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**Macroprudential policy in the Euro Area: does cross country and banking heterogeneity matters?**

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Master in Economics

Supervisor:
Professor Diptes Chandrakante Prabhudas Bhimjee, Invited Assistant Professor, ISCTE Business School, ISCTE-IUL

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ISCTE BUSINESS SCHOOL

ISCTE CIÊNCIAS SOCIAIS E HUMANAS

Department of Economics, Department of Political Economy

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“The ideas of economists and political philosophers, both when they are right and when they are wrong are more powerful than is commonly understood. Indeed, the world is ruled by little else. Practical men, who believe themselves to be quite exempt from any intellectual influences, are usually slaves of some defunct economist.”

John Maynard Keynes (1883-1946) - *The General Theory of Employment, Interest and Money* (1936)

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## Resumo

A presente Dissertação aborda a forma como a heterogeneidade entre países e bancos afeta a elaboração e implementação de um determinado enquadramento de política macroprudencial na Zona Euro.

Para o efeito, recorreu-se a métodos de estimação econométrica de dados em painel, usando dados trimestrais, entre 2015 e 2019, de 12 países da Zona Euro, tendo como fontes o BIS, o BCE, e o Eurostat, relacionados com o crédito concedido ao setor não financeiro (particulares e sociedades não financeiras) e os seus principais fatores explicativos, tendo em consideração a literatura existente.

Averiguou-se quais os efeitos dos indicadores de capital dos bancos, de acordo com os critérios de Basileia III, de liquidez, de alavancagem, risco de crédito, dimensão media das instituições bancárias, taxa de juro aplicada aos agentes económicos não financeiros, preço dos ativos imobiliários, agregados monetários e comportamento do PIB na concessão de crédito bancário. Além disso, foram implementados testes de robustez e estudados possíveis efeitos não lineares associados às variáveis explicativas.

Os resultados da presente Dissertação permitem concluir que diferentes fatores influenciam o crédito concedido às famílias e às sociedades não financeiras, pelo que possíveis medidas que têm como objetivo combater o crescimento excessivo do endividamento do setor não financeiro devem ter objetivos muito concretos, evitando abordagens genéricas.

Conclui-se igualmente pela existência de efeitos não-lineares para a evolução do crédito concedido, reforçando o argumento de que um futuro cenário de políticas macroprudenciais na Zona Euro deve considerar as heterogeneidades entre Estados Membros e os seus correspondentes sistemas bancários.

Palavras-chave: Política macroprudencial, Zona Euro, Estabilidade Financeira, Basileia III, dados em painel

Classificação JEL: E51, F33

## Abstract

The following Dissertation addresses how cross country and banking heterogeneity affects the design and implementation of a given macroprudential policy framework in the Euro Area.

Panel data econometric methods to quarterly data collected from 12 Euro Area Member States, from 2015 up to 2019, from the BIS, ECB, and Eurostat databases were employed. The extracted variables are related to credit lent to the non-financial sector (households and non-financial firms) and their corresponding main drivers, according to the literature related to financial stability topics.

It was explored the effects of bank's capital indicators, following the criteria established from the Basel III accords, namely liquidity, leverage, credit risk, bank's average size, interest rate charged to non-financial economic agents, real estate asset prices, monetary aggregates and business cycle on bank lending dynamics. Furthermore, robustness checks and the possible non-linear effects of the explanatory variables described previously were also tested.

The findings state that different factors influence credit dynamics on households and non-financial firms, reflecting that possible measures that have the main goal of controlling excessive credit growth must be well-targeted, in order to avoid general approaches.

Moreover, the existence of non-linear effects on the variables statistically significant to explain credit flows was observed, showing that a future macroprudential policy framework for the Euro Area must consider cross country and banking heterogeneity among Member States.



Keywords: Macroprudential policy, Euro Area, Financial Stability, Basel III, panel data

JEL Classification: E51, F33

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## Glossary

BIS – Bank for International Settlements

CCB – Countercyclical Capital Buffer

DSGE – Dynamic Stochastic General Equilibrium

DTSI – Debt-to-service income

EBA - European Banking Authority

EBITDA – Earnings Before Interest, Taxes, Depreciation and Amortization

ECB - European Central Bank

ESA – European System of Accounts

ESRB – European Systemic Risk Board

GDP – Gross Domestic Product

IMF – International Monetary Fund

NCB – National Central Bank

QE- Quantitative Easing

SSM – Single Supervision Mechanism

SRM – Single Resolution Mechanism

# 1. Introduction

Since the Global Financial Crisis and the subsequent Sovereign Debt Crisis, which threatened the survival of the Euro and, in consequence, the whole European Integration process, macroprudential policy has gained an increasing role in academic and policy debates regarding the promotion of financial stability issues, especially where the interconnectedness between banking and financial markets and the real economy is concerned.

Moreover, international organisations such as the ECB, BIS and IMF have thoroughly explored the role of developments in many asset markets (such as the real estate or securities markets), and its impact on credit flows, not only on individual countries but also taking into consideration cross-country effects. Prior to the above-mentioned crises, the main idea had been that the price stability goal, using the interest rate policy tool to achieve that goal, was enough to control risks that might threaten macroeconomic stability. The referred crisis events described previously thoroughly refuted it.

Indeed, there is now a consensus that it revolves around the notion that there must be a sort of policies that have as the main goal to spur financial stability

Even thought, the design and implementation of a given macroprudential policy framework in a Monetary Union remain a topic of crucial importance and debate, not only on academia but also on political agenda.

If some argue that, since countries share the same monetary policy and they are economically and financially integrated, a given macroprudential policy arrangement must have the utmost degree of coordination to avoid negative spillovers between Member States and promote monetary policy efficiency and effectiveness, others say that cross-country and banking heterogeneity remains a crucial point to justify that countries should have a certain degree of freedom to implement policies that better fit their specific economic and financial situations.

Against this background, the main question that this Dissertation answers is the following: To what extent does cross-country and banking heterogeneity matter for macroprudential policy design and implementation in a Monetary Union?

The literature review firmly shows the importance of the said research question, presenting arguments for the increasing importance of the linkages between the financial sector and the real economy and the main causes and consequences of the Sovereign Debt Crisis. On the other hand, the increasing importance of macroprudential policy and its developments on the Euro Area are also discussed, as well as a debate of possible macroprudential policy frameworks in a Monetary Union. In the end, theoretical and empirical evidence related to the implementation of certain policy instruments that have as main goal the promotion of financial stability is also discussed.

The Dissertation's empirical strategy uses panel data estimation, using data collected for 12 Euro Area Member States between the first quarter of 2015 and the last quarter of 2019. The data sources are quite varied, including the: (i) BIS Macroprudential Database; (ii) ECB Statistical Data Warehouse; (iii) Eurostat. The variables include: (i) banking credit; (ii) bank capital; (iii) credit risk indicators; (iv) liquidity and leverage indicators; (v) the interest rate charged to non-financial economic agents; (vi) housing prices; (vii) monetary aggregates; and (viii) GDP growth

A panel-data econometric analysis is performed (using STATA), which include the estimation of essential statistical tests before the main regression results are presented. Moreover, robustness checks are also conducted in order to verify for possible nonlinear effects on credit dynamics.

The main findings suggest that different factors affect credit dynamics on households and non-financial firms. Banks' average size, real estate prices and interest rate are the main determinants of household's credit dynamics, while capital indicators seem to be the main driver of non-financial firm's credit lent by Banks. Robustness checks are also conducted in order to confirm the baseline findings. Further policy recommendations are also discussed.

Moreover, the presence of non-linear effects of banks' average size, interest rate, business cycle fluctuation, and capital indicators demonstrate that cross-country and banking heterogeneity presents a pivotal role in the debate of macroprudential policy in a Monetary Union (like the Euro Area).

The present Dissertation is structured as follows: section 2 reviews the main literature relevant to the research question; section 3 presents the dataset used in the Dissertation, its main sources, some summary statistics and the main statistical tests; it also describes the methodology used to answer to the Dissertation's research question;  section 4 presents the main findings, while critically discussing these results and the corresponding policy implications, appropriately contextualized within the main arguments of the major literature regarding bank's lending operations and financial stability topics; the section also discusses the implemented robustness checks and the possible non-linear effects and their main implications for macroprudential policy framework debates on the Euro Area; section 6 concludes

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# 2. Literature Review

## 2.1. The linkages between the financial sector and the real economy

Prior to addressing the main literature addressing the Dissertation's research topic, it should be noted that there are strong linkages between the real and financial sectors, and monetary policy might be unable, in certain circumstances, to deal with financial shocks, as this type of event typically tends to be the main cause of business cycle fluctuations over the years. Moreover, the effects of these shocks are typically not symmetric among countries, even if they share the same monetary policy standards.

Therefore, economic theory has given increasing importance to these important research topics, providing a more accurate analysis of business cycle fluctuations, their causes and consequences, and how to deal with these fluctuations (Cerutti, Claessens and Laeven, 2015).

For a considerable period, financial stocks were assumed to be exogenous to the real economy, and developments in the financial sector might not affect the real economy at all (Allen and Gale, 1998). The onset of US. 'Subprime' Crisis and the ensuing global economic recession in the preceding decade demonstrates the lack of accuracy associated with this notion.

This line of argument suggesting the exogeneity of financial shocks has since been questioned since these shocks tend to have a sort of endogeneity caused by the increasing complexity of the financial system, its linkages to the real sector, and the role of market interventions and regulations, which are all crucial to explain the major developments related to the financial system (Minsky, 1999).

In addition, there is an amplifying effect of the financial shocks that cause business cycle fluctuations, due to developments in credit markets, given the endogeneity of these markets' influence. This is justified by the existence of borrowing constraints that different types of agents may face (Bernanke, Gilchrist and Gertler, 1998).

Moreover, the housing sector can be a very important source to explain the impact of financial frictions to the real economy, due to the impact on agents' collateral value, borrowing constraints, credit flows, investment, consumption and, in a broad sense, on economic output (Iacoviello, 2005).

### 2.2. The Sovereign Debt Crisis: causes and consequences

Even with a single currency, business cycle synchronization among the different Euro Area Member States is not complete, as was demonstrable by the Sovereign Debt Crisis. Indeed, financial factors are an important source to understand the causes and consequences of a crisis that threatened the Euro as a single currency, and even the sustainability of the European Integration process, in a broad sense. Countries were affected unequally due to structural differences among them, which had been reinforced over the years preceding the Crisis (Merler, 2015).

The accumulation of macroeconomic imbalances, mainly associated with increasing and persisting current account deficits, as well as the indebtedness trajectories that occurred in some Member States, happened in a period of macroeconomic stability, with an inflation rate stabilized around 2%, and a real convergence process well underway.

Nevertheless, this also entailed that there was a 'catching up' process whereby poorer countries try to reach the overall income levels associated with the richest ones, in terms of GDP per capita, and, throughout this process, borrowing costs became smaller for all Member States and all economic agents (households, firms, governments). Moreover, the onset of many asset bubbles, mainly in the real estate sector, fed the virtuous cycle of economic growth that was observable at that time, namely, for example, the speculation phenomenon that occurred in the Spanish and Irish real estate markets (Merler, 2015).

When the global recession materialized, the Member States that presented clear evidence of weaknesses in their macroeconomic environment - with their high level of public indebtedness (measured in terms of GDP), public account deficits and current account deficits - were the first to feel the harsh effects of a sudden increase in financing costs associated with their corresponding public debts, subsequently facing a slower GDP growth, stagnation, or even, in the worst scenario, a recession (Merler, 2015).

In the end, some of these Member States were forced to ask for international financial assistance in order to avoid the collapse of their corresponding financial sectors and real economies.

The implosion of the asset bubbles that had previously been created many years before had transformed into a major financial problem to multiple economic agents, in terms of their ability to fulfil their financial obligations (Merler, 2015). In sum, structural macroeconomic differences among the Member States ended up being reinforced throughout the Sovereign Debt Crisis, threatening the stability of the Eurozone.

On the other hand, the existence of multiple differences among banking and financial sectors that operate by different legal and economic contexts has also become a crucial point of discussion, when examining asymmetries between the Member States in a Monetary Union, especially taking into consideration the impact these shocks have on the trajectory of business cycle fluctuations (Bokan et al., 2018).

### 2.3. The increasing importance of macroprudential policy

In order to avoid the accumulation of risks that might threaten financial stability (with significant spillovers to the macroeconomy), macroprudential policies have been gaining increasing importance in the academic and economic policy debate domains.

This is especially relevant in the aftermath of the bankruptcy of Lehman Brothers, which visibly prompted the dispersion of the economic/financial impact associated with the economic and financial crisis that spread across the world in the preceding decade, as well as the increasing interdependence of the real economy and financial sectors. It is important to refer that this type of policies has been implemented over the years, mainly in developing economies that had a substantial exposure to exchange rate movements, as was the case with almost all Latin American and Eastern European countries (Akinci and Olmstead-Rumsey, 2015).

Indeed, the effectiveness of these policies is well demonstrated by the states of these economies, since their financial systems do not have the same degree of development and complexity when compared to the case of more advanced economies (Akinci and Olmstead-

Rumsey 2015). Moreover, there is also room to explore policies that try to prevent the onset of asset bubbles (e.g., in the real estate sector), since these macroprudential policies tends to originate quite positive outcomes (Akinci and Olmstead-Rumsey, 2015).

Although macroprudential policies are implemented in an *ex-ante* scenario, that is, to avoid the accumulation of risks in the financial sector which may have substantial effects on the real economy, *ex-post* macroprudential policies, the ones that are implemented when risks actually materialize, present better outcomes comparing to the former (Benigno et al., 2013).

Even if there are positive outcomes concerning lower volatility in terms of several aggregate real and financial variables, *ex-ante* measures reduce households' lifetime consumption, reducing economic welfare, and those effects do present a stronger impact (Benigno et al., 2013). This raises the question of how aggressive macroprudential policy should be to attain the objective of financial stability without causing harsh effects in terms of economic welfare.

In terms of banking regulation, Basel III also explores financial stability issues and their importance to the overall economy, assuming that prudential policy and the overall previous Basel agreements (I and II) only addresses the case of each institution individually considered, overlooking at some point the impact of systemic risk and the role of market failures on the banking system as a whole, something that further aggravates business cycle fluctuations (Basel Committee on Banking Supervision, 2010a).

Due to this fact, Basel III recommends that countries should adopt an additional capital regulatory requirement that varies according to the evolution of the credit-to-GDP ratio gap (Basel Committee on Banking Supervision, 2010b), and it must be within the range of 0% up to 2.5 % of the total risk-weighted assets (R.W.A.'s) of a given financial institution, the so-called Countercyclical Capital Buffers (CCB) (Basel Committee on Banking Supervision, 2010b).

Although there are some criticisms regarding Basel III, especially those associated with the argument that tighter capital regulation may induce lower credit flows and output growth, nevertheless, the net effects are positive since the new regulatory framework brings lower credit and price volatility (Rubio and Carrasco-Gallego, 2016b). On top of that, monetary policy must be more aggressive since financial accelerator effects are smaller than before the implementation of the regulation (Rubio and Carrasco-Gallego, 2016b)[1].

### 2.4. Macroprudential policy in the Euro Area

In optimal Monetary Unions, like the Euro Area, the lack of responsiveness of monetary policy to deal with the asymmetrical effects of the Sovereign Debt Crisis led to a fundamental debate related to the need to build a macroprudential policy framework that has, as its main goal, the promotion of financial stability in the Euro Area as a whole.

Comparing to the scenario where financial stability policies did not exist, there is a Pareto improving situation when a given macroprudential policy framework is being implemented (Quint and Rabanal, 2013). Also, the said implementation reduces the volatility of major macroeconomic variables, improves general welfare, and partially reduces the lack of national monetary policies (Quint and Rabanal, 2013).

In terms of economic welfare, a combination of macroprudential and monetary policies that deal with financial and price stability, respectively, is Pareto improving, when compared to a case of an extended monetary policy rule or an inexistent macroprudential one, reinforcing the idea presented in the “Tinbergen principle”, which states that there must be at least one policy instrument for each policy goal (Rubio and Comunale, 2018).

In the Euro Area, macroprudential policy is conducted by i) each national authority, which can be the N.C.B.’s; ii) an independent authority/agency that can establish close relations with the N.C.B.’s or other important stakeholders; or iii) the Finance Ministry (Gros et al., 2014).

Moreover, a given policy must be subject to the evaluation of the E.S.R.B., ruled by the ECB., although the results of these evaluations and the following recommendations are not mandatory (Gros et al., 2014). Accordingly, the implementation of coordination among countries relative to macroprudential policy is not as strong as in the case of (conventional) monetary policy, which is complete.

[1] Higher capital requirements reduce credit and inflation volatility since there will be a smooth path for credit flows among different phases of the business cycle (Rubio and Carrasco-Gallego, 2016b)

But the debate of how macroprudential policy should be adopted within a Monetary Union (as in the case of the Euro Area) is not closed. Some advocate closer coordination among the Member States, while others argue that the scenario that has been implemented should produce better outcomes.

For the supporters of closer macroprudential policy integration and coordination throughout the Euro Area, the lack of coordination can lead to inefficient outcomes (Palek and Schwanebeck, 2019). The main reason for this is that the commitment degree of the ECB. policy, in terms of a single optimal monetary policy, can be compromised, jeopardizing the effectiveness of the said policy, since it can cause conflicts between monetary and macroprudential policies, leading to policy failures (Palek and Schwanebeck, 2019).

Also, since there is an increasing economic and financial integration among the Member States, there will be spillover effects associated with different macroprudential policies among countries (Rubio and Carrasco-Gallego, 2016a).

It is also important to observe that even with the effectiveness of a union-wide macroprudential policy, structural differences in terms of mortgage contracts, mainly in the proportion of fixed-term and variable interest rate ones can have a non-negligible role on how this type of policies should be designed and implemented (Rubio, 2014b).

Even with a scenario of housing mortgage market homogeneity in the Euro Area, there might not be economic welfare gains, since it will lead to a higher aggregate economic volatility in some countries (Rubio, 2014a). Accordingly, redistributive effects between borrowers and savers may be too large and unequal to achieve some form of institutional harmonization (Rubio, 2014a).

Moreover, those defending that each country should have the freedom to design and implement the policy that best fits their specific situations, even considering significant cross-border lending, a macroprudential policy that is based on national lending conditions is more effective than a similar policy that only looks to aggregate lending conditions (Poutineau and Vermandel, 2017).

Another important point to note is that, mostly due to the Sovereign Debt Crisis, countries that are affected mostly by asymmetrical shocks and are integrated into a Monetary Union should have a mix involving a single monetary policy and a national macroprudential policy, since a single monetary policy is unable to fit individual country economic and financial circumstances, meaning that the policy framework might be unadjusted (Dehmej and Gambacorta, 2019).

This type of shocks, which are greatly related to financial frictions, is partly due to the bursting of asset bubbles, especially those connected to the housing market, and this justifies the adoption of a decentralized macroprudential policy that might be Pareto improving when compared to a union-wide one (Brzoza-Brzezina, Kolasa and Makarski, 2015).

## 2.5. The theoretical approach of different macroprudential policy instruments

In the related academic literature associated, one of the methodologies that has been most useful to address this challenging research topic addresses simulation studies involving DSGE models with New Keynesian assumptions. In this setting, different macroprudential policies are implemented, mostly the ones that structurally impact credit demand, such as LTV and DTSI ratio caps. The effectiveness of these macroprudential instruments is typically consensual throughout the academic literature (Benigno et al., 2013), (Akinci and Olmstead-Rumsey, 2015), (Cerutti, Claessens and Laeven, 2015).

In terms of policy instruments, there is a second class of instruments, which has the main goal of influencing credit supply, as is the case of countercyclical capital buffers. The implementation of the latter has a substantial impact in reducing credit growth and policy interest rate volatility (Benes and Kumhof, 2015), which can be considered as a complement to (conventional) monetary policy.

In the case of a country that has restrictions on the ability to adapt its monetary policy (e.g., for the Member States belonging to a Monetary Union, or in a fixed exchange rate regime), the effects of this type of instrument are also quite significant in reducing the impact of adverse shocks caused by business and financial cycles (Clancy and Merola, 2017).

Nevertheless, in the greater part of the literature regarding macroprudential policy in a Monetary Union, the usual approach follows the credit demand policies approach, neglecting at some point the supply side

Indeed, this kind of instrument tends to bring additional assumptions in a DSGE model that can deeply transform and further complexify this framework, making this difficult and hard to treat, thus rendering this model's application less effective. An example concerns the detailed description of financial sector conditions regarding capital requirements, and how these might further affect lending/borrowing decisions (e.g., by banks).

But the fact remains that the introduction of the overall conditions in this family of models brings about more accuracy and realism to the proposed research question. In the end, there is a trade-off between keeping DSGE models as simple as possible without compromising the proposed model's accuracy in dealing with real-world situations.

Indeed, policies that are mostly driven by developments on credit supply (lending) rather than demand (borrowing) present better outcomes, since they affect the marginal cost of lending, thus forcing banks to pursue a more prudent behaviour in terms of credit concession to economic agents (Poutineau and Vermandel, 2017).

## 2.6. Empirical evidence of the effects of macroprudential policy on financial stability

Macroprudential policy is a novelty in developed countries since the regulatory framework that gives a pivotal role on financial stability (Basel III accords) is quite recent and its implementation is not complete in all countries in the same way. In the Euro Area, the empirical evidence addressing policies to spur financial stability is not so deeply studied, since quite a significant part of the Member States tends to implement borrower-based measures, which are quite difficult to use in a proper comparison of the outcomes among them.

In terms of bank risk (credit, liquidity, market and systemic), macroprudential policies tend to be quite effective in restraining this type of risk (Altunbas, Binici, and Gambacorta, 2018). The expected probability of default tends to be lower when this type of policies is implemented and is clearer on small and least capitalized banks (Altunbas, Binici, and Gambacorta, 2018).

This can be explained by the fact that banks face more constraints on financial markets access, and it becomes more costly to get external funds, and, accordingly, banks start allocating most of their resources to retail activities than to trading ones (Altunbas, Binici, and Gambacorta, 2018).

The effects of the Basel III framework on bank lending growth, namely in terms of capital and liquidity ratios, is a topic that has also to be considered. In this scenario, tighter capital regulation has a significant negative outcome on bank lending growth (Roulet, 2018). Consequently, this further implies a substitution towards safer assets, i.e., from riskier assets such as retail-and-other loan assets to risk-free, more liquid government bond securities (Roulet, 2018).

Indeed, credit spreads tend to be higher when prudential policies are more rigorous (Meeks, 2017). Also, spillover effects on real estate markets are moderate, due to the increasing costs of lending/borrowing operations (Meeks, 2017).

In terms of liquidity indicators, the effects are not clear due to different allocation of lending funds by financial institutions (households *vs.* non-financial corporations) and heterogeneous banks´ size (Roulet, 2018). The main conclusion is that banks´ heterogeneity matters in terms of banking regulation, not only on microprudential but also on macroprudential policies.

# 3. Data and model description

## 3.1. Data description

The data herein used covers the period from the first quarter of 2015 up to the last quarter of 2019. This time window is chosen in order to circumscribe the time period beginning with the full implementation of Basel III capital requirements (Tier 1 and 2) (which happened at the beginning of 2015) for all banks that operate in the European Economic Area (EEA)[2] and the moment of impact of the COVID-19 outbreak (which occurred in 2020).

The sample is comprised of the following 12 Euro Area Member States: Ireland, France, Slovakia, Austria, Belgium, Spain, Finland, Germany, Italy, Luxembourg, Netherlands and Portugal.

The variables are presented in Table 3.1.

[2] (Regulation (EU) no 575/2013 of the European Parliament and of the Council of 26 June 2013 on prudential requirements for credit institutions and investment firms and amending Regulation (EU) No 648/2012)

Table 3.1 - Variables description and source

| Variable | Description | Source |
|---|---|---|
| $cgap_{i,t}$ | credit to GDP ratio gap, computed from the difference of real credit to GDP ratio of its steady-state value. The steady-state values are computed using the HP filter to the observed data | BIS Macroprudential Database |
| $lnchouseholds_{i,t}$ | log-linearized observed data of the outstanding amount of credit conceded to households (in millions €) (S.14, according to ESA 2010) | ECB Statistical Data Warehouse |
| $lncnfc_{i,t}$ | log-linearized observed data of the outstanding amount of credit conceded to non-financial firms (in millions €) (S.11, according to ESA 2010) | ECB Statistical Data Warehouse |
| $irh_{i,t}$ | the average interest rate charged by Other Monetary Financial Institutions (S.122 and S.123, according to ESA 2010) to the outstanding amount of credit conceded to households | ECB Statistical Data Warehouse |

| | | |
|---|---|---|
| $irnfc_{i,t}$ | the average interest rate charged by Other Monetary Financial Institutions (S.122 and S.123, according to ESA 2010) to the outstanding amount of credit conceded to non-financial firms | ECB Statistical Data Warehouse |
| $cet1_{i,t}$ | average observed Common Equity Tier 1 risk-weight ratio of Other Monetary Financial Institutions (S.122 and S.123, according to ESA 2010) | ECB Statistical Data Warehouse |
| $tt1_{i,t}$ | average observed Total Equity Tier 1 risk-weight ratio of Other Monetary Financial Institutions (S.122 and S.123, according to ESA 2010) | ECB Statistical Data Warehouse |
| $lev_{i,t}$ | average observed leverage ratio of Other Monetary Financial Institutions (S.122 and S.123, according to ESA 2010) | ECB Statistical Data Warehouse |
| $liqassets_{i,t}$ | average observed liquid assets to total assets ratio of Other Monetary Financial Institutions (S.122 and S.123, according to ESA 2010) | ECB Statistical Data Warehouse |

| | | |
|---|---|---|
| $lnbsize_{i,t}$ | log-linearized average observed total assets (in millions €) of Other Monetary Financial Institutions (S.122 and S.123, according to ESA 2010) | ECB Statistical Data Warehouse |
| $npl_{i,t}$ | average observed non-performing loans ratio of Other Monetary Financial Institutions (S.122 and S.123, according to ESA 2010) | ECB Statistical Data Warehouse |
| $lnm3_t$ | log-linearized observed Euro Area M3 aggregate (in millions €) | ECB Statistical Data Warehouse |
| $lnGDP_{i,t}$ | log-linearized observed real GDP at chain-linked volumes (index 2015 =100) seasonally and calendar adjusted | Eurostat |
| $lnhprices_{i,t}$ | log-linearized observed housing price index (index 2015 =100) | Eurostat |

The use of the credit-to-GDP ratio gap has been more frequent over the years by Central Banks, and other macroprudential authorities and international organizations, such as the IMF and the BIS. This metric is used to evaluate possible pressures on credit and financial markets that can transform into a systemic crisis that ultimately affects the financial sector and the real economy (Basel Committee on Banking Supervision, 2010a).

Households and non-financial firms present different approaches for banks, in terms of lending operations. Non-financial firms tend to present a higher credit risk and so risk weights used to compute the several components of a bank's capital are higher (Roulet, 2018). In sum, credit to households presents a lower cost in terms of obtaining external funds to banks than credit to non-financial firms.

Interest rates perform an essential role in lending operations since they represent the cost of obtaining external funds for economic agents. So, the effects of changes in interest rates on credit markets have to be acknowledged.

Capital adequacy ratios have become higher since the Global Financial Crisis, mainly due to the Basel III accord, which provides more rigorous and clear definitions of the elements that must be considered in Tier 1 and Tier 2 capital (Roulet, 2018). Since banks need to allocate more funds to reinforce their capital ratios, two options are typically on the table: (i) increase retained earnings; or (ii) restrain their credit concession. Banks, over the last years, have adopted several measures using both strategies presented previously. So, capital ratios are a key point to understand the dynamics of credit markets.

Liquidity and leverage indicators also perform an important role on bank lending, since mismatches between assets and liabilities, in terms of their liquidity, may transform into a massive problem to financial institutions in periods of extreme volatility associated with financial markets (Roulet, 2018). Also, a highly leveraged financial institution that is impacted by a negative shock may observe its assets' value(s) decrease considerably, due to credit impairments and provisions that banks must comply with in their balance sheets and the corresponding negative effects on EBITDA and capital ratios.  Indeed, in those periods, banks tend to have a more risk-averse approach to lending.

Larger financial institutions have a lower default risk perception by financial markets, due to "big-to-fail" assumption (Altunbas, Binici, and Gambacorta, 2018). Therefore, the cost of obtaining external funds will be lower when compared to that of a smaller bank, thus influencing the lending interest rates charged to non-financial agents (Roulet, 2018). Due to this fact, a given bank's size also plays an important role in the evaluation of credit conditions.

A bank or a banking system that has a substantial amount of NPL's needs to allocate a non-neglectable amount of funds to cover those losses, leaving credit activities with fewer resources. Moreover, since lending decisions are based on a historical approach, high NPL ratios will originate a negative perception by economic agents on bank activity, in terms of credit risk, therefore ultimately increasing financial costs to households and non-financial corporations (Roulet, 2018).

Over the last years, Central Banks have adopted a substantial number of non-conventional monetary policy decisions. The main goal is to achieve the desired inflation rate (near 2%), injecting funds to banks and other financial institutions that can be allocated to lending activities, spurring private consumption and investment (Bokan et al., 2018). Ultimately, movements in monetary aggregates represent a discussion point that should be acknowledged in the analysis of credit dynamics.

Credit cycles are not disconnected from business cycle fluctuations. On the contrary, credit tends to be procyclical when compared to GDP (Merler, 2015). Moreover, periods of economic expansion tend to diminish the default risk perception of financial markets in relation to banks' credit portfolios, and ultimately lower their costs to obtain external funds (Altunbas, Binici, and Gambacorta, 2018). Due to this fact, GDP fluctuations have quite a significant impact on credit decisions.

The US. Subprime Crisis stated how real estate dynamics affect credit decisions since real estate can be used as collateral by economic agents to obtain external funds, which changes their intertemporal budget constraints (Iacoviello, 2005). Indeed, the crash in housing prices in Spain and Ireland left banks in a sensitive situation due to an increasing NPL ratio (Merler, 2015). To conclude, real estate prices dynamics constitutes a relevant topic to evaluate credit dynamics.

Table 3.2 presents the main summary statistics of the variables used in the analysis. Annex A provides additional information regarding these summary statistics.

Table 3.2 - Main statistical outputs

| | (1) | | | | |
|---|---|---|---|---|---|
| | count | mean | sd | min | max |
| cgap | 240 | -18.84374 | 25.05704 | -95 | 69.3 |
| lnchouseho~s | 240 | 12.31033 | 1.266865 | 10.06845 | 14.37615 |
| lncnfc | 240 | 11.92721 | 1.34817 | 9.584659 | 13.86983 |
| irnfc | 240 | 2.242625 | .5647803 | 1.33 | 3.83 |
| irh | 240 | 2.841542 | .7605259 | 1.44 | 5.67 |
| cet1 | 240 | 15.90201 | 3.44586 | 10.8635 | 34.481 |
| tt1 | 240 | 16.59518 | 3.45974 | 11.1787 | 34.549 |
| lev | 240 | 13.91705 | 3.659 | 6.6309 | 26.5319 |
| liqassets | 240 | 15.43752 | 3.908295 | 3.9529 | 28.8016 |
| lnm3 | 240 | 16.27255 | .0653265 | 16.16315 | 16.38009 |
| lnbsize | 240 | 16.53426 | 1.437858 | 14.36174 | 19.78236 |
| lngdp | 240 | 4.654984 | .0475429 | 4.582925 | 4.875197 |
| lnhprices | 240 | 4.70545 | .1009743 | 4.542017 | 4.970508 |
| npl | 240 | 4.462467 | 4.065016 | .498 | 16.2241 |
| N | 240 | | | | |

The credit-to-GDP ratio gap presents a very high standard deviation, meaning that even between countries that share the same monetary policy, credit cycles may be different among them.

The fact that the interest rate charged to households and non-financial corporations presents a small variability between the Member States shows that the economic and financial integration process brought about by the introduction of the Euro currency has meant that financing costs to the real economy have become smaller and similar within the Euro Area.

Some banking sector indicators ($cet1_{i,t}$, $tt1_{i,t}$, $lev_{i,t}$, $liqassets_{i,t}$ and $npl_{i,t}$) show significant variability. Accordingly, bank- and country-specific heterogeneity should be considered in the design and implementation of monetary policies upholding financial stability.

## 3.2. Methodology

The models were estimated using STATA, and can be described as follows:

$$Y_{i,t} = \alpha + X'_{i,t}\beta + u_{i,t} , u_{i,t} = v_{i,t} + \mu_i, \ i = 1, \ldots, N; t = 1, \ldots , T \quad (1)$$

$Y_{i,t}$ represents a matrix of dimension N*T of independent variable observations, $\alpha$ is a scalar, β is K*1 vector, $X_{i,t}$is the *i*;*t* th observation on K explanatory variables, $\mu_i$ denotes the unobservable individual-specific effect and $v_{i,t}$ denotes the remainder disturbance (Baltagi, 2005).

Many arguments can be presented in order to justify why a panel-data approach is the most accurate for the topic in the analysis.

First, is becomes easier to control individual heterogeneity. Second, it, provides more informative data, more variability, less collinearity among the variables, more degrees of freedom and more efficiency. Third, it is better able to capture the dynamics of adjustment and to identify and measure effects that are simply not detectable in pure cross-section or pure time-series data, allowing to build and test more elaborated behavioural models (Baltagi, 2005).

Since data are gathered on individuals, firms and households, panel-data tends to be measured more accurately similar variables than purely cross-section or time-series data analysis. Fourth, compared to time series data, panel-data has a longer time series and does not suffer the problem of nonstandard distributions, usual in unit roots tests in time-series frameworks (Baltagi, 2005).

According to the methodology described below, the estimated models are the following:

$$\begin{aligned} cgap_{i,t} = \alpha &+ \beta_1 cet1_{i,t-2} + \beta_2 tt1_{i,t-2} + \beta_3 lev_{i,t-2} \\ &+ \beta_4 liqassets_{i,t-2} + \beta_5 lnbsize_{i,t-2} + \beta_6 npl_{i,t-2} \\ &+ \beta_7 lnm3_{i,t} + \beta_8 lnhprices_{i,t} + v_{i,t} + \mu_i \end{aligned} \tag{2}$$

$$\begin{aligned} &lnchouseholds_{i,t} \\ &= \alpha + \beta_1 irh_{i,t} + \beta_2 cet1_{i,t-2} + \beta_3 tt1_{i,t-2} \\ &+ \beta_4 lev_{i,t-2} + \beta_5 liqassets_{i,t-2} + \beta_6 lnbsize_{i,t-2} \\ &+ \beta_7 npl_{i,t-2} + \beta_8 lnm3_{i,t} + \beta_9 lnhprices_{i,t} \\ &+ \beta_{10} lngdp_{i,t} + v_{i,t} + \mu_i \end{aligned} \tag{3}$$

$$\begin{aligned} lncnfc_{i,t} = \alpha &+ \beta_1 irnfc_{i,t} + \beta_2 cet1_{i,t-2} + \beta_3 tt1_{i,t-2} + \beta_4 lev_{i,t-2} \\ &+ \beta_5 liqassets_{i,t-2} + \beta_6 lnbsize_{i,t-2} + \beta_7 npl_{i,t-2} \\ &+ \beta_8 lnm3_{i,t} + \beta_9 lngdp_{i,t} + v_{i,t} + \mu_i \end{aligned} \tag{4}$$

Notice that all variables are previously described in Table 3.1.

The term $\mu_i$ represents the time-invariant country fixed effects, which are estimated using a Hausman test, which prompts the conclusion as to the best approach (fixed *vs*. random effects).

Banking sector variables, except $irh_{i,t}$ and $irnfc_{i,t}$ , are lagged twice to surpass potential endogeneity problems (Roulet, 2018). Moreover, portfolio changes take some time to occur. In other words, there is some rigidity, and those decisions are based on past values of the dataset, and this fully justifies the use of lagged values for these banking variables.

Stationarity tests are performed using a Philips-Peron Fisher-type unit root test, which is robust to heteroscedasticity and autocorrelation, when compared to a Dickey-Fuller test.

The results are summarized in Table 3.3 and the detailed outputs of Stata are presented in Appendix B.

Table 3.3- Stationarity tests summarized results

| **Variable** | **Stationarity** |
|---|---|
| $cgap_{i,t}$ | Yes |
| $lnhouseholds_{i,t}$ | Yes |
| $lncnfc_{i,t}$ | No |
| $irh_{i,t}$ | Yes |
| $irnfc_{i,t}$ | Yes |
| $cet1_{i,t}$ | Yes |
| $tt1_{i,t}$ | Yes |
| $lev_{i,t}$ | No |
| $liqassets_{i,t}$ | No |
| $lnbsize_{i,t}$ | No |
| $npl_{i,t}$ | No |
| $lnm3_t$ | No |
| $lnGDP_{i,t}$ | No |
| $lnhprices_{i,t}$ | No |

Note: The critical p-value used on stationarity tests is 0.1.

For the non-stationary variables, the first-order differences of the corresponding variables were used in the estimations.

# 4. Empirical findings and results

To check for the presence of autocorrelation in the empirical applications, the Wooldridge test for panel data is employed. The test results can be summarized in Table 4.1 and the detailed STATA outputs are presented in Appendix C.

Table 4.1– Autocorrelation tests summarized results

| Model | Autocorrelation? |
|---|---|
| (2) | Yes |
| (3) | Yes |
| (4) | Yes |

Note: The critical p-value used on autocorrelation tests is 0.1

To ascertain whether the models are subject to fixed or random effects, the Hausman tests is performed. The results are summarized in Table 4.2 and the detailed STATA output is presented in Appendix D.

Table 4.2– Hausman test results

| Model | Fixed/Random effects |
|---|---|
| (2) | Random effects |
| (3) | Random effects |
| (4) | Random effects |

Note: The critical p-value used in the Hausman tests is 0.01.

## 4.1. Baseline results

The models are estimated using the Hausman test findings. The results can be summarized in Table 4.3 and the detailed STATA output is in Appendix E.

Table 4.3– Estimation results and p-values of each independent variables

| | (1) cgap | (2) lnchouseho~s | (3) D.lncnfc |
|---|---|---|---|
| L2.cet1 | -4.246 | -0.0103 | 0.0164* |
| | (0.495) | (0.596) | (0.018) |
| L2.tt1 | 3.429 | -0.00513 | -0.0137* |
| | (0.521) | (0.767) | (0.030) |
| L2D.lev | -3.974 | 0.00587 | -0.0000966 |
| | (0.583) | (0.687) | (0.979) |
| L2D.liqass~s | -0.486 | -0.000461 | 0.000613 |
| | (0.883) | (0.934) | (0.800) |
| D.lnm3 | 836.0 | -2.793 | -0.598 |
| | (0.225) | (0.222) | (0.398) |
| L2D.lnbsize | -80.44 | 0.408* | 0.0430 |
| | (0.105) | (0.012) | (0.640) |
| D.lnhprices | 204.2 | 2.237* | |
| | (0.569) | (0.033) | |
| L2D.npl | 0.215 | 0.0134 | -0.00119 |
| | (0.912) | (0.056) | (0.528) |
| irh | | -0.151*** | |
| | | (0.000) | |
| D.lngdp | | -1.441** | 0.0934 |
| | | (0.001) | (0.218) |
| irnfc | | | 0.000341 |
| | | | (0.951) |
| _cons | -22.73 | 13.02*** | -0.0308 |
| | (0.409) | (0.000) | (0.241) |
| N | 60 | 60 | 60 |

p-values in parentheses
* p<0.05, ** p<0.01, *** p<0.001

Regarding $cgap_{i,t}$, all the explanatory variables are not statistically significant. This reflects the fact that, according to this specification, credit-to-GDP gaps are not an important variable to analyse and evaluate on topics related to financial stability and macroprudential policy issues.

Considering $lnchouseholds_{i,t}$, a banking system composed by larger financial institutions tends to present higher credit flows, in terms of the household sector, since larger financial institutions present lower costs to obtain external funds due to their lower probability of default (Altunbas, Binici, and Gambacorta, 2018). The main consequence is that the interest rate charged to households will be lower, giving further incentive for lending operations. The fact that $lnbsize_{i,t}$ presents a positive and statistically significant impact demonstrates the effect previously described.

Indeed, additional capital requirements for larger and systemic financial institutions can be a good example of a policy to control excessive credit growth.

The positive and statistically significant impact of $lnhprices_{i,t}$ demonstrates the importance of collateral effects on credit flows (Iacoviello, 2005). Since real estate has considerable weight on household's wealth, market dynamics that affect housing prices tend to be a good indicator of how credit behaves over time, since households present those goods as collateral for borrowing operations (Iacoviello, 2005).

In addition, banks tend to possess substantial real estate exposures, mainly associated with housing mortgages, which means that housing prices trajectories are an important point to further research and discussions related to financial stability issues.

LTV and DTSI ratio caps, and dynamic loan-loss provisions may have important effects in controlling households´ credit dynamics, while reducing risks that banks and households assume in the upward part of the business cycle but might impact the real economy in periods of economic downturn.

About $irh_{i,t}$, the negative and statistically significant impact of financing costs on households credit flows is compatible with the mainstream economic theory which states that there is an inverse relationship between the interest rate and credit flows (monetary aggregates, in a broad sense), influencing consumption and investment decisions.

A negative and statistically significant impact of $lnGDP_{i,t}$ seems to be difficult to interpret given the existence of previous research that states that credit tends to be procyclical to business cycles (Merler, 2015). Nevertheless, the 2015-2019 period was marked by economic growth in the Eurozone, in almost all Member States. It is important to observe that different countries can have different credit flow responses to business cycle fluctuations due to differences in the corresponding intertemporal budget constraints, average preferences, and so on. In a nutshell, different institutional factors may explain the results obtained.

Banking capital indicators ($cet1_{i,t}$ and $tt1_{i,t}$) seem to have a statistically significant impact on credit lent to non-financial firms. Interestingly, Total Tier 1 ratios present a negative impact, converging with almost all literature related to the effects of capital indicators on bank lending growth, although Common Equity Tier 1 ratios present a positive impact. The fact that larger financial institutions present higher CET 1 ratios can be an explanation for the obtained results. In the end, banking capital indicators is a relevant determinant to analyse credit flow dynamics to non-financial firms.

Implementation of dynamic capital ratios, such as countercyclical capital buffers, and dynamic loan-loss provisions should be considered when macroprudential authorities need to take measures to restrain non-financial firms´ credit growth.

For the fact that credit lent to non-financial firms is more costly compared to that of households (since the default risk is higher), risk weight indicators for firms are higher than to households in order to compute capital ratios (Roulet, 2018)., This can be a good explanation of why banking capital indicators are important over non-financial firms credit concession and not on household's credit.

Liquidity and leverage indicators do not seem to have substantial relevance in credit dynamics, demonstrating that financial integration across Euro-Area tends to reduce liquidity risk associated with banking activities.

Bank risk indicators ($npl_{i,t}$) present a non-statistically significant impact on credit flows. Indeed, the period under analysis was marked by a substantial reduction of NPL's (non-performing loans) related to banks' balance sheets in Southern European countries such as Portugal, Spain, and Italy. These Member States felt the harsh effects of the Sovereign Debt Crisis.

A quite interesting result, both for non-financial firms and households, is the negligible effect of monetary aggregate indicators ($lnm3_t$) on credit flows, mainly in a period where several expansionary non-conventional monetary policies was pursued by the ECB. These findings should be the object of further discussions related to the real impact of non-conventional monetary policies on credit flows and economic output.

To conclude, macroprudential policies must be well-targeted and subject to specific measures when risks to financial stability are rising, in order to avoid general approaches that may not be quite effective in controlling excessive credit growth.

## 4.2. Robustness checks

The previously presented baseline findings presented in the previous sub-section may not be linear and/or equal among countries, even if they share the same monetary policy and are closely economically integrated, since cross-country heterogeneity remains an important obstacle to further integration among Euro Area Member States (Merler, 2015).

Moreover, even with closer integration in terms of banking and financial regulation, mainly with the Banking Union framework that brought together the SSM, the SRM and the EBA, differences in terms of economic and legal contexts that banks in different Member States operate under must be taken into account when a given macroprudential policy framework is designed and implemented (Bokan et al., 2018).

To understand how those factors can affect credit dynamics unequally among Member States, further testing assessing the potential existence of non-linear effects for the independent variables that are statistically significant were estimated, and F-tests were also performed to prove this assumption. The model outputs as so the summarized F-test results are available in Tables 4.4, 4.5 and 4.6 and the detailed STATA outputs are available in Appendix F.

Table 4.4– Estimation results and p-values of each independent variable

| | (1) lnchouseho~s | (2) D.lncnfc |
|---|---|---|
| irh | -0.121 | |
| | (0.522) | |
| irh2 | -0.00381 | |
| | (0.867) | |
| L2.cet1 | -0.00697 | 0.0466 |
| | (0.767) | (0.406) |
| L2.tt1 | -0.00771 | -0.0352 |
| | (0.713) | (0.462) |
| L2D.lev | 0.00459 | 0.000223 |
| | (0.791) | (0.960) |
| L2D.liqass~s | -0.00249 | 0.000758 |
| | (0.758) | (0.766) |
| D.lnm3 | -2.669 | -0.337 |
| | (0.345) | (0.611) |
| L2D.lnbsize | 1.557 | 0.0256 |
| | (0.520) | (0.788) |
| L2D.lnbsize2 | -0.0330 | |
| | (0.646) | |
| D.lngdp | 15.82 | 0.0794 |
| | (0.774) | (0.336) |
| D.lngdp2 | -1.836 | |
| | (0.756) | |
| D.lnhprices | -24.49 | |
| | (0.529) | |
| D.lnhprices2 | 2.785 | |
| | (0.501) | |
| L2D.npl | 0.0134 | -0.00230 |
| | (0.100) | (0.418) |
| irnfc | | -0.00387 |
| | | (0.505) |
| L2.cet12 | | -0.000912 |
| | | (0.614) |
| L2.tt12 | | 0.000629 |
| | | (0.683) |
| _cons | 12.96*** | -0.0888 |
| | (0.000) | (0.354) |
| N | 60 | 60 |

p-values in parentheses
* p<0.05, ** p<0.01, *** p<0.001

Table 4.5- F-tests results for nonlinear effects on $lnchouseholds_{i,t}$ model

| F-test (H0) | Statistically significant (H0 rejected)? |
|---|---|
| $irh_{i,t} = irh_{i,t}{}^2 = 0$ | Yes |
| $lnbsize_{i,t-2} = lnbsize_{i,t-2}{}^2 = 0$ | Yes |
| $lngdp_{i,t} = lngdp_{i,t}{}^2 = 0$ | Yes |
| $lnhprices_{i,t} = lnhprices_{i,t}{}^2 = 0$ | No |

Note: The critical p-value used on F-tests tests is 0.05

Table 4.6 - F-test results for nonlinear effects on $lncnfc_{i,t}$ model

| F-test (H0) | Statistically significant (H0 rejected)? |
|---|---|
| $cet1_{i,t-2} = cet1_{i,t-2}^2 = 0$ | Yes |
| $tt1_{i,t-2} = tt1_{i,t-2}^2 = 0$ | Yes |

Note: The critical p-value used on F-tests tests is 0.05

Starting with credit lent to households, $irh_{i,t}$ the test indicates statistically significant non-linear effects, meaning that even though differences of interest rates among Member States became smaller over the years (mainly due to a closer economic and financial integration between Member States), different financial conditions have to be considered when the main objective is to build policies that promote financial stability in the Euro Area as a whole.

Furthermore, the fact that $lnbsize_{i,t}$ also demonstrates statistically significant non-linear effects gives stronger arguments for the assumption that banking heterogeneity between Member States has an impact on credit dynamics. The same proposition applies to different business cycle phases that countries may face, justified by the F-test results associated with non-linear effects related to $lnGDP_{i,t}$.

Notwithstanding, $lnhprices_{i,t}$ does not have significant non-linear effects on credit conceded on households, but it´s important to remember that before the Sovereign Debt Crisis, some Member States (like Spain and Ireland) suffered from a housing bubble that burst, which originated negative spillover effects to their economies and financial sectors, a phenomenon that was a the time not carefully watchdog at the time (Merler, 2015). Indeed, the fact that housing markets may have different behaviours between countries has to be acknowledged in macroprudential regulation.

Lastly, in relation to credit lent to non-financial firms, banking capital indicators ($cet1_{i,t}$ and $tt1_{i,t}$) seem to have statistically significant non-linear effects, reinforcing the idea of the impact of banking heterogeneity among Member States in terms of credit flows to the non-financial sector.

Ultimately, cross country and banking heterogeneity remain important points to address when monetary authorities try to design and implement a given macroprudential policy framework for a Monetary Union. These findings also reveal that although the positive effects of closer economic and financial integration among Member States that the Euro brought, a "one-size-fits-all" strategy to promote overall financial stability may not be the most efficient and effective approach.

### 4.3. Policy implications

The main determinants that drive credit dynamics in the non-financial sector are not equal between households and non-financial firms. This means that possible macroprudential policies that can be applied in the future must be chirurgical in order to be effective, thus taking into consideration the specificities of households and non-financial firms.

In other words, if households' credit is mainly influenced by real estate prices and by the concentration and size of banking institutions, LTV and DTSI caps, dynamic loan loss provisions on bank's credit lent to this economic sector and additional/dynamic capital requirements for larger and systemically financial institutions should be implemented if risks are increasing on household's indebtedness.

On the other hand, if non-financial firms are the main source of increasing possible risks that threatens financial stability, additional/dynamic capital requirements and dynamic loan loss provisions on banks' credit lent to the corporate sector should be introduced.

Despite a high economic and financial integration across Member States, macroprudential policy must consider that different countries do not have the same banking structure and, furthermore, complete and instantaneous business cycle synchronization does not exist.

Although the fact that authorities should consider possible spillover effects of different national macroprudential policies, meaning that coordination among Member States must be encouraged, there is a strong need to have a sort of flexibility of national authorities to implement measures that fits to the economic and financial situation that are inserted.

## 5. Conclusion

Since the Euro Area Sovereign Debt Crisis, macroprudential policy has gained an increasing importance in the academic and political debate of how the Monetary Union should mitigate risks that threaten the financial stability of the Monetary Union as a whole, considering that even with a single monetary policy and a deeper economic and financial integration, policy transmission mechanisms does not behave equally between Member States.

The goal of this Dissertation is to address the main determinants of credit dynamics in Euro Area Member States, and the role of cross country and banking heterogeneity on credit flows and the impacts of these determinants in further designing and implementing macroprudential policy arrangements in the Euro Area.

Accordingly, panel data econometric estimation is performed, using data collected for 12 Euro Area Member States between the first quarter of 2015 and the last quarter of 2019. The data sources are quite varied, including the: (i) BIS Macroprudential Database; (ii) ECB Statistical Data Warehouse; and (iii) Eurostat. The variables include: (i) banking credit; (ii) bank capital; (iii) credit risk indicators; (iv) liquidity and leverage indicators; (v) the interest rate charged to non-financial economic agents; (vi) housing prices; (vii) monetary aggregates; and (viii) GDP growth.

The first fundamental finding is that macroprudential policies must be well-targeted to be effective and efficient, avoiding general approaches. In other words, if the main risks are from excessive households' indebtedness, policies that try to promote financial stability should focus on restraining households' excessive credit growth, for example.

Second, despite closer economic and financial integration among Member States that share the same monetary policy, cross country and banking heterogeneity remain a crucial discussion point in the design and implementation of macroprudential frameworks. Despite the need for a considerable level of coordination between Member States, in order to avoid negative spillovers of a given policy adopted by a given country, Member States should have a certain flexibility to implement the appropriate measures that best fit their specific economic and financial situation.

Although the fact that a more granular dataset of the banking sector could bring more accuracy to the main findings reached by this Dissertation, the use of country aggregate data for a more recent time period (first quarter of 2015 until the last quarter of 2019) might lead to more accurate policy debates and policy decisions regarding the future state of financial stability, most especially in the context of the pandemic environment. This would allow policy makers to accurately tackle potential risks that can form during boom economic time periods.

Further research on macroprudential policy in the Euro Area should focus on the possible trade-offs between the price and financial stability goals. For example, the ECB must harmonize its main objective of attaining an inflation rate closer but below 2% without inducing potential downside risks to financial/banking stability that can form into a financial shock to the Euro Area Economy.

On the other hand, the impact of QE programs on banks' lending activity and corresponding spillover effects on asset prices (real estate, stocks, etc) should provide interesting insights on how non-conventional monetary policies might attain financial stability. Lastly, and this depends on how national and European macroprudential authorities collect and harmonize data related to implemented policies, the real effects of the macroprudential measures already being applied and their corresponding effectiveness should also be researched.

To conclude, macroprudential policy in the Euro Area must not forget that Member States show non-negligible heterogeneity within their economic and financial structures, a fact that prompts some degree of freedom in the design and implementation of macroprudential policies. Indeed, coordination among national macroprudential authorities is encouraged in order to avoid negative and unexpected spillovers of prudential measures applied unilaterally by a given Member State.

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# Appendixes

## Appendix A

```
. xtsum cgap lnchouseholds lncnfc irnfc irh cet1 tt1 lev liqassets lnm3 lnbsize lnç
```

| Variable | | Mean | Std. Dev. | Min | Max | Observations | |
|---|---|---|---|---|---|---|---|
| cgap | overall | -18.84374 | 25.05704 | -95 | 69.3 | N = | 240 |
| | between | | 21.36178 | -52.935 | 7.195 | n = | 12 |
| | within | | 14.41549 | -60.90874 | 103.3913 | T = | 20 |
| lnchou~s | overall | 12.31033 | 1.266865 | 10.06845 | 14.37615 | N = | 240 |
| | between | | 1.318367 | 10.34639 | 14.28711 | n = | 12 |
| | within | | .0709122 | 12.0324 | 12.54699 | T = | 20 |
| lncnfc | overall | 11.92721 | 1.34817 | 9.584659 | 13.86983 | N = | 240 |
| | between | | 1.40227 | 9.751568 | 13.75578 | n = | 12 |
| | within | | .0867272 | 11.48755 | 12.17224 | T = | 20 |
| irnfc | overall | 2.242625 | .5647803 | 1.33 | 3.83 | N = | 240 |
| | between | | .510858 | 1.476 | 3.238 | n = | 12 |
| | within | | .2806205 | 1.688625 | 3.208625 | T = | 20 |
| irh | overall | 2.841542 | .7605259 | 1.44 | 5.67 | N = | 240 |
| | between | | .6976745 | 1.5775 | 4.095 | n = | 12 |
| | within | | .3610341 | 1.686542 | 4.416542 | T = | 20 |
| cet1 | overall | 15.90201 | 3.44586 | 10.8635 | 34.481 | N = | 240 |
| | between | | 3.30111 | 12.32294 | 22.05858 | n = | 12 |
| | within | | 1.35755 | 12.8778 | 29.28854 | T = | 20 |
| tt1 | overall | 16.59518 | 3.45974 | 11.1787 | 34.549 | N = | 240 |
| | between | | 3.322423 | 12.98827 | 22.71317 | n = | 12 |
| | within | | 1.344934 | 13.37792 | 29.73602 | T = | 20 |
| lev | overall | 13.91705 | 3.659 | 6.6309 | 26.5319 | N = | 240 |
| | between | | 3.593151 | 7.430435 | 20.3507 | n = | 12 |
| | within | | 1.226347 | 9.625448 | 20.09825 | T = | 20 |
| liqass~s | overall | 15.43752 | 3.908295 | 3.9529 | 28.8016 | N = | 240 |
| | between | | 3.164418 | 11.32036 | 21.93785 | n = | 12 |
| | within | | 2.461155 | 7.966275 | 22.30127 | T = | 20 |
| lnm3 | overall | 16.27255 | .0653265 | 16.16315 | 16.38009 | N = | 240 |
| | between | | 0 | 16.27255 | 16.27255 | n = | 12 |
| | within | | .0653265 | 16.16315 | 16.38009 | T = | 20 |
| lnbsize | overall | 16.53426 | 1.437858 | 14.36174 | 19.78236 | N = | 240 |
| | between | | 1.492346 | 14.4534 | 19.60387 | n = | 12 |
| | within | | .1318645 | 15.94268 | 17.11579 | T = | 20 |
| lngdp | overall | 4.654984 | .0475429 | 4.582925 | 4.875197 | N = | 240 |
| | between | | .0244242 | 4.63003 | 4.723304 | n = | 12 |
| | within | | .0413667 | 4.514604 | 4.806877 | T = | 20 |
| lnhpri~s | overall | 4.70545 | .1009743 | 4.542017 | 4.970508 | N = | 240 |
| | between | | .056181 | 4.598264 | 4.770452 | n = | 12 |
| | within | | .085384 | 4.506292 | 4.905506 | T = | 20 |
| npl | overall | 4.462467 | 4.065016 | .498 | 16.2241 | N = | 240 |
| | between | | 3.745276 | .731045 | 11.24144 | n = | 12 |
| | within | | 1.900629 | -1.848873 | 10.67275 | T = | 20 |

# Appendix B

```
. xtunitroot fisher cgap, pperron lags(2)

Fisher-type unit-root test for cgap
Based on Phillips-Perron tests
-----------------------------------
Ho: All panels contain unit roots          Number of panels  =     12
Ha: At least one panel is stationary       Number of periods =     20

AR parameter:    Panel-specific            Asymptotics: T -> Infinity
Panel means:     Included
Time trend:      Not included
Newey-West lags: 2 lags
------------------------------------------------------------------------------
                                  Statistic      p-value
------------------------------------------------------------------------------
 Inverse chi-squared(24)   P       119.2522       0.0000
 Inverse normal            Z        -2.1608       0.0154
 Inverse logit t(64)       L*       -6.0535       0.0000
 Modified inv. chi-squared Pm       13.7485       0.0000
------------------------------------------------------------------------------
 P statistic requires number of panels to be finite.
 Other statistics are suitable for finite or infinite number of panels.
------------------------------------------------------------------------------
```

```
. xtunitroot fisher irh, pperron lags(2)

Fisher-type unit-root test for irh
Based on Phillips-Perron tests
-----------------------------------
Ho: All panels contain unit roots          Number of panels  =     12
Ha: At least one panel is stationary       Number of periods =     20

AR parameter:    Panel-specific            Asymptotics: T -> Infinity
Panel means:     Included
Time trend:      Not included
Newey-West lags: 2 lags
------------------------------------------------------------------------------
                                  Statistic      p-value
------------------------------------------------------------------------------
 Inverse chi-squared(24)   P       122.9049       0.0000
 Inverse normal            Z        -6.4134       0.0000
 Inverse logit t(64)       L*       -9.0350       0.0000
 Modified inv. chi-squared Pm       14.2757       0.0000
------------------------------------------------------------------------------
 P statistic requires number of panels to be finite.
 Other statistics are suitable for finite or infinite number of panels.
------------------------------------------------------------------------------
```

```
. xtunitroot fisher lnchouseholds, pperron lags(2)

Fisher-type unit-root test for lnchouseholds
Based on Phillips-Perron tests
--------------------------------------------
Ho: All panels contain unit roots           Number of panels  =     12
Ha: At least one panel is stationary        Number of periods =     20

AR parameter:    Panel-specific             Asymptotics: T -> Infinity
Panel means:     Included
Time trend:      Not included
Newey-West lags: 2 lags
------------------------------------------------------------------------------
                                  Statistic      p-value
------------------------------------------------------------------------------
 Inverse chi-squared(24)   P        55.4635       0.0003
 Inverse normal            Z        -0.9725       0.1654
 Inverse logit t(54)       L*       -1.8995       0.0314
 Modified inv. chi-squared Pm        4.5414       0.0000
------------------------------------------------------------------------------
 P statistic requires number of panels to be finite.
 Other statistics are suitable for finite or infinite number of panels.
------------------------------------------------------------------------------

.
. xtunitroot fisher lncnfc, pperron lags(2)

Fisher-type unit-root test for lncnfc
Based on Phillips-Perron tests
-------------------------------------
Ho: All panels contain unit roots           Number of panels  =     12
Ha: At least one panel is stationary        Number of periods =     20

AR parameter:    Panel-specific             Asymptotics: T -> Infinity
Panel means:     Included
Time trend:      Not included
Newey-West lags: 2 lags
------------------------------------------------------------------------------
                                  Statistic      p-value
------------------------------------------------------------------------------
 Inverse chi-squared(24)   P        32.8522       0.1072
 Inverse normal            Z         2.4883       0.9936
 Inverse logit t(64)       L*        2.8134       0.9967
 Modified inv. chi-squared Pm        1.2777       0.1007
------------------------------------------------------------------------------
 P statistic requires number of panels to be finite.
 Other statistics are suitable for finite or infinite number of panels.
------------------------------------------------------------------------------
```

```
. xtunitroot fisher lnbsize, pperron lags(2)

Fisher-type unit-root test for lnbsize
Based on Phillips-Perron tests
--------------------------------------
Ho: All panels contain unit roots           Number of panels  =     12
Ha: At least one panel is stationary        Number of periods =     20

AR parameter:    Panel-specific             Asymptotics: T -> Infinity
Panel means:     Included
Time trend:      Not included
Newey-West lags: 2 lags
------------------------------------------------------------------------------
                                  Statistic      p-value
------------------------------------------------------------------------------
 Inverse chi-squared(24)   P         9.4212       0.9966
 Inverse normal            Z         3.1787       0.9993
 Inverse logit t(64)       L*        3.2828       0.9992
 Modified inv. chi-squared Pm       -2.1043       0.9823
------------------------------------------------------------------------------
 P statistic requires number of panels to be finite.
 Other statistics are suitable for finite or infinite number of panels.
------------------------------------------------------------------------------
```

```
. xtunitroot fisher irnfc, pperron lags(2)

Fisher-type unit-root test for irnfc
Based on Phillips-Perron tests
------------------------------------
Ho: All panels contain unit roots          Number of panels  =     12
Ha: At least one panel is stationary       Number of periods =     20

AR parameter:    Panel-specific            Asymptotics: T -> Infinity
Panel means:     Included
Time trend:      Not included
Newey-West lags: 2 lags
------------------------------------------------------------------------------
                                  Statistic      p-value
------------------------------------------------------------------------------
 Inverse chi-squared(24)   P       367.9611       0.0000
 Inverse normal            Z       -14.2327       0.0000
 Inverse logit t(64)       L*      -28.8579       0.0000
 Modified inv. chi-squared Pm       49.6465       0.0000
------------------------------------------------------------------------------
 P statistic requires number of panels to be finite.
 Other statistics are suitable for finite or infinite number of panels.
------------------------------------------------------------------------------

.
. xtunitroot fisher cet1, pperron lags(2)

Fisher-type unit-root test for cet1
Based on Phillips-Perron tests
-----------------------------------
Ho: All panels contain unit roots          Number of panels  =     12
Ha: At least one panel is stationary       Number of periods =     20

AR parameter:    Panel-specific            Asymptotics: T -> Infinity
Panel means:     Included
Time trend:      Not included
Newey-West lags: 2 lags
------------------------------------------------------------------------------
                                  Statistic      p-value
------------------------------------------------------------------------------
 Inverse chi-squared(24)   P        85.3691       0.0000
 Inverse normal            Z        -1.7267       0.0421
 Inverse logit t(64)       L*       -4.7551       0.0000
 Modified inv. chi-squared Pm        8.8579       0.0000
------------------------------------------------------------------------------
 P statistic requires number of panels to be finite.
 Other statistics are suitable for finite or infinite number of panels.
------------------------------------------------------------------------------

.
. xtunitroot fisher tt1, pperron lags(2)

Fisher-type unit-root test for tt1
Based on Phillips-Perron tests
----------------------------------
Ho: All panels contain unit roots          Number of panels  =     12
Ha: At least one panel is stationary       Number of periods =     20

AR parameter:    Panel-specific            Asymptotics: T -> Infinity
Panel means:     Included
Time trend:      Not included
Newey-West lags: 2 lags
------------------------------------------------------------------------------
                                  Statistic      p-value
------------------------------------------------------------------------------
 Inverse chi-squared(24)   P        91.7245       0.0000
 Inverse normal            Z        -3.1130       0.0009
 Inverse logit t(64)       L*       -5.9174       0.0000
 Modified inv. chi-squared Pm        9.7752       0.0000
------------------------------------------------------------------------------
 P statistic requires number of panels to be finite.
 Other statistics are suitable for finite or infinite number of panels.
------------------------------------------------------------------------------
```

```
. xtunitroot fisher lev, pperron lags(2)

Fisher-type unit-root test for lev
Based on Phillips-Perron tests
----------------------------------
Ho: All panels contain unit roots           Number of panels  =     12
Ha: At least one panel is stationary        Number of periods =     20

AR parameter:    Panel-specific             Asymptotics: T -> Infinity
Panel means:     Included
Time trend:      Not included
Newey-West lags: 2 lags
------------------------------------------------------------------------------
                                  Statistic      p-value
------------------------------------------------------------------------------
 Inverse chi-squared(24)   P        18.8451       0.7602
 Inverse normal            Z         1.0076       0.8432
 Inverse logit t(64)       L*        0.9403       0.8247
 Modified inv. chi-squared Pm       -0.7440       0.7716
------------------------------------------------------------------------------
 P statistic requires number of panels to be finite.
 Other statistics are suitable for finite or infinite number of panels.
------------------------------------------------------------------------------

.
. xtunitroot fisher liqassets, pperron lags(2)

Fisher-type unit-root test for liqassets
Based on Phillips-Perron tests
----------------------------------------
Ho: All panels contain unit roots           Number of panels  =     12
Ha: At least one panel is stationary        Number of periods =     20

AR parameter:    Panel-specific             Asymptotics: T -> Infinity
Panel means:     Included
Time trend:      Not included
Newey-West lags: 2 lags
------------------------------------------------------------------------------
                                  Statistic      p-value
------------------------------------------------------------------------------
 Inverse chi-squared(24)   P        31.4839       0.1403
 Inverse normal            Z        -0.6423       0.2603
 Inverse logit t(64)       L*       -0.8078       0.2111
 Modified inv. chi-squared Pm        1.0802       0.1400
------------------------------------------------------------------------------
 P statistic requires number of panels to be finite.
 Other statistics are suitable for finite or infinite number of panels.
------------------------------------------------------------------------------

.
. xtunitroot fisher lnm3, pperron lags(2)

Fisher-type unit-root test for lnm3
Based on Phillips-Perron tests
-----------------------------------
Ho: All panels contain unit roots           Number of panels  =     12
Ha: At least one panel is stationary        Number of periods =     20

AR parameter:    Panel-specific             Asymptotics: T -> Infinity
Panel means:     Included
Time trend:      Not included
Newey-West lags: 2 lags
------------------------------------------------------------------------------
                                  Statistic      p-value
------------------------------------------------------------------------------
 Inverse chi-squared(24)   P         1.4767       1.0000
 Inverse normal            Z         5.3953       1.0000
 Inverse logit t(64)       L*        5.3084       1.0000
 Modified inv. chi-squared Pm       -3.2510       0.9994
------------------------------------------------------------------------------
 P statistic requires number of panels to be finite.
 Other statistics are suitable for finite or infinite number of panels.
------------------------------------------------------------------------------
```

```
. xtunitroot fisher lngdp, pperron lags(2)

Fisher-type unit-root test for lngdp
Based on Phillips-Perron tests
--------------------------------------
Ho: All panels contain unit roots           Number of panels  =     12
Ha: At least one panel is stationary        Number of periods =     20

AR parameter:    Panel-specific             Asymptotics: T -> Infinity
Panel means:     Included
Time trend:      Not included
Newey-West lags: 2 lags
------------------------------------------------------------------------------
                                  Statistic      p-value
------------------------------------------------------------------------------
 Inverse chi-squared(24)   P        30.0805       0.1821
 Inverse normal            Z         1.0569       0.8547
 Inverse logit t(64)       L*        0.6769       0.7495
 Modified inv. chi-squared Pm        0.8776       0.1901
------------------------------------------------------------------------------
 P statistic requires number of panels to be finite.
 Other statistics are suitable for finite or infinite number of panels.
------------------------------------------------------------------------------

.
. xtunitroot fisher lnhprices, pperron lags(2)

Fisher-type unit-root test for lnhprices
Based on Phillips-Perron tests
------------------------------------------
Ho: All panels contain unit roots           Number of panels  =     12
Ha: At least one panel is stationary        Number of periods =     20

AR parameter:    Panel-specific             Asymptotics: T -> Infinity
Panel means:     Included
Time trend:      Not included
Newey-West lags: 2 lags
------------------------------------------------------------------------------
                                  Statistic      p-value
------------------------------------------------------------------------------
 Inverse chi-squared(24)   P         6.9894       0.9997
 Inverse normal            Z         4.4185       1.0000
 Inverse logit t(64)       L*        4.8554       1.0000
 Modified inv. chi-squared Pm       -2.4553       0.9930
------------------------------------------------------------------------------
 P statistic requires number of panels to be finite.
 Other statistics are suitable for finite or infinite number of panels.
------------------------------------------------------------------------------

.
. xtunitroot fisher npl, pperron lags(2)

Fisher-type unit-root test for npl
Based on Phillips-Perron tests
------------------------------------
Ho: All panels contain unit roots           Number of panels  =     12
Ha: At least one panel is stationary        Number of periods =     20

AR parameter:    Panel-specific             Asymptotics: T -> Infinity
Panel means:     Included
Time trend:      Not included
Newey-West lags: 2 lags
------------------------------------------------------------------------------
                                  Statistic      p-value
------------------------------------------------------------------------------
 Inverse chi-squared(24)   P        26.0284       0.3517
 Inverse normal            Z         1.0644       0.8564
 Inverse logit t(64)       L*        1.1995       0.8826
 Modified inv. chi-squared Pm        0.2928       0.3848
------------------------------------------------------------------------------
 P statistic requires number of panels to be finite.
 Other statistics are suitable for finite or infinite number of panels.
------------------------------------------------------------------------------
```

# Appendix C

```
. xtserial cgap cet1 lnbsize_tt1 tt1 lev liqassets lnm3 lnbsize lnbsize2 lnhprices npl

Wooldridge test for autocorrelation in panel data
H0: no first-order autocorrelation
    F(  1,      11) =    133.738
           Prob > F =      0.0000

.
. xtserial lnchouseholds irh cet1 tt1 lev liqassets lnm3 lnbsize lngdp lnhprices npl

Wooldridge test for autocorrelation in panel data
H0: no first-order autocorrelation
    F(  1,      11) =     49.574
           Prob > F =      0.0000

.
. xtserial lncnfc irnfc cet1 tt1 lev liqassets lnm3 lnbsize lngdp npl

Wooldridge test for autocorrelation in panel data
H0: no first-order autocorrelation
    F(  1,      11) =     25.158
           Prob > F =      0.0004
```

# Appendix D

```
. quietly xtreg lnchouseholds irh l2.cet1 l2.tt1 l2.D.lev l2.D.liqassets D.lnm3 l2.D.lnbsize D.lngdp D.lnhprices l2.D.npl,re

.
. estimate store random

.
. quietly xtreg lnchouseholds irh l2.cet1 l2.tt1 l2.D.lev l2.D.liqassets D.lnm3 l2.D.lnbsize D.lngdp D.lnhprices l2.D.npl,fe

.
. estimate store fixed

.
. hausman fixed random, sigmamore

Note: the rank of the differenced variance matrix (9) does not equal the number of coefficients being tested (10); be sure this is
        what you expect, or there may be problems computing the test.  Examine the output of your estimators for anything
        unexpected and possibly consider scaling your variables so that the coefficients are on a similar scale.
```

| | Coefficients (b) fixed | (B) random | (b-B) Difference | sqrt(diag(V_b-V_B)) S.E. |
|---|---|---|---|---|
| irh | -.150828 | -.150813 | -.0000149 | .0006423 |
| cet1 L2. | -.009777 | -.010279 | .0005021 | .0004414 |
| tt1 L2. | -.0051671 | -.0051308 | -.0000363 | .0006493 |
| lev L2D. | .00574 | .0058701 | -.0001301 | .0002698 |
| liqassets L2D. | -.0003998 | -.0004611 | .0000613 | .0000558 |
| lnm3 D1. | -2.765825 | -2.792545 | .0267204 | .0326376 |
| lnbsize L2D. | .4082856 | .407812 | .0004736 | .0019886 |
| lngdp D1. | -1.429209 | -1.440874 | .0116643 | .0099651 |
| lnhprices D1. | 2.22127 | 2.236665 | -.0153945 | .0221584 |
| npl L2D. | .013439 | .0133785 | .0000605 | .0000943 |

```
                   b = consistent under Ho and Ha; obtained from xtreg
    B = inconsistent under Ha, efficient under Ho; obtained from xtreg

  Test:  Ho:  difference in coefficients not systematic

              chi2(9) = (b-B)'[(V_b-V_B)^(-1)](b-B)
                      =        7.74
            Prob>chi2 =      0.5603
            (V_b-V_B is not positive definite)
```

```
. quietly xtreg D.lncnfc irnfc l2.cet1 l2.tt1 l2.D.lev l2.D.liqassets D.lnm3 l2.D.lnbsize D.lngdp l2.D.npl,re

.
. estimate store random

.
. quietly xtreg D.lncnfc irnfc l2.cet1 l2.tt1 l2.D.lev l2.D.liqassets D.lnm3 l2.D.lnbsize D.lngdp l2.D.npl,fe

.
. estimate store fixed

.
. hausman fixed random

                 ---- Coefficients ----
             |      (b)          (B)            (b-B)     sqrt(diag(V_b-V_B))
             |     fixed        random       Difference          S.E.
-------------+----------------------------------------------------------------
       irnfc |    .0323825     .0003407        .0320417        .0105547
        cet1 |
         L2. |    .0054092     .0164248       -.0110156        .0053138
         tt1 |
         L2. |   -.0015198    -.0137243        .0122045        .0066802
         lev |
        L2D. |    .0062937    -.0000966        .0063903         .002283
   liqassets |
        L2D. |    .0020776     .0006133        .0014643        .0004688
        lnm3 |
         D1. |   -1.557097    -.5984187       -.9586785        .3001309
     lnbsize |
        L2D. |    .0510009     .0430199         .007981               .
       lngdp |
         D1. |    .0525241     .0934295       -.0409054        .0391781
         npl |
        L2D. |   -.0025862    -.0011912        -.001395        .0006259
------------------------------------------------------------------------------
                           b = consistent under Ho and Ha; obtained from xtreg
            B = inconsistent under Ha, efficient under Ho; obtained from xtreg

    Test:  Ho:  difference in coefficients not systematic

                  chi2(9) = (b-B)'[(V_b-V_B)^(-1)](b-B)
                          =       18.19
                Prob>chi2 =      0.0331
                (V_b-V_B is not positive definite)


. quietly xtreg cgap l2.cet1 l2.tt1 l2.D.lev l2.D.liqassets D.lnm3 l2.D.lnbsize D.lnhprices l2.D.npl,re

.
. estimate store random

.
. quietly xtreg cgap l2.cet1 l2.tt1 l2.D.lev l2.D.liqassets D.lnm3 l2.D.lnbsize D.lnhprices l2.D.npl,fe

.
. estimate store fixed

.
. hausman fixed random

                 ---- Coefficients ----
             |      (b)          (B)            (b-B)     sqrt(diag(V_b-V_B))
             |     fixed        random       Difference          S.E.
-------------+----------------------------------------------------------------
        cet1 |
         L2. |   -4.251331    -4.245708       -.0056225        2.259853
         tt1 |
         L2. |     4.04983     3.429181        .6206492        2.698628
         lev |
        L2D. |   -3.675745    -3.974182        .2984367        1.661747
   liqassets |
        L2D. |   -.3350637    -.4861125        .1510488        .6420624
        lnm3 |
         D1. |    905.3008     835.9617        69.33908        195.2431
     lnbsize |
        L2D. |   -84.51715    -80.44039       -4.076764        17.28166
  lnhprices |
         D1. |    222.5725     204.1784        18.39407        88.82571
         npl |
        L2D. |   -.0087127      .215261       -.2239736        1.010248
------------------------------------------------------------------------------
                           b = consistent under Ho and Ha; obtained from xtreg
            B = inconsistent under Ha, efficient under Ho; obtained from xtreg

    Test:  Ho:  difference in coefficients not systematic

                  chi2(8) = (b-B)'[(V_b-V_B)^(-1)](b-B)
                          =        0.78
                Prob>chi2 =      0.9993
```

# Appendix E

```
. xtreg cgap l2.cet1 l2.tt1 l2.D.lev l2.D.liqassets D.lnm3 l2.D.lnbsize D.lnhprices l2.D.npl,re vce(cluster country)

Random-effects GLS regression                   Number of obs     =         60
Group variable: country                         Number of groups  =         12

R-sq:                                           Obs per group:
     within  = 0.1974                                         min =          5
     between = 0.1155                                         avg =        5.0
     overall = 0.1021                                         max =          5

                                                Wald chi2(8)      =      22.23
corr(u_i, X)   = 0 (assumed)                    Prob > chi2       =     0.0045

                               (Std. Err. adjusted for 12 clusters in country)
------------------------------------------------------------------------------
             |               Robust
        cgap |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        cet1 |
         L2. |  -4.245708   6.217848    -0.68   0.495    -16.43247    7.941051
             |
         tt1 |
         L2. |   3.429181   5.347584     0.64   0.521    -7.051891    13.91025
             |
         lev |
        L2D. |  -3.974182   7.246972    -0.55   0.583    -18.17799    10.22962
             |
   liqassets |
        L2D. |  -.4861125   3.316663    -0.15   0.883    -6.986652    6.014427
             |
        lnm3 |
         D1. |   835.9617   688.5696     1.21   0.225    -513.6099    2185.533
             |
     lnbsize |
        L2D. |  -80.44039   49.61806    -1.62   0.105      -177.69    16.80923
             |
   lnhprices |
         D1. |   204.1784   358.5853     0.57   0.569    -498.6359    906.9928
             |
         npl |
        L2D. |    .215261    1.94559     0.11   0.912    -3.598026    4.028547
             |
       _cons |  -22.73366   27.55957    -0.82   0.409    -76.74943     31.2821
-------------+----------------------------------------------------------------
     sigma_u |  28.908915
     sigma_e |  11.383325
         rho |  .86576261   (fraction of variance due to u_i)
------------------------------------------------------------------------------
```

```
. xtreg lnchouseholds irh l2.cet1 l2.tt1 l2.D.lev l2.D.liqassets D.lnm3 l2.D.lnbsize D.lngdp D.lnhprices l2.D.npl,re vce(cluster c
> ountry)

Random-effects GLS regression                   Number of obs     =         60
Group variable: country                         Number of groups  =         12

R-sq:                                           Obs per group:
     within  = 0.8027                                         min =          5
     between = 0.0186                                         avg =        5.0
     overall = 0.0200                                         max =          5

                                                Wald chi2(10)     =     145.08
corr(u_i, X)   = 0 (assumed)                    Prob > chi2       =     0.0000

                               (Std. Err. adjusted for 12 clusters in country)
------------------------------------------------------------------------------
             |               Robust
lnchouseho~s |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         irh |   -.150813   .0279364    -5.40   0.000    -.2055674   -.0960587
             |
        cet1 |
         L2. |   -.010279   .0193774    -0.53   0.596     -.048258       .0277
             |
         tt1 |
         L2. |  -.0051308   .0173435    -0.30   0.767    -.0391235    .0288618
             |
         lev |
        L2D. |   .0058701   .0145525     0.40   0.687    -.0226524    .0343925
             |
   liqassets |
        L2D. |  -.0004611   .0055963    -0.08   0.934    -.0114296    .0105074
             |
        lnm3 |
         D1. |  -2.792545    2.28732    -1.22   0.222    -7.275611     1.69052
             |
     lnbsize |
        L2D. |    .407812   .1622948     2.51   0.012     .0897201    .7259039
             |
       lngdp |
         D1. |  -1.440874   .4452787    -3.24   0.001    -2.313604   -.5681434
             |
   lnhprices |
         D1. |   2.236665   1.050101     2.13   0.033     .1785046    4.294825
             |
         npl |
        L2D. |   .0133785   .0070114     1.91   0.056    -.0003635    .0271205
             |
       _cons |   13.02389   .3852738    33.80   0.000     12.26876    13.77901
-------------+----------------------------------------------------------------
     sigma_u |  1.4022364
     sigma_e |  .03793591
         rho |  .99926862   (fraction of variance due to u_i)
------------------------------------------------------------------------------
```

```
. xtreg D.lncnfc irnfc l2.cet1 l2.tt1 l2.D.lev l2.D.liqassets D.lnm3 l2.D.lnbsize D.lngdp l2.D.npl,re vce(cluster country)

Random-effects GLS regression                   Number of obs     =         60
Group variable: country                         Number of groups  =         12

R-sq:                                           Obs per group:
     within  = 0.0950                                         min =          5
     between = 0.6297                                         avg =        5.0
     overall = 0.4220                                         max =          5

                                                Wald chi2(9)      =      53.98
corr(u_i, X)   = 0 (assumed)                    Prob > chi2       =     0.0000

                               (Std. Err. adjusted for 12 clusters in country)
------------------------------------------------------------------------------
             |               Robust
    D.lncnfc |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       irnfc |   .0003407   .0054952     0.06   0.951    -.0104296    .0111111
             |
        cet1 |
         L2. |   .0164248   .0069166     2.37   0.018     .0028685     .029981
             |
         tt1 |
         L2. |  -.0137243    .006308    -2.18   0.030    -.0260876   -.0013609
             |
         lev |
        L2D. |  -.0000966   .0036645    -0.03   0.979    -.0072789    .0070857
             |
   liqassets |
        L2D. |   .0006133   .0024174     0.25   0.800    -.0041247    .0053514
             |
        lnm3 |
         D1. |  -.5984187   .7073288    -0.85   0.398    -1.984758    .7879202
             |
     lnbsize |
        L2D. |   .0430199    .091973     0.47   0.640    -.1372439    .2232836
             |
       lngdp |
         D1. |   .0934295   .0758297     1.23   0.218    -.0551939    .2420529
             |
         npl |
        L2D. |  -.0011912    .001887    -0.63   0.528    -.0048898    .0025073
             |
       _cons |  -.0308425   .0263048    -1.17   0.241    -.0823989    .0207139
-------------+----------------------------------------------------------------
     sigma_u |  .01194084
     sigma_e |   .0147037
         rho |  .39740997   (fraction of variance due to u_i)
------------------------------------------------------------------------------
```

# Appendix F

```
. quietly xtreg lnchouseholds irh irh2 l2.cet1 l2.tt1 l2.D.lev l2.D.liqassets D.lnm3 l2.D.lnbsize l2.D.lnbsize2 D.lngdp D.lngdp2 D
> .lnhprices D.lnhprices2 l2.D.npl,re

.
. estimate store random

.
. quietly xtreg lnchouseholds irh irh2 l2.cet1 l2.tt1 l2.D.lev l2.D.liqassets D.lnm3 l2.D.lnbsize l2.D.lnbsize2 D.lngdp D.lngdp2 D
> .lnhprices D.lnhprices2 l2.D.npl,fe

.
. estimate store fixed

.
. hausman fixed random, sigmamore

Note: the rank of the differenced variance matrix (9) does not equal the number of coefficients being tested (14); be sure this is
        what you expect, or there may be problems computing the test.  Examine the output of your estimators for anything
        unexpected and possibly consider scaling your variables so that the coefficients are on a similar scale.
```

| | Coefficients (b) fixed | (B) random | (b-B) Difference | sqrt(diag(V_b-V_B)) S.E. |
|---|---|---|---|---|
| irh | -.1208284 | 2.731201 | -2.852029 | 2.791601 |
| irh2 | -.0038057 | -.4576706 | .4538649 | .3469348 |
| cet1 | | | | |
| L2. | -.0069715 | -.8617931 | .8548216 | .4306043 |
| tt1 | | | | |
| L2. | -.0077107 | .6616471 | -.6693578 | .4787061 |
| lev | | | | |
| L2D. | .0045867 | -.6916938 | .6962806 | .2771769 |
| liqassets | | | | |
| L2D. | -.0024905 | -.1624439 | .1599534 | .1356218 |
| lnm3 | | | | |
| D1. | -2.669148 | 18.0326 | -20.70175 | 28.1932 |
| lnbsize | | | | |
| L2D. | 1.556699 | -45.49559 | 47.05229 | 30.31607 |
| lnbsize2 | | | | |
| L2D. | -.0329838 | 1.456473 | -1.489457 | .906034 |
| lngdp | | | | |
| D1. | 15.82192 | -769.0684 | 784.8903 | 876.7634 |
| lngdp2 | | | | |
| D1. | -1.836416 | 81.33049 | -83.1669 | 94.45759 |
| lnhprices | | | | |
| D1. | -24.49186 | 412.8096 | -437.3014 | 299.4397 |
| lnhprices2 | | | | |
| D1. | 2.785129 | -43.89046 | 46.67559 | 31.46827 |
| npl | | | | |
| L2D. | .0134188 | .0693453 | -.0559265 | .1505012 |

```
                         b = consistent under Ho and Ha; obtained from xtreg
          B = inconsistent under Ha, efficient under Ho; obtained from xtreg

    Test:  Ho:  difference in coefficients not systematic

                  chi2(9) = (b-B)'[(V_b-V_B)^(-1)](b-B)
                          =       43.77
                Prob>chi2 =      0.0000
                (V_b-V_B is not positive definite)


. xtreg lnchouseholds irh irh2 l2.cet1 l2.tt1 l2.D.lev l2.D.liqassets D.lnm3 l2.D.lnbsize l2.D.lnbsize2 D.lngdp D.lngdp2 D.lnhpric
> es D.lnhprices2 l2.D.npl,fe vce(cluster country)

Fixed-effects (within) regression               Number of obs     =         60
Group variable: country                         Number of groups  =         12

R-sq:                                           Obs per group:
     within  = 0.8127                                         min =          5
     between = 0.0176                                         avg =        5.0
     overall = 0.0190                                         max =          5

                                                F(12,11)          =          .
corr(u_i, Xb)  = 0.0474                         Prob > F          =          .

                               (Std. Err. adjusted for 12 clusters in country)
```

| lnchouseho~s | Coef. | Robust Std. Err. | t | P>\|t\| | [95% Conf. | Interval] |
|---|---|---|---|---|---|---|
| irh | -.1208284 | .1826509 | -0.66 | 0.522 | -.5228404 | .2811836 |
| irh2 | -.0038057 | .0222668 | -0.17 | 0.867 | -.0528145 | .0452032 |
| cet1 | | | | | | |
| L2. | -.0069715 | .0229411 | -0.30 | 0.767 | -.0574645 | .0435215 |
| tt1 | | | | | | |
| L2. | -.0077107 | .0204014 | -0.38 | 0.713 | -.052614 | .0371926 |
| lev | | | | | | |
| L2D. | .0045867 | .0169286 | 0.27 | 0.791 | -.0326728 | .0418462 |
| liqassets | | | | | | |
| L2D. | -.0024905 | .0078686 | -0.32 | 0.758 | -.0198092 | .0148282 |
| lnm3 | | | | | | |
| D1. | -2.669148 | 2.707549 | -0.99 | 0.345 | -8.628423 | 3.290128 |
| lnbsize | | | | | | |
| L2D. | 1.556699 | 2.342907 | 0.66 | 0.520 | -3.600004 | 6.713402 |
| lnbsize2 | | | | | | |
| L2D. | -.0329838 | .0698824 | -0.47 | 0.646 | -.186794 | .1208265 |
| lngdp | | | | | | |
| D1. | 15.82192 | 53.69298 | 0.29 | 0.774 | -102.3555 | 133.9994 |
| lngdp2 | | | | | | |
| D1. | -1.836416 | 5.768319 | -0.32 | 0.756 | -14.5324 | 10.85957 |
| lnhprices | | | | | | |
| D1. | -24.49186 | 37.66798 | -0.65 | 0.529 | -107.3985 | 58.4148 |
| lnhprices2 | | | | | | |
| D1. | 2.785129 | 3.998556 | 0.70 | 0.501 | -6.015634 | 11.58589 |
| npl | | | | | | |
| L2D. | .0134188 | .0074745 | 1.80 | 0.100 | -.0030325 | .0298701 |
| _cons | 12.95958 | .3675038 | 35.26 | 0.000 | 12.15071 | 13.76845 |
| sigma_u | 1.303869 | | | | | |
| sigma_e | .03907913 | | | | | |
| rho | .99910251 | (fraction of variance due to u_i) | | | | |

```
. test irh irh2

 ( 1)  irh = 0
 ( 2)  irh2 = 0

       F(  2,    11) =   12.23
            Prob > F =    0.0016

.
. test l2.D.lnbsize l2.D.lnbsize2

 ( 1)  L2D.lnbsize = 0
 ( 2)  L2D.lnbsize2 = 0

       F(  2,    11) =    4.90
            Prob > F =    0.0301

.
. test D.lngdp D.lngdp2

 ( 1)  D.lngdp = 0
 ( 2)  D.lngdp2 = 0

       F(  2,    11) =    8.08
            Prob > F =    0.0069

.
. test D.lnhprices D.lnhprices2

 ( 1)  D.lnhprices = 0
 ( 2)  D.lnhprices2 = 0

       F(  2,    11) =    2.22
            Prob > F =    0.1545
```

```
. quietly xtreg D.lncnfc irnfc l2.cet1 l2.cet12 l2.tt1 l2.tt12 l2.D.lev l2.D.liqassets D.lnm3 l2.D.lnbsize D.lngdp l2.D.npl,re

.
. estimate store random

.
. quietly xtreg D.lncnfc irnfc l2.cet1 l2.cet12 l2.tt1 l2.tt12 l2.D.lev l2.D.liqassets D.lnm3 l2.D.lnbsize D.lngdp l2.D.npl,fe

.
. estimate store fixed

.
. hausman fixed random

                 ---- Coefficients ----
             |      (b)          (B)            (b-B)     sqrt(diag(V_b-V_B))
             |     fixed        random       Difference          S.E.
-------------+----------------------------------------------------------------
       irnfc |    .0402221    -.0038723        .0440944        .0122426
        cet1 |
         L2. |    .0298847     .0466286       -.0167438        .0145515
       cet12 |
         L2. |   -.0007688    -.0009116        .0001428        .0004388
         tt1 |
         L2. |      .00185    -.0352112        .0370612        .0141481
        tt12 |
         L2. |   -.0000528     .0006293        -.000682        .0003574
         lev |
        L2D. |    .0100755     .0002228        .0098526        .0020283
   liqassets |
        L2D. |    .0029167     .0007583        .0021584               .
        lnm3 |
         D1. |   -1.396165    -.3366833       -1.059482         .194326
     lnbsize |
        L2D. |    .0369421     .0255714        .0113707               .
       lngdp |
         D1. |   -.0976398     .0793702         -.17701        .0537699
         npl |
        L2D. |   -.0033018    -.0023009       -.0010009               .
------------------------------------------------------------------------------
                          b = consistent under Ho and Ha; obtained from xtreg
           B = inconsistent under Ha, efficient under Ho; obtained from xtreg

    Test:  Ho:  difference in coefficients not systematic

                 chi2(11) = (b-B)'[(V_b-V_B)^(-1)](b-B)
                          =        4.68
                Prob>chi2 =      0.9458
                (V_b-V_B is not positive definite)
```

```
. xtreg D.lncnfc irnfc l2.cet1 l2.cet12 l2.tt1 l2.tt12 l2.D.lev l2.D.liqassets D.lnm3 l2.D.lnbsize D.lngdp l2.D.npl,re vce(cluster
>  country)

Random-effects GLS regression                   Number of obs     =         60
Group variable: country                         Number of groups  =         12

R-sq:                                           Obs per group:
     within  = 0.0982                                         min =          5
     between = 0.6912                                         avg =        5.0
     overall = 0.4603                                         max =          5

                                                Wald chi2(11)     =     111.74
corr(u_i, X)   = 0 (assumed)                    Prob > chi2       =     0.0000

                               (Std. Err. adjusted for 12 clusters in country)
------------------------------------------------------------------------------
             |               Robust
    D.lncnfc |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       irnfc |  -.0038723   .0058053    -0.67   0.505    -.0152505    .0075059
             |
        cet1 |
         L2. |   .0466286   .0560773     0.83   0.406    -.0632809     .156538
             |
       cet12 |
         L2. |  -.0009116   .0018053    -0.50   0.614      -.00445    .0026268
             |
         tt1 |
         L2. |  -.0352112    .047837    -0.74   0.462    -.1289699    .0585475
             |
        tt12 |
         L2. |   .0006293   .0015396     0.41   0.683    -.0023884    .0036469
             |
         lev |
        L2D. |   .0002228   .0044081     0.05   0.960    -.0084169    .0088625
             |
   liqassets |
        L2D. |   .0007583   .0025517     0.30   0.766    -.0042429    .0057594
             |
        lnm3 |
         D1. |  -.3366833   .6610938    -0.51   0.611    -1.632403    .9590368
             |
     lnbsize |
        L2D. |   .0255714   .0951598     0.27   0.788    -.1609383    .2120811
             |
       lngdp |
         D1. |   .0793702   .0824134     0.96   0.336    -.0821571    .2408974
             |
         npl |
        L2D. |  -.0023009   .0028383    -0.81   0.418    -.0078639    .0032621
             |
       _cons |  -.0888256   .0958699    -0.93   0.354    -.2767272    .0990759
-------------+----------------------------------------------------------------
     sigma_u |  .00747412
     sigma_e |  .01429869
         rho |  .21459538   (fraction of variance due to u_i)
------------------------------------------------------------------------------
```

```
. test l2.cet1 l2.cet12

 ( 1)  L2.cet1 = 0
 ( 2)  L2.cet12 = 0

           chi2(  2) =    6.67
         Prob > chi2 =    0.0355

.
. test l2.tt1 l2.tt12

 ( 1)  L2.tt1 = 0
 ( 2)  L2.tt12 = 0

           chi2(  2) =    6.23
         Prob > chi2 =    0.0444
```