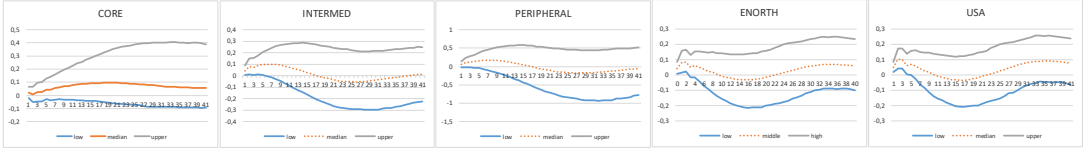
Responses of house prices



Responses of equity prices



Responses of private consumption



Note: The full lines represent the intervals of confidence at the 95 % level. The dotted line denotes the response to US private credit shock.

persistent in other Eurozone subgroups, PERIPHERAL countries do not exhibit significant external transmission effects. INTERMED and CORE countries exert an influence on other Eurozone economies, but such influence is limited to private credit, GDP, and long-term interest rates. Importantly, all Eurozone subgroups exhibit a similar pattern for asset prices. On the one hand, a positive credit shock in a subgroup does not lead to synchronization in house prices over the studied period as responses are insignificant. On the other hand, equity prices responses are either insignificant or positive at the impact only, whatever the origin of the shock from a Eurozone subregion.

Overall, our results are in line with the literature on the global financial cycle (Rey, 2013, Dées, 2016; Dées and Galesi, 2021): we identify more sizeable international spillover effects from US private credit shocks than transmission ones from Eurozone subregions.

2.5.2 House prices shocks

House prices shocks are of particular interest as developments in housing markets in advanced economies have played a significant role in the accumulation of financial disequilibria leading to the global financial crisis. In addition, housing markets have amplified the recession's macroeconomic effects. As previously, we focus on the domestic effects of house prices in the United States and the Eurozone subregions. Then, we investigate spillover effects attached to this shock.

As depicted in Figure 2.5.5, in the United States, house prices shock lasts 6 quarters. Indeed, Figure 2.5.5 suggests the presence of a financial accelerator mechanism insofar as we observe an increase in private credit. The increase is persistent as the effect of the initial shock

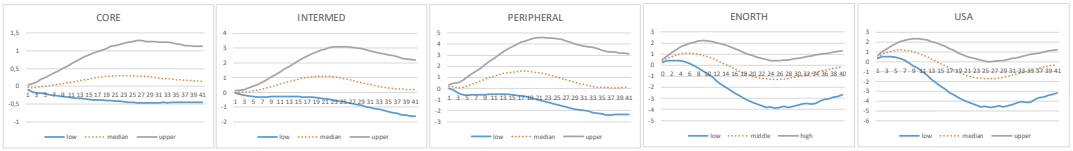
vanishes after 19 quarters. All other domestic variables follow a similar path. Specifically, these variables respond to the shock with a delay of 2 to 3 quarters. It should be noted that these responses are positive and persistent over time (they last between 8 for the private consumption and more than 20 quarters for the CPI). Thus, the positive house prices shock has a significant expansionary impact on the American economy.

On the other hand, in the three Eurozone subregions (Figures 2.5.6 to 2.5.8), the impact of the positive house prices shock is persistent. However, in contrast to the findings concerning the United States, our results do not lend support to the financial accelerator hypothesis. Indeed, most of the responses of the variables used in our GVAR are not statistically different from zero. There are two exceptions concerning the INTERMED subregion: on the one hand, the GDP increases in the aftermath of the shock from quarter 3 to quarter 15; on the other hand, we note a positive response of private consumption from the impact to quarter 19.

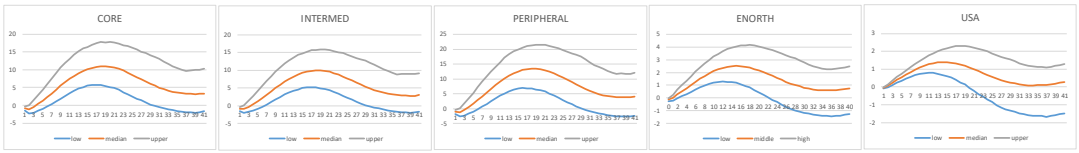
Regarding spillovers from the United States, it is worth highlighting the overall significant and persistent impact of the US house prices shock (See Figure 2.5.5). In all European regions, private credit increases in the aftermath of the positive US house prices shock. Private credit exhibits both inertia – as responses are significant after 6 quarters in all Eurozone subregions and 2 quarters in ENORTH – and lasting impact as responses remain significant for almost 20 quarters. In all regions, we observe a persistent increase in CPI after a delay of 3 quarters, suggesting the presence of inertia in price responses. Except in the PERIPHERAL subgroup, the shock is accompanied by an increase in GDP with a long-lasting impact. GDP reacts with a lag of 2-6 quarters but remains positive thereafter. Long-term interest rates in the European region follow a trend similar to that of the United States. After 2 quarters, they exhibit a persistent rise, in particular in Eurozone subregions. Share prices do not react at the impact of the shock but increase after 2 quarters. However, responses tend to be relatively short-lived, especially in Eurozone subregions. Private consumption increases

Figure 2.5.5: US house prices shock

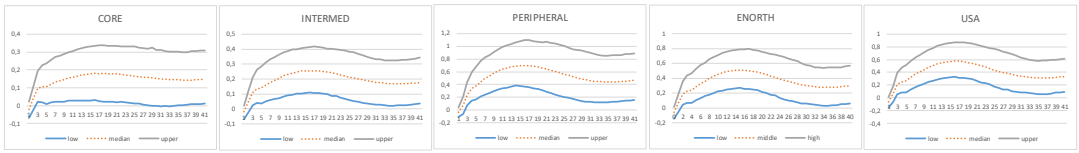
Responses of house prices



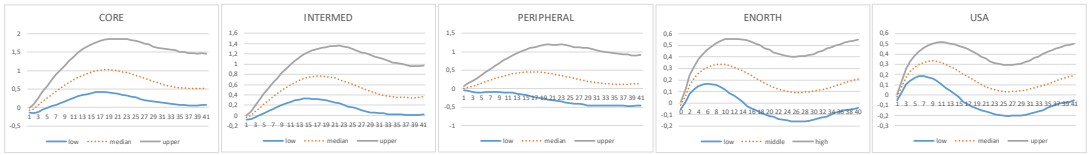
Responses of private credit



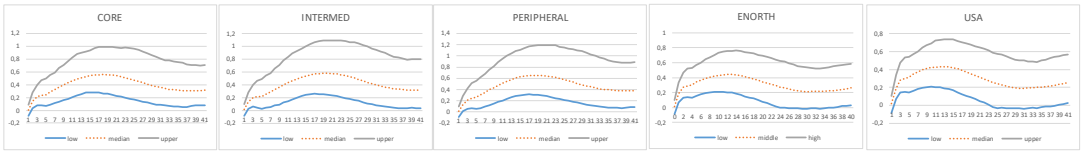
Responses of CPI



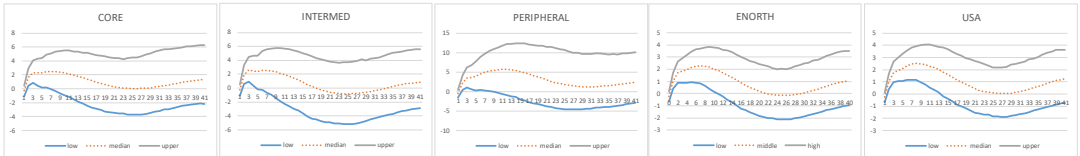
Responses of GDP



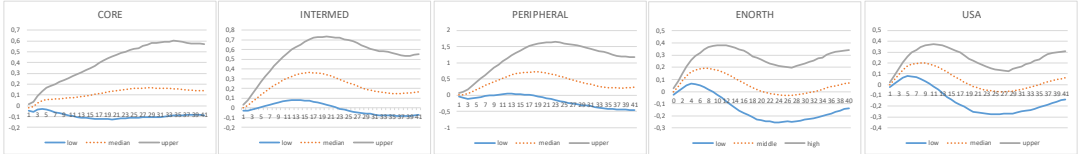
Responses of long-term interest rates



Responses of equity prices



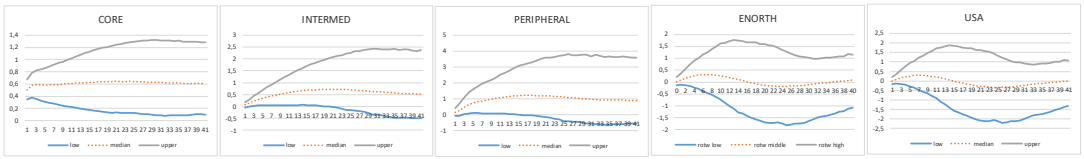
Responses of private consumption



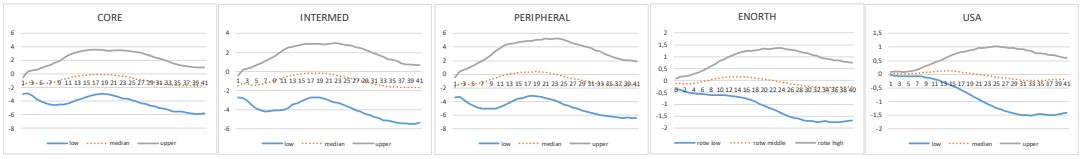
Note: The full lines represent the intervals of confidence at the 95 % level. The dotted line denotes the response to US house prices shock.

Figure 2.5.6: CORE Eurozone house prices shock

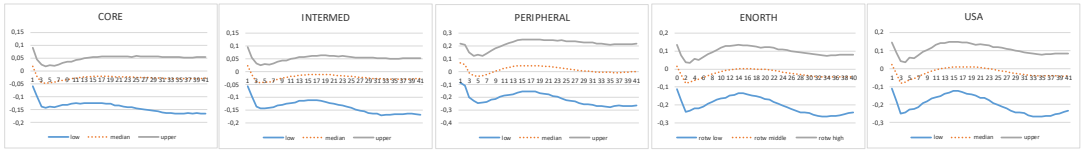
Responses of house prices



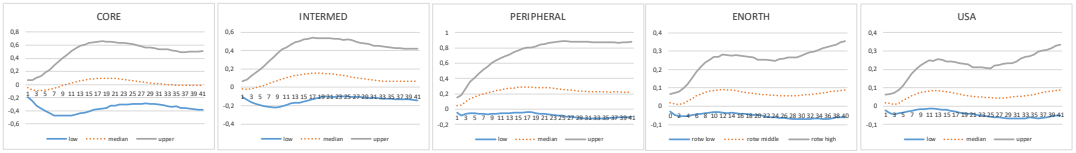
Responses of private credit



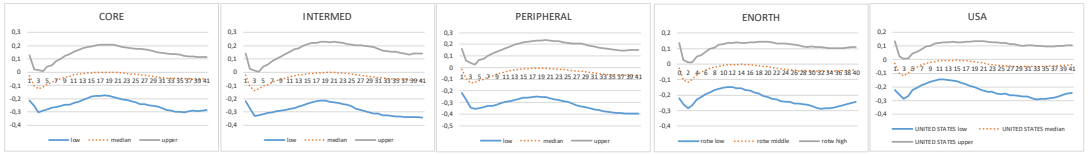
Responses of CPI



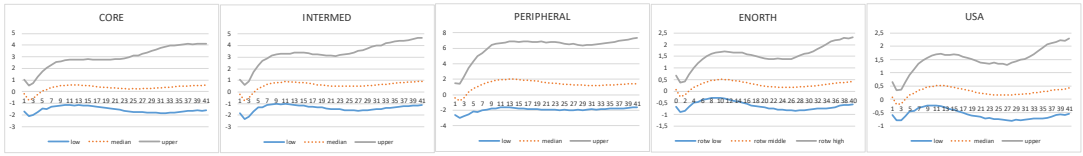
Responses of GDP



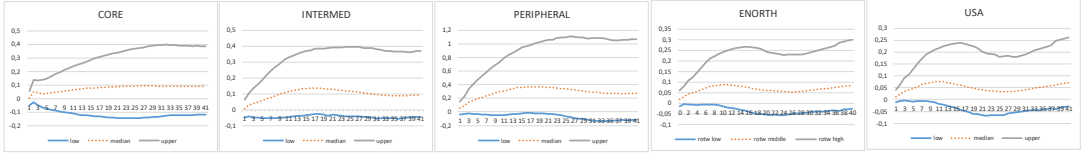
Responses of long-term interest rates



Responses of equity prices



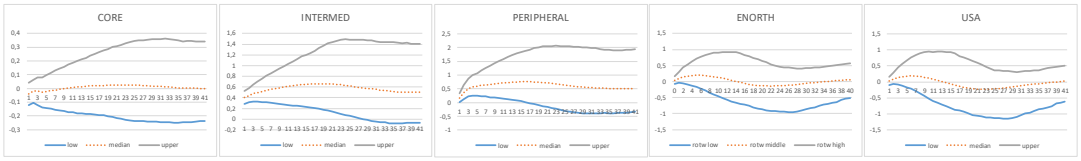
Responses of private consumption



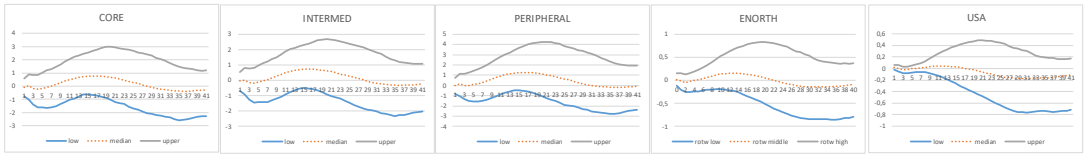
Note: The full lines represent the intervals of confidence at the 95 % level. The dotted line denotes the response to CORE house prices shock.

Figure 2.5.7: INTERMED Eurozone house prices shock

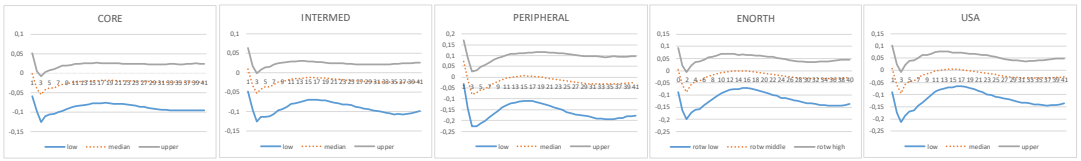
Responses of house prices



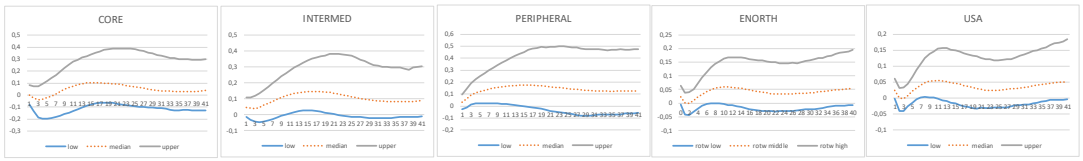
Responses of private credit



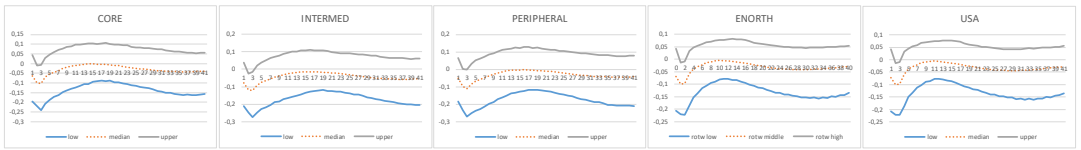
Responses of CPI



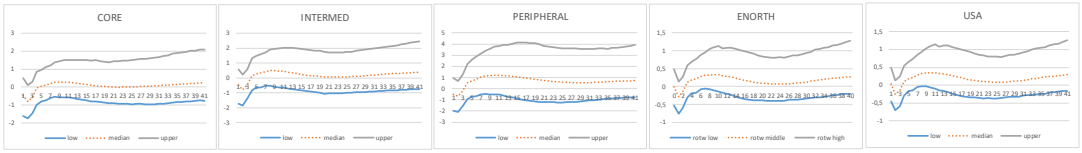
Responses of GDP



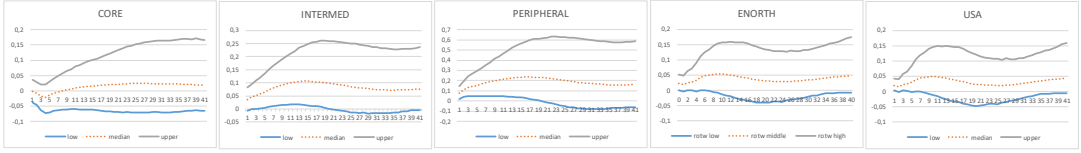
Responses of long-term interest rates



Responses of equity prices



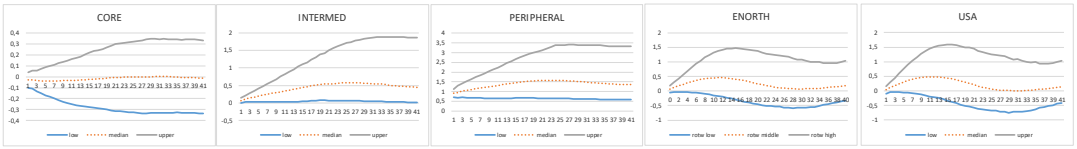
Responses of private consumption



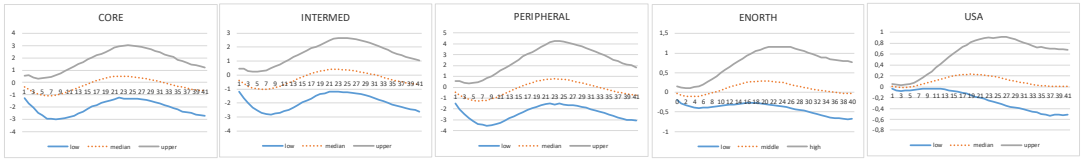
Note: The full lines represent the intervals of confidence at the 95 % level. The dotted line denotes the response to INTERMED house prices shock.

Figure 2.5.8: PERIPHERAL Eurozone house prices shock

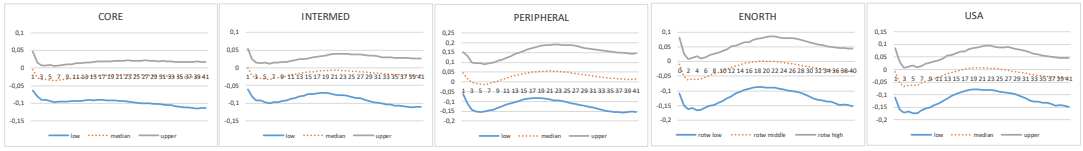
Responses of house prices



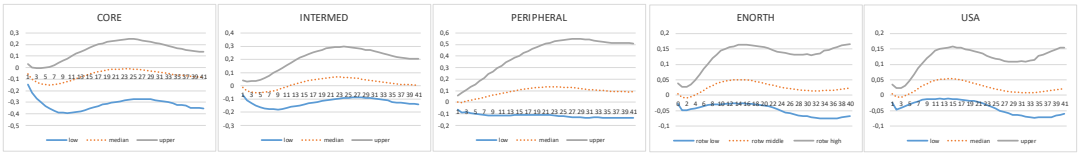
Responses of private credit



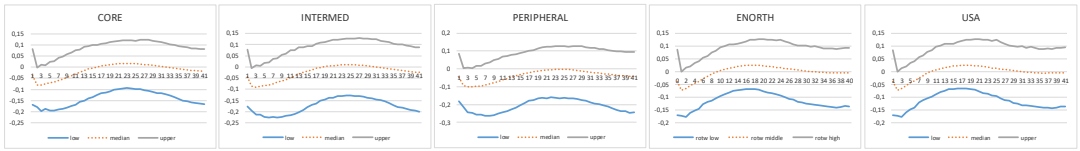
Responses of CPI



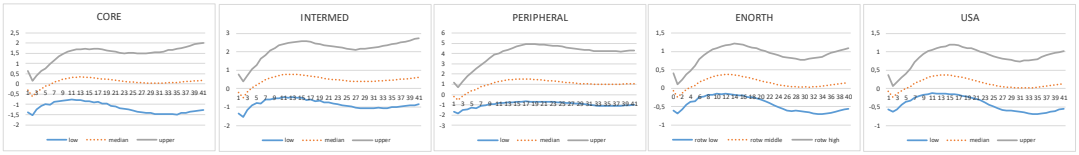
Responses of GDP



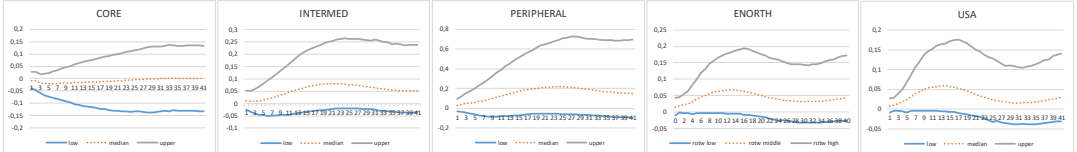
Responses of long-term interest rates



Responses of equity prices



Responses of private consumption



Note: The full lines represent the intervals of confidence at the 95 % level. The dotted line denotes the response to PERIPHERAL house prices shock.

in the aftermath of the shock. The response is not significantly different from zero in the CORE subgroup, while we observe a significant lag in the reaction of private consumption in the other economic area studied (2 quarters in ENORTH, 4 quarters in INTERMED and 8 quarters in PERIPHERAL). Last but not least, house prices are the only variable that does not react significantly to the US shock, the only exception being the ENORTH region for 6 quarters. It should, however, be stressed that the responses have the expected theoretical sign (positive).

A striking result is that the spillover effects from the Eurozone are very weak, particularly towards the United States and the ENORTH region. The house prices shock from the CORE subregion exhibits positive spillovers on house prices responses in all regions (see Figure 2.5.6), but responses are significant only for INTERMED (2-18 quarters) and PERIPHERAL (3-15 quarters). The shock elicits insignificant responses for other variables. However, it should be noted that many of the responses have the expected effects in the sense that a positive house price shock has an expansionary macroeconomic effect. Figure 2.5.7 shows that positive house prices shock in INTERMED lead to an increase in house prices in other regions. But responses are significantly different from zero only in the PERIPHERAL Eurozone subregion (over 16 quarters). Similarly, we identify positive and significant responses for GDP and private consumption in the PERIPHERAL Eurozone subregion. These results suggest a very weak transmission from the INTERMED subgroup to other regions. We identify even weaker spillover effects from the PERIPHERAL euro area subregion. Our results are in line with Vansteenkiste and Hiebert (2011), who find that spillovers from country-specific house price shocks are relatively low in the Eurozone.

2.5.2.1 Equity prices shocks

In the five studied countries/regions analyzed, Figures 2.5.9 to 2.5.12 exhibit a similar result: equity prices shocks do not significantly influence other domestic variables despite the persistence of the shock. For all countries/subregions, CPI and long-term interest rates decrease at the impact of the equity prices shock. Except in the CORE Eurozone subregion, GDP increases after the shock, but the response is significant only for the United States (from Q5 to Q7). Private consumption increases with lasting effect once again except for the CORE Eurozone subregion. However, the response is significantly different from zero only for the United States at the impact. The equity price shock is accompanied by increased private credit in all countries/subregions but the CORE Eurozone. When significant, the response is short-lived (3 quarters for the INTERMED Eurozone subgroup). Overall, these results suggest that equity prices shocks are not closely connected to the business cycles, particularly in the CORE Eurozone subgroups.

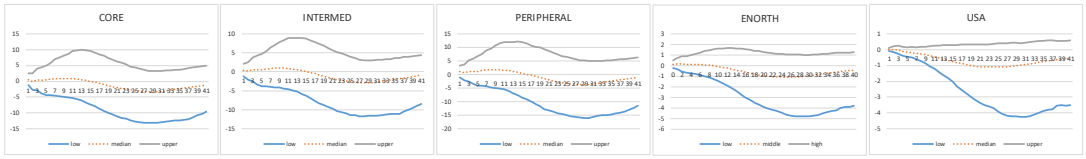
Regarding spillover effects, positive US equity prices shocks exert a sizeable and persistent influence on foreign equity prices. By contrast, Eurozone subregions tend to affect only other Eurozone equity markets, or spillovers to non-Eurozone countries are short-lived. An interesting exception is the PERIPHERAL subgroup for which the positive equity prices shock leads to an increase in ENORTH equity prices from Q4 to Q11 and in the United States equity prices over four quarters (Q5-Q9). These findings confirm the global impact of US financial shocks while those of the Eurozone are more regional. Spillovers from US and Eurozone equity price shocks exert insignificant or very short-lived influence on other variables included in the GVAR model.

Our results regarding the impacts of house price and stock price shocks confirm the related

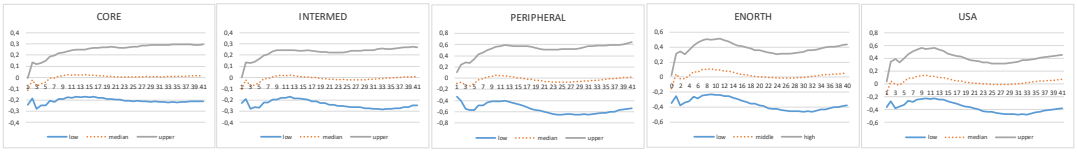
literature. Specifically, Analyzing the United States, Kishor (2007) finds that 99% of the change in housing wealth is permanent, *i.e.* it remains after one quarter, whereas only 46% of the change in equity wealth is. As housing represents a larger share of total household wealth, we can expect that changes in house prices exert a more important influence on household consumption decisions than equity prices changes. This expectation is confirmed by Case et al. (2005), who show that house prices are more important than stock prices in influencing consumption for a panel of 14 advanced economies. Carroll et al. (2011), in the case of the United States, report that the propensity to consume from a $1 increase in housing wealth ranges between two (short-run) and nine (long-run) cents. This share is double that estimated for equity wealth.

Figure 2.5.9: US Equity price shock

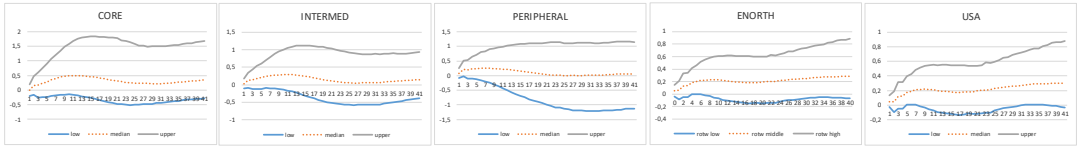
Responses of private credit



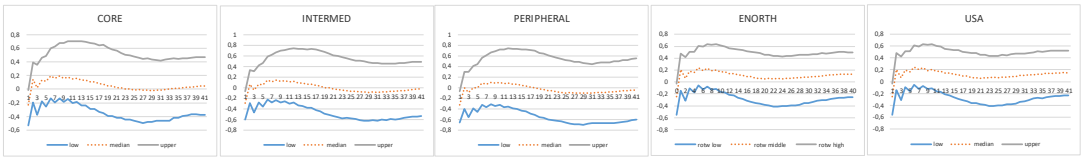
Responses of CPI



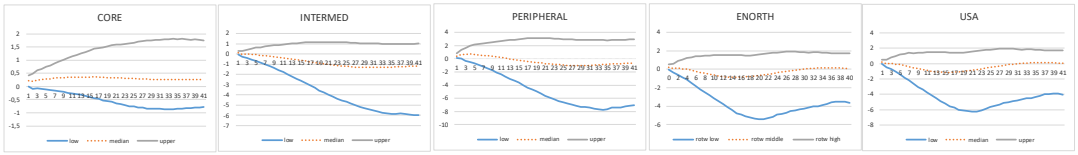
Responses of GDP



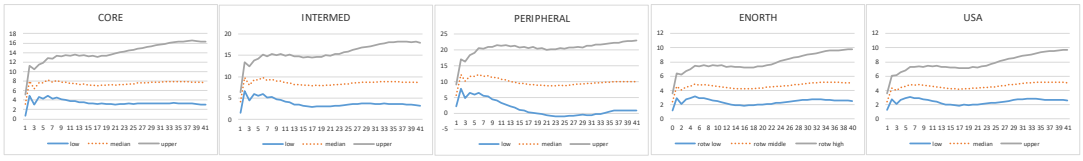
Responses of long-term interest rates



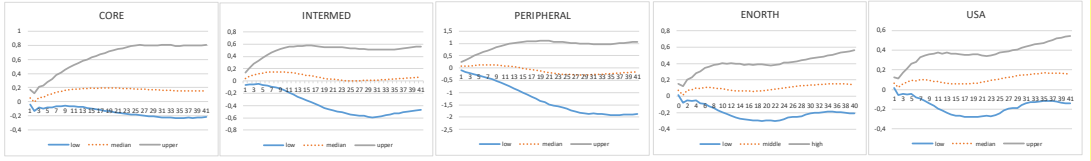
Responses of house prices



Response of equity prices



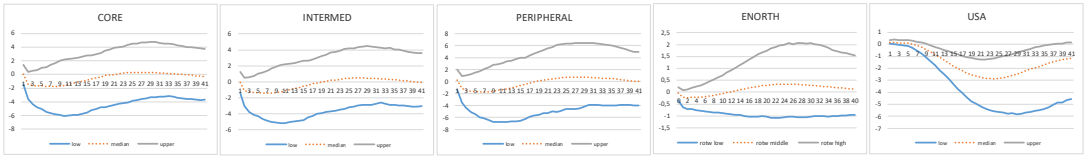
Responses of private consumption



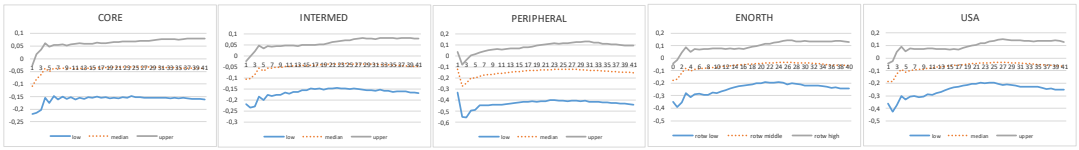
Note: The full lines represent the intervals of confidence at the 95 % level. The dotted line denotes the response to US equity prices shock.

Figure 2.5.10: CORE Eurozone Equity price shock

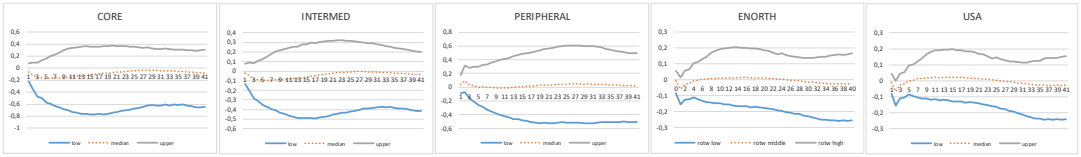
Responses of private credit



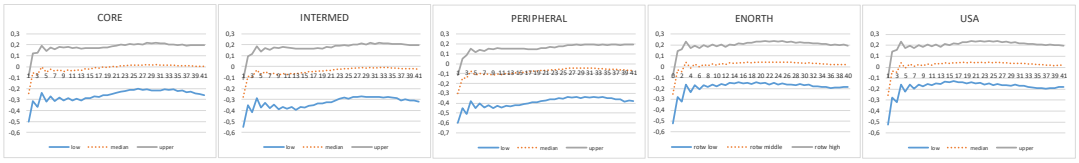
Responses of CPI



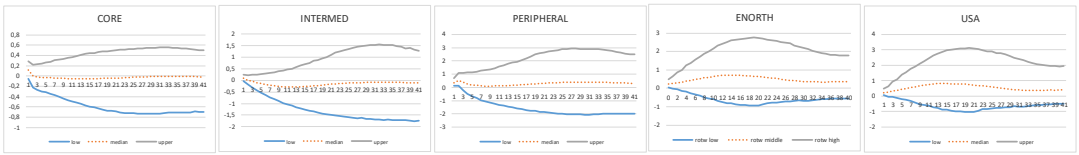
Responses of GDP



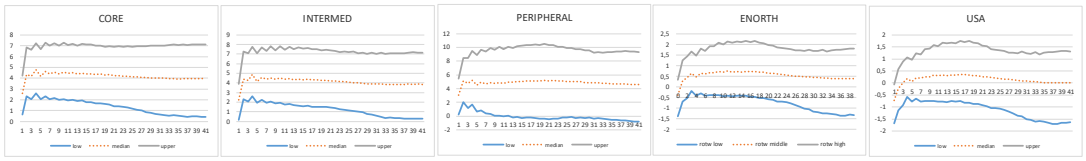
Responses of long-term interest rates



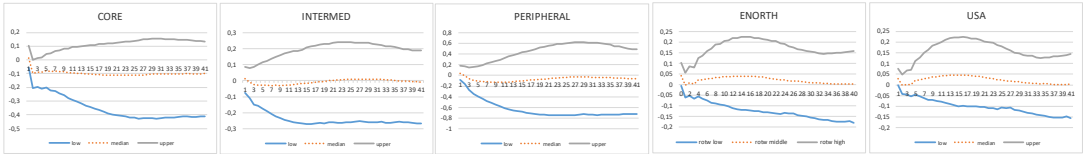
Responses of house prices



Response of equity prices



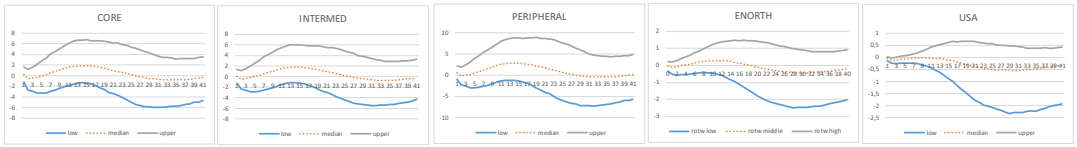
Responses of private consumption



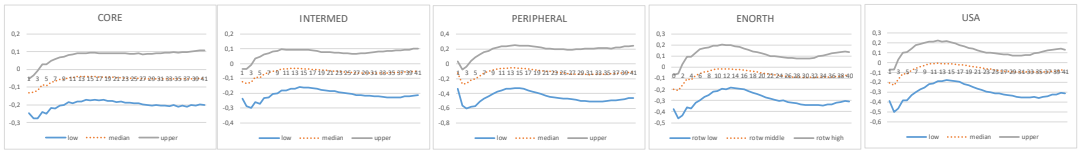
Note: The full lines represent the intervals of confidence at the 95 % level. The dotted line denotes the response to CORE Eurozone equity prices shock.

Figure 2.5.11: INTERMED Eurozone Equity price shock

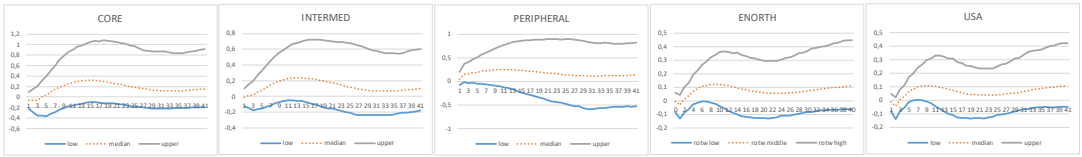
Responses of private credit



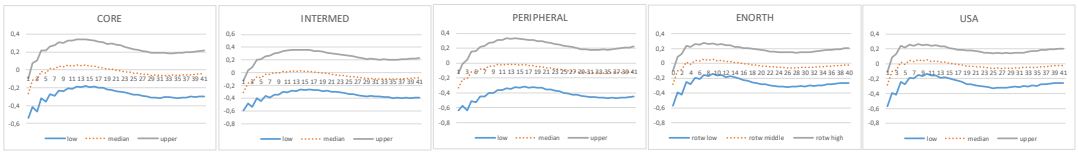
Responses of CPI



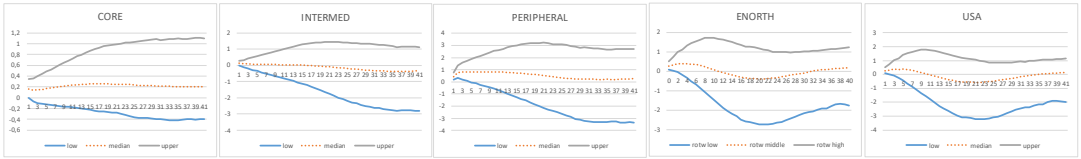
Responses of GDP



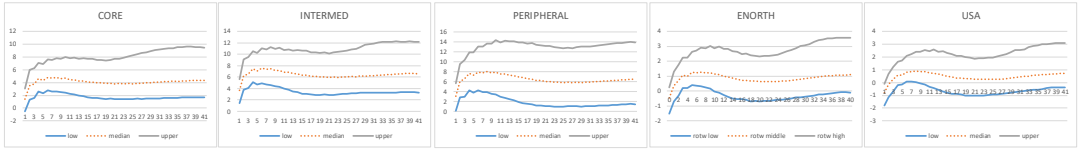
Responses of long-term interest rates



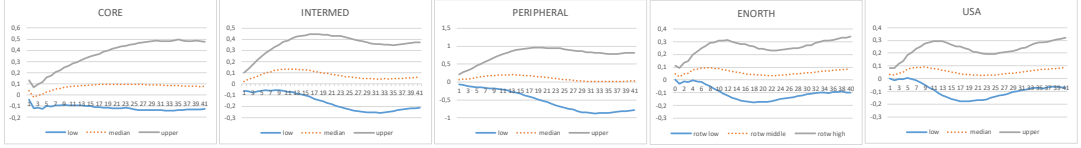
Responses of house prices



Response of equity prices



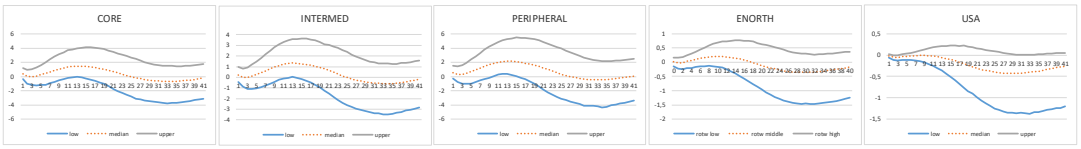
Responses of private consumption



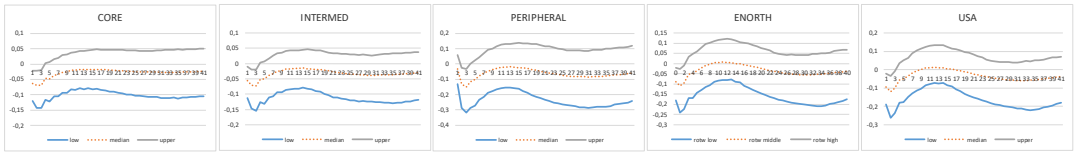
Note: The full lines represent the intervals of confidence at the 95 % level.
The dotted line denotes the response to INTERMED Eurozone equity prices shock.

Figure 2.5.12: PERIPHERAL Eurozone Equity price shock

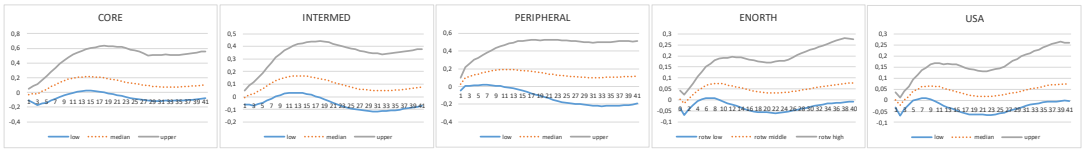
Responses of private credit



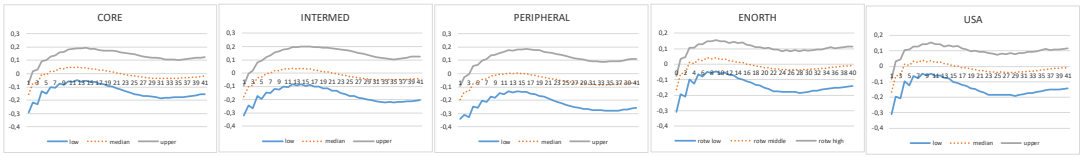
Responses of CPI



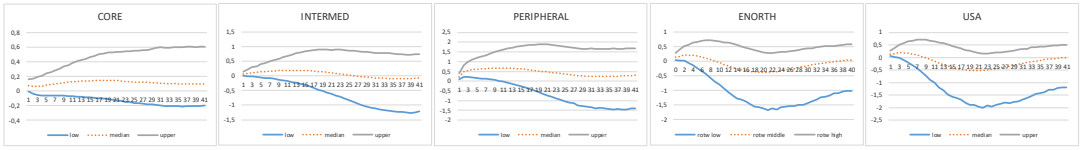
Responses of GDP



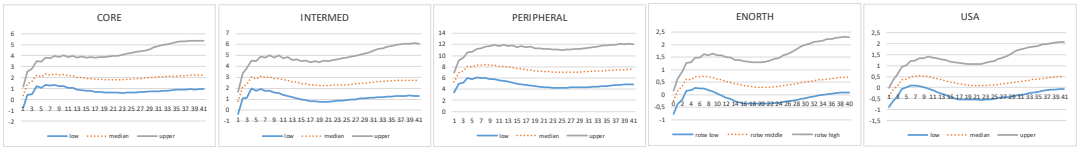
Responses of long-term interest rates



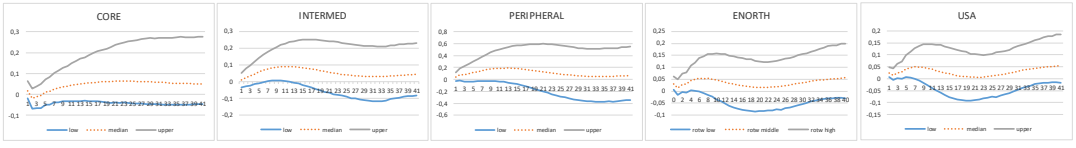
Responses of house prices



Response of equity prices



Responses of private consumption



Note: The full lines represent the intervals of confidence at the 95 % level.
The dotted line denotes the response to PERIPHERAL Eurozone equity prices shock.

2.6 Are financial variables shocks a source of amplification and propagation of the macroeconomic fluctuations and are financial variables shocks transmitted internationally?

In the following subsections, we will analyze : (i) whether financial variables shocks are a source of amplification and propagation of the macroeconomic fluctuations; (ii) and if they are transmitted internationally.

2.6.1 Are financial variables shocks a source of amplification and propagation of the macroeconomic fluctuations?

In this chapter, we first assess the role of financial variables in real economic fluctuations. Our results suggest that: (i) financial variables shocks and, in particular, US financial variables shocks are a source of amplification and propagation of macroeconomic fluctuations; (ii) the financial accelerator mechanisms are not very significant in the Eurozone, contrary to the US; (iii) equity prices are not closely connected to the business cycle in the CORE Eurozone subregions. Those insights are discussed in the following paragraphs.

First, we confirm that financial variables shocks are a source of amplification and propagation of macroeconomic fluctuations. For instance, we find that after a private credit shock, there is: (i) a high persistence in the Eurozone economies in terms of GDP after a private credit shock; (ii) and a positive influence on private consumption. Plus, whether it is a private credit shock or an asset price shock, the GDP, the private consumption, the CPI, and the long-term interest rates tend to react positively to financial variables shocks.

Hence, as demonstrated by Dées (2016), credit and asset prices variables matter to explain real economic fluctuations. In particular, Zabavnik and Verbic (2021) show how the financial sector is a great source of amplification and propagation of macroeconomic variables. They explain that the financial sector is supposed to be providing funds to boost consumption and investment by households and firms, which will induce economic growth. On the contrary, instability in the financial market can be the cause of a significant macroeconomic downturn, as the Great Recession of 2007-2009 demonstrated. In other words, our results are in line with the literature and suggest that financial variables shocks are necessarily a source of macroeconomic fluctuations.

Specifically, our results confirming that financial variables shocks are a source of amplification and propagation of macroeconomic fluctuations might be explained by the strong linkages between the different phases of business and financial cycles (Claessens et al., 2012). Recessions associated with financial disruptions – such as house and equity price busts – tend to be longer and deeper than other recessions. On the contrary, recoveries associated with rapid growth in credit and house prices are often stronger (Claessens et al., 2012). In particular, Bernanke et al. (1999) and Kiyotaki and Moore (1997) suggest that in a world with financial frictions, wealth and substitutions effects can be amplified because of changes in external financing, including through the financial accelerator mechanism (Claessens et al., 2012). In other words, changes in the supply of external financing can affect firms and households and thereby aggregate business cycles. This is why our results imply that financial variables shocks are a source of amplification and propagation of macroeconomic fluctuations.

However, our results show that the propagation of financial shocks is explained mainly by the US, including the propagation of financial shocks within the Eu-

rozone subregions. On the other hand, the Eurozone subregions do not explain significant share of the macroeconomic fluctuations, including within the Eurozone subregions. The latter might be explained by the size and the depth of the US financial markets and the US's large dominant place in global trade. Indeed, as Arora and Vamvakidis (2001) indicate, this might be explained by the fact that the main channel for the significant role of the United States in the world economy is through financial linkages as the US foreign direct and portfolio investment play a large and growing role in the world financial flows. In the same line, Kose et al. (2017) show that US financial markets are highly integrated with global markets as they followed a rapid expansion over three decades. Indeed, they point out that by 2010-2014, their international assets and liabilities were on average three times GDP, broadly in line with that of other advanced economies. Plus, according to them, the US is the world's largest source and recipient of foreign direct investment flows as they account for about one-fourth of world FDI inflows and outflows in 2015 in which the European Union with Japan, Canada, and Switzerland hold about 90% of FDI assets in the United States (Kose et al., 2017).

Secondly, our results add that, contrary to the US, the financial accelerator mechanisms are not very significant in the Eurozone. Indeed, as showed by Antoshin et al. (2017) and Mian et al. (2017b), following a financial crisis, the context tends to be lethargic and weak when a credit boom precedes a financial collapse. More precisely, as the link between the real economy and the financial markets relies on the need for firms for external finance, and as the firms' ability to borrow depends on their market value, if there is a collapse in asset prices, firms will experience a deterioration of their ability to borrow. This deterioration will preclude firms from investing, leading to a decrease in economic activity, which will, in turn, further cut assets prices down and conduct to a tightening of financing conditions and hence deteriorate even more the economic activity. However, once this stage

passes and the financial markets become lethargic, the financial accelerator mechanisms will not be present as the financial accelerator mechanisms stem from change(s) in the financial markets. That is what happened after the financial crisis of 2007 in the Eurozone: the financial markets were lethargic; hence there was no presence of financial accelerator mechanisms. In addition, Baková (2018) also found that after the financial crisis of 2007, the European banking sector did not experience a financial accelerator mechanism. She argues that this is primarily due to changes in central banks' instruments and commercial banks' behavior due to increased risk such as extremely low interest rates.

Finally, a striking result suggests that equity prices in the CORE Eurozone subregions are not closely connected to the business cycle. Indeed, according to the literature, equity prices are closely connected to the business cycles and recessions associated with equity prices busts tend to be longer and deeper than other recessions (Claessens et al., 2012). Nonetheless, in the CORE Eurozone subregion, we did not find evidence of a close connection between equity prices and the business cycle **suggesting that recessions would not be impacted by equity prices busts in this region.** This might be explained by the fact that contrary to the US, the Eurozone financial markets are credit-based and not equity-based (ECB, 2020). In addition, the poor linkages between equity prices and business cycles are related to the measure of the European financial cycle. Indeed, the financial cycles may be measured by different financial variables, including equity prices, house prices, and private credit. Plus, as explained above, business and financial cycles are strongly connected. In the Eurozone case, financial cycles have as dominant explanatory factors house prices and private credit; and as auxiliary explanatory factors equity prices (Hiebert et al. 2014). On the other hand, Borio (2014) argues that the business and financial cycles display strong linkages when the financial cycle is measured by the mean component of house prices and private credit. Thus, equity prices are not the most representative proxy of the Eurozone

financial sector dynamism, which might explain why they are not closely connected to the business cycle in the CORE Eurozone subregions.

2.6.2 Are financial shocks transmitted internationally?

We find that financial variables shocks are transmitted internationally but are mostly transmitted via the US shocks as: (i) there is an overall and persistent impact of the US house prices shock; (ii) positive equity prices shocks exert a sizeable and persistent influence on foreign equity prices; (iii) Eurozone subregions equity markets shocks tend to affect only other Eurozone equity markets or spillovers to non-EA countries are short-lived; (iv) Eurozone share prices display a short-lived response to the house price shocks of the US.

Those last four points we found, confirm the global impact of US financial shocks on foreign asset prices. Our four results are also in line with Claessens et al. (2012) and Ehrmann et al. (2011). Indeed, Claessens et al. (2012) show that there is a US domination as a driver of foreign asset prices while Ehrmann et al. (2011) explain that there is an international transmission of credit and asset prices shocks. In other words, according to the latter authors, the US financial markets explain a significantly larger part of the Eurozone prices changes than the influence exerted by the Eurozone financial markets on US ones.

However, we add to the literature on the international transmission of financial shocks that there is a form of regionalism in the Eurozone. For instance, private credit spillover effects remain primarily confined to a regional dimension as private credit impacts positively and persistently the Eurozone subgroups. Our result is in line with Galesi and Sgherri (2009), who find that European Union spillovers effects on credit growth are country-specific. Plus, MacDonald et al. (2015) show that coun-

tries in the Eurozone tend to respond to their own financial shocks and are more responsive to the increasing financial stress of the same group. The latter might be explained by the fact that there are multiple channels of interconnectedness within the Eurozone with an eminent role for banking and money markets (MacDonald et al., 2018). MacDonald et al. (2018) pointed out that the direction of these spillover effects is towards the CORE and PERIPHERAL countries. They also emphasize that this form of regionalism is an indication of fragmentation in terms of potential vulnerability transmission effects. Finally, according to MacDonald et al. (2018), the Eurozone regionalism can also "be an indication of divergent policies and response reactions to the crisis outbreak from banks and governments in the common currency area."

Finally, we confirm Dées's (2016) conclusion that international transmissions of financial shocks on macroeconomic fluctuations tend to be large and persistent. We add that this international transmission is mostly stemming from the US. Indeed, we find that a positive private credit shock in the US exhibits sizeable spillover effects particularly in our three Eurozone subregions and to a lesser extent in the ENORTH region on macroeconomic variables. In this case, the macroeconomic fluctuations tend to be large and persistent. Similarly, there is an overall significant and persistent impact of : (i) the US house price shock on the European regions as there is an increase in all regions – except the peripheral region – of private credit, CPI, GDP (with long-lasting effect), and long-term interest rate; (ii) of the US equity prices on foreign equity prices. This leads to the conclusion that there are international propagation channels through credit and equity markets, suggesting the existence of an international financial cycle (Eickmeier and Ng, 2015).

2.7 Conclusion

This chapter contributes to the debate regarding the transmission of financial shocks to the real economy both at the level specific to each region studied and at the international level. To this end, we consider a Global VAR model with a world economy composed of the United States, three Eurozone subregions, and North European countries over the 1995Q1-2016Q4 period. In the spirit of the financial accelerator approach – whose importance was underlined with the global financial crisis – three financial shocks are investigated (*i.e.* private credit, house prices, equity prices shocks).

Our main striking results can be summarized as follows: (i) there is a more sizeable international spillover effect from the US private credit shocks than transmission ones from the Eurozone subregions; (ii) equity prices are not closely connected to the business cycle in the CORE Eurozone subregions, and (iii) there is a global impact of the US financial shocks and a more regional one of the Eurozone. In addition, the real economy responses to the financial shocks within the Eurozone are heterogeneous and depend highly on the region analyzed. Such a result suggests that financial accelerator mechanisms are not very significant within the Eurozone.

The main implication of our results is to underline the decisive weight of the United States in the international transmission of financial shocks. Not only does the transmission of the Eurozone shocks remain regional, but it is often less important than that from the United States. We interpret this result as indicating a lower financial integration within the Eurozone, compared to the United States. Hence, it would be interesting to have a deeper financial integration in the Eurozone so that the Eurozone could be less impacted by the US transmission of financial shocks.

In addition, having a deeper financial integration in the Eurozone is crucial to increase the level of co-movement between member states and thus decrease the impact of financial variables shocks propagation and amplification of macroeconomic fluctuations. For instance, Goetz and Gozzi (2020) analyze the effect of the geographic expansion of banks across US states on the co-movement of economic activity between states. They find that financial integration – and more specifically bilateral banking integration – increases output co-movement between states and the similarity of bank lending fluctuations between states and contributes to the transmission of deposit shocks across states. As mentioned in our first chapter, the degree of convergence in output co-movement – or the degree of business cycles convergence – has a significant impact on the effectiveness of the monetary policy. Plus, as shown in chapter one, the Eurozone financial cycle's amplitudes phases are greater than the business cycle ones. The latter reflects the divergent financial systems in the Eurozone and the different financing constraints, which in turn leads to divergences in terms of business cycles as the financial accelerator mechanism would not rely on the same financing conditions from a state-member to another one. As a consequence of the lack of financial integration, idiosyncratic financial accelerator mechanisms occur in the Eurozone during a period of recession. In turn, the macroeconomic fluctuations are amplified but in different amplitudes depending on the nature of the state-member financial system.

Another way to dampen the cross-border transmission of shock and its impacts on macroeconomic fluctuations would be to harmonize the banking and deposit insurance conditions. Indeed, enhancing the financial integration alone will imply negative spillover from countries with weak insurance (Dubois, 2021). In addition, harmonizing the deposit insurance in the Eurozone would improve welfare in all countries but also reduce the probability of bank runs and macroeconomic volatility (Dubois, 2021). In other words, increasing the financial

integration in a more harmonized banking and deposit insurance context would prevent the financial accelerator mechanism from propagating and amplifying macroeconomic fluctuations.

Finally, one way to enhance the financial integration, to provide for more financial stability and hence to limit the effects of the financial variables shocks international transmission is to establish the same financial conditions. To this effect, the approach chosen by the Eurozone is the implementation of a Banking Union which is studied in the next and final chapter of this PhD dissertation.

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Appendix

Appendix 2.A

Table 2.A.1 Trade weights (2015)

Countries	AUS	BEL	DEN	FIN	FRAN	GER	GRE	IRE	ITA	NET	NOR	POR	SPA	SWD	SWI	UK	USA
AUS	0.000	0.010	0.013	0.014	0.013	0.075	0.018	0.005	0.040	0.014	0.005	0.008	0.012	0.013	0.050	0.011	0.017
BEL	0.027	0.000	0.031	0.043	0.127	0.096	0.052	0.124	0.057	0.161	0.031	0.040	0.048	0.055	0.031	0.075	0.061
DEN	0.008	0.008	0.000	0.056	0.011	0.025	0.016	0.012	0.013	0.019	0.060	0.009	0.010	0.108	0.009	0.019	0.014
FIN	0.008	0.007	0.032	0.000	0.007	0.015	0.014	0.005	0.009	0.015	0.024	0.008	0.007	0.080	0.007	0.012	0.013
FRAN	0.055	0.184	0.064	0.058	0.000	0.0142	0.099	0.065	0.177	0.103	0.093	0.130	0.238	0.066	0.122	0.120	0.11
GER	0.535	0.234	0.246	0.217	0.239	0.000	0.238	0.097	0.244	0.301	0.106	0.168	0.198	0.187	0.331	0.181	0.232
GRE	0.004	0.005	0.006	0.006	0.007	0.009	0.000	0.003	0.020	0.007	0.002	0.003	0.008	0.005	0.006	0.006	0.004
IRE	0.005	0.048	0.017	0.011	0.016	0.013	0.013	0.000	0.014	0.016	0.021	0.009	0.016	0.013	0.027	0.081	0.073
ITA	0.106	0.054	0.048	0.051	0.120	0.096	0.215	0.040	0.000	0.059	0.037	0.065	0.122	0.045	0.127	0.063	0.084
NET	0.039	0.188	0.076	0.089	0.075	0.133	0.084	0.055	0.065	0.000	0.098	0.053	0.061	0.072	0.053	0.098	0.081
NOR	0.003	0.013	0.075	0.038	0.013	0.021	0.004	0.015	0.008	0.02	0.000	0.009	0.011	0.110	0.004	0.044	0.017
POR	0.004	0.008	0.012	0.008	0.015	0.012	0.006	0.004	0.012	0.010	0.006	0.000	0.084	0.006	0.006	0.011	0.007
SPA	0.027	0.036	0.032	0.031	0.0117	0.061	0.066	0.031	0.093	0.043	0.029	0.0363	0.000	0.031	0.043	0.062	0.031
SWD	0.016	0.022	0.175	0.202	0.017	0.030	0.022	0.013	0.018	0.026	0.115	0.014	0.016	0.000	0.013	0.030	0.034
SWI	0.067	0.012	0.014	0.014	0.039	0.058	0.020	0.032	0.055	0.016	0.007	0.009	0.022	0.013	0.000	0.033	0.046
UK	0.043	0.096	0.096	0.091	0.100	0.106	0.079	0.300	0.084	0.109	0.235	0.071	0.099	0.098	0.064	0.000	0.175
USA	0.056	0.075	0.061	0.072	0.085	0.108	0.054	0.200	0.091	0.083	0.076	0.041	0.046	0.098	0.108	0.152	0.000

Source: Authors' calculations using Direction of Trade Statistics database.

Table 2.A.2 Financial weights (2017)

Countries	AUS	BEL	DEN	FIN	FRAN	GER	GRE	IRE	ITA	NET	NOR	POR	SPA	SWD	SWI	UK	USA
AUS	0.000	0.006	0.003	0.005	0.009	0.029	0.005	0.005	0.009	0.010	0.004	0.002	0.01	0.007	0.027	0.005	0.003
BEL	0.006	0.000	0.001	0.002	0.019	0.006	0.000	0.043	0.012	0.05	0.002	0.003	0.022	0.003	0.004	0.007	0.004
DEN	0.012	0.007	0.000	0.04	0.015	0.036	0.001	0.007	0.002	0.007	0.115	0.001	0.006	0.345	0.009	0.016	0.004
FIN	0.003	0.003	0.003	0.000	0.003	0.003	0.001	0.001	0.000	0.004	0.009	0.000	0.000	0.021	0.000	0.001	0.000
FRAN	0.072	0.704	0.049	0.038	0.000	0.128	0.037	0.121	0.511	0.209	0.052	0.086	0.268	0.090	0.226	0.114	0.161
GER	0.263	0.085	0.061	0.081	0.183	0.000	0.484	0.133	0.140	0.204	0.12	0.083	0.176	0.176	0.24	0.175	0.156
GRE	0.002	0.001	0.000	0.000	0.001	0.001	0.000	0.001	0.001	0.000	0.000	0.000	0.002	0.000	0.001	0.004	0
IRE	0.001	0.003	0.002	0.001	0.005	0.001	0.000	0.000	0.002	0.003	0.003	0.001	0.006	0.006	0.001	0.03	0.002
ITA	0.411	0.019	0.012	0.004	0.058	0.158	0.016	0.03	0.000	0.04	0.007	0.022	0.159	0.008	0.038	0.028	0.014
NET	0.057	0.000	0.015	0.038	0.117	0.142	0.03	0.103	0.048	0.000	0.033	0.02	0.101	0.029	0.104	0.058	0.088
NOR	0.000	0.002	0.057	0.082	0.007	0.005	0.000	0.020	0.001	0.002	0.000	0.000	0.001	0.079	0.003	0.014	0.001
POR	0.001	0.001	0.000	0.000	0.005	0.002	0.003	0.003	0.012	0.003	0.000	0.000	0.052	0.001	0.004	0.001	0.001
SPA	0.026	0.018	0.017	0.014	0.064	0.050	0.012	0.025	0.11	0.037	0.034	0.728	0.000	0.025	0.022	0.206	0.086
SWD	0.002	0.022	0.698	0.606	0.012	0.026	0.001	0.005	0.001	0.021	0.496	0.001	0.005	0.000	0.031	0.032	0.038
SWI	0.050	0.016	0.028	0.015	0.074	0.060	0.065	0.033	0.03	0.053	0.017	0.007	0.028	0.040	0.000	0.091	0.165
UK	0.033	0.028	0.018	0.029	0.232	0.155	0.130	0.243	0.042	0.210	0.043	0.015	0.066	0.056	0.147	0.000	0.282
USA	0.063	0.084	0.035	0.044	0.198	0.199	0.214	0.246	0.079	0.146	0.063	0.031	0.099	0.112	0.142	0.215	0.000

Source: Authors' calculations using Bank of International Settlements locational banking statistics.

Chapter 3

Banking Union Capital Requirements Regulation: does its current shape break the 'diabolic loop' between banks and sovereign debts?*

Abstract

This chapter examines if the Capital Requirements Regulation (CRR) set by the European banking union are efficient on the Eurozone financial integration and the financial stability. To this extent, I compare two sets of Impulse Response Functions (IRFs) stemming from two panel Vector Autoregression (pVARs) specifications where the financial stability is represented by a financial cycle indicator and non-performing loans; the real sector is proxied by the business cycle; and the financial integration by the cross-border banking positions in a first specification and by the bond yields in a second specification. I find that the banking union CRR improve the financial integration but do not enhance the financial stability. Hence, the BU CRR do not serve their initial purpose: stabilizing the financial system and correct the financial fragmentation that followed the financial crisis.

Keywords: Eurozone, European Banking Union; Capital requirements; Financial integration; Financial stability.

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3.1 Introduction

In 2012, the European Union (EU) implemented a structural change in its banking policy by starting a Banking Union (BU). It replaced the decentralized supervision and regulatory competition between countries with a single supervisor by a more harmonized approach (De Rynck, 2016). Gros and Schoenmaker (2014) describe the BU as a transfer to the European level of the regulatory and institutional framework for safeguarding the robustness and stability of the banking sector. During the 2007 financial crisis, those mechanisms did not exist and the responsibility for supervising the banking system and ensuring its stability was held by national governments. Specifically, the financial crisis pointed out that an integrated banking sector could not be effective without a BU. First, because leaving the supervision and stability responsibility to national governments has shown that the latter only consider and preserve national interests (Schoenmaker, 2013; Gros and Schoenmaker, 2014). Such behavior leads to systemic effects of banking failures at the Eurozone (EZ) level. Secondly, because there is an interdependency between government and bank credit risk during financial crises (Alter and Schüler, 2013). Also called 'diabolic loop' (Brunnermeier et al., 2016) between national governments and banks, it may be avoided by settling a BU. In other words, 'a fully-fledged BU could act as an important shock absorber mechanism' (Gros, 2012).

This conclusion can be drawn by observing the United States (US) most recent decades, which is an achieved monetary union. In 2007, the US and the EZ faced a very similar financial crisis (Belke and Gros, 2016). Their economic contractions and financial busts were very similar. However, their recoveries were divergent as the United States recovered by 2010 while the EZ knew an arousal of strong regional divergences and sovereign debt. Yet, regional divergences existed in the US before the financial crisis, so why their post financial crisis experience was different from the EZ one? According to Belke and Gros (2016), it is

because the BU in the US provided an insurance against local financial shocks. On the contrary, when the financial crisis arises in the EZ, the banking sector experienced serious losses and national government intervened in order to absorb them. For countries with sustainable public debt and strong macroeconomic fundamentals, the shock absorption was effective. However, for some countries showing unsustainable debt levels, *e.g.* the PIGS (Portugal, Ireland, Greece, Spain), the absorption of those losses exacerbated the financial crisis and led to a sovereign debt crisis and to a long-lasting regional financial crisis.

Those local financial crises could have been avoided if there was a complete BU with all the mechanisms it implies: supervision; resolution; and deposit guarantee schemes (Belke and Gros, 2016).[1] In that case, the losses of the financial private sector would have been absorbed by the BU. Hence national governments would not have intervened in order to save banks and neither accumulation of sovereign debt nor regional financial crisis would have occurred (see **Figures 3.1.1 and 3.1.2**).

[1]For instance, the US had a complete BU implying the Federal Deposit Insurance Corporation (FDIC). "The FDIC is an independent agency created by the Congress to maintain stability and public confidence in the nation's financial system. The FDIC insures deposits; examines and supervises financial institutions for safety, soundness, and consumer protection; makes large and complex financial institutions resolvable; and manages receiverships." (https://www.fdic.gov/)

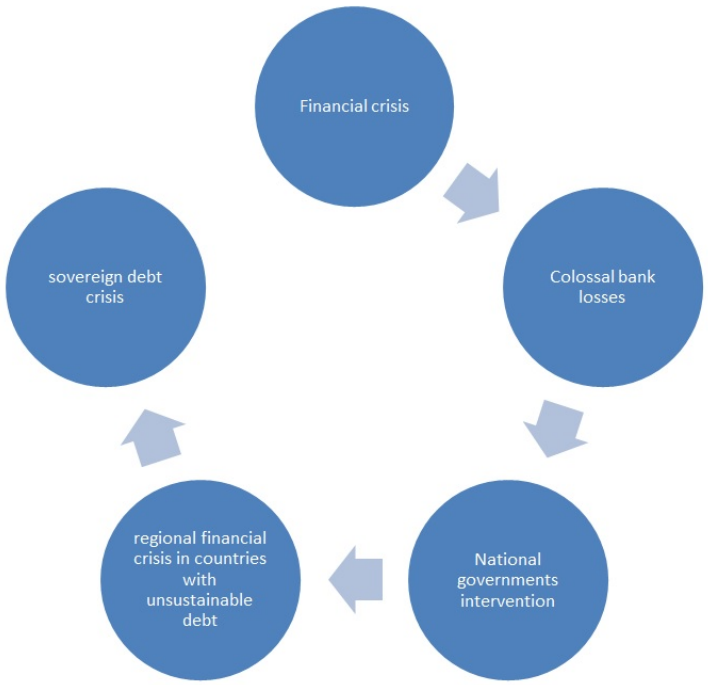


Figure 3.1.1: EZ scheme of the financial crisis management without a BU.
Source: Author

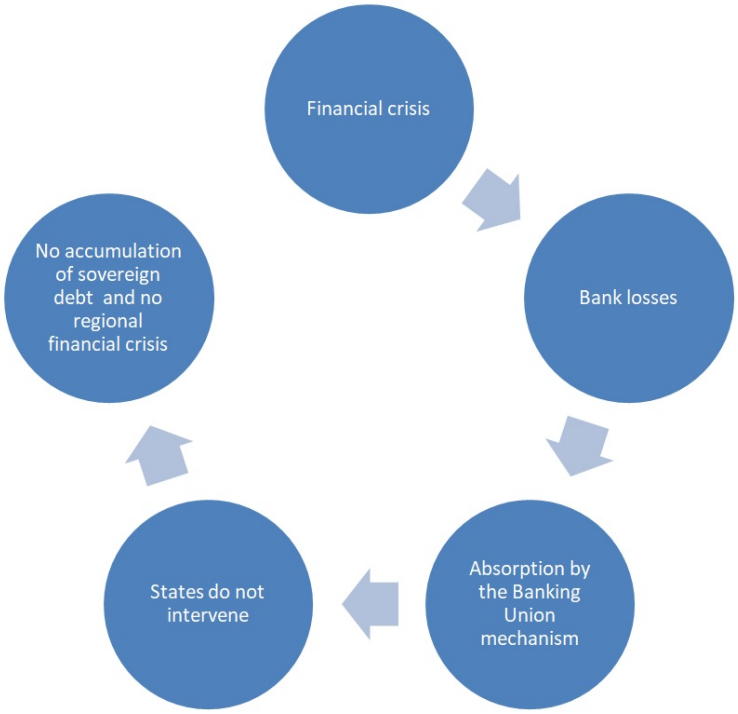


Figure 3.1.2: US scheme of the financial crisis management with a BU.
Source: Author

A sole resolution procedure at a European level, similar to the US one, would improve European integrity and in particular at the EZ level. Many strands of the literature (Belke and Gros, 2016; Gelpern and Veron, 2020; Lindner, Soemer and Theobald, 2014) on the European BU are in favor of a unitary regime to handle all bank failures in the European Union and in particular in the EZ. However, very few of them establish empirically if the current unitary regime handling all banking failures would improve the EZ financial integrity and stability to break the vicious circle between the sovereign debt and banks. The "diabolic loop" between sovereign and banks deteriorates the situation of the banking system which in turn degrades public confidence in the sovereign due to the anticipation of bailouts of "too big to fail banks" institutions, while the holding banks of sovereign securities, whose prices are falling, degrades public confidence in the banking system (De Bandt, Dumetez, Pfister, 2020). Those close links between the public sector finances and the banking sector can be easily spill over national borders and cause financial distress in other countries. To break those links, the European Banking Authority (EBA) suggests that having more financial stability and financial integration would lead to common banking supervision, resolution and policies. Thus, it would add more stability to the banking system and prevent national authorities to take the bank debt burden. In addition, Belke and Gros (2013, 2016) argue that if the EZ had a BU during the financial crisis, as it existed in the US, there would be no distortion of the single monetary policy impact at the national level. But also that, no local financial crisis and sovereign debt crisis would have erupted.

Overall, in spite of the rich research on BU, very few empirical researches emphasize the role of the BU capital requirements regulations (CRR I and II) on the Eurozone financial integration and stability. It either studies it relying on a political economy point of view or on stylized facts showing a decrease or an increase of the financial integration and stability (Lindner, Soemer and Theobald, 2014; Brei and Gambacorta, 2014 ; Howarth and Quaglia,

2020; Jensen and Schoenmaker, 2020; Asimakopolous and Howarth, 2021). However, some papers study the impact of basel III micro and macro prudential policies (Gambacorta, 2011; Raberto, Teglio and Cincotti, 2012; Krug, Lengnick and Wohltmann, 2015; Kockerols, Kravik and Mimir, 2021) but none of them investigates directly the impact of the ratios set by the EZ BU.

This chapter addresses some of these gaps. I investigate to which extent the BU CRR, which are the most fully phased-in, improve the financial integration and stability of the Eurozone. This is a very important issue as the CRR levels keep evolving following the argument that they have a positive effect on the financial stability and integration. As suggested earlier, financial integration and financial stability are two main ways to break the link between the sovereign debt and banks. Hence, establishing to which extent the CRR are really effective on them will bring more lights on the further steps needed to effectively break the sovereign-debt vicious circle. In other words, I wonder if the BU CRR regulations increase the EZ financial integration and the financial stability?

To do so, I compare two sets of Impulse Response Functions (IRFs) stemming from respectively two panel Vector Autoregression models (pVARs) to assess the impact of the CRR on financial integration and on the financial stability. Impulse response functions allow to depict the reaction of the financial integration and stability variables to a simulated shock on the CRR. Three capital requirements are used: the total amount of capital ratio (CR), the leverage ratio (LR), and the liquidity coverage ratio (LCR). The financial stability is represented by the financial cycle and the non-performing loans whereas the financial integration is represented by the cross-border banking positions (CBD) in a first pVAR and the bond yields in a second pVAR. Finally, the real economy is represented by the business cycle (BC) as business and financial cycles are considered to be closely linked (Borio, 2014; Claessens,

Kose and Terrones, 2012). For each set of impulse response functions, ten countries are considered (Austria, Belgium, Finland, France, Germany, Ireland Italy, the Netherlands, Portugal and Spain) and cover the 2016Q3-2021Q1 period.

I find that the BU CRR are efficient to increase financial integration but inefficient on financial stability. Hence, they do not break the vicious circle between banks and sovereign debt with its current design. Indeed, my results on the first pVAR demonstrate that CRR are inefficient on the financial stability and efficient on the increase of cross-border banking positions *i.e.* the financial integration. Most CRR ratios do not impact the financial cycle (and it impacts the NPLs only in the short term) which means that they do not enhance the financial stability. My findings also show that when the bond yields (BY) are encompassed as the representative of the financial integration, the CRR are efficient on the financial integration but not on the financial stability. My results are in line with the literature (Brei and Gambacorta, 2014; Malherbe, 2020; Claussen, Kriebel and Pfingsten, 2018; Sterzel and Neyer, 2017; Franch, Nocciola, Żochowski, 2021).

The chapter is composed of six major sections. Section 3.2 presents the BU and its construction. Section 3.3 presents the literature review. Section 3.4 presents the methodology and data used in this study. Section 3.5 displays some stylized facts. Section 3.6 analyses and discusses the empirical results. Section 3.7 concludes.

3.2 What is the BU functioning and objectives?

According to the European Commission, a BU ensures that EU banks are stronger and better supervised. It was implemented in response to the 2007 financial crisis in order to create a safer financial sector for the Single Market. This initiative relies on a single rulebook for

all financial actors in the 27 EU countries. It includes: (i) stronger prudential requirements for banks; (ii) improved protection for depositors; (iii) rules for managing failing banks. In particular, the purpose of the BU is to make the European banking system more transparent, unified and safer:

- "More transparent by having common rules and administrative standards for supervision, recovery, and resolution of banks.
- More unified by treating national and cross-border banking activities equally and by delinking the financial health of banks from the countries in which they are located.
- Safer by intervening early if banks face problems in order to help prevent them from failing and, if necessary, by resolving banks efficiently".[2]

More precisely, the BU is mandatory for all EZ countries and optional for EU countries (which need to specifically mention that they want to be part of the BU).[3] Indeed, when the financial crisis of 2007 evolved into the EZ sovereign debt crisis, it became crucial to design deeper banking system integration for the EZ countries. For instance, in a monetary union such as the EZ, the close links between the public sector finances and the banking sector can be easily spill over national borders and cause financial distress in other countries.

The BU consists into the establishment of two main pillars:

- A single supervisory mechanism (SSM)
- A single resolution mechanism (SRM)

[2] https://www.bankingsupervision.europa.eu/about/bankingunion/html/index.en.html

[3] This aspect will not be discussed in the present chapter as I only focus on the impact of the BU on the EZ.

The first pillar is based on the Article 127(6) of the Treaty on The Functioning of the European Union (TFEU) and consists in "a new system of banking supervision for Europe. It comprises the ECB and the national supervisory authorities of the participating countries" (banking supervision website, ECB).

The second pillar ensures "the efficient resolution of failing banks with minimal costs for taxpayers and to the real economy" (banking supervision website, ECB). In the second pillar, the ECB is the supervisor and its role is to decide whether a bank is failing or likely to fail. The SRM is supported by a single resolution fund (SRF) financed by contributions from banks.

A third pillar was added to the BU in 2015: the European deposit insurance scheme (EDIS). The EDIS is built on the system of national deposit guarantee schemes (DGS) regulated by Directive 2014/49/EU. Its purpose is to provide for a stronger and more uniform degree of insurance cover in the EZ. In the long term, it would work similarly to the FDIC and hence would "reduce the vulnerability of national DGS to large local shocks, ensuring that the level of depositor confidence in a bank would not depend on the bank's location and weakening the link between banks and their national sovereign".[4]

More globally, dealing with existing bank issues is essential in order to avoid exacerbating future EZ crisis. For instance, in 2007, the financial crisis was exacerbated by national banking crises (Elliott, 2012). In the PIGS countries in particular, failing banks added massive liabilities to the balance sheets of the sovereigns weighting them down in Ireland and Spain; sovereigns endangered the banks through various mechanisms in Greece; and

[4] https://ec.europa.eu/info/business-economy-euro/banking-and-finance/banking-union/european-deposit-insurance-scheme_en

some interrogations were raised towards the value of the large bank holdings of government bonds in Greece (Elliott, 2012). As suggested by Elliott (2012), "these two sets of mechanisms also combined to make each other worse, with sovereigns pulled down by increasingly troubled banks whose woes have been made much worse by the problems of their sovereigns". In consequence, **in order to break the vicious circle between sovereign debt and banks debt, it was necessary to create a stable banking system delinked from the sovereign of the home countries, and more anchored in a single European authority**, *namely*, the BU. In other words, a BU would reduce the risk of this type of downward spiral of failing banks leading to failing countries or vice versa in the EZ. **However, this achievement cannot be fulfilled in the absence of financial integration (European Council Summit of October 18, 2012, point 4) open to all member states wishing to participate.**

In order to stabilize the banking and financial systems but also to obtain deeper financial integration, the EBA[5] Regulation and Institutional framework was created. It plays a key role in implementing the regulatory framework in the European Union. The objective of its implementing act in Europe through Capital Requirements Regulation and Directive (respectively, CRR and CRD), is to "strengthen the resilience of the banking sector across the European Union (EU) so it would be better placed to absorb economic shocks while ensuring that banks continue to finance economic activity and growth".[6]

[5]The main task of the EBA – part of the European System of Financial Supervision together with two other supervisory authorities – is to contribute, through the adoption of binding Technical Standards (BTS) and Guidelines, to the creation of the European Single Rulebook in banking.

[6]https://www.eba.europa.eu/regulation-and-policy/implementing-basel-iii-europe

In particular, the CRR applied in all EZ countries has three main objectives: (i) the improvement of the banking sector's ability to withstand economic shocks; (ii) the improvement of its risk management; (iii) ensuring normal lending activities during economic downturns. In the following, I will explain in what the CRR consist.

Capital requirements are integrated in the BU's single rulebook. They consist in prudential requirements for capital, liquidity and credit risk for investment firms and credit institutions *i.e. banks*. In other words, and as defined on the European Council website, the regulation "**requires banks to have set aside enough capital to cover unexpected losses** and keep themselves solvent in a crisis. As a main principle, the amount of capital required depends on the risk attached to the assets of a particular bank". The riskier the assets, the more capital the bank has to set aside. There are three types of requirements:

- The **CR** divided in (i) Tier 1 capital which concerns capital allowing a bank to continue its activities and keeps it solvent;[7] (ii) Tier 2 capital which is the gone concern capital allowing an institution to repay depositors and senior creditors if a bank became insolvent; (iii) **the total amount of capital which I focus on.** It is the **total amount of capital** that banks and investment firms are required to hold **to at least 8% of risk-weighted assets**.

- The **LCR** is a liquidity requirement to credit institutions. They must hold sufficient liquid assets to cover net liquidity outflows under gravely stressed conditions over a period of 30 days. More precisely, the LCR is an **unemcumbered high quality assets against net cash outflows over a 30-day stress period**.

[7]The highest quality of Tier 1 capital is the CET1 capital (common equity tier 1).

- The **LR** is the relationship between a bank's capital base and its total assets. A bank's assets are 'leveraged' when they exceed its capital base. Hence, the more leverage there is, the more negative effects on bank's solvency exist.

  But does the BU regulation responds to the financial stability and financial integration objectives?

3.3 Literature review

The creation of the BU was supposed to address the institutional shortcoming of the financial trilemma (Jensen and Schoenmaker, 2020; Niemann and Ioannou, 2015; Epstein and Rhodes, 2016),[8] by transferring financial policies from the national level to a supranational level within the Eurozone namely the BU (Howarth and Quaglia, 2016). Indeed, according to Schoenmaker (2011) the financial trilemma is the impossibility to achieve simultaneously financial stability, financial integration and national financial policies. As a result, there is a necessity to lose the national financial policies in order to achieve financial stability and integration within the Eurozone. Creating a supranational entity of financial policies is one of the way to skirt the financial trilemma. Specifically, Schoenmaker (2013) examines the interplay of financial stability, international banking and national financial policies. He argues that the establishment of the European Monetary Union made the financial trilemma more acute and ultimately untenable in the Eurozone leading to the decisive act of implementing the BU to save the euro (Glöcker et al., 2017; Draghi, 2012).

First, one of the main BU regulations consists in implementing capital requirements in order to avoid home bias in European banks' sovereign debt exposures (Véron, 2017). In order to

[8]See Schoenmaker (2011) for further explanations on the financial trilemma mechanisms.

do so, capital requirements must enhance financial integration and stability. Indeed, capital requirements might impact the size of distribution of banks, the legal and institution framework of bank lending and risk assessment, as well as the menu of financial products that banks provide (Esa and Matti, 2019). Thus, they intend to reduce home bias in European banks' sovereign debt exposures (Véron, 2017) as higher capital requirements should be mandatory on banks with high domestic sovereign debt concentrations. More precisely, while financial integration and freedom of capital movement should protect the financial system from extreme bias in favour of domestic institutions, idiosyncrasies specific to the monetary union have instead accelerated financial fragmentation compared with other areas of the world (Esa and Matti, 2019). Thus, home bias persisted despite early signs of recovery contrary to the United Kingdom (UK), US or Japan (Esa and Matti, 2019; Vérona, 2017).

Secondly, since 2014, one has to state that none of its two objectives – breaking the vicious loop between banks and sovereign debt, and stabilizing the financial system – has been achieved. On the contrary, according to Garicano (2019) the banking market is even more fragmented than it was before the implementation of the BU because home and host regulators for cross-border European banks fight to ensure sufficient capital and liquidity in each market that a bank might operate in. Quaglia (2019) argues that the BU is still incomplete and has asymmetric effects through the Eurozone. She also suggests that the BU has weakened the institutional capacity of some national authorities, *e.g.* Spain, to deal with ailing banks, without sufficiently strengthening the capacity of supranational authorities (Esa and Matti, 2019). Hence, under its current state it cannot ensure to tackle the bank-sovereign loop that threatened financial stability and impeached financial integration during the sovereign debt crisis.

This can be explained by the fact that among the three pillars structure of the BU only the

first one *i.e. the SSM* works smoothly. The two others are either circumvented or paralyzed (Garicano, 2019). As a result, the bank-sovereign linkages are still very strong in the Eurozone (Vérona, 2017). The home bias is still very important as most banks' exposures to the sovereign of the country in which they are headquartered or domestic sovereign exposures remain very high (Vérona, 2017). Put simply, those types of exposures are concentrated in the home country. In the same strand, Asimakopolous and Howarth (2021) show that the core element of the BU is not efficient since 2014 because of: (i) an insufficient availability of EU resolution funds and limited access to it; (ii) an inadequate national deposit guarantee schemes in most EU member states in conjunction with the relatively high minimum requirements for own fund and eligible liabilities for many EU banks. Plus, in many cases, requirements are unlikely ever to be met particularly for retail banks most likely to require resolution in the euro periphery.

Yet, meeting the right requirements is necessary. Higher bank capital contributes to financial stability as the right requirements provide a cushion for absorbing losses during a crisis or other bank distress but also tends to curb risk-taking (OECD, Global financial development report 2019/2020, bank capital regulation, chapter 3). Indeed, when capital requirements are properly implemented, they incentivize banks to improve their risk management (Calomiris and Nissim, 2014; World Bank, 2012).

On another hand, capital requirements are crucial in order to correct market fragmentation because they reinforce the Single Market by stabilizing banks and the EMU (Howarth and Quaglia, 2016). Esa and Matti (2019) explain that as the sovereign debt crisis expanded, the retrogression of financial integration in the Eurozone accelerated compared with claims against other major areas of the world. They point out that claims of EMU banks versus those of other EMU countries dropped by almost 23% while claims of EMU banks vis-à-

vis other European counterparties dropped by a lesser amount. More broadly, Jones et al. (2016) used a two-step approach and showed that negative spill-overs from previous incomplete integration in the EMU triggered the sovereign debt crisis (Jensen and Shoenmaker, 2020). In turn, within an incomplete EMU and without a BU, the global financial crisis and the sovereign debt crisis fragmented the single financial market by reducing cross-border banking activities – which were increasing since the introduction of the euro (Schoenmaker, 2011, 2013) – and increased the interest rate paid on bank loans *i.e.* cost of money (Jensen and Schoenmaker, 2020) within the Eurozone member states. In the same line, Hoffmann et al. (2019) point out that cross-border lending of banks within the Eurozone remained at a moderate level before the financial crisis and seemed to have gone in reverse ever since.

Finally, Morgan et al. (2004) examine the impact of the centralization of bank regulation in the United States. They show that thanks to the centralization of bank regulation *i.e. banking integration*, business cycles tend to be smaller and more alike. In other words, within the Monetary Union of the United States, the credit supply in single states that have occasionally experienced economic or financial distress was maintained thanks to: (i) regionally diversified banking institutions; (ii) and federally organized public institutions overseeing and stabilizing commercial banking (Esa and Matti, 2019). Davison (2020) shows that before the *Reigle-Neal Interstate banking and branching Act of 1994*, regulation and supervision at the federal and state levels in the US were inadequate. He also shows that having multiple little banking systems as it existed in the US (around 50 little banking systems) not only aggravates existing crises, it also tends to amplify business cycles and create financial instability. Drawing on the US experience, it is crucial for the Eurozone to: (i) federalize its banking system; (ii) stabilize its financial system; (iii) enhance its financial integration.

3.4 Data and methodology

This section introduces the data and the nature of the variables used in this study. It also presents the panel Vector Autoregression (pVAR) methodology I use in this paper and provides information on the previous necessary steps to the estimation of a pVAR.

3.4.1 Data

In this subsection, I present the data used in this study. All the data extracted concern ten countries: Austria, Belgium, Finland, France, Germany, Ireland, Italy, the Netherlands, Portugal and Spain and cover the 2016Q3-2021Q1 period.

3.4.1.1 Financial stability

According to the ECB, financial stability can be defined as a condition in which the financial system – which comprises financial intermediaries, markets and market infrastructures – is capable of withstanding shocks and the unravelling of financial imbalances. This mitigates the prospect of disruptions in the financial intermediation process that are severe enough to adversely impact real economic activity. Various indicators and methodological ways exist to estimate financial stability (Aikman, Bridges, Burgess, Galletly, Levina, O'Neill and Varadi, 2018; Angelopoulou, Balfoussia and Gibson, 2014; Gray, Merton and Bodie, 2011; Gadanecz and Jayaram, 2009). However, they all lead to the same goal which is to contain the magnitude and exacerbation of financial and business cycles respectively. As pointed out by Villeroy de Galhau (2021), the Basel Committee on Banking Supervision (BCBS) established a two-part macroprudential framework for bank supervision in order to contain the tendency of the banking system to exacerbate business cycle peaks and troughs through excessive or insufficient credit but also to reduce the magnitude of financial cycles. In other

words, as financial stability risks increase, credit and property prices grow rapidly which in turn drive the business cycle into an economic expansion until credit and property prices stop growing and macroeconomic crises appear following the boom-bust financial cycles (Aikman, Bridges, Burgess, Galletly, Levina, O'Neill and Varadi, 2018; Angelopoulou, Balfoussia and Gibson , 2014). Hence, instead of calculating an indicator of financial stability and as there is no consensus on how to calculate financial stability (Allen and Wood, 2006; Schinasi, 2004), I investigate the impact of the BU on the financial stability by taking into consideration the (i) non-performing loans (NPLs) [9]; and (ii) the financial cycles (FC):

(i) As explained by Anastasiou et al. (2016), "a high rate of non-performing loans may also cause expectations about the stability of the banking system to deteriorate, creating systemic risk which may in turn lead to a run on deposits, significantly reducing the intermediation power of banks" which would threaten the financial stability. Hence, a decreasing rate of non-performing loans may indicate that the financial stability is increasing.

(ii) Similarly, a strong positive response of the financial cycle to CRR shocks would indicate that there is strong financial instability and hence that the BU did not stabilize the financial system. However, if the financial cycle displays a negative response to CRR shocks after the implementation of the BU, it would indicate that the BU helped in stabilizing the financial system. Indeed, as Minsky (1977) and Kindleberger (1978) pointed out, the conditions that foster an expansion in the financial cycle are liable to shift abruptly into reverse, tightening financial conditions. Hence, instead of focusing on the financial conditions in which the financial system is capable of withstanding shocks and the unravelling of financial imbalances, I focus directly on the consequence of the financial conditions which is embodied into the

[9]Non-performing loans are loans where the borrowers are not fulfilling their financial commitments to repay in accordance with their contractual agreements (EBA).

financial cycle.

I define the financial cycle following the work of Borio (2014).[10] In particular, he proposes to estimate the financial cycle by taking the mean of the cyclical components of the property prices and the credit to the private sector.[11] Credit to the private sector refers to financial resources provided to the private sector by financial corporations, through loans, purchases of non-equity securities, and trade credits and other accounts receivable that establish a claim for repayment.[12] Property prices are the prices of every type of property bought during the amount of time studied, regardless of the type of owner. More precisely, Borio (2014) suggests that one can think of the credit gap as a rough measure of leverage in the economy providing an indirect indication of the loss absorption capacity of the system and the property price gap as a rough measure of the likelihood and size of the subsequence price reversal, which tests that absorption capacity. Hence, the financial cycle is a suitable proxy to evaluate the BU loss absorption capacity.

The data used for the construction of the financial cycle data are extracted from the Bureau of International Settlements (BIS) database. Non-performing loans ratio[13] data are extracted from the European Banking Authority (EBA) database. In particular, I took the harmonized NPLs data provided by the EBA in order to avoid the impact of any level/definition shift.

[10] Borio (2014) defines the financial cycle as "Self-reinforcing interactions between perceptions of value and risk, attitudes towards risk and financing constraints, which translate into booms followed by busts. These interactions can amplify economic fluctuations and possibly lead to serious financial distress and economic dislocations".

[11] The cyclical components are extrated via a two-sided Hodrick and Prescott Filter (1997) using a smoothing parameter of 400 000 suitable for financial cycles data.

[12] https://competitivite.ferdi.fr/en/indicators/domestic-credit-to-private-sector-of-gdp.

[13] Amount of non-performing loans in a bank's portfolio to the total amount of outstanding loans the bank holds.

3.4.1.2 Financial integration

According to the definition displayed by the European Central Bank (ECB), examining the degree of financial integration in the EZ is equal to look at "the extent to which financial services are available under same rules and conditions across the regions". Hence, financial integration implies that "assets with the same risk-return characteristics have the same prices, irrespective of the country in which they are traded". The existence of financial integration within the EZ plays a crucial role in the uniform transmission of the ECB's monetary policy across the EZ. Indeed, as suggested by the ECB,[14] "more advanced financial integration across EZ countries can mean that market participants have greater investment opportunities and are able to diversify financial risks beyond their national borders. Retail bank interest rates are more equal for consumers across borders and businesses may have easier access to money to expand". One of the ways to achieve this objective is to implement uniformity across financial conditions which a complete BU can have an impact upon.

But increasing financial integration is not only a fertile soil for a uniform transmission of the monetary policy, it is also an indicator of the level of risk present in the financial system. As the BU purpose is to stabilize the financial system, and as stabilizing the financial system is minimizing the financial risk, increasing the degree of financial integration implies that market participants within the EZ were able to diversify the financial risks. To sum it up, the BU sets up the same rules and conditions across the EZ and financial integration is a direct indicator of whether financial services are available under the same rules and conditions across the EZ. Hence, including financial integration indicators into the model would demonstrate if the BU regulation had an impact on the financial stability underlying conditions.

[14] https://www.ecb.europa.eu/home/search/financial$_i$*ntegration/html/index.en.html*

More precisely, in order to estimate financial integration, I used the cross-border banking positions,[15] the bond yields[16] and the credit risk.[17] Data are extracted respectively from the BIS database, the Eurostat database, and the ECB database. Those variables are known to be relevant to estimate the degree of financial integration. For instance, an increased financial integration implies a rise of cross-border lending as banks are treated equally regardless of where they are based (Baele, Ferrando, Hördahl, Krylova and Monnet, 2004). In other words, financial integration would remove the home bias' effect. Similarly, when within a union the financial market is integrated, the bond yields tend to converge (Vukovic, Hanic and Hanic, 2017). Indeed, bond yields in perfectly integrated markets should be equal across countries (Baele, Ferrando, Hördahl, Krylova and Monnet, 2004). Finally, the credit risk of government debt in the EZ should not be different if there is financial integration as there would be no differences in credit ratings of such debt (Baele, Ferrando, Hördahl, Krylova and Monnet, 2004).

More precisely, I choose those three variables in order to take into account the broader part of the financial integration factors. For instance, the ECB created a price and quantity based composite indicator that is constructed from a selection of price and quantity based indicators *i.e. the money, the bond, the equity and banking markets* (Financial Integration in Europe, ECB, 2018). That is why, I selected the cross-border banking positions, the credit risks, the bond yields in order to represent at least 3 out of the 4 segments of the indicators

[15]Cross-border banking positions are asset and liability positions vis-à-vis banks and non-banks located in a country other than the country of residence of the reporting bank (Glossary of statistical terms, OECD). Cross-border banking positions are calculated by taking the sum of the cross-border partners of the country considered in the sample. Then, they are put in logarithm.

[16]Government long-term interest rates. Monthly data transformed into quarters by the average observations method.

[17]Calculated by the standardised approach.

encompassed in the price and quantity based indicators provided by the ECB.[18]

3.4.1.3 Banking Union

The BU is a big milestone in the integration of the EZ countries. It ensures the essential underpinnings for financial stability and addresses the fragmentation of financial markets. Plus, it contributes to breaking the negative feedback loop between bank debt and sovereign debt.[19] In other words, it contributes to the financial stability. In order to achieve this objective, a single rulebook designing the BU and financial sector regulation in the EU was launched. It is composed of a set of legislative texts that are applied to all credit institutions within the EZ (and more globally the EU with specific conditions)[20] and ensure to apply the same rule in all EZ countries to avoid any distortions of the Single Market (*i.e.* improve financial integration) and to ensure financial stability. As explained above, three main cumulative ways allow the latter: (i) capital requirements for the banking sector; (ii) the improvement of the deposit guarantee schemes; (iii) the rules for bank recovery and resolution.

In this study, I will only focus on the capital requirements mainly because of the difficulty to find a suitable representation of the deposit guarantee schemes and because of the difficulty to find the data representing the rules for bank recovery and resolution.

The capital requirements have been crucially lacking during the financial crisis that hit the

[18] I also selected the interest spread rates. However, the pVAR encompassing the interest spread rates had serious stabilities issues.

[19] https://www.oenb.at/en/financial-market/three-pillars-banking-union.html

[20] All EZ member states are part of the BU. Non-EZ EU member states can join the BU by entering into close cooperation with the European Central Bank. However, if they are systemic institutions that can threaten the stability of the European Union, they have to be part of the BU. Regulation (EU) 2013/1024; Regulation (EU) 2014/806 and Directive 2014/49/UE.

EZ in 2008 and during the sovereign debt crisis that followed. It showed how the EZ desperately needed common regulation and supervision summed up into three main variables which I use in this paper: (i) the total CR; (ii) the LCR; (iii) and the LR.[21]

Taking into account simultaneously capital and liquidity requirements is subject to debates. Indeed, capital requirements and liquidity requirements can be seen either as complements or substitutes. I choose to implement them as complements. In fact, capital requirements could act as complement to help banks to pursue separate objectives (Birn, Dietsch and Durant, 2017) such as the control of credit risk or the control of liquidity risk. However, when they are used as complements, it is more difficult to reach the regulatory constraints simultaneously at due date (Birn, Dietsch and Durant, 2017). Moreover, Acharya (2002) points out that bank capital and banks' liquidity positions are concepts that are central to understand how bank risks should be mitigated jointly by the financial markets and by the prudential regulators (Birn, Dietsch and Durant, 2017). In this case, supervisory discipline could be strategic complements or strategic substitutes according to the objective desired. When using strategic complementarity, market and supervisors discipline power might increase discipline and decrease risk taking. In other words, using capital and liquidity requirements as complements might help reaching regulatory objectives in the Eurozone such as financial stability. Plus, a broad strand of the literature focuses on the interactions between capital and liquidity requirements (De Nicolo et al., 2014; Farag et al., 2013; Kashyap and al., 2014; Diamond and Kashyap, 2016; Puhr and Schmitz, 2014; de Bandt and Chahad, 2016; Boissay and Collard, 2016). For instance, Boissay et al. (2016) show that both liquidity and capital requirements are necessary to implement the socially optimal outcome and reinforce each other. On the other hand, Ikeda (2018) suggests that using both requirements would help to attain a level of stability while incurring lower long-term costs to the real economy.

[21] The definitions were given in Section 3.2

Finally, I only took into consideration the LCR and did not encompass the Net Stable Financial Ratio (NSFR) as LCR and NSFR have qualitative effects and can substitute (De Bandt and Chahad, 2016). Also, I did not take into account the capital buffers in my pVARs because I already have seven variables that were encompassed in them and more variables would threaten the stability of my pVARs.[22]

BU variables are extracted from the EBA database. They represent the ratios per country and not the ratio per bank.

3.4.1.4 Real Sector

As suggested by Gadanecz and Jayaram (2009), financial stability is not easy to define or measure given the complex interactions of different elements of the financial system among themselves and with the real economy. Hence, I added the Gross Domestic Product (GDP) in order to represent the real economy. The GDP reflects the ability of the economy to create wealth and its risk of overheating (Gadanecz and Jayaram, 2009). Here, I use the GDP[23] in order to estimate the business cycle using a two-sided Hodrick and Prescott filter (Hodrick and Prescott, 1997) with the standard value of 1600 for the smoothing parameter involved in the Hodrick and Prescott filter at the quarterly frequency. The extracted business cycle ensures to capture the effect of a stable financial system on the real economy. Indeed, if the BU ensures the financial stability and strengthen the financial integration, hence, the financial cycle would not be engaged into great boom-bust magnitudes. And as the business cycle (represented by the GDP) is endogenously driven by boom-bust financial cycle, it should also not display great amplitudes in its expansion-recession phases.[24]

[22] I will take them into account in further research.

[23] The GDPs are extracted from the IMF-IFS Database.

[24] In this study, I cannot assess the impact on the amplitude. I rather assess if the BU CRR improve or not the cycle values.

Finally, I consider successively the impact of three types of shocks (CR, LR, LCR) on the real economy variable, the financial integration variables (cross-border, bond yields, credit risks) and on the financial stability variables (non-performing loans, financial cycle, business cycle).

3.4.2 Empirical strategy

In order to estimate a pVAR, one has to first check the stationarity (subsection 3.4.2.1); then the pVAR can be performed (subsection 3.4.2.2).

3.4.2.1 Testing for unit roots

Before performing any type of VAR, one must ensure that the variables are stationary, otherwise, the stability of the pVAR is not guaranteed. In this section, the unit root tests used in order to assess the stationarity of the variables are explained. The results of the panel unit root tests are available in **Table 3.A.1** in **Appendix A**.

Some of our variables present evidence of stationarity and are taken in level (NPLs, CBD, BY)[25] while others do not and are taken in first difference (capital ratio, liquidity coverage ratio, leverage ratio, credit risk). The business and financial cycles variables are also taken in level as cyclical component are stationary.

To test for unit roots, I apply three panel unit root tests: (i) the Levin, Lin and Chin (LLC) test (2002); (ii) the Im, Pesaran and Shin (IPS) test (2003); (iii) the CIPS test of Pesaran

[25] 2 out of 3 tests concludes on the absence of unit roots in the BY if a trend and a constant is considered in the specification.

(2007).

The LLC null hypothesis assumes that there is a unit root among each individual time series while its alternative hypothesis assumes that each time series is stationary (Baltagi, 2013). However, the LLC test is very restrictive as it is based on the assumption of homogeneity across individuals (Baltagi, 2013). Indeed, the autoregressive coefficient is homogeneous across the panel individuals.

The IPS overcomes this shortcoming as it permits the autoregressive coefficient to be heterogeneous across the different individuals. Under the null hypothesis, each series in the panel contains a unit root while under the alternative hypothesis, some (but not all) of the individual series have unit roots.

The LLC and the IPS belongs to the first generation of panel unit root tests based upon the assumption of independence across individuals. In practice, this assumption might not be fulfilled. To deal with potential cross-sectional dependence, I thus implement the CIPS test.

The CIPS test of Pesaran (2007) belongs to the second generation of panel unit root test. Its null hypothesis mentions that all individuals have a unit root while its alternative hypothesis assumes that some individuals have a unit root. More precisely, the CIPS test controls for the presence of cross section dependence (CSD). By augmenting the usual ADF regression with the lagged cross-sectional mean and its first-differences, thus, capturing the presence of CSD.

3.4.2.2 Performing a pVAR

In order to assess the impact of the BU regulation on the financial stability and on the financial integration, I use a pVAR. pVAR are particularly suitable for small data span. For instance, as the capital requirements have a quarterly frequency and were fully phased-in in 2016, a VAR or SVAR model would have induced some mispecifications due to the lack of data. Plus, a pVAR has the same structure as a standard VAR model as each endogenous variable is assumed to depend on lagged values of itself and of all other endogenous variables (Dées and Güntner, 2014). Contrary to a traditional VAR, it allows encompassing the cross-sectional dimension in the data. A pVAR model can be written as:

$$Y_{(i,t)} = \nu_i + A_{1i}Y_{(t-1)} + ... + A_{(p,i)}Y_{(t-p)} + e_{(i,t)} \tag{3.4.1}$$

Where:

$i = 1, \ldots, N$

$t = 1, \ldots, T$ is the time series dimension

$Y_{(i,t)}$ denotes the $(K \times 1)$ vector of endogenous variables for unit i

$Y_t = (Y'_{(1,t)}, Y'_{(2,t)}, ..., Y'_{(N,t)})'$ denotes the $(N \cdot K \times 1)$ vector of stacked $Y_{(i,t)}$.

ν_i is a $(K \times 1)$ vector of intercepts.

$A_{(j,i)}$, $j = 1, \ldots, p$, and $i = 1, \ldots, N$ are $(K \times N \cdot K)$ matrices of slope coefficients.

$e_{(i,t)}$ is a $(K \times 1)$ vector of possibly contemporaneously correlated reduced-form disturbances.

A reduced form of the pVAR can be written as:

$$Y_{(i,t)} = \alpha_i + \Gamma(L)Y_{(i,t)} + e_{(i,t)} \tag{3.4.2}$$

Where $i = 1, \ldots, N$; t and $e_{(i,t)}$ denote respectively the country, the time and the vector of

error terms. $Y_{(i,t)}$ is the vector of endogenous variables, $\Gamma(L)$ is the polynomial matrix of polynomial in the lag operator L, and α_i is the country fixed effects.

As the pVAR assumes that all individuals share the same underlying process, and as this assumption might not be fulfilled (Love and Zicchino, 2006), I include country fixed effects in order to control for unobserved heterogeneity. Plus, in order to overcome the Nickell's bias (1981), *i.e.* the bias due to the inclusion of the lagged endogenous variables on the right hand-side, I use the Generalized Method of Moments estimator (Arellano and Bond, 1991; Blundell and Bond, 1998) suitable for dynamic panel data specifications. More specifically, the lagged endogenous variables and their first difference are used as instruments. In order to check their validity, I apply the Hansen test *i.e.* test of overidentification restrictions. Under the null hypothesis, the instruments are valid. The P-value must be between 0.1 and 0.25 or it would be signs of trouble (Roodman, 2009).[26]

Moreover, in order to remove the fixed effect, I use the Helmert procedure / forward orthogonal deviation procedure (Arellano and Bover, 1995). The Helmert transformation consists in substracting the mean of the remaining future observations available and to equalize the variance. Then, I use the Cholesky decomposition in order to interpret the Impulse Response Functions (IRFs) results. The Cholesky decomposition relies on an arrangement of the variables from the most exogenous one to the least exogenous one. Three pVAR models are being estimated but only two are analyzed.[27] They respectively encompass the seven following variables with that exact arrangement:

1. Cross-border banking positions (CBD_{it}), Non-performing loans (NPL_{it}), Financial Cycle (FC_{it}), Business Cycle (BC_{it}), Capital Ratio (CR_{it}), Leverage Ratio (LR_{it}),

[26] See Table **3.C.1** in

[27] This is justified below.

Liquidity Coverage Ratio (LCR_{it}).

2. Bond Yields (BY_{it}), Non-performing loans (NPL_{it}), Financial Cycle (FC_{it}), Business Cycle (BC_{it}), Capital Ratio (CR_{it}), Leverage Ratio (LR_{it}), Liquidity Coverage Ratio (LCR_{it}).

3. Credit Risks (CdR_{it}), Non-performing loans (NPL_{it}), Financial Cycle (FC_{it}), Business Cycle (BC_{it}), Capital Ratio (CR_{it}), Leverage Ratio (LR_{it}), Liquidity Coverage Ratio (LCR_{it}).

This can be rewritten as:

$$Y_{it} = (CBD_{it}, NPL_{it}, FC_{it}, BC_{it}, CR_{it}, LR_{it}, LCR_{it}) \tag{3.4.3}$$

$$Y_{it} = (BY_{it}, NPL_{it}, FC_{it}, BC_{it}, CR_{it}, LR_{it}, LCR_{it}) \tag{3.4.4}$$

$$Y_{it} = (CdR_{it}, NPL_{it}, FC_{it}, BC_{it}, CR_{it}, LR_{it}, LCR_{it}) \tag{3.4.5}$$

In this decomposition, I assume that the three regulation variables are the most endogenous variables because of the strong link between bank lending and profitability and the CR, the LR and the LCR. Indeed, the capacity of a bank to lend money or on its profitability highly relies on the level of these ratios (Berger, 1995; Berger et al., 1995; Osborne et al., 2012; Bordeleau and Graham, 2013).

On the other hand, the financial integration variables are assumed to affect contemporaneously the non-performing loans, the financial cycle and the business cycle, as: (i) the more financial integration, the less non-performing loans[28] (Financial Integration in Europe, ECB,

[28]As noted in the Financial Integration Report published by the ECB on May 2018, Chapter 2, page 47:

2018); (ii) financial integration is assumed to increase the degree of business cycle synchronization (Kalemli-Ozcan, Papaioannou and Peydró, 2009) and to be strongly linked with the degree of financial stability (Papademos, 2010).[29]

The optimal lag numbers are selected following the usual information criteria (AIC and BIC). They indicated that one lag number was optimal, hence, a pVAR(1) was considered. From that selection, I derive the orthogonalized IRF and perform a Forecast Error Variance Decomposition (FVED) at a ten period horizon. Impulse response functions are represented by the blue solid line. Standard-errors are generated through Monte-Carlo simulations with 1000 repetitions. Red dashed lines represent 95% confidence interval. The estimated shock is equal to one standard deviation. The FVED is a part of structural analysis which decomposes the variance of the forecast error into the contributions from specific exogenous shocks. It demonstrates how important a shock is in explaining the variations of the variables in the model.

Finally, the eigenvalue stability conditions are checked for each pVAR. This step assesses the stability of the pVAR. A pVAR is stable if all the eigenvalues lie inside the unit circle. Hence, the pVAR estimated in this paper are stable (see Table 3.C.2 in the Appendix).

"Efforts to reduce non-performing loans support financial integration in various ways. First, the presence of players with high levels of NPLs undermines trust between counterparties, leading to the fragmentation of banking markets within and across Member States. Second, measures that support the reduction of NPLs, such as transaction platforms, support financial integration through their data harmonisation and cross-border features. And last but not least, a reduction in NPLs can contribute to risk reduction – an important step towards the completion of the BU".

[29]Lucas Papademos Speech delivered at the conference "Financial integration and stability: the legacy of the crisis" at the European Central Bank in 2010.

3.4.3 Empirical Analyses of the Forecast Error Variance Decomposition

Finally, before studying the implication of the BU CRR on financial integration and stability, I analyse the FVED of each pVAR specification. This would allow to determine which pVAR specification is the most appropriate to explain the variables' variations in the model after performing impulse responses.

First, I find that when the pVAR takes into account the cross-border banking positions or the bond yields, it displays more significance for the explanation of the variables' variations in the model by the different shocks. Indeed, as we can see in **Table 3.4.1**, when the pVAR takes into account the cross-border banking positions, the impact of a CR shock explains 18% of the NPLs variance more than it affects, by descending order, the financial cycle and the cross-border banking positions (7%). Similarly, a LCR shock affects the business cycle (8%) more than it affects the cross-border banking positions (6%) and more than it affects the NPLs one (4%). Finally, the LR shock only affects the cross-border banking positions by 20% but does not impact the other variables especially the financial cycle.

In a minor way, when the pVAR takes into account the bond yields, the results display higher explainable variability by the three types of shocks *namely* the CRR shocks, than the pVAR with credit risk. Indeed, as presented in **Table 3.4.2** the impact of the CR shock explains the business cycle variance by 8% more than it affects, in descending order, the bond Yields (5%), the NPLs (0.27%). Secondly, a LR shock explains the financial cycle variance by 9% more than it impacts the bond yields (6%) and the business cycle (5%). Finally, a LCR shock explains the variance of the the bond yields (8%) more than it affects the NPLs (2%).

Another pVAR specification – the credit risk – was estimated. However, the percentage of

Table 3.4.1 FVED of pVAR including cross-border banking positions

	Cross border			NPLs		
	CR	**LR**	**LCR**	**CR**	**LR**	**LCR**
0	0%	0%	0%	0	0	0
1	0%	0%	0%	0	0	0
2	**7%**	13%	3%	20%	1%	4%
3	5%	20%	**6%**	**18%**	1%	**4%**
4	5%	**20%**	7%	16%	3%	4%
5	5%	19%	7%	15%	5%	4%
6	5%	18%	6%	14%	6%	5%
7	5%	18%	6%	14%	6%	5%
8	5%	17%	7%	13%	6%	5%
9	5%	17%	7%	13%	6%	5%
10	5%	16%	7%	13%	6%	5%

	FC			BC		
	CR	**LR**	**LCR**	**CR**	**LR**	**LCR**
0	0	0	0	0	0	0
1	0	0	0	0	0	0
2	6%	1%	1%	1%	3%	6%
3	7%	1%	2%	1%	3%	**8%**
4	**7%**	1%	4%	1%	3%	8%
5	7%	1%	5%	1%	4%	7%
6	7%	1%	5%	1%	5%	7%
7	7%	1%	6%	1%	6%	7%
8	7%	1%	5%	1%	7%	7%
9	7%	1%	5%	1%	7%	7%
10	7%	2%	5%	1%	7%	7%

Note: Results in bold corresponds to the last significant period. CR, LR, LCR represent the shock implemented while the results displayed represent the shock responses of the financial integration, financial stability and real sector variables.

Table 3.4.2 FVED of pVAR including bond yields.

	Yields			**NPLs**		
	CR	**LR**	**LCR**	**CR**	**LR**	**LCR**
0	0	0	0	0	0	0
1	0	0	0	0	0	0
2	4%	6%	5%	0.27%	0%	**2%**
3	**5%**	9%	**8%**	**2%**	0%	3%
4	4%	**9%**	8%	2%	1%	3%
5	4%	9%	8%	2%	2%	3%
6	4%	9%	8%	3%	2%	3%
7	4%	9%	7%	3%	2%	3%
8	4%	9%	7%	3%	3%	3%
9	4%	9%	7%	3%	3%	3%
10	4%	9%	7%	3%	3%	3%

	FC			**BC**		
	CR	LR	LCR	CR	LR	LCR
0	0	0	0	0	0	0
1	0	0	0	0	0	0
2	1%	9%	0.07%	8%	0.03%	0.5%
3	1%	9%	0.17%	8%	1%	1%
4	1%	9%	0.16%	8%	3%	1%
5	1%	**9%**	0.14%	**8%**	**5%**	1%
6	1%	9%	0.13%	6%	%	1%
7	1%	**9%**	0.15%	6%	6%	1%
8	1%	9%	0.16%	4%	7%	1%
9	1%	9%	0.16%	4%	7%	1%
10	1%	9%	0.15%	4%	7%	1%

Note: Results in bold corresponds to the last significant period. CR, LR, LCR represent the shock implemented. The results displayed represent the shock responses of the financial integration, financial stability and real sector variables.

variance explained for the financial integration and stability variables by the CRR shocks do not surpass 3%. Hence, the results of this pVAR are displayed in Figure 3.E in Appendix but

it is not analyzed in the following. Moreover, one has to point out that the the credit risks is one major proxy for financial integration. Hence, this absence of high explainability by the CRR shocks which are intended – *inter alia* – to diminish the credit risks, points out to the lack of effectiveness of the BU on the factors of financial integration but also on the financial stability. Indeed, as one can notice, in the pVAR model, multiple financial stability variables are encompassed. Yet, by adding the interactions of those variables with the credit risks, they are found to be non-explained by the impact of the CR, LR and LCR shocks. In other words, by taking into account those dynamics (credit risk with the CRR considered in this chapter), the BU regulation is quite ineffective in dampening the financial instability and in increasing the financial integration. Those results are in line with the literature showing that the BU in its current shape, is not efficient and might be unable to deal with the next financial crisis (Asimakopoulo and Howarth, 2021; de Juan, 2019; Schäfer 2016).

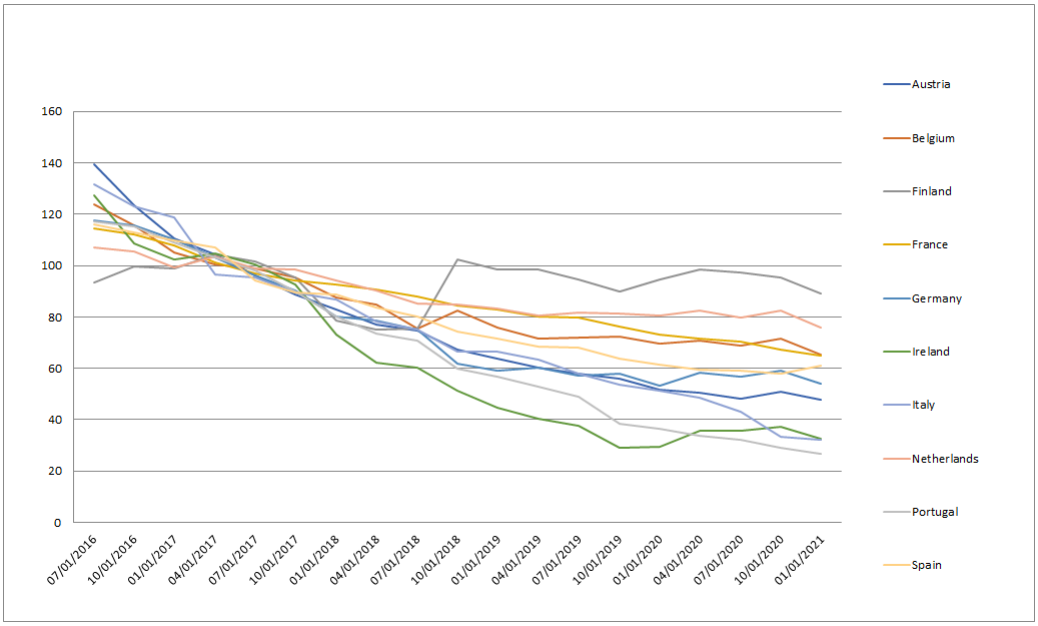
Keeping in mind the interactions between the financial instability indicators and the credit risks, I focus on the empirical analysis of the two previous pVARs models. In other words, I provide an in-depth discussion regarding the results of equations (**3.7.1**) and (**3.7.2**) *i.e.* the pVARs that respectively include the cross-borders positions and the bond yields.

3.5 Stylized Facts

Before analyzing our results, I investigate the features of our data. Thus, I present the non-performing loans, the leverage ratio, the liquidity coverage ratio, the capital ratio, the bond yields, and the cross-border banking positions figures for our ten countries (Austria, Belgium, Finland, France, Germany, Ireland, Italy, the Netherlands, Portugal, Spain) spanning the 2016Q3-2021Q1 period. It allows us to highlight some stylized facts.

Table 3.B.1 provides descriptive statistics for our variables. First, I depict a decrease of the non-performing loans ratios in all countries (Figure 3.5.1). More specifically, in 2018, I notice a level shift in the variable which coincides with the fully phased-in CRD IV. The CRD IV is mostly composed of capital buffers which imply that the more capital ratios/buffers there is, the less NPLs.

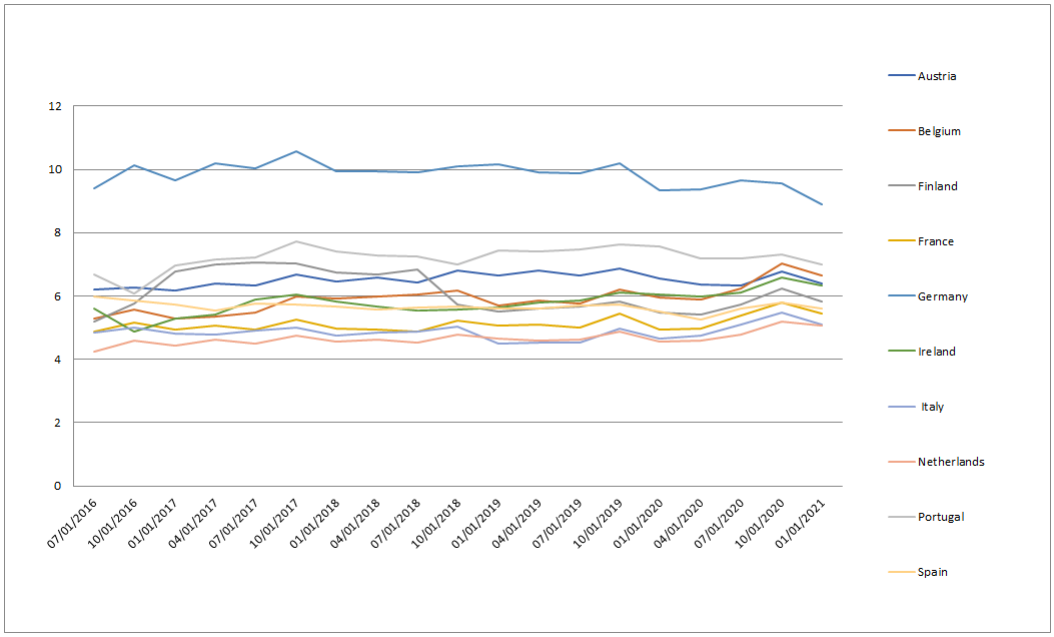
Figure 3.5.1: Non performing loans



Source: EBA. (*base 100=2017*)

Secondly, the three capital ratios under consideration in this chapter are the leverage ratio, the total capital ratio and the liquidity coverage ratio (Figures 3.5.2; 3.5.3; 3.5.4). Following their respective graphs, I observe that: (i) there is a global increase among countries and over time for the liquidity coverage ratio; (ii) there is an increase of the leverage ratio at the beginning of our data period followed by slightest increases over time reaching their peak in 2020; (iii) there is an overall decrease of the capital ratio over time followed by a stagnation for all countries.

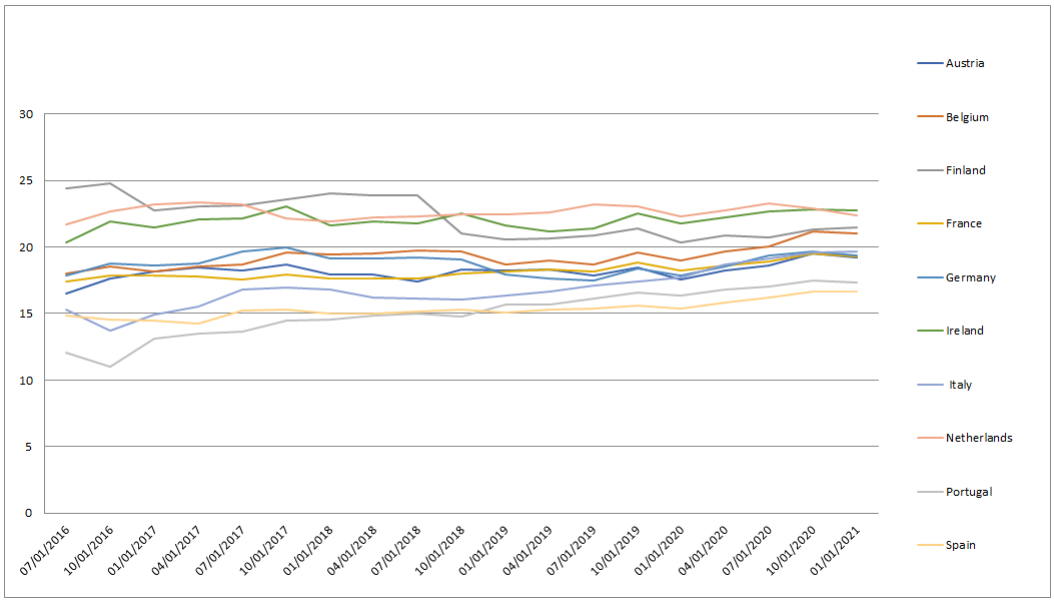
Figure 3.5.2: Leverage ratio



Source: EBA

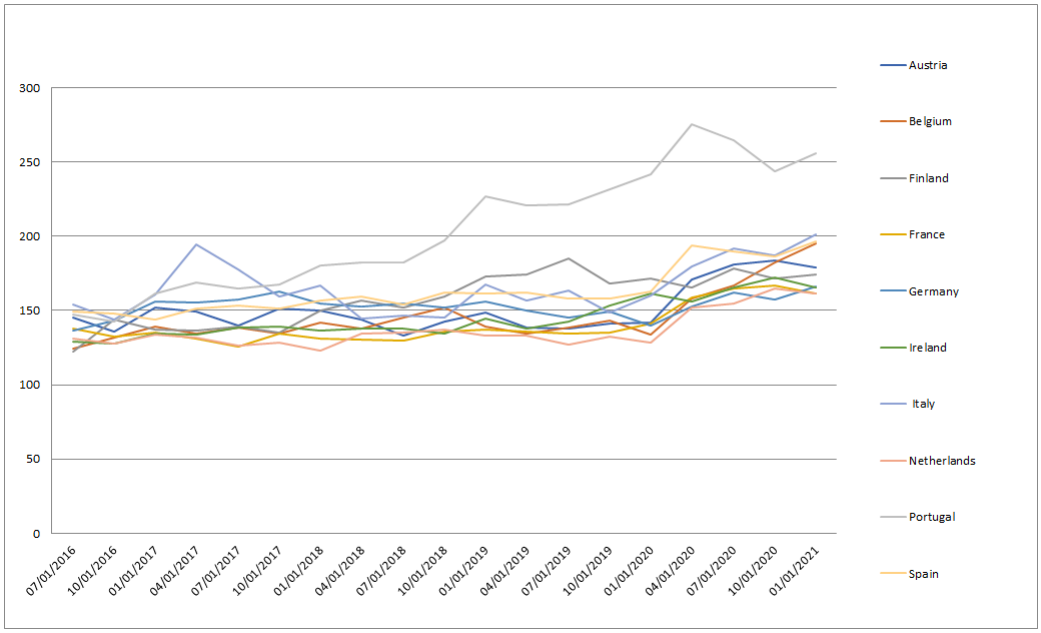
Thirdly, there is an important diminution of the level of bond yields (Figure 3.5.5) over time especially from 2017 at a European Level. More precisely, this decrease tends to be more convergent especially at the end of the sample period. Indeed, in comparison with the beginning of the data sample, I notice that since the CRR were fully phased-in there is an increase in the similarities between the bond yields.

Figure 3.5.3: Capital ratio



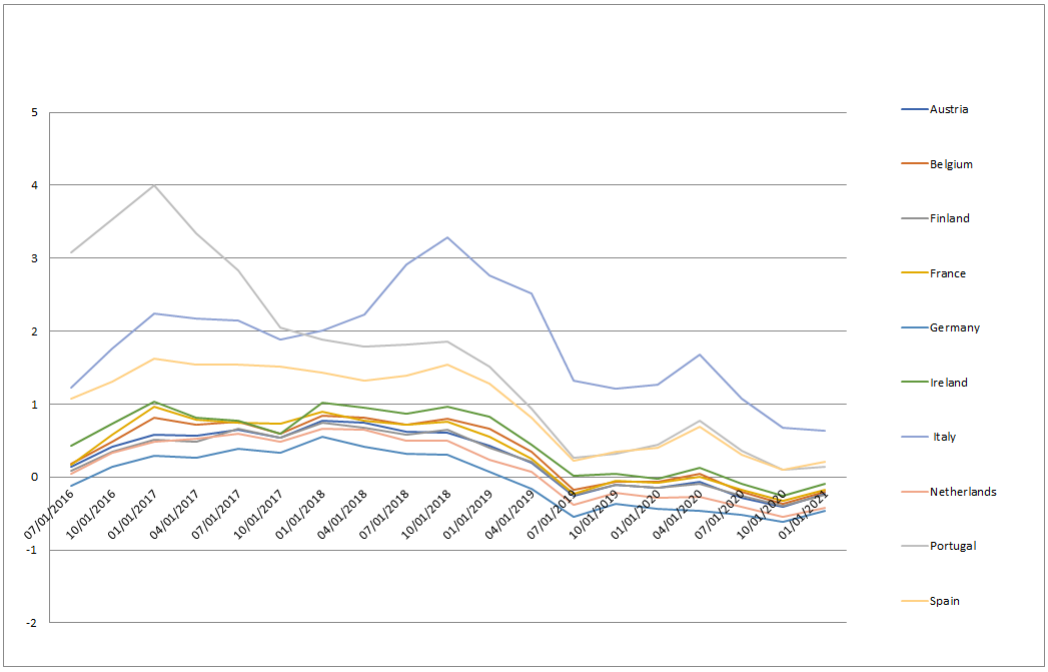
Source: EBA

Figure 3.5.4: Liquidity coverage ratio



Source: EBA

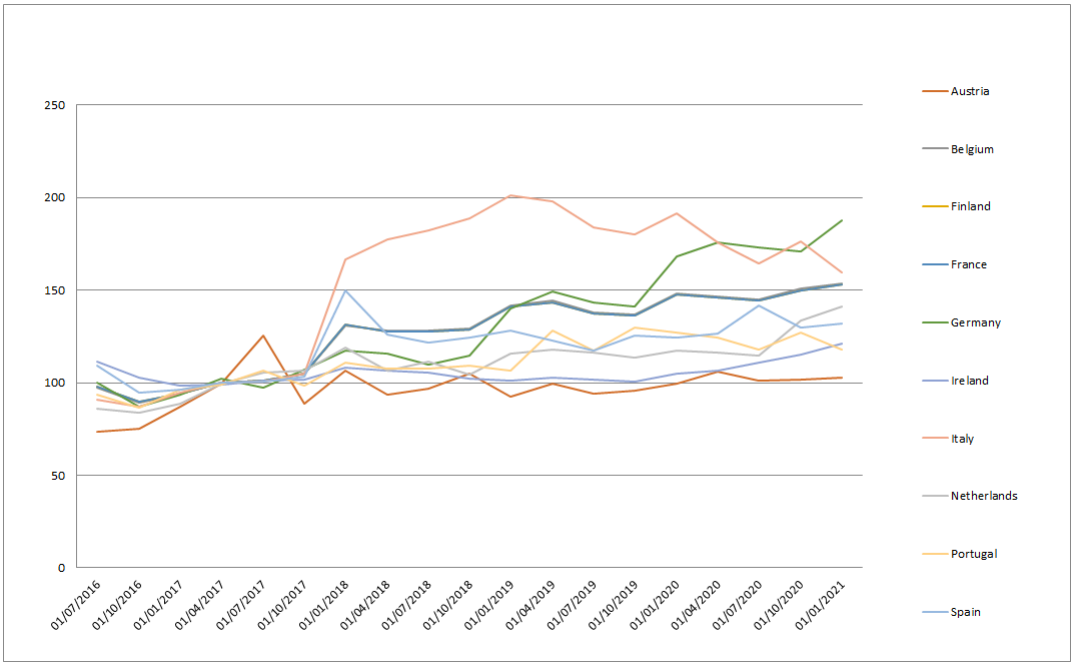
Figure 3.5.5: Bond yields



Source: Eurostat database

Finally, there is a global increase of the cross-border banking positions (Figure 3.5.6) where I depict an augmentation of 60% of the cross-border banking volume in 2017 for Italy and 30% for France. In other words, after the fully phased-in CRR I and II, the cross-border banking positions has on average doubled within the Eurozone. This could induce that there is an increase of the financial integration, or at least of the cross-border banking positions, across the Eurozone.

Figure 3.5.6: Cross-border banking positions



Source: BIS. (*base 100=2017*)

3.6 Is the BU Capital Requirements Regulation efficient on financial integration and stability?

As I am interested by the BU impact on the financial integration and stability, I consider successively three types of shocks: CR, LCR and LR. As previously explained, I analyse in details the results of the pVAR models encompassing the cross-border banking positions and the bond yields as indicators of financial integration. It corresponds to equations **(3.7.1)** and **(3.7.2)**. For each of them, I respectively analyze their impact on: (i) the financial cycle, the non-performing loans, the business cycle, and on the cross-border banking positions; (ii) the financial cycle, the non-performing loans, the business cycle, and the bond yields.

In the following, for more clarity, I will refer to the pVAR including the cross-border banking positions as a financial integration indicator with the term "pVAR-1"; and to the pVAR inclunding the bond yields as a financial indicator with the term "pVAR-2".

3.6.1 Cross-border banking positions as an indicator of financial integration

In this subsection, I present and discuss the impulse responses functions of pVAR-1.

3.6.1.1 Estimation results

The CR shock is mostly reflected immediately on the financial stability variables and on the financial integration variables in respectively the long and short terms.[30] **However, it is not reflected on the real economic variable**. Indeed, as **figure 3.6.1** displays, there is a positive response on the financial cycles within four periods while it impacts negatively and immediately the NPLs for three periods. There is also a positive effect from the CR shock on the cross-border banking positions within two periods whereas the response of the business cycle to the CR shock is never significant.

Meanwhile, **the LCR shock is mostly immediately reflected on the NPLs and real economic variables at long term but does not impact at all the financial cycle variables**. Indeed, as **figure 3.6.2** displays, the LCR shock is immediately reflected on the business cycle, the cross-border banking positions and the NPLs. More precisely, this shock induces a negative response on the NPLs and a positive response on the business cycle and the cross-border banking positions for three periods. However, it has no significant impact on the financial cycle.

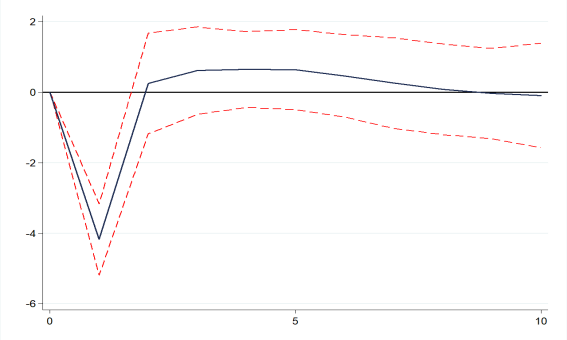
Finally, **the LR shock presents fewer patterns in the variables' responses. Overall, it does not stabilize the financial system nor the real economy and is irrelevant in**

[30] I consider that the short term corresponds to a time length inferior to 2 periods. When the impact of the shock lasts more than three periods, it is considered as long term.

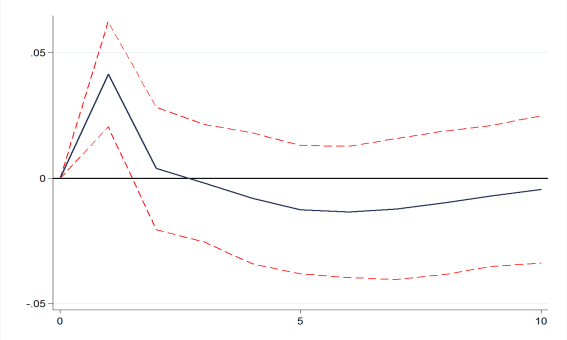
pursuing more financial integration. Indeed, as presented in **figure 3.6.3**, both cycles display no significant response to the LR shock while the NPLs present a weakly significant response at short term. Contrariwise, the cross-border banking positions show a positive and long term response to the LR shock which means that the cross-border banking positions are enhanced by the LR shock.

Figure 3.6.1: Response to a Capital Ratio Shock (pVAR-1)

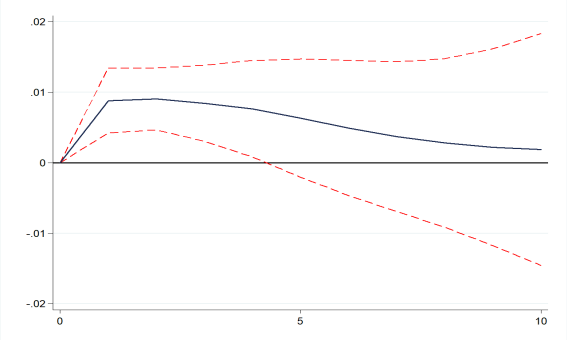
Response of non-performing loans



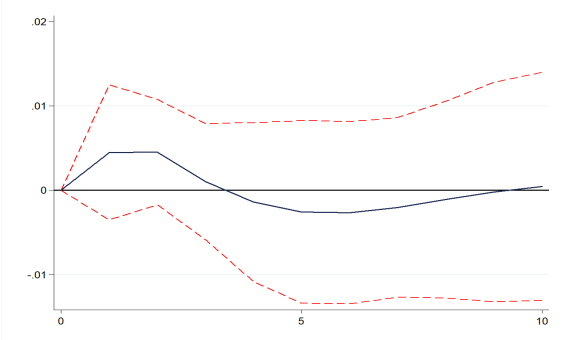
Response of Cross-border



(c) Response of Financial Cycle



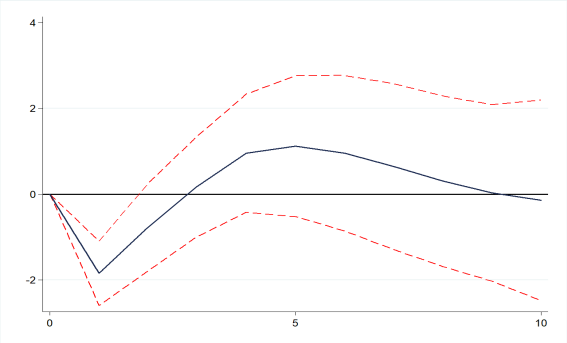
(d) Response of Business Cycle



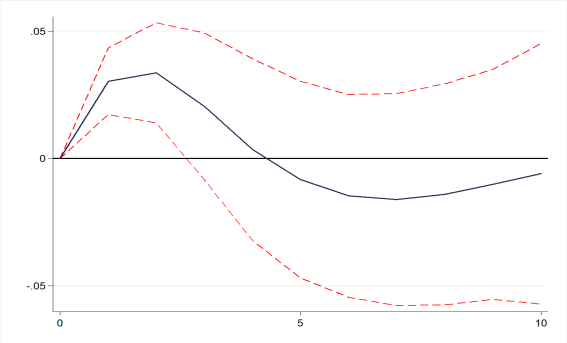
Note: Impulse response functions are represented by the blue solid line. Standard-errors are generated through Monte-Carlo simulations with 1000 repetitions. Red dashed lines represent 95% confidence interval. The estimated shock is equal to one standard deviation.

Figure 3.6.2: Response to a Liquidity Coverage Ratio Shock (pVAR-1)

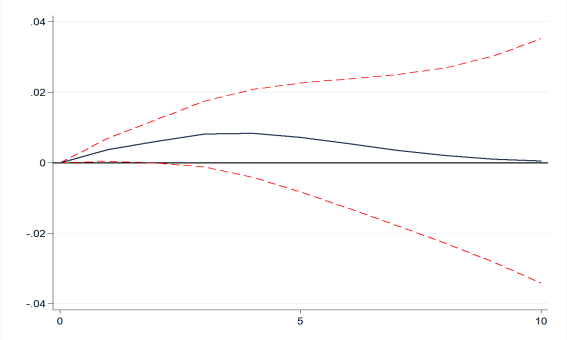
Response of non-performing loans



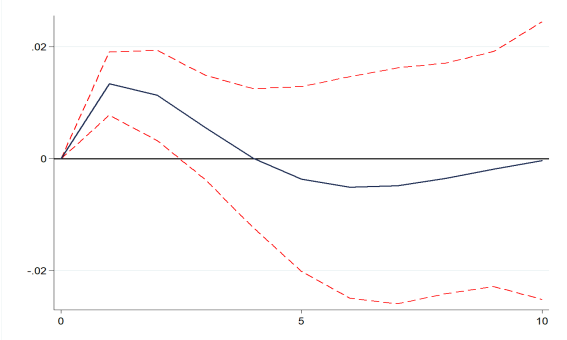
Response of Cross-border



Response of Financial Cycle



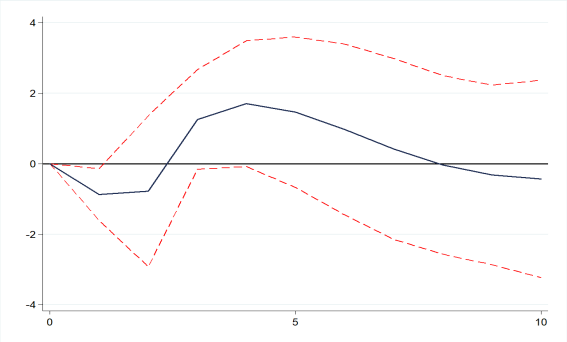
Response of Business Cycle



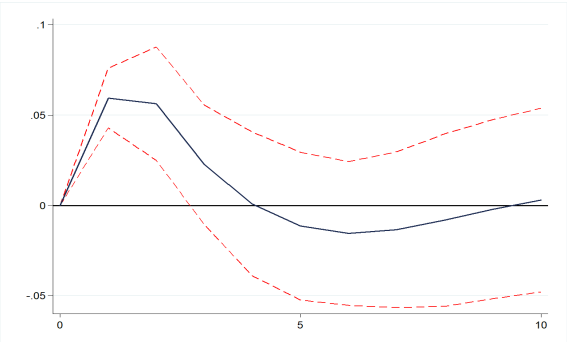
Note: Impulse response functions are represented by the blue solid line. Standard-errors are generated through Monte-Carlo simulations with 1000 repetitions. Red dashed lines represent 95% confidence interval. The estimated shock is equal to one standard deviation.

Figure 3.6.3: Response to a Liquidity Ratio Shock (pVAR-1)

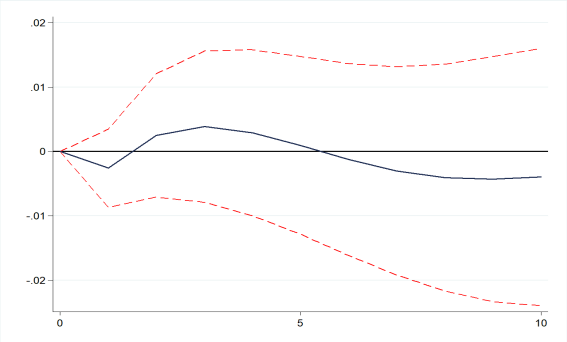
Response of non-performing loans



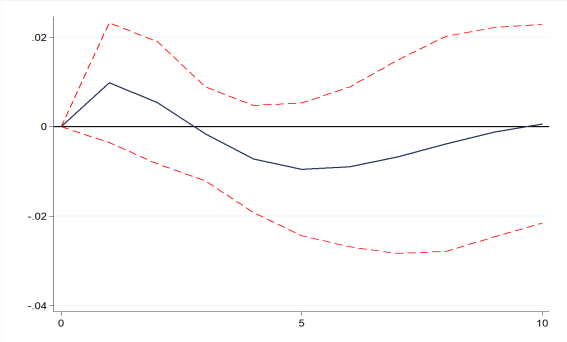
Response of Cross-border



Response of Financial Cycle



Response of Business Cycle



3.6.1.2 Are the Capital Requirements Regulation a barrier to financial integration and stability?

Overall, the CRR are efficient on the financial integration as whatever the type of ratio shock, the cross-border banking positions always respond to them. However, they are inefficient on the financial stability as it highly depends on the type of shock considered.

First, I consider the effect of the BU CRR on the financial integration in the EZ. I find that the BU CRR increases the financial integration.

As a reminder, the financial integration is represented by the cross-border banking positions in this pVAR. One of the objective of the BU CRR is to achieve further financial integration. According to our results, cross-border banking positions tends to increase immediately and in the short term following the three types of shock. Hence, there is no long-lasting effect of the CRR on financial integration. This might be explained by the fact that - as demonstrated by Franch, Nocciola, Żochowski (2021) - there is an inverse relation between capital requirements and cross-border banking positions. Plus, we observed in Section 3.5 that CRR were tightened through the years with a slight stagnation over the last quarters. Hence, following Franch, Nocciola and Zochowski (2021), I find that the more capital requirements are

tightened, the less cross-border banking positions decrease as banks tend to lend within the countries where their bank parents reside. In other words, one of the component of financial integration *e.g.* cross-border banking positions tend to increase with the tightening of CRR.

Secondly, the effect on the financial stability varies according to the financial stability variable and the shock examined.

For instance, the NPLs are not always reacting to the three shocks examined (CR, LCR, LR). They respond negatively – as expected – to the CR and LCR shocks whereas they do not respond – surprisingly – to the LR shock. The reaction to the CR and LCR shocks is expected as regulatory capital requirements are supposed to decrease the risk-taking in the EZ. Consequently, non-performing loans decrease. Indeed, the increase of NPLs affects banks' ability to generate new lendings into the real economy (EBA).[31] Thus, in order to manage their risks, banks need to put money aside as a safety to compensate for the losses incurring from NPLs. Controlling the level of NPLs is a necessity as, as declared on the EBA website, "past financial crisis have shown that NPLs can reach levels high enough to become a real problem for bank's business activities, financial stability and lending to the real economy (NPLs reached EUR 1.2 trillion in June 2015)".

However, what is less expected is that the LR shock weakly impacts the level of NPLs. Indeed, Ghosh (2005) shows that the LR can serve as a useful signpost of asset quality. Plus, on a press release by the EBA on the 13 January 2021, it is stressed out that the non-performing loans ratio continued to decline from 2.9% in 2021Q2 to 2.8% in 2021Q3 supported by a contraction in the NPLs volume and rising total loans and advances. As NPLs build-ups are a recurrent feature of financial crises and financial stress episodes in

[31] https://www.eba.europa.eu/risk-analysis-and-data/npls

several economies (OECD, 2021),[32] it is important to understand why does the LR shock weakly impact the NPLs. One potential explanation for this result is that the current LR requirement is not at its optimal regulation level (Malherbe, 2020) which in turn distorts the LR effectiveness on the NPLs. Another reason that could explain this irregularity is that I solely took the effect of the LR shock on the NPLs. The result might be different if one tests the effects of the CRR by creating a singular CRR variable composed of the CR, LR, and LCR. Finally, this weakly response might also be due to the short time span of our sample.

The financial cycle is the second variable considered as an indicator of the financial stability. The capital requirements are supposed to dampen the financial instability as it aims to ensure that the banking sector in the EZ is safe and reliable. Hence, the fact that the financial cycle responds positively to the CR shock while not significantly responds to the LCR and LR shocks, means that the CR is more procyclical than the other requirements. In other words, globally, the CRR do not improve the financial stability in the EZ as intended by the capital requirements. Finally, there is no significant response of the financial cycle to the LR shock which is counterintuitive. Yet, Schoenmaker and Wierts (2015) explain that the LR is supposed to act as a countercyclical instrument: it is a tighter constraint for banks in booms and a looser constraint in recessions (Brei and Gambacorta, 2014). On the other hand, Malherbe (2020) shows that optimal capital requirements that would not exacerbate economic and financial fluctuations must take into consideration the general equilibrium effect. He points out that a regulation that fails to take into account this effect allows for excessive build-up of risk in the financial sector during booms. Plus, government guarantees – as they are in the EZ – tend to amplify this mechanism (Malherbe, 2020). Hence, capital requirements may not be optimal which in turn may obstruct the achievement of the finan-

[32]For example: the Asian economies in the late 1990s, (Fung et al, 2004), the Nordic countries in the 1990s (Borio et al., 2010), and the US savings and loan (SL) crisis in the 1980s (FDIC, 1997).

cial stability objective.

Overall, the capital requirements do not fill their role of stabilizing the economy and the business cycle as they enhance the business cycle in the short term only following the LCR shock but not at all following a CR or LR shock. This might be caused by the interactions between the business cycle and the financial cycle and the bank regulation. Indeed, if bank regulation is not adapted to the financial cycle, there would also be irregularities in the way the business cycle answers to the capital requirements shocks, as the financial fluctuation affects the business cycle. In other words, the financial sector is not able to finance the economy and its activities if the BU is inefficient.

3.6.2 Bond yields as an indicator of financial integration.

In this subsection, I present the results obtained from pVAR-2 and then discuss them.

3.6.2.1 Estimation results

Contrary to the pVAR-1, when the bond yields are integrated into the pVAR instead of the cross-border banking positions, **I find that the CR shock dampens the real economy in the long term and increases the financial integration but has no conclusive impact on the financial stability.** Indeed, as displayed in **figure 3.6.4**, there is a negative and non immediate response of the business cycle to the CR shock whereas bond yields display a negative but immediate short term response to the CR shock. Finally, there is a weakly negative response of the NPLs at period two to the CR shock and no significant

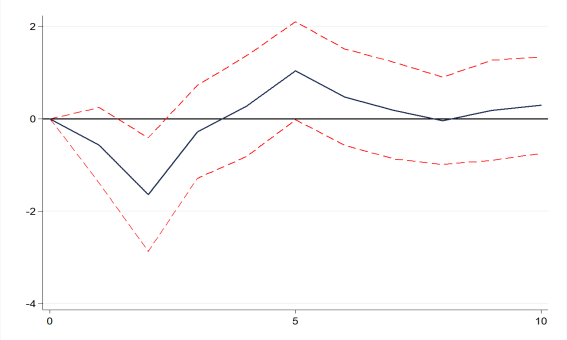
response from the financial cycle to the CR shock.

The LCR shock impacts positively the financial integration variables in the long term and provides mitigated impacts on the financial stability as it weakly dampens the NPLs but does not impact the financial cycle. In other words, following a LCR shock, the financial integration increases while only one financial stability variable decreases. Indeed, as **figure 3.6.5** shows, there is (i) a negative response of NPLs to the LCR shock that is deadened in the short term and no significant response of the FC to the LCR shock; (ii) a non-significant response of the business cycle to the LCR shock; (iii) a weakly significant response of the bond yields to the LCR shock that is deadened at three periods.

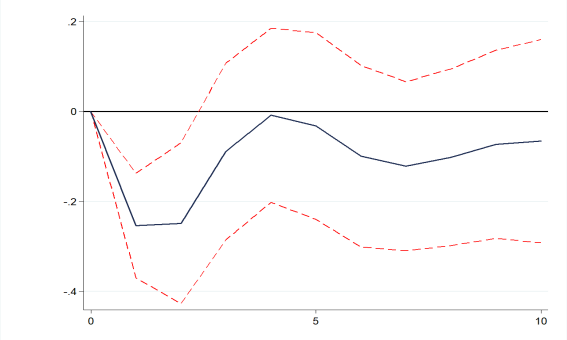
Overall, the LR shock impacts negatively, immediately and in the long term the financial integration and the financial cycle variables; and displays a negatively delayed response on the real economy. More precisely, **figure 3.6.6** displays that there is: (i) a negative, immediate and long term response of the financial cycle – however interspersed with non-significant moments – to the LR shock that is deadened at seven periods; (ii) a negative, immediate, long term response of bond yields to the LR shock that is deadened at four periods; (iii) a negative and long term response of the business cycle to the LR shock that is deadened at five periods; (iv) and a non-significant response of the NPLs to the LR shock.

Figure 3.6.4: Response to a Capital Ratio Shock (pVAR-2)

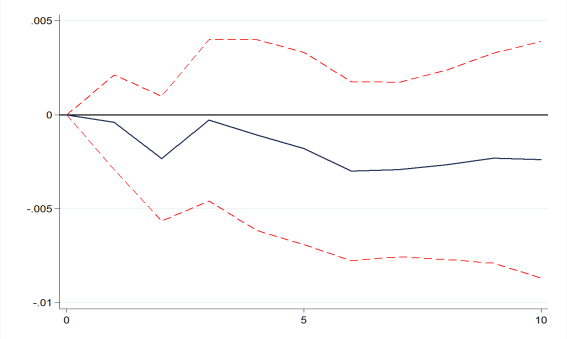
Response of non-performing loans



Response of bond yields



Response of Financial Cycle



Response of Business Cycle

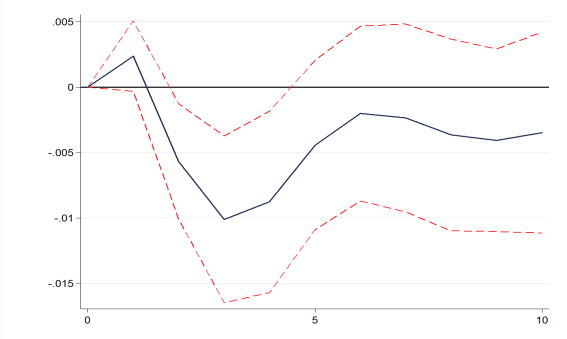
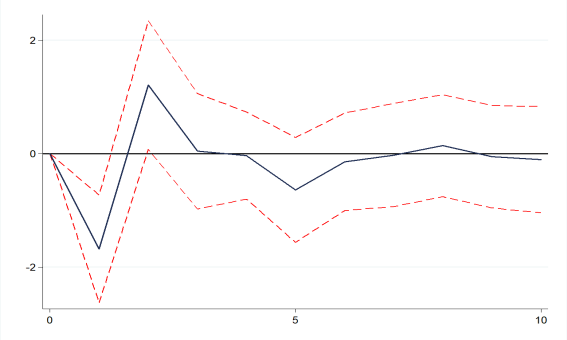
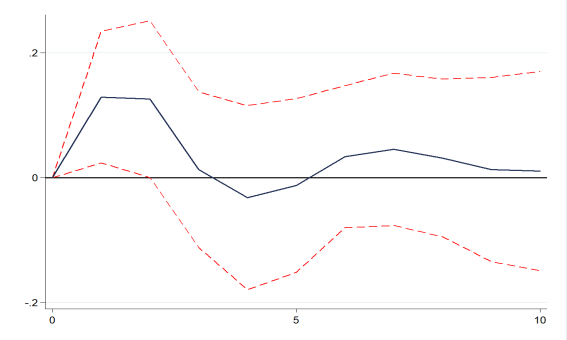


Figure 3.6.5: Response to a Liquidity Coverage Ratio Shock (pVAR-2)

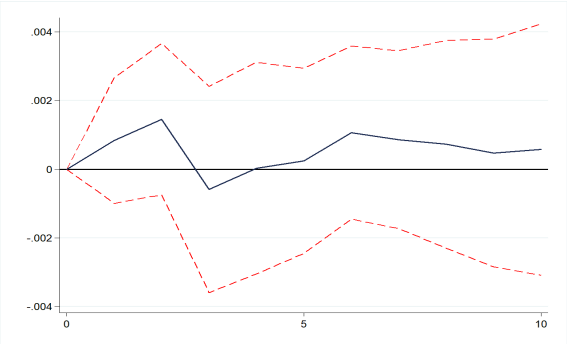
Response of non-performing loans



Response of bond yields



Response of Financial Cycle



Response of Business Cycle

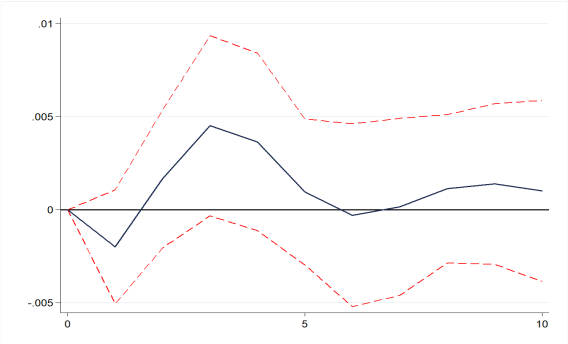
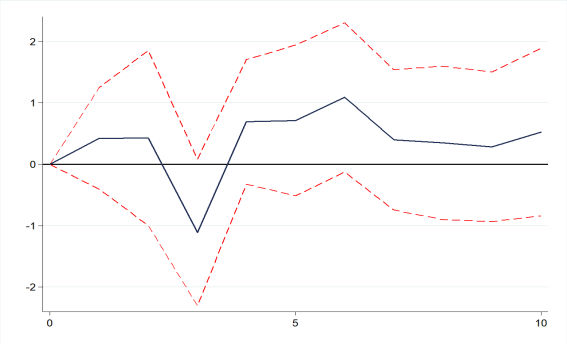
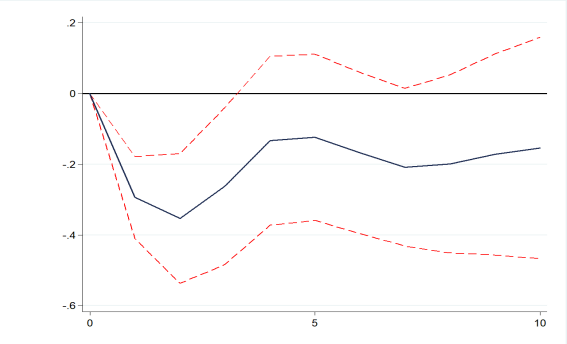


Figure 3.6.6: Response to a Liquidity Ratio Shock (pVAR-2)

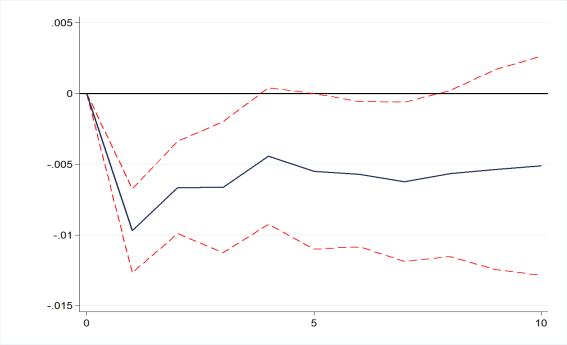
Response of non-performing loans



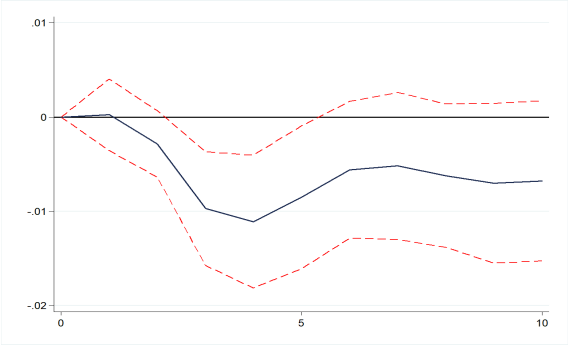
Response of bond yields



Response of Financial Cycle



Response of Business Cycle



3.6.2.2 Why Capital Requirements Regulations do not dampen financial stability?

In comparison with pVAR-1, **the capital requirements are**: (i) **efficient on the financial integration** as the CR and LR shocks impact negatively and in the long term the bond yields; (ii) **inefficient on the financial stability** as the LCR and the LR shocks impact mostly non significantly the financial cycle and display mostly negative but short term responses of the NPLs.

Indeed, the CR and LR shocks impact negatively, immediately and in the long term the bond yields. In other words, the CR and LR shocks tend to increase the financial integration. Two explanations may be associated to this phenomenon. First, the increase of capital requirements means that the total amount of capital that banks and investment firms are required to hold must be at least 8% of risk-weighted assets. Government bonds are the safer assets which in turn decreases the bond yields. As a reminder, a part of the definition of financial integration implies that assets with the same risk-return characteristics have the same prices, irrespective of the country in which they are traded. Hence, the global decrease of bond yields induces that financial integration increased as the assets present the same risk-return.[33] Another reason would rely on the fact that the introduction of capital requirements for government bonds induces banks to decrease their investment in government bonds and to increase their investment in high yields assets (Sterzel and Neyer, 2017). As a consequence, a CR shock would negatively influence the bond yields, leading to the convergence of bond yields.

[33]I presented in section 3.5 a graph including the bond yields shapes of each countries and they all decreased among the last years.

Secondly, the financial stability is not improved following the implementation of the capital requirements.

For instance, the financial stability is not reinforced after the CRR shocks as NPLs respond negatively in the short term to them and the FC responds significantly and in the long term to the LR shock only.

Indeed, on the one hand, the capital requirements are supposed to dampen the financial instability as they aim to ensure that the banking sector in the EZ is safe and reliable. **Hence, the fact that the financial stability is not reinforced thanks to the capital requirements is a counterintuitive result**. As a matter of fact, the increase of the level of the liquidity ratio in the EZ should dampen the FC and the NPLs in the longer terms. Consequently, they should display an inverse relationship as some CRR are supposed to be countercyclical (Schoenmaker and Wierts, 2015): it is a tighter constraint for banks in booms and a looser constraint in recessions (Brei and Gambacorta, 2014).

On the other hand, the amplitude of the financial cycle is supposed to be highly influenced by financial regulation regimes (Borio and Lowe, 2002; Borio, 2007) but also by the financial context. Oppositely to pVAR-1, the bond yields are not a financial constraint for financial cycles. Indeed, cross-border banking positions are a financial constraint if they are low, it means that banks do not trust the financial environment enough, hence, lowering the credit supply within the EZ. In this case, there is an optimal requirement calculated in order to allow for the countercyclical effects. However, in this pVAR, the bond yields are not a financial constraint for the financial cycle. Hence, the capital requirements will not be at their optimal regulation level (Malherbe, 2020) which will affect their impact

on the financial cycle and hence on the financial stability.

Another reason why the financial stability is not reached is because of the incompleteness of the BU. Indeed, as the European Commission highlighted in October 2017,[34] a common system for deposit protection has to be established and further measures are needed to tackle the remaining risks of the banking sector. In particular, measures related to NPLs or initiatives to help banks diversifying their investment in sovereign bonds would increase the degree of financial stability.

Finally, **the capital requirements do not fill their role of stabilizing the economy as they do not enhance the business cycle in the short term or in the long term.** Indeed, the real economy responds by a negatively delayed response to the LCR and LR shocks and solely over a few quarters. One of the reasons explaining the real economy destabilization might stem from the reaction of the financial system to capital requirements shocks. As Borio (2014) suggested, it is not possible to understand business fluctuations and the corresponding analytical and policy challenges without understanding the financial cycle. In particular, the financial cycle bust phase has a great impact on the real economy as it is a phase where the credit is tightened and the property prices are decreasing indicating a reduction of the loss absorption capacity of the BU. When the loss capacity of the BU decreases, it impacts the banks debts. Bank debts are going to be solved by governments if banks do not respond to the SRM criteria leading to the accumulation of sovereign debt, thereby, dampening the real economy.

[34]Brussels, 11.10.2017; COM(2017) 592 final, European Commission.

3.7 Robustness checks

To check for the robustness of our results, I use a different Cholesky decomposition. The Cholesky decomposition relies on an arrangement of the variables from the most exogenous one to the least exogenous one. Two pVAR models are being estimated. They respectively encompass the seven following variables with that exact arrangement:

$$Y_{it} = (CBD_{it}, FC_{it}, NPL_{it}, BC_{it}, CR_{it}, LR_{it}, LCR_{it}) \tag{3.7.1}$$

$$Y_{it} = (BY_{it}, FC_{it}, NPL_{it}, BC_{it}, CR_{it}, LR_{it}, LCR_{it}) \tag{3.7.2}$$

I considered this alternative decomposition in which the financial integration variables are assumed to affect contemporaneously the financial cycle first then the non-performing loans and the business cycle,[35] as: (i) the more financial integration, the more similar the financial structure of the EZ countries and the less non-performing loans (Financial Integration in Europe, ECB, 2018); (ii) financial integration is assumed to increase the degree of business cycle synchronization (Kalemli-Ozcan, Papaioannou and Peydró, 2009) and to be strongly linked with the degree of financial stability (Papademos, 2010).[36]

The eigenvalues coefficients are displayed in Table 3.C.3 in the Appendix. In comparison to the first Cholesky decomposition, results are similar which reinforce our first specifications results. IRFs are available in the Appendix 3.F.

[35] Instead of having the financial integration variables that affect contemporaneously first the non-performing loans and then the financial cycle.

[36] Lucas Papademos Speech delivered at the conference "Financial integration and stability: the legacy of the crisis" at the European Central Bank in 2010.

Conclusion

In this chapter, I study one of the most important questions concerning the EZ crisis: does the BU enhance the financial stability and increase its financial integration within the Eurozone? Indeed, the BU capital requirements regulation in the EZ was intended to increase the financial integration and to enhance the financial stability in order to break the vicious circle between sovereign debts and banks. More precisely, this study overlooks the impact of the ratio's first pillars of the BU *i.e. the capital requirements regulation (CRR)*, on the financial stability and the financial integration. In order to do so, I consider ten countries of the EZ over the 2016Q3-2021Q1 period examining two pVARs specifications. For each of them, the CR, the LR and the LCR are examined. Following the Forecast Error Variance Decomposition results, only two pVARs have been selected: (i) a first pVAR encompassing the cross-border banking positions as a representative of the financial integration; (ii) a second pVAR using the bond yields as an indicator of the financial integration. Finally, these two pVARs encompass the same financial stability and real economy variables: the financial cycle, the NPLs and the business cycle.

My main striking result is that the BU in its current shape is efficient on the financial integration but not on the financial stability. Hence, it does not break the vicious circle between banks and sovereign debts with its current design. Indeed, my results stemming from the pVAR using the cross-border banking positions as an indicator of financial integration, demonstrate that CRR are efficient on the financial integration and inefficient on the financial stability. For instance, the impact of the CRR shocks on the cross-border banking positions are positively significant. Whereas the CRR shocks impact positively the financial cycle which means that they do not enhance the financial stability. In addition, the CRR shocks in this first pVAR dampen the NPLs at short term,

so that one cannot conclude on a long-lasting effect of the CRR. My findings also show that when the bond yields are encompassed as the indicator of the financial integration, the CRR shocks increase the bond yields convergence implying that there is an increase of financial integration. Furthermore, in line with the previous pVAR, the CRR are still inefficient on the financial stability in the long term. However, the effect on financial integration might display some ambiguities as in the second pVAR, one of the CRR ratio does not enhance the financial integration.

Specifically, my paper is one of the first investigating empirically the BU first pillar effectiveness on the EZ financial integration and stability. My results are in line with the literature (Brei and Gambacorta, 2014; Malherbe, 2020; Claussen, Kriebel and Pfingsten, 2018; Sterzel and Neyer, 2017; Franch, Nocciola, Żochowski, 2021). However, most of the results emphasized in the literature relies on political economy analysis. Overall, the ineffectiveness of the BU CRR on the financial stability and the ambiguous conclusion regarding the financial integration can be explained by the following.

First, the BU CRR have ambiguous effects on the financial integration in the EZ depending on the variable chosen to represent it. When it is represented by the cross-border banking positions, the BU CRR have positive effect on the financial integration. This can be explained by the fact that foreign affiliates increase lending following the tightening of sector-specific capital buffers in the countries where their parent banks reside (Franch, Nocciola, Żochowski, 2021). Hence, the BU CRR imply intra-country movements of the lending and cross-border movements which explains why, there is positive variations of the cross-border banking positions when CRR shocks happen.

On the contrary, when financial integration is measured by bond yields, my results show that a BU CRR shock increases the financial integration. According to Claussen, Kriebel and Pfingsten (2018) the costs for banks associated with capital requirements for holding bonds may lead to the demand for a higher compensatory yield. As in the EZ, the capital requirements are homogeneous for all banks, the cost associated to it for holding bonds may also be more homogeneous. The latter would lead banks to have the same behavior inducing a convergent increase demand for government bonds, and hence decreasing bond yields.

Secondly, the BU CRR do not enhance the financial stability. Indeed, they only decrease the NPLs in both pVAR specifications while they have almost never a contracylical effect on the financial cycle.

More precisely, the financial cycle and the NPLs were expected to answer negatively to the CRR shocks. However, the results show that the effect of the CRR shocks on the financial stability is not long-lasting in the second pVAR as their impacts are in the short term only. Plus, NPLs do not always decrease in the second pVAR. In particular, this could be explained by Malherbe's (2020) proposition that there are optimal capital requirements that the financial stability would benefit from. Indeed, when the capital requirements are not at their optimal levels, they tend to exacerbate the economic and financial fluctuations. In this case, the CRR regulation fails to enhance the financial stability and would not be efficient in a crisis context. Another reason explaining the lack of stabilization of the financial system following a positive CRR shock is that the BU is still incomplete. Hence, my investigation suggests that a common system for deposit protection and further measures to tackle the remaining risks of the banking sector would be a first step in order to achieve more financial stability.

Indeed, on the one hand integrated financial markets help enlarge the opportunity sets of lenders and borrowers, increasing competitions in the provision of financial services and offering possibilities to diversify idiosyncratic risks away from the national economies, thereby contributing to financial stability (Carstens, 2019).[37] As a consequence, the BU CRR should not be as restrictive as they are and provide more flexibility in their ratios implementation. In particular, my results suggest that the current CRR ratios tend to decrease the financial stability.

On the other hand, the absence of a complete European Deposit Insurance Scheme prevents the EZ to deepen its financial stability and then from breaking the 'diabolic loop'. For instance, in the US, before the arousal of the FDIC, the multiple banking systems even under regulation acts were not sufficiently stabilized. It is only when a federalization of a deposit insurance scheme was established that the regulation of financial institutions and of the financial market activity was profoundly affected. Belke and Gros (2016) show that the establishment of the FDIC improved the crisis prevention and crisis resolution mechanisms as the United States after about 2009-10, started to recover with financial markets stabilizing early on. Meanwhile, in the EZ, Belke and Gros (2016) demonstrate that the financial crisis was transformed into a regional one with pockets of concentrated tensions and large risk premia on government debts even in countries whose budgets had been in surplus before the subprime crisis such as Ireland or Spain. In other words, the two first pillars are the most advanced in the EZ but they are insufficient if not accompanied with a third pillar consisting in a complete European Deposit Insurance Scheme (EDIS). **The current EDIS is still in its infancy and needs to be improved by setting a set of reforms.**

[37]Speech of Agustín Carstens, General Manager of the BIS, at the Eurofi Financial Forum, Helsinki, 12 September 2019, BIS.

This set of reforms may be elaborated by learning lessons from the US experience.

First, the US experience shows that a high degree of banking integration - cross-border equity based and not cross-border credit based - is a better mechanism of shocks' absorption. For instance, the EZ banking integration is bank based while the US banking integration is market based. Mink and de Haan (2014) show that sometimes larger cross-border financial flows and stocks can be at the origin of a crisis. Hence, instead of setting the increase of cross-border banking positions (credit) as an objective of the CRR, it could be more pertinent to focus on the increase of the cross-border equity. More precisely, 40% of shocks to per capita GDP are smoothed by capital market in the US (Asdrubali, Sorensen, Yosha, 1996). On the other hand, financial markets play the biggest role in smoothing income after shocks in the US (Belke and Gros, 2016). Hence, further research in the EZ should focus on to which extent the financial markets in the EZ can provide for better shock absorption mechanisms.

A second reform may induce that all banks should benefit from the BU pillars. Indeed, currently, only the eligible banks are let to be resolute by the BU which still divides the burden of the banking system between national governments and the BU. By suppressing this rule, one may untighten the sovereign debt-bank link.

A third reform could rely in a first time on basing the EDIS on the FDIC dominant resolution offering from mid-2009 through 2010: the loss-share transaction.[38] According to the book "Crisis and response: an FDIC history, 2008–2013" published

[38]Loss share is a feature that the Federal Deposit Insurance Corporation (FDIC) first introduced into selected purchase and assumption transactions in 1991. Under loss share, the FDIC absorbs a portion of the

by the FDIC in 2017, the loss-share transactions saved $42 billion, or 13.6 percent of total assets, compared with the estimated cost of a payout. In a second time, it could expand into loan pools[39] with or without loss share as well as whole-bank transactions in order to broaden its resolution system. In other words, in the long-run, the EDIS should be able to offer more resolution and financing option to acquirers and hence provide a more reliable solution to break the link between sovereign debt and bank debt.

loss on a specified pool of assets which maximizes asset recoveries and minimizes FDIC losses. Loss share also reduces the FDIC's immediate cash needs, is operationally simpler and more seamless to failed bank customers and moves assets quickly into the private sector.

[39]For more information on loan pools, see section 3.2 of the safety manual (https://www.fdic.gov/regulations/safety/manual/section3-2.pdf)

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Appendix

Appendix 3.A

Table 3.A.1 Results of the panel unit root tests

	CIPS Trend Constant	CIPS Constant	IPS Trend Constant	IPS Constant	LLC Trend Constant	LLC Constant
LR	-2.22	-1.69	-2.13	-0.39	-3.691***	-1.074
Δ LR	-5.038***	-4.854***	-5.016***	-8.345***	-1.046	-7.865***
LCR	-3.071**	-2.273*	0.071	2.237	-2.052**	0.838
Δ LCR	-4.636***	-4.622***	-6.856***	-9.141***	-8.569***	-10.977***
CR	-3.33	-2.17	-1.953	0.136	-2.782	-1.149
Δ CR	-4.128***	-4.052***	-8.294***	-10.11***	-8.837***	-12.554***
NPL	-2.709	-2.464**	2.728	-3.687***	-0.294	-6.579***
CBD	-2.511	-2.34**	-1.48*	1.436	-1.312*	0.394
CdR	-2.107	-1.985	0.009	-1.096	-1.326*	-1.425*
Δ CdR	-4.506***	-4.007***	-7.689***	-9.66***	-12.17***	-11.01***
BY	-2.027	-1.923	-2.735***	2.631	-4.770***	0.829

Note: LLC: Levin.Lin and Chin (2002) test. CIPS: CADF test of Pesaran (2007). IPS : Im. Pesaran and Shin (2003). Lags selected using the AIC criterion. max lag authorized for the variable equals 3. *.**.*** respectively indicate the rejection of the null hypothesis at the 10%. 5% and 1% level. Δ denotes the time series first difference operator.

Appendix 3.B

Table 3.B.1 Descriptive statistics

Variable	N	mean	sd	min	max
NPLs	190	79.17	24.12	26.60	139.2
FC	190	-0.0627	0.0724	-0.282	0.0816
BC	190	0.00393	0.0328	-0.186	0.0680
LR	190	6.169	1.464	4.239	10.57
LCR	190	156.1	26.36	122.6	275.5
CR	190	18.85	2.805	11.00	24.79
BY	190	0.624	0.853	-0.613	3.993
CBD	190	10.85	0.583	9.594	11.58
Crisk	190	42.30	15.53	13.61	63.09
Spread	190	2.379	0.937	1.232	4.756

Source: Author's calculations

Appendix 3.C

Table 3.C.1 Hansen coefficients

PVAR_CBD	PVAR_Crisk	PVAR_BY
0.20	0.25	0.24

Table 3.C.2 Eigenvalues coefficient of stability

PVAR_CBD	PVAR_Crisk	PVAR_BY
Stability	Stability	Stability
0.91	0.84	0.94
0.74	0.65	0.94
0.74	0.65	0.92
0.66	0.25	0.75
0.46	0.28	0.28
0.30	0.08	0.28
0.10	0.03	0.23

Source: Author's calculations

Table 3.C.3 Robustness checks: Eigenvalues coefficient of stability

PVAR_CBD	PVAR_BY
Stability	Stability
0.91	0.94
0.74	0.94
0.74	0.92
0.66	0.75
0.46	0.28
0.30	0.28
0.10	0.23

Source: Author's calculations

Appendix 3.D

Table 3.D.1 FVED of pVAR including credit risk

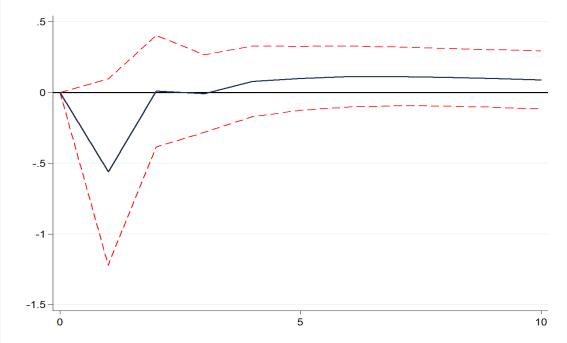
	Credit Risk			NPLs		
	CR	**LR**	**LCR**	**CR**	**LR**	**LCR**
0	0%	0%	0%	0	0	0
1	0%	0%	0%	0	0	0
2	1%	0%	0%	1%	0%	0%
3	1%	0%	0%	1%	0%	0%
4	**1%**	0%	0%	1%	0%	0%
5	1%	0%	0%	1%	0%	0%
6	1%	0%	0%	1%	0%	0%
7	1%	0%	0%	1%	0%	0%
8	1%	0%	0%	1%	0%	0%
9	1%	0%	0%	1%	0%	0%
10	1%	0%	0%	1%	0%	0%

	FC			BC		
	CR	**LR**	**LCR**	**CR**	**LR**	**LCR**
0	0%	0%	0%	0%	0%	0%
1	0%	0%	0%	0%	0%	0%
2	0%	0%	1%	0%	0%	0%
3	0%	0%	1%	0%	0%	0%
4	0%	0%	1%	0%	0%	0%
5	0%	0%	1%	0%	0%	0%
6	0%	0%	1%	0%	0%	0%
7	0%	0%	1%	0%	0%	0%
8	0%	0%	1%	0%	0%	0%
9	0%	0%	1%	0%	0%	0%
10	0%	0%	1%	0%	0%	0%

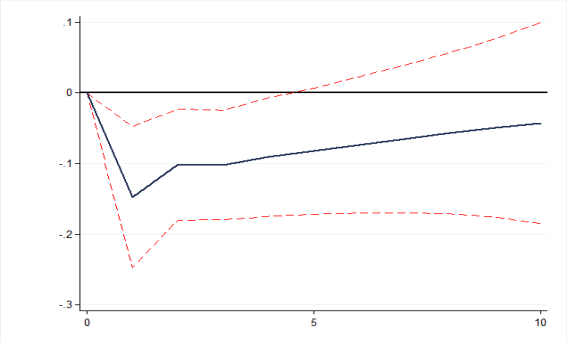
Appendix 3.E

Figure 3.E.1: Response to a Capital Ratio Shock (Credit risks)

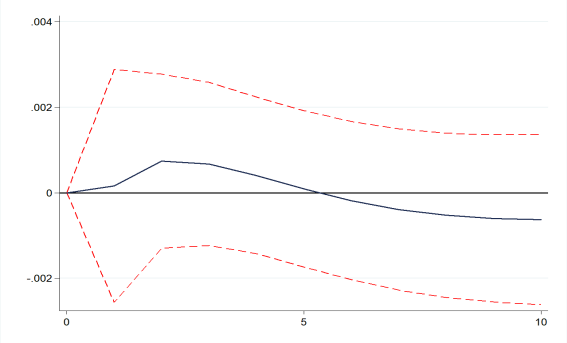
(a) Response of non-performing loans



(b) Response of credit risks



Response of Financial Cycle



Response of Business Cycle

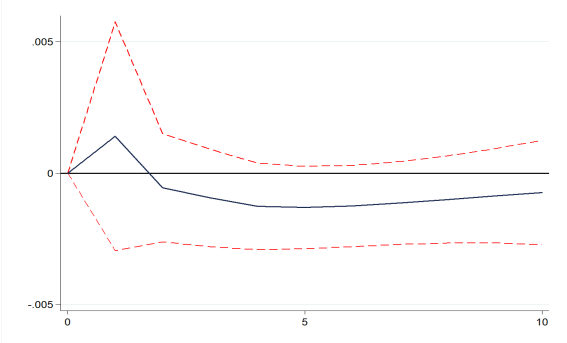
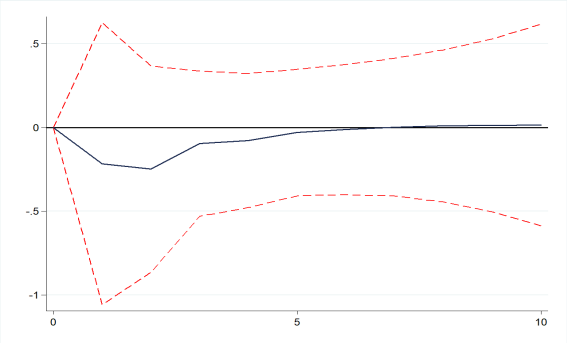
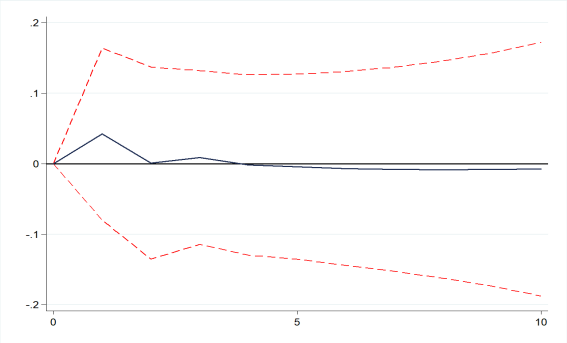


Figure 3.E.2: Response to a Liquidity Coverage Ratio Shock (Credit risks)

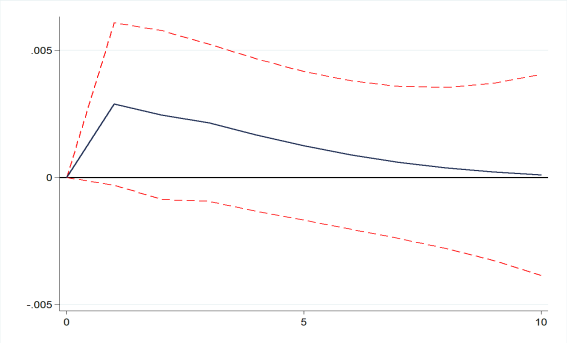
(a) Response of non-performing loans



(b) Response of credit risks



Response of Financial Cycle



Response of Business Cycle

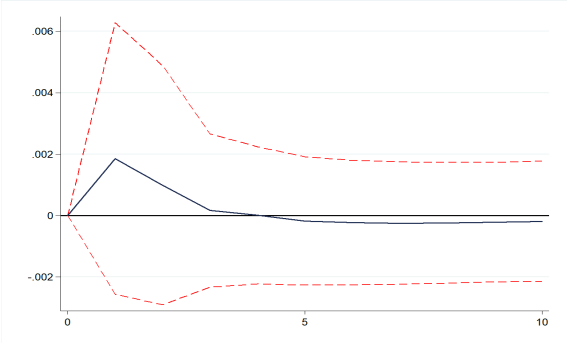
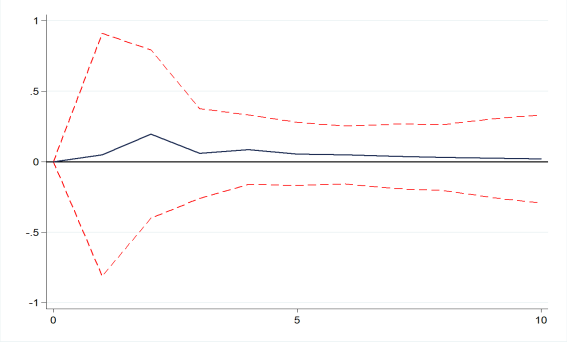
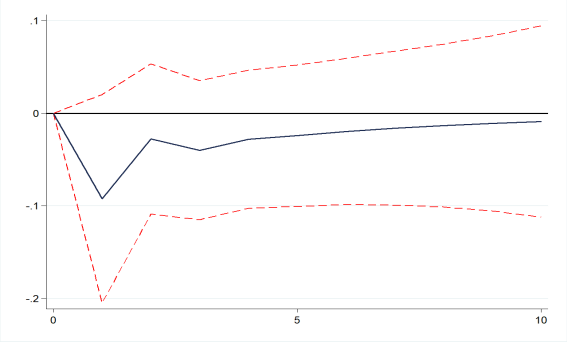


Figure 3.E.3: Response to a Liquidity Ratio Shock (Credit risks)

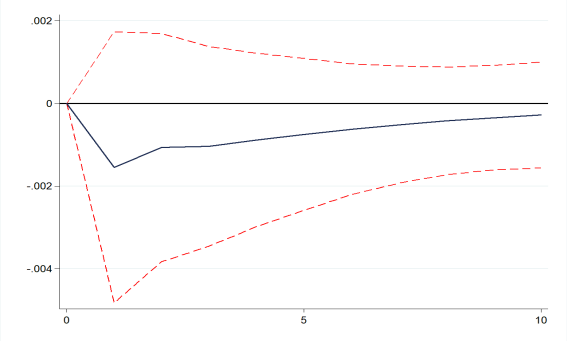
(a) Response of non-performing loans



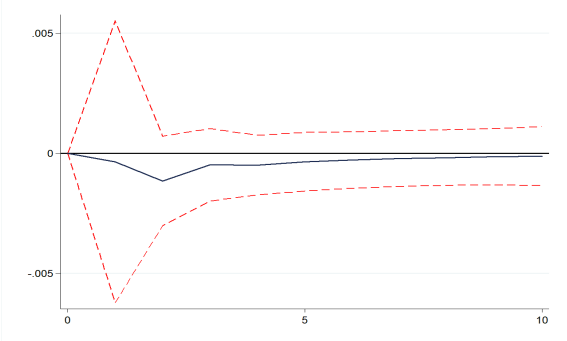
(b) Response of credit risks



Response of Financial Cycle



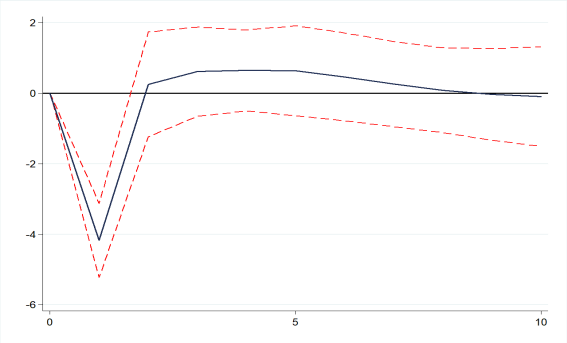
Response of Business Cycle



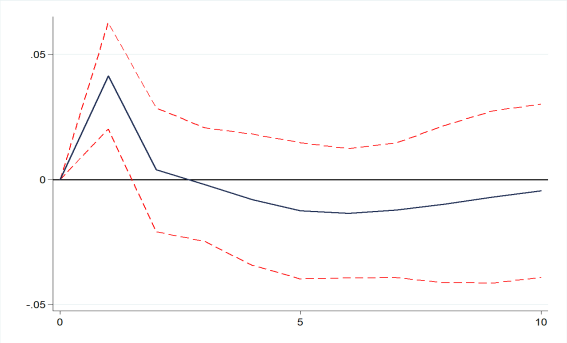
Appendix 3.F

Figure 3.F.1: Robustness checks: response to a Capital Ratio Shock (pVAR-1)

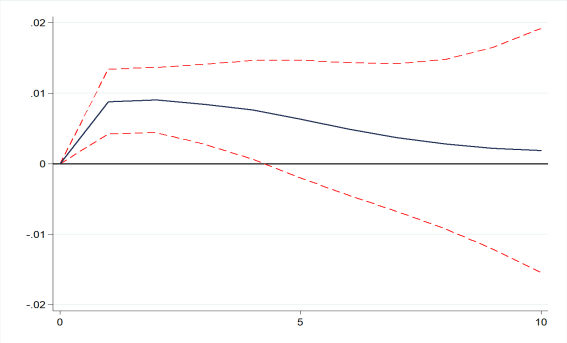
Response of non-performing loans



Response of Cross-border



Response of Financial Cycle



Response of Business Cycle

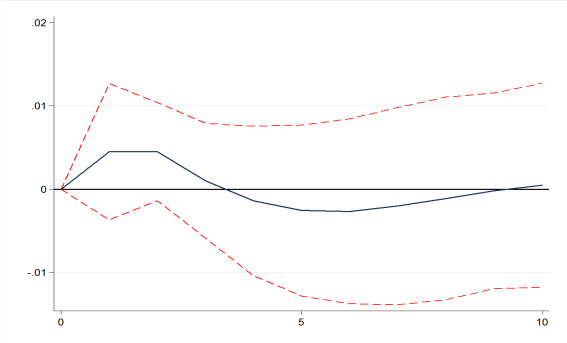
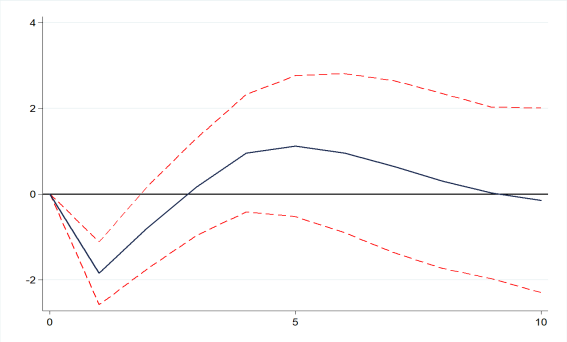
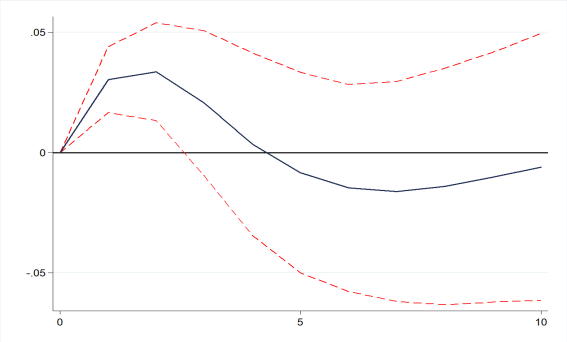


Figure 3.F.2: Robustness checks: response to a Liquidity Coverage Ratio Shock (pVAR-1)

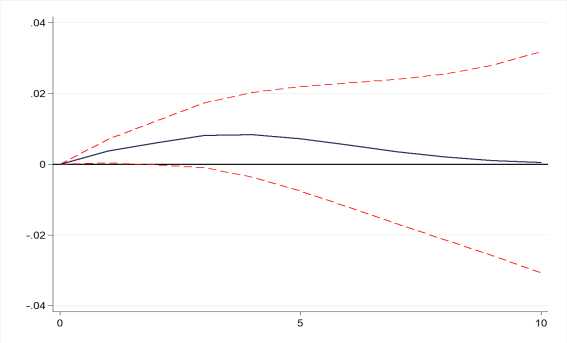
Response of non-performing loans



Response of Cross-border



Robustness checks: response of Financial Cycle



Response of Business Cycle

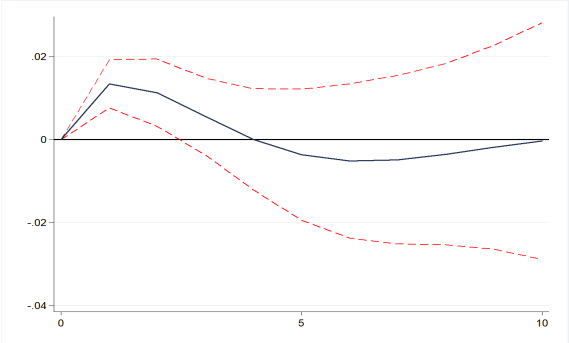
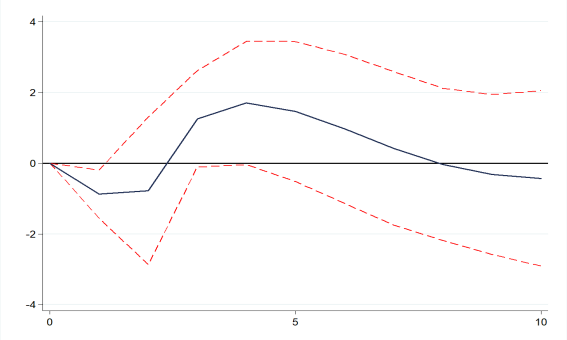
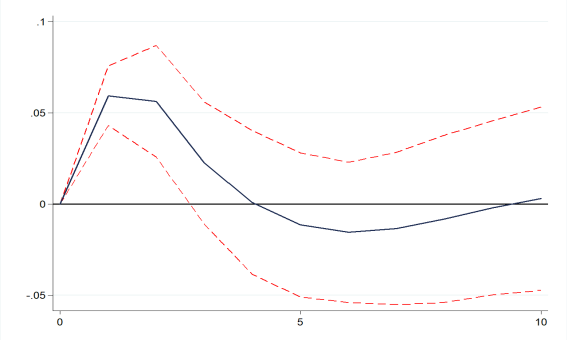


Figure 3.F.3: Robustness checks: response to a Liquidity Ratio Shock (pVAR-1)

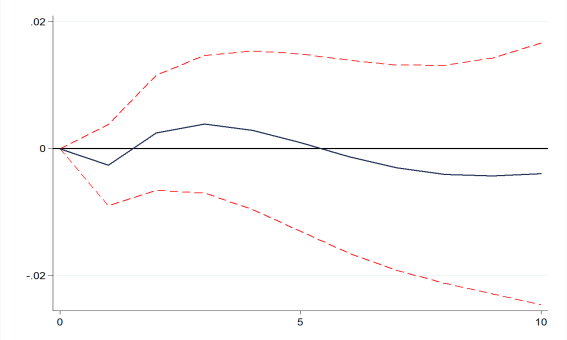
Response of non-performing loans



Response of Cross-border



Response of Financial Cycle



Response of Business Cycle

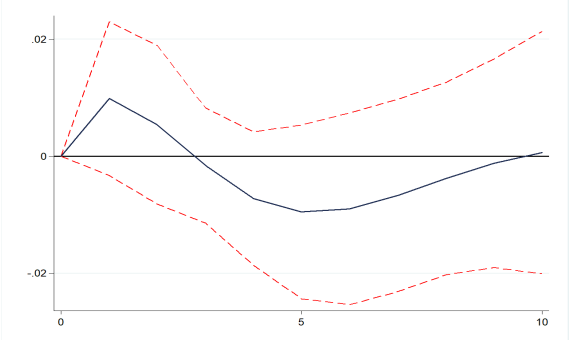
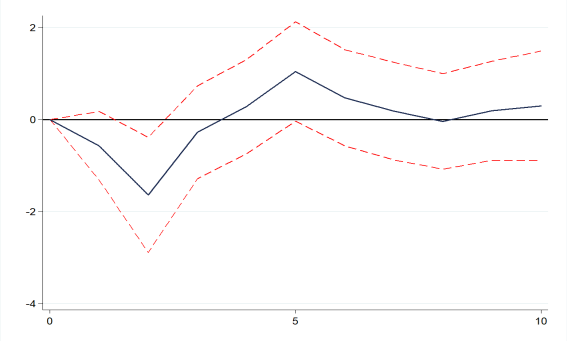
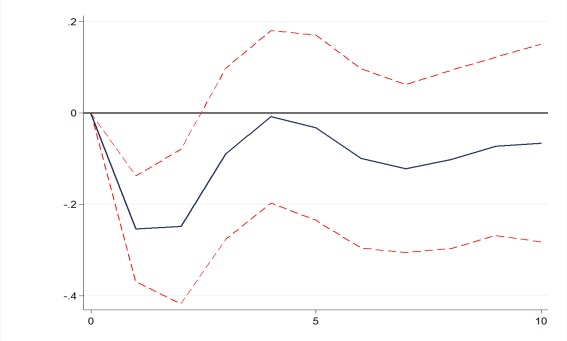


Figure 3.F.4: Robustness checks: response to a Capital Ratio Shock (pVAR-2)

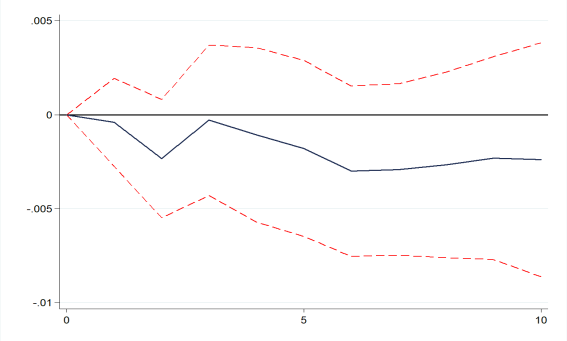
Response of non-performing loans



Response of bond yields



Response of Financial Cycle



Response of Business Cycle

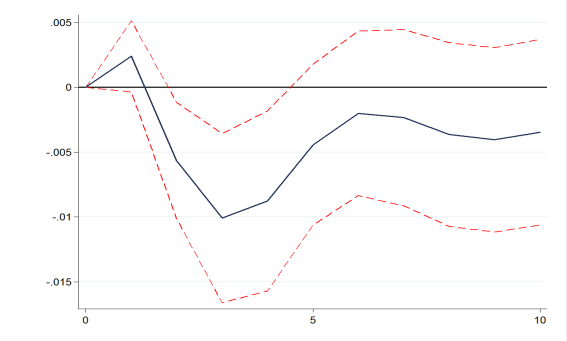
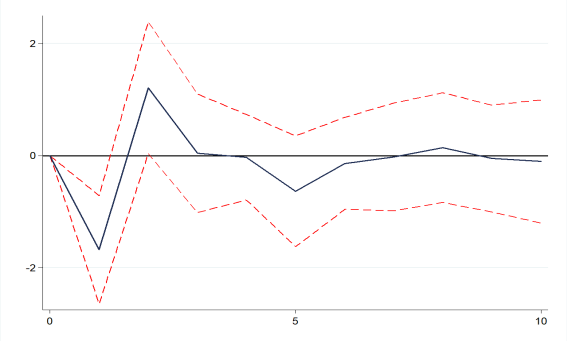
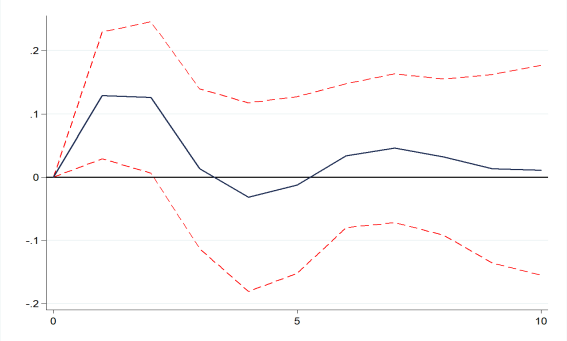


Figure 3.F.5: Robustness checks: response to a Liquidity Coverage Ratio Shock (pVAR-2)

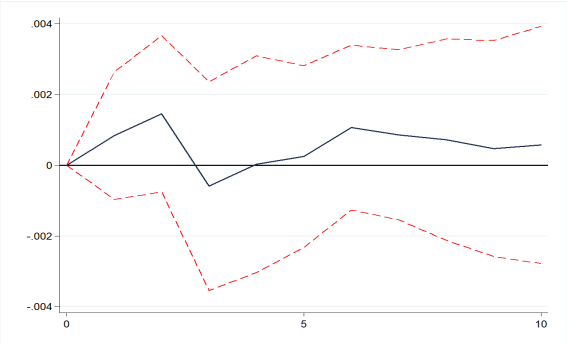
Response of non-performing loans



Response of bond yields



Response of Financial Cycle



Response of Business Cycle

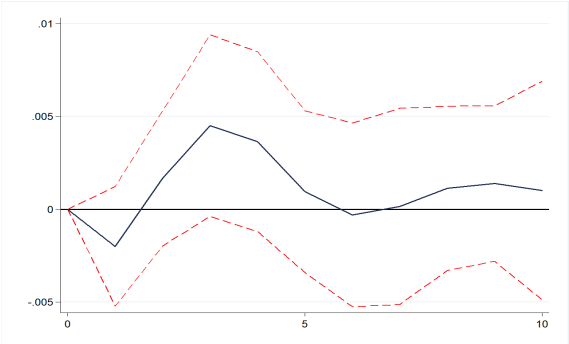
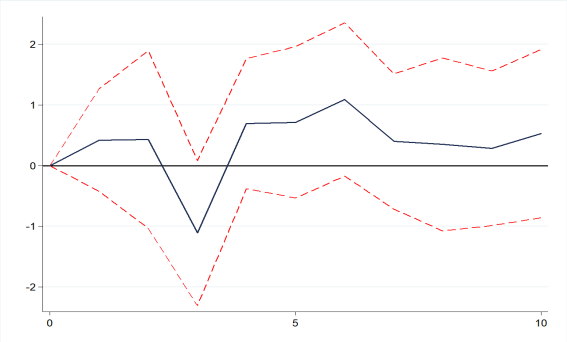
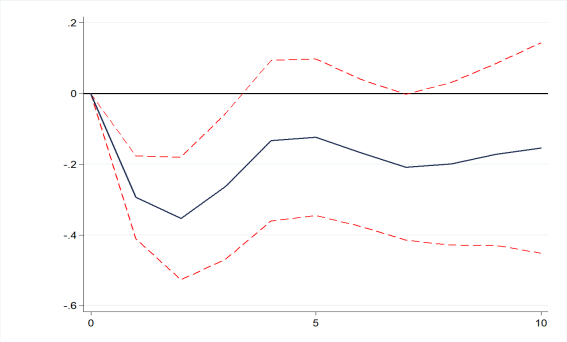


Figure 3.F.6: Robustness checks: response to a Liquidity Ratio Shock (pVAR-2)

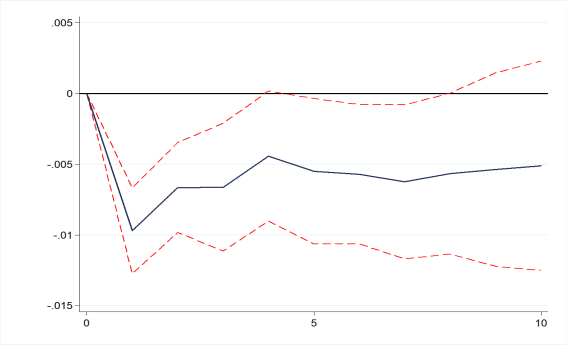
Response of non-performing loans



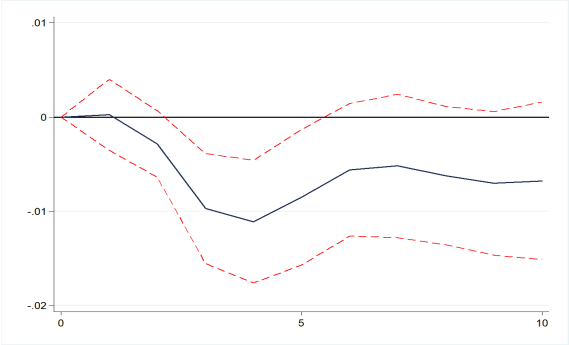
Response of bond yields



Response of Financial Cycle



Response of Business Cycle



Conclusion générale

Les récentes et multiples crises ayant impacté la zone euro ont mis en exergue l'urgence pour les pays de la zone euro de mieux se coordonner afin de mettre en place des mécanismes susceptibles de pallier les insuffisances d'une politique monétaire unique. Une politique monétaire unique ne peut, en effet, répondre aux besoins ciblés de chaque économie en particulier dans la zone euro où les politiques budgétaires restent toujours contraintes par le pacte de stabilité et de croissance.

Aussi, dans cette thèse, nous avons cherché à évaluer l'ampleur du processus d'intégration économique et financière des pays européens. Nous avons montré le degré d'hétérogénéité dans la zone euro et analysé les sources de divergences structurelles au sein de cette dernière. Enfin, nous avons cherché à savoir dans quelle mesure le premier pilier de l'Union bancaire favoriserait un accroissement de l'intégration financière et économique au sein de la zone euro. Nous avons à travers ces trois questions mis en évidence à la fois le degré de divergence dans la zone euro et nous avons proposé des moyens de pallier ces divergences afin de permettre à la politique monétaire de jouer son rôle contracyclique.

Plus précisément, dans le premier chapitre, nous avons examiné le processus de convergence au sein de la zone euro à travers l'étude des fréquences des cycles financiers et économiques

au cours du temps. Pour cela, nous avons utilisé une transformée en ondelettes discrètes (MODWT) afin d'analyser si les cycles financiers, d'une part et les cycles économiques, d'autre part sont synchronisés, interconnectés, interdépendants et covariants au cours du temps et ce à travers les fréquences inter-pays et intra-pays. Nos résultats démontrent que : une fois le degré de convergence établi, il est crucial d'évaluer par quels canaux les fluctuations macroéconomiques sont impactées car les divergences en termes d'amplitudes à chaque phase des cycles empêchent la politique monétaire d'être efficace. Nous avons montré que : (i) les pays de la zone euro sont majoritairement divergents à court terme ; (ii) la politique monétaire a conduit à une période de boom entre 2002 et 2006 qui a masqué les divergences déjà existantes dans la zone euro ; (iii) les cycles économiques et financiers se sont développés dans un environnement macroéconomique et financier idiosyncratique, ce qui a conduit à une aggravation des divergences ; (iv) le manque de synchronisation à toutes les fréquences et dans le temps intra-pays et inter-pays a empêché la politique monétaire de jouer pleinement son rôle contracyclique.

Dans un deuxième chapitre, nous avons évalué si les chocs de variables financières sont une source d'amplification et de propagation des fluctuations macroéconomiques et s'ils se transmettent à une échelle internationale. A l'aide d'un modèle GVAR (Global Vector Autoregressive), nos résultats montrent que : (i) les chocs de crédit privé aux États-Unis exercent des effets de débordements internationaux importants alors que la transmission financière des chocs au sein des régions de la zone euro reste circonscrite à l'échelle régionale ; (ii) le cours des actions n'est pas étroitement lié au cycle économique des pays situés au cœur de la zone euro ; (iii) les chocs financiers américains exercent un impact global alors que ceux de la zone euro ont un impact plus régional; (iv) Enfin, nos résultats suggèrent que les mécanismes d'accélérateur financier sont faiblement présents au sein de la zone euro.

En conséquence, la politique monétaire de la zone euro ne peut pas être efficace car elle fait face à des chocs régionaux et internationaux. De ce fait, une amélioration de la stabilité financière et du processus d'intégration semble souhaitable car elle entraînerait une meilleure synchronisation des fluctuations macroéconomiques au sein de la zone euro et des réponses de la politique monétaire plus adaptées à l'ensemble des pays membres. Les exigences en matière de fonds propres applicables aux banques établies par l'Union bancaire européenne afin de stabiliser le système financier, d'améliorer l'intégration financière et d'éviter que les chocs externes influencent le système financier interne de la zone euro, devraient permettre, à terme, à la politique monétaire d'être efficace.

Enfin, dans un troisième chapitre, nous avons examiné si les « *capital requirement regulation I and II* » fixés par l'Union bancaire européenne améliorent l'intégration financière et la stabilité financière dans la zone euro. Pour ce faire, nous comparons deux ensembles de fonctions de réponse impulsionnelle issus de deux modèles vectoriels autorégressifs estimés en panel. Dans ces modèles, la stabilité financière est représentée par un indicateur de cycle financier et par les prêts non productifs; le secteur réel est représenté par le cycle économique ; et l'intégration financière par les positions bancaires transfrontalières dans une première spécification et par les rendements obligataires dans une seconde spécification. Nos résultats démontrent que le règlement sur les exigences de fonds propres de l'Union bancaire améliore l'intégration financière mais n'augmente pas le degré de stabilité financière. Par conséquent, il ne sert pas son objectif initial : stabiliser le système financier et corriger la fragmentation financière qui a suivi la crise financière.

Au terme de cette thèse, les trois chapitres concluent à la nécessité d'améliorer les mécanismes entourant la conduite de la politique monétaire en zone euro. A cet égard, plusieurs pistes de recherche sont envisageables. Tout d'abord, et dans le prolongement de nos travaux de

recherche, il serait intéressant d'étudier la possibilité de mécanismes de transferts des pays créditeurs vers les pays débiteurs. En effet, comme l'ont montré De Grauwe et Moesen (2009), les pays dont les situations financières étaient créditrices ont, en réalité, largement bénéficié des pays dont les situations financières étaient en déficit. Ainsi, un mécanisme de transfert financier entre ces deux types de pays permettrait de contrebalancer les déséquilibres financiers entre les pays membres. Etudier les modalités du cadre dans lequel une telle mesure pourrait s'appliquer mais également vérifier empiriquement si une telle mesure serait bénéfique à l'ensemble de la zone sera l'objet de futures recherches. En particulier, il serait opportun d'étudier ce type de mécanisme à la lumière d'analyses temporelle et fréquentielle afin d'identifier le plus précisément possible l'efficacité de ce type de mesure.

Le deuxième chapitre, conclut quant à lui, sur l'importance d'accroître le degré d'intégration financière dans la zone euro afin de diminuer l'impact de chocs financiers extra-européens sur la zone euro. Lors de l'élaboration de nos trois chapitres, nous avons constaté qu'il n'existait pas d'indicateur d'intégration financière par pays. L'intégration financière est mesurée à l'échelle de la zone euro, c'est-à-dire de manière agrégée. Nous ne disposons donc pas d'indicateurs permettant d'établir quels sont les pays les moins intégrés en comparaison à ceux qui le sont le plus. Le développement d'un indicateur d'intégration financière par pays apparaît donc comme une piste de recherche pertinente puisqu'un certain nombre de mécanismes mis en place dans la zone euro a pour objectif d'accroître l'intégration financière entre les pays membres.

Enfin, une troisième piste de recherche concerne l'Union bancaire et ses canaux de transmission. Nous avons étudié dans cette thèse l'impact du premier pilier de l'Union bancaire sur la stabilité et l'intégration financière. Une autre possibilité serait d'étudier si la mise en place de l'Union bancaire en tant que mécanisme d'intégration bancaire dans une Union

Economique et Monétaire serait efficace. En effet, les leçons tirées des Etats-Unis démontrent que la fin de l'instabilité monétaire et financière a été permise par la mise en place de l'Union bancaire sur le territoire. En particulier, Belke et Gros (2007, 2015) démontrent l'importance de l'Union bancaire dans l'absorption des chocs au sein d'une Union monétaire. Ces derniers analysent la gestion de la crise financière de 2007 en Union Européenne et aux Etats-Unis et démontrent que des Etats américains (*e.g.* la Floride), dont les structures économiques et financières sont similaires à des pays Européens (*e.g.* l'Espagne), n'ont pas connu de crises de dette souveraine comme celles survenues en zone euro. Ils soulignent aussi que l'Union bancaire (Government Sponsored Enterprise (GSEs) et Federal Deposit Insurance Corporation (FDIC)) induit des mécanismes d'absorption des chocs financiers. Une limite importante de ces études est l'absence d'analyse économétrique permettant une démonstration rigoureuse des arguments avancés. C'est pourquoi, de futurs travaux de recherche pourraient mesurer si l'existence d'une Union bancaire en zone euro aurait permis une meilleure absorption des chocs durant la crise de 2007.

En outre, comparer ces deux Unions monétaires permettrait d'expliquer les raisons pour lesquelles la phase de reprise aux Etats-Unis a eu lieu plus rapidement qu'en zone euro. En effet, la crise financière de 2007 a mis en lumière les défauts de construction de la zone euro. Cette crise a notamment mené à (i) des pertes bancaires importantes : de nombreuses banques commerciales ont perdu de l'argent en raison de leur exposition aux créances irrécouvrables aux Etats-Unis (c'est-à-dire les prêts hypothécaires à risque) ; (ii) une récession : la baisse des prêts et des investissements bancaires a entrainé une grave récession mais aussi une augmentation rapide de la dette publique ; (iii) une chute des prix immobiliers, ces derniers étant fortement corrélés au crédit. Si ces phénomènes se sont également produits aux Etats-Unis, ils n'ont pas eu des conséquences similaires à celles observées au sein de la zone euro.

Contrairement à la zone euro, les marchés et le système bancaire américains se sont rétablis rapidement à la suite de la crise financière mondiale (Belke et Gros, 2015). De plus, les Etats-Unis n'ont pas connu de renflouement financier aussi important qu'en zone euro. Aussi, il serait intéressant de s'interroger sur la ou les raisons pour lesquelles ces deux Unions monétaires ont connu des expériences différentes alors même qu'elles ont subi le même choc. En particulier, lorsque la crise financière globale a induit d'énormes pertes pour l'État du Nevada, la FDIC[1] a absorbé les pertes du système bancaire local à hauteur d'environ 30% du produit intérieur brut de l'État. Ainsi, l'Etat du Nevada n'a pas eu besoin de renflouer les banques et a pu éviter la création d'une dette souveraine (Belke et Gros, 2015). D'autre part, Frame et Wall (2002) expliquent que les GSEs jouent un rôle central sur les marchés américains du financement du logement. Selon eux, les GSEs assurent près de trois milliards de dollars d'actifs principalement liés aux hypothèques[2]. Etant donné le rôle majeur joué par le secteur immobilier dans la formation de la crise financière mondiale, il apparaît crucial d'étudier l'impact de la création d'une telle institution au sein de la zone euro.

Il en résulte que l'Union bancaire et la FDIC (dont l'équivalent est la EIDS en zone euro) auraient pu être des freins à l'accumulation de dettes souveraines en Zone Euro et vecteur d'absorption des chocs. L'Union bancaire pourrait ainsi être examinée dans le cadre de futurs travaux de recherche dans lesquels une analyse contrefactuelle entre les Etats-Unis et la zone euro serait implémentée afin de déterminer si l'Union bancaire a une réelle capacité d'absorption des chocs dans une Union monétaire.

[1]La FDIC consiste en un mécanisme et un fonds commun à la fois pour l'assurance des dépôts et la résolution (Belke et Gros, (2015)). Il vient achever la création de l'Union bancaire en 1933 par le biais du « Banking Act » et est complété par le GSEs.

[2]Plus précisément, Frame et Wall (2002) soulignent que « les GSE ont été créés pour améliorer la disponibilité du financement hypothécaire en complétant le financement local par celui des marchés financiers nationaux ».

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