Macroprudential Policy Spillovers: Do Capital Buffers Influence Non-Bank Financial Intermediation in the Euro Area?

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Dissertation written under the supervision of Professor Diana Bonfim

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Abstract

The heightened regulation on banks prompts the question of if and how non-banks are affected by it, especially if there is the possibility of non-banks acting as a substitute source of funding and thus decrease the effectiveness of a policy. While this effect has been studied for other types of policy, the literature on macroprudential policy and regulatory arbitrage is still scarce. To shed light on this topic, I study how macroprudential capital buffers affect non-bank credit. I focus only on capital-based measures as they apply exclusively to banks, while borrower-based measures can and have been applied to non-banks as well, i.e., they do not create regulatory differences between these two sectors. I contribute to the existing literature by using a new definition of non-banks, comprising of investment funds and other financial institutions, and by building a new measure of macroprudential policy intensity, which weights the capital requirements by the exposures they cover. I find that macroprudential shocks are not associated with spillovers to non-bank lending, and this result is robust for different specifications of the model.

Keywords: macroprudential policy, non-banks, spillovers, regulatory arbitrage, financial supervision, capital requirements.

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Abstrato

As progressivas reformas na regulação bancária levantam a questão de se e de que forma o setor não-bancário é impactado por elas, especialmente se existe a possibilidade de este servir como uma fonte substituta de crédito e, consequentemente, reduzir a eficácia de medida implementadas. Embora a existência deste efeito de substituição já tenha sido encontrada no caso de supervisão microprudencial, estudos para política macroprudencial ainda são escassos. Assim, este estudo analisa a relação entre reservas de capital macroprudenciais e crédito concedido pelo setor não-bancário. Só são consideradas medidas aplicadas ao beneficiário, dado que o setor não-bancário também está sujeito a medidas aplicadas ao mutuário, pelo que este segundo tipo de instrumentos não cria uma diferença regulatória entre o setor bancário e não-bancário. Contribuo para a existente literatura neste tópico ao utilizar uma definição do setor não-bancário diferente, e também ao desenvolver índices que medem a intensidade da política macroprudencial, obtidos por pesar as reservas de capital pelas exposições afetas. Não encontro evidência empírica de que choques macroprudenciais geram uma migração de crédito do setor bancário para o não-bancário, sendo que este resultado é robusto para diferentes especificações do modelo.

Keywords: política macroprudencial, setor não-bancário, *spillovers*, arbitragem regulatória, supervisão financeira, reservas de capital.

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Contents

1. Introduction

The Great Financial Crisis (GFC) was a turning point for regulatory standards. The consequences of excessive risk-taking and lack of resilience led to a needed reform on regulation, instruments and practices. Macroprudential policy is one example of an institutional change that was put in place in response to this defining event.

Until recently, the focus of regulators has been directed mainly at the banking sector. However, the growth of non-bank financial intermediation (NBFI) has been putting these entities under the spotlight. In 2020, around 30% of financial assets held by financial intermediaries in the Euro area were under IFs and OFIs. This represents an increase of approximately 8 percentage points since the Great Financial Crisis. While the rising share of assets under these entities has been slowing down since 2015, authorities are still worried about the threats that they can pose.

The increasing importance of non-banks is especially relevant since their activity poses risks for financial stability. Particularly, non-banks can be a source of systemic risk as they engage in credit intermediation, liquidity and maturity transformation, and leverage. Non-banks and banks are also interconnected, meaning that if the above-mentioned risks materialize, there can be a swift contagion to the banking sector, amplifying the negative consequences from the shock.

Goodhart (2008) points out that "the more effective regulation is, the greater the incentive to find ways around it". This reasoning is supported by research findings on how non-banks benefit from regulatory arbitrage (for example, Irani et al. (2021)). With the implementation of new regulation and policy tools, banks see their activity suddenly constrained, either by imposition of the regulation or by own decision given profitability, and non-banks take this opportunity to expand their business into segments that were previously occupied by banks.

The question that this dissertation explores is whether macroprudential policy also generates this substitution effect between bank and non-bank credit. The macroprudential framework implemented in 2014 made available a wide range of tools to address different sources of risk. Among them there are capital buffers, which are additional requirements of Common Equity Tier 1 (CET1) capital that banks must hold. A particularity of capital buffers lies in the fact that they apply only to banks, while other macroprudential instruments, such as borrower-based measures, apply to borrowers directly and, as such, impact on all financial institutions that provide credit. Therefore, the possibility of spillovers from macroprudential policy arises for

the case of capital buffers, as their use introduces a regulatory difference between banks and non-banks.

An important distinction must be made regarding the different nature of institutions encompassed in the definition of non-banks. Given their activity, they can be characterized into the following sectors: insurance companies, pension funds, investment funds and other financial institutions. Following the European Systemic Risk Board entity-based approach, used on their annual NBFI monitoring reports, I only considered in my analysis investment funds and other financial institutions as non-banks. The reasoning behind tapering the measure of non-banks rests on the risk profile of each type of entity and how it is comparable to banks.

My contribution to the literature is twofold. First, I contribute to the growing literature on cross-sector substitution between banks and non-banks (investment funds and other financial institutions) by deepening the analysis and assessing how lending to the private non-financial sector reacts to macroprudential capital buffers applied to banks. Second, I develop macroprudential policy intensity indices, which weight the macroprudential instrument by the exposures that it covers. This constitutes an improvement to the current approach that most literature on macroprudential policy uses, which consists on using the cumulative count of policy implementations, as it takes the structure of the market into account. This new approach results on a measure that is able to capture the intensity of macroprudential policy on each economy, and thus creates an indicator with a scale comparable across countries. To the best of my knowledge, this is the first study that uses macroprudential intensity indices to investigate substitution effects between banks and non-banks.

I find no empirical evidence of spillovers of macroprudential policy from bank to non-bank credit. This result in robust to different specifications of the model, different definitions of non-banks, and other considerations.

The remainder of this dissertation is structured as follows: Section 2 introduces previous studies on the topic; Section 3 presents data sources and definitions followed to build the variables used in the analysis; Section 4 describes the methodology adopted; Section 5 discusses the results; Section 6 explains robustness tests; and finally, Section 7 concludes.

2. Literature

Although the GFC led to more heightened regulatory efforts, they focus mostly on traditional banking. Other sectors have been more loosely regulated and supervised, meaning that a policy may be less effective than intended if other institutions are able to step in and act as substitutes for banks.

Buchak et al. (2018) note that between 2007 and 2015, the non-bank sector doubled its market share in the US. Although technology developments are partly responsible for it, the majority of this growth is driven by regulatory arbitrage: non-banks expand into segments where banks faced a significant regulatory burden, such as riskier and minority borrowers. Indeed, Chernenko et al. (2022) find that two-thirds of non-bank lending (which accounted for a third of loans between 2010 and 2015 in the US) is a result of regulations that constrained banks' ability to lend to unprofitable and highly leveraged borrowers: nonbanks lent with higher interest rates, which highlights how the access to funding, and not prices, can drive the demand of nonbank lending. This regulatory burden can induce a migration from the banking to the non-banking sector, which emphasizes the need for increased regulation of NBFI, something that would complement the reforms that banks and other large financial institutions were subjected to (Kashyap et al. (2010)). The growing exposure to NBFI is not restricted to one continent, given the interconnectedness of institutions. Abad et al. (2022) detail asset exposures of EU banks to non-banking entities across the globe and find that around 60% of exposures are towards non-banks, and almost half of them are based in the US. Bednarek et al. (2023) study the impact of a capital exercise in Germany conducted by the European Banking Authority in 2011 and estimate that non-banks grew their exposure to real sector firms faster than banks, especially for the case of insurance companies, financial enterprises, and factoring companies.

Aiyear et al. (2014) take advantage of a UK policy experiment in the 1990s, consisting on setting bank-specific time-varying capital requirements, which mimics a cyclical macroprudential buffer. They find that banks that were constrained by this capital regulation contracted their lending while those that were not (foreign branches) expanded their lending by around one third of the estimated aggregate change in loan supply that would have happened.

While the focus of the previously mentioned studies is on requirements from microprudential policy, these substitution effects do not appear to be exclusive to them. Recently, there have been efforts to better understand if and how non-banks benefit from not being a target of the

macroprudential toolkit. Cizel et al. (2019) study the evolution of credit to the non-financial private sector by banks and non-banks for 37 advanced and emerging market economies, from 2000 to 2014, and their results point for substitution effects between bank and non-bank credit in economies with well-developed non-bank credit markets, especially when the policy implemented is binding.[1] Claessens et al. (2021) analyse not only the impact of domestic macroprudential policies, but also foreign ones, for 24 advanced and emerging market economies between 2002 and 2017. They find that a domestic macroprudential tightening leads to an increase in the NBFI share of assets at the expense of a decline in banks' assets, while the opposite happens with a tightening in foreign policies. Hodula and Ngo (2021) restrict their analysis to include only loans from other financial institutions, and consider 23 EU countries from 1999 to 2019.[2] Their findings corroborate previous papers, i.e., a policy tightening shifts bank lending to non-bank lending, and these effects are more pronounced for less capitalized sectors and borrower-based measures.

A common feature of the papers mentioned previously is that they often measure macroprudential policy using dummy variables, where a tightening action is assigned a "+1" and a loosening action a "–1". While this approach accounts for the direction of the macroprudential instrument, it completely disregards its strength. An introduction of an LTV limit of 50% is characterized in the same way as an introduction of a cap of 90%, although the impact each measure has in the credit market and consequently in the economy is arguably different.

Recently, there have been attempts to develop methodologies that account for the intensity of the policy. Vandenbussche et al. (2015) develop numerical rules to study the impact of macroprudential policy on house prices and private sector credit in CESEE countries. Their analysis is further expanded in time by Eller et al. (2020), who make some tweaks to the rules. For example, they apply different weights to a tool depending on whether it is a recommendation or a binding policy. Richer et al. (2018) focus only on LTV limits and consider the size of the change and the scope. Alam et al. (2019) decide to consider a simple average of LTV limits in all categories for each country, although they recognize this can overstate the importance of some categories of loans. Belkhir et al. (2022) follow a similar reasoning of

[1] In a more developed non-bank credit markets, there would exist more options that can act as substitutes for bank credit.

[2] They argue that considering the whole NBFI sector is not representative, as some institutions are not involved in credit intermediation or are commonly regulated. Institutions excluded are insurance companies, pension funds, investment and market funds, and captive institutions.

Meuleman and Vennet (2020), where the weights attributed differ according to the phase of the life cycle of the instruments: e.g., the introduction of a tool receives the highest weight, changes in the level of a tool have a higher weight than changes in the definition or scope, while the activation of the instrument receives the highest weight. Chari et al. (2021) develop a new measure of macroprudential stance: an equally weighted index of CCyB, LTV and FX, each scaled by their standard deviation. They argue that by focusing on these three instruments, they target three major systemic risk areas: countercyclical risk in banks, the housing sector, and international exposures.

Although the described approaches represent a first attempt at developing common rules to characterize different instruments, they are not able to take into account the structure of the credit market, which is crucial to measure the intensity of macroprudencial policies. Incorporating micro-data when building an index can be a solution to overcome this issue. Jong and Veirman (2019) track how changes in the LTV limit affect the average of the LTV distribution, using De Nederlandsche Bank credit register data. Gregori and Ramos (2024) follow a similar approach for borrower-based measures using Portugal's credit register data but weight the difference between the limit and the distribution average by the share of loans that are affected by the instrument. Coulier and Schryder (2022) develop an index that accounts for the timing, scope, restrictiveness, and legal enforceability for an extensive list of instruments, namely minimum capital requirements, capital buffers, risk weights, leverage ratios, borrower-based measures, minimum reserve requirements and liquidity requirements. To illustrate their methodology, for the case of borrower-based measures, they take advantage of the ECB's Household Consumption and Finance Survey, which allows them to assess the scope (i.e., the percentage of the market that is affected by the policy) and the restrictiveness (given by the share of loans that are above the imposed limit) of a tool. For capital buffers, they weight the requirements by the market share of the institutions that are subjected to it, using data from S&P Global.

One of the caveats recognized by Cizel et al. (2019) in their analysis (which is common across the remaining papers on the topic) is not being able to include a measure of instrument intensity. The hypothesis they study is that the more binding a measure is, the larger the leakage to the NBFI sector. This dissertation fills that gap by incorporating indices of intensity of macroprudential policy to analyse the magnitude of the substitution effects between bank and non-bank credit.

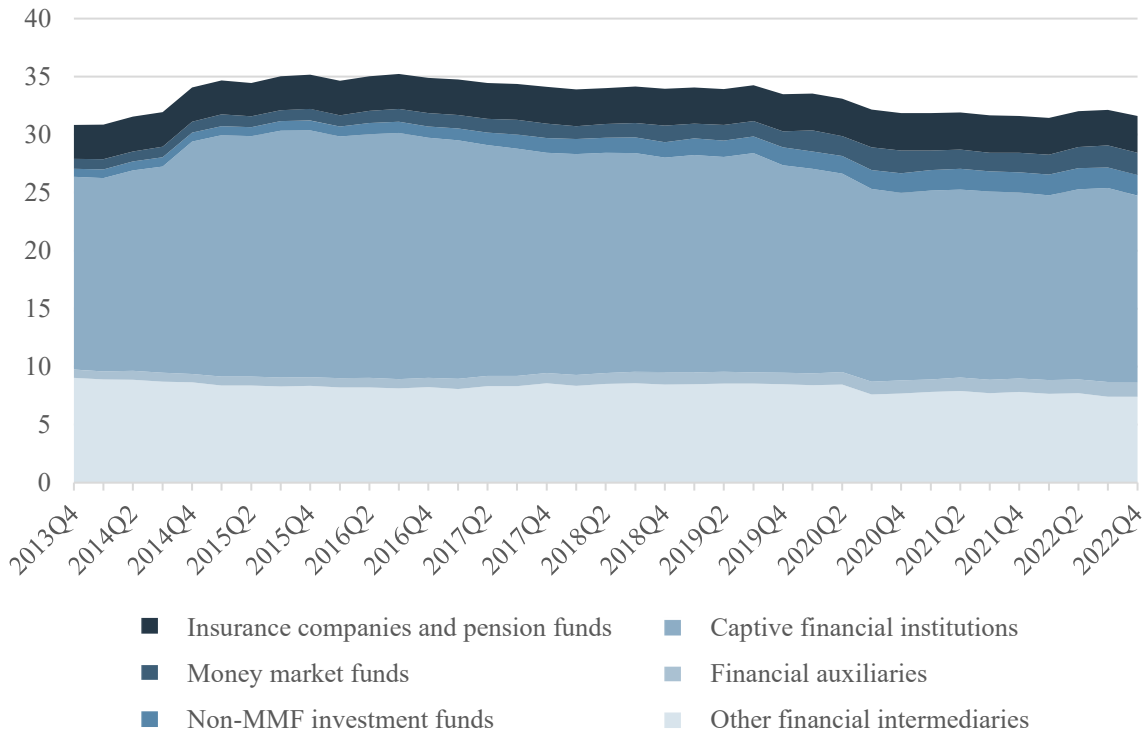
3. Data and variables

This section provides information regarding data sources and definitions used to build the database employed in my analysis. It also presents descriptive statistics of the data and some graphical analyses to better frame the context surrounding the research question.

3.1. Non-bank credit

Non-banks are defined as all financial institutions that are not central banks, banks and public financial institutions. They are grouped by sectors, namely insurance companies, pension funds, investment funds and other financial institutions (other than monetary financial institutions). In the Euro Area, loans granted by these institutions have increased substantially compared to before the GFC, but their share in total lending has been relatively constant from 2014 onwards (Figure 1).

Figure 1. Share of loans granted by non-banks in the Euro Area (in percentage)



Source: ECB

Although the focus is on non-bank credit, it is important to first address the definition of non-bank financial intermediation used in the analysis. While, in practice, all of the above mentioned entities are non-banks, some of them are not particularly relevant in this exercise, either because

they belong to a regulated sector or because their activity has different business and risk profiles than the one of banks, as is the case of insurance companies and pension funds. Thus, what I am really interested in studying is a subset of the NBFI sector.

One international body that has done extensive research on non-banks is the Financial Stability Board (FSB). It has authored annual monitoring reports on NBFI since 2012 and has put forward multiple policy recommendations given its analysis of this sector. In these reports, the FSB developed a "narrow measure" of NBFI. The "narrow measure" is made up of institutions whose financing activity may give rise to systemic risk by maturity and liquidity transformation or leverage build-up, meaning that these entities are subject to risks and vulnerabilities that are associated with the banking system.

The European Systemic Risk Board (ESRB), which is the body responsible for macroprudential oversight across the European Union, has also been monitoring developments in the non-banking sector. Similar to the Financial Stability Board, they only consider non-bank institutions that have a risk profile similar to the one of banks: investment funds and other financial institutions. The decomposition by sector and sub-sector of the ESRB NBFI measure follows the European System of Accounts (ESA) 2010 and is detailed in Table 1.

Table 1. ESRB classification of NBFI

	ESA	Sector	Sub-sector
Investment funds (IFs)	S.123	Money market funds (MMF)	
	S.124	Non-MMF investment funds	Bond funds, equity funds, mixed funds, real estate funds, hedge funds, exchange-traded funds, private equity funds, other funds
Other financial institutions (OFIs)	S.125	Other financial intermediaries	Financial vehicle corporations engaged in securitisation, financial corporations engaged in lending, security and derivative dealers, specialised financial corporations
	S.126	Financial auxiliaries	
	S.127	Captive financial institutions and money lenders	

Using data from the sector accounts, available on the ECB Statistical Data Warehouse, I was able to build a database of domestic loans granted by these entities for 17 Euro area countries.[3,4] Covering only domestic loans is important because what I am interested in studying is cross-sector substitution, i.e., between banks and non-banks. Including all loans (domestic and non-domestic) could capture cross-border spillovers hindering the result. It is also possible to decompose total non-bank credit by the borrowing sector. Therefore, I also built another series on non-bank credit to households and non-profit institutions serving households and to non-financial corporations, which together represent the private non-financial sector.

Throughout this dissertation, whenever non-banks or non-bank financial intermediation (NBFI) is used, I am referring solely to the entities that are encompassed by the ESRB measure: investment funds and other financial institutions.

3.2. Macroprudential policy intensity index

The current European macroprudential framework was introduced on 1 January 2014 with the implementation of the Capital Requirements Directive IV and the Capital Requirements Regulation (CRD IV/CRR). While the goal of macroprudential policy is safeguarding financial stability, either by increasing the resilience of the system or decreasing the build-up of systemic risks, the instruments that are part of the toolkit are designed to address intermediate objectives that ultimately contribute to the final goal, namely:

a. mitigating and preventing excessive credit growth and leverage;
b. mitigating and preventing excessive maturity mismatch and market illiquidity;
c. limiting direct and indirect exposure concentrations;
d. limiting the systemic impact of misaligned incentives with a view to reduce moral hazard;
e. strengthening the resilience of financial infrastructures.

Capital buffers are one of the categories of instruments that are available to macroprudential authorities, and they aim to increase the loss-absorbing capacity of institutions in the face of

[3] Loans traded in the secondary market, excluding those that become negotiable on an organised market, are also included.
[4] Countries included in the sample are Austria, Belgium, Cyprus, Estonia, Finland, France, Germany, Greece, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Portugal, Slovakia, Slovenia and Spain. Ireland is not included due to lack of reported data and Luxembourg is not included as it is an outlier in the sample, in terms of the share of non-bank credit when compared to the remaining countries.

unexpected and adverse conditions. These buffers can either address cyclical or structural systemic risks. The countercyclical capital buffer (CCyB) is a cyclical buffer. It is intended to be activated in periods of excessive credit growth, so that when cyclical systemic risk materializes it can be released. Increasing it during the upturn phase of the cycle also helps to curb excessive credit growth. It only applies to domestic credit granted to the private non-financial sector, and it benefits from mandatory reciprocity up to a certain threshold, meaning that if a foreign branch is operating in a country, it has to comply with it. The buffer for global and other systemically important institutions (GSII and OSII, respectively) address excessive risk-taking tendencies of institutions that are "too-big-to-fail" due to misaligned incentives and moral hazard at global and domestic levels, respectively. The identification of systemically important institutions follows a methodology based on guidelines from the European Banking Authority, which considers many indicators that evaluate the size of the institution, its importance for the economy, its complexity (including cross-border activity) and how interconnected it is with the financial system. The buffer applied to each institution varies depending on its systemic importance, meaning not all institutions have to comply with the same capital requirement. The systemic risk buffer (SyRB) is a buffer for limiting direct and indirect exposures concentration. It is a very flexible instrument, in the sense that it can apply to only a subset or to all exposures, as well as only to a subset or all banks. The capital conservation buffer (CCoB) applies to all exposures and is set at 2.5% for all European countries.

This study focuses only on capital buffers, which make up a substantial part of the macroprudential toolkit. Other macroprudential instruments, such as borrower-based measures (e.g., loan-to-value, debt-to-income and debt-service-to-income ratios), can and have been also applied to non-banks. The underlying hypothesis on this branch of literature lies on regulatory differences between sectors being a possible source of arbitrage. If both banks and non-banks are encompassed by the same regulation, then those measures should be excluded from the study, as no regulatory arbitrage can arise from it. Therefore, I only consider macroprudential capital buffers as they are applied solely to banks.

One of the challenges of studying macroprudential policy is in measuring policy actions. Most of the literature on macroprudential policy uses a "–1/0/+1" approach. Policies are classified as tightening and loosening, depending on their direction. Tightening policy actions are assigned "+1" and loosening actions "–1". Periods where there was no policy change are assigned a "0". The macroprudential index is then given by the cumulative sum of changes in policy. This

methodology characterizes policy actions in an oversimplified way (tightening or loosening). I deviate from this approach and build an intensity index by weighting the buffer rate by the exposures targeted by each buffer, i.e., the share of bank loans that the buffer applies to (Coulier and Schryder (2022), Gregori and Ramos (2024)).

The main innovation of this type of indices is that they measure the loan share in the market that the instrument affects. This is especially relevant when comparing macroprudential policy across countries. Two countries can have a countercyclical capital buffer set at 2%, but if in one the domestic private non-financial sector accounts for 90% of credit, while in the other it only accounts for half of the loans, the impact of the same instrument at the same rate is expected to be different.

The first step in developing the intensity indices is building a database covering all capital buffers that have been enacted and the respective institutions and exposures targeted. To do so, I used the notification templates from the ESRB, available in their website. Cooperation arrangements require macroprudential authorities to notify the ESRB when enacting new policies by filling a common template, which has information on, among other things, the institutions concerned, their respective legal identity identifier, application dates, buffer rate and consolidation level.

The aggregate macroprudential intensity index (MPII), for country i at period t, is given by:

$$MPII_{i,t} = CCoB_{i.t} + CCyB_{i,t}w_{i,t} + \sum_{j=1}^{J} GSII_{ij,t}w_{ij,t} + \sum_{k=1}^{K} OSII_{ik,t}w_{ik,t} + \sum_{l=1}^{L} SyRB_{il,t}w_{il,t}$$

where $CCoB$ stands for the capital conservation buffer; $CCyB$ is the countercyclical capital buffer; $GSII$ and $OSII$ represent the requirements for global systematically important institutions and other systemically important institutions, respectively; and $SyRB$ is the systemic risk buffer. When applicable, each buffer is weighted by the corresponding targeted exposures. The CCoB applies to all exposures, so no weighting is needed. The CCyB is weighted by the share of domestic lending to the private non-financial sector, represented by $w_{i,t}$. Both the GSII and the OSII apply to all exposures of systemically important banks. Thus, the weight $w_{ij,t}$ represents the share of loans in country i granted by the global systemically important bank j at period t. The weight $w_{ik,t}$ is the same, but for bank k, which represents other systemically important banks. The same reasoning of the GSII/OSII is followed for the SyRB if it applies to a subset of banks. In cases where the SyRB applies to sets of exposures

(e.g., only domestic exposures), I follow the same method described for the CCyB. If it applies to all banks and all exposures, no weighting is necessary, similarly to the CCoB. Loan data for systemically important banks was taken from BankFocus. Total lending by country, domestic lending, and lending to domestic private non-financial sector was sourced from the ECB Statistical Data Warehouse.

For the majority of policy measures, there is a time gap between the moment the measure is announced and the moment banks have to comply with it. For the case of the CCyB, for example, it is defined that there needs to be a year between the announcement and the enforcement date. While institutions react to policy announcements (see Falagiarda and Reitz (2015), Falagiarda and Gregori (2015)), I argue that it is unlikely that banks will start building their capital reserves long before the enforcement date, as it is costly to them to hold capital without need. Therefore, these indices are built considering the date where the buffers have to be met.

Figure 2 plots the evolution of the intensity of macroprudential policy. As mentioned previously, the capital conservation buffer is 2.5% for all countries, which means that the closer the MPII is to this value, the less instruments are in place. Some countries opted for implementing it right away in 2014 (e.g., Italy and Luxembourg), while the majority decided to allow for a phase-in period of 4 years, where banks had to comply with it in equal steps.

Figure 2. Macroprudential policy intensity index (in percentage)

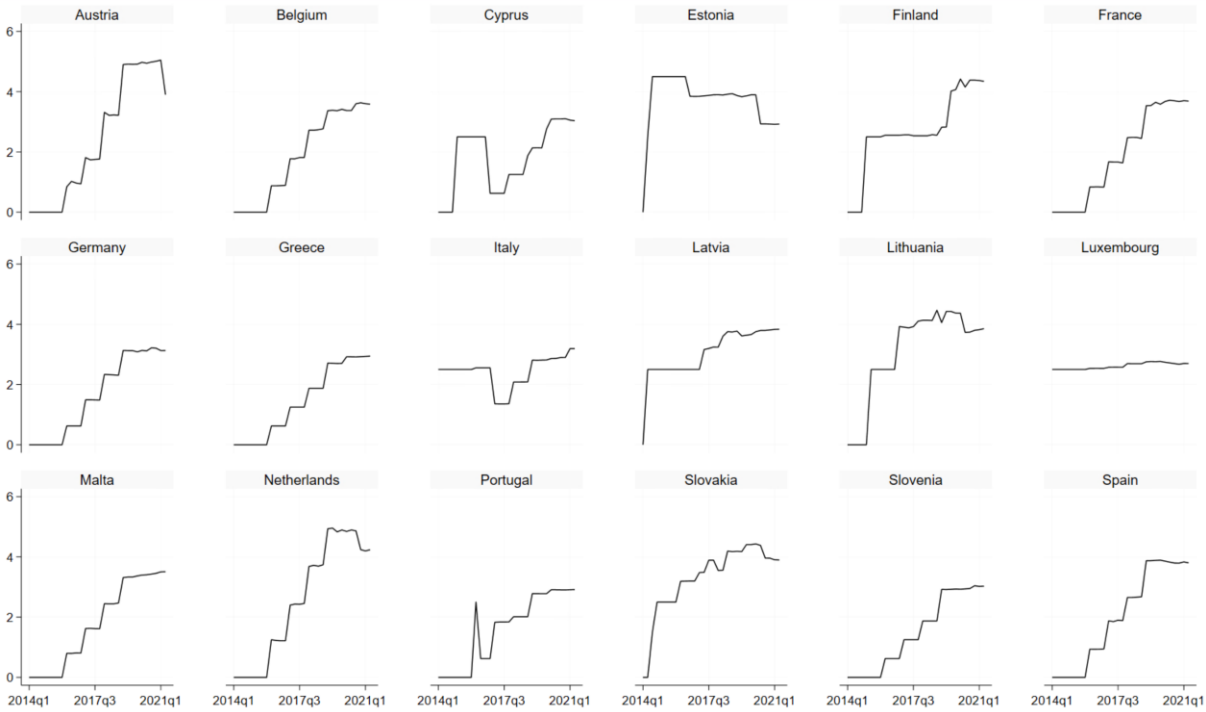


Table 2 breakdowns the policy actions during the sample, for all countries considered. Of all the countries in the sample, only Belgium, France, Germany, Lithuania and Slovakia have activated a CCyB different from 0 during the period analysed. The remaining countries have it set at 0%. The buffer for global systemically important institutions is only activated in Finland, France, Germany, Italy and the Netherlands. The instruments that accounts for the majority of policy actions in the sample is the buffer for other systemically important institutions, which identifies banks that have a high systemically importance domestically.

Table 2. Classification of capital based measures

Acronym	Instrument	Events in sample	
		Number	Share
CCoB	Capital conservation buffer	57	29.2
CCyB	Countercyclical capital buffer	13	6.7
GSII	Global systemically important institutions buffer	18	9.2
OSII	Other systemically important institutions buffer	82	42.1
SyRB	Systemic risk buffer	25	12.8

3.3. Covariates

The goal of this study is to investigate whether macroprudential policy is a source of substitution effects between bank and non-bank lending. Different factors simultaneously shape the outcome of the market, policies being one of them. This means that it is necessary to control for other variables that can influence developments in credit.

I collected data on GDP growth (year-on-year) as a proxy for the business cycle from the ECB Statistical Data Warehouse (SDW). To account for periods marked by a systemic crisis, I used the database developed by Lo Duca et al. (2017), which dates financial crises in European countries starting in 1970. To control for monetary policy and financing conditions, I use the 3-month interbank deposit rate. Given that one main driver of non-bank activity is maturity transformation (Poszar (2011)), I include the slope of the yield curve, computed as the difference between the 10-year government yield and the 3-month interbank deposit rate, to measure the term premium. If there is a flattening of the curve, reflected in a lower slope, the profitability and willingness of non-banks to grant credit can decrease (Infante et al. (2022)).

Both the 10-year government yield and the 3-month interbank deposit rate are taken from the ECB SDW.

I use two measures for the financial cycle. The first is the Systemic Risk Indicator (SRI), a domestic cyclical systemic risk measure developed by Lang et al. (2019). It is a composite indicator, given by the weighted average of six early warning indicators of systemic crises: bank credit-to-GDP changes, current account balance, residential real estate price-to-income ratio changes, real equity price growth, debt service ratio changes and real total credit growth. While the credit-to-GDP gap is a common cyclical indicator used when measuring systemic risk, it is already incorporated in this indicator, which is why it is not considered in this analysis. Additionally, Lang et al. (2019) show that the warning properties of the SRI are more robust, and it has a better predictive power for the likelihood and severity of financial crises. The second indicator is the Country Level Indicator of Financial Stress (CLIFS) proposed by Duprey et al. (2015). It is computed using financial stress measures from equity, bond and foreign exchange markets.

3.4. Descriptive statistics

I start by presenting selected descriptive statistics of the database used in my study. The sample covers 18 Euro area countries, starts in the first quarter of 2014 and ends in the first half of 2021. The cut-off point in the period analysed is this specific quarter due to lack of data for more recent periods for the systemic risk indicator.

Figures 3 and 4 plot the evolution of the annualized growth rate of non-bank credit across countries and the distribution of the non-bank credit growth rate across the sample, respectively. Two countries immediately stand out – Cyprus and Luxembourg, for the growth rate in some periods. By looking at the distribution of non-bank credit growth, it is clear that these periods are outliers compared to the remaining of the sample. Therefore, I excluded these observations, which represent around 1% of the original sample.[5] Table 3 presents summary statistics on some variables that are used in the analysis.[6]

[5] Excluding Luxembourg and Cyprus, instead of removing the observations that are outliers, leads to similar results.

[6] Summary statistics cannot be presented for the share of non-bank credit and the growth rate of bank credit as these variables are built using confidential data.

Figure 3. Annualized growth rate of non-bank credit (in percentage)

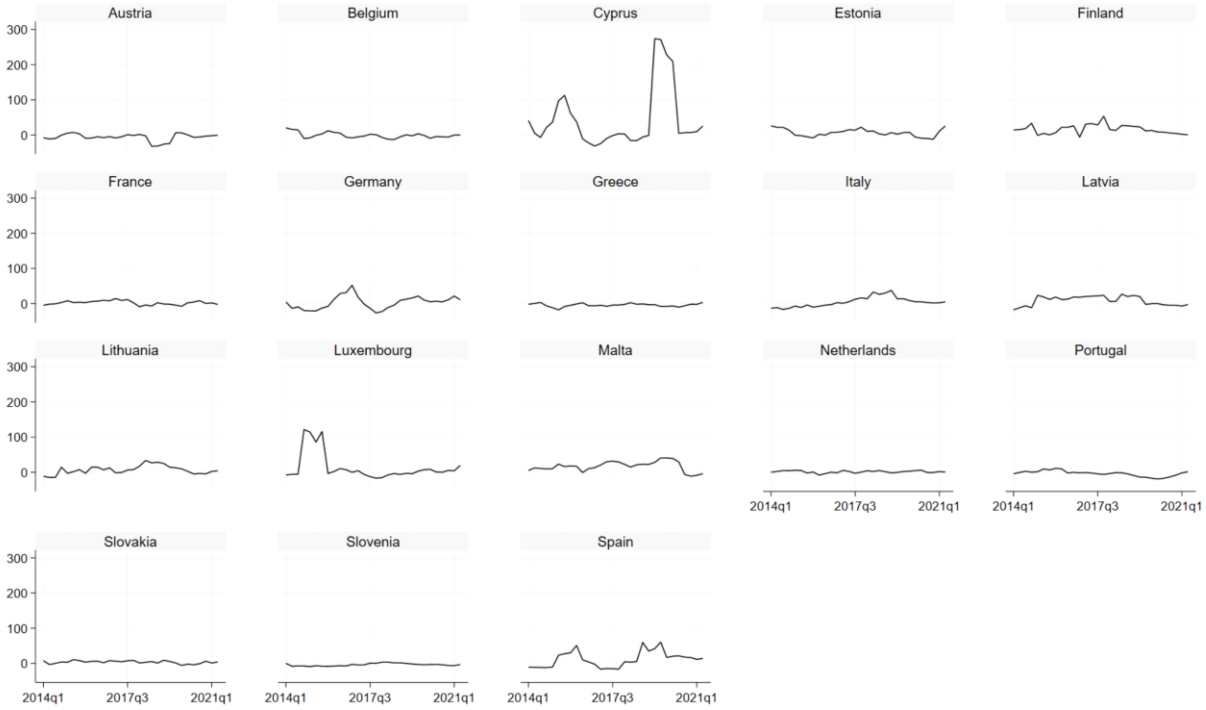


Figure 4. Non-bank credit growth rate distribution

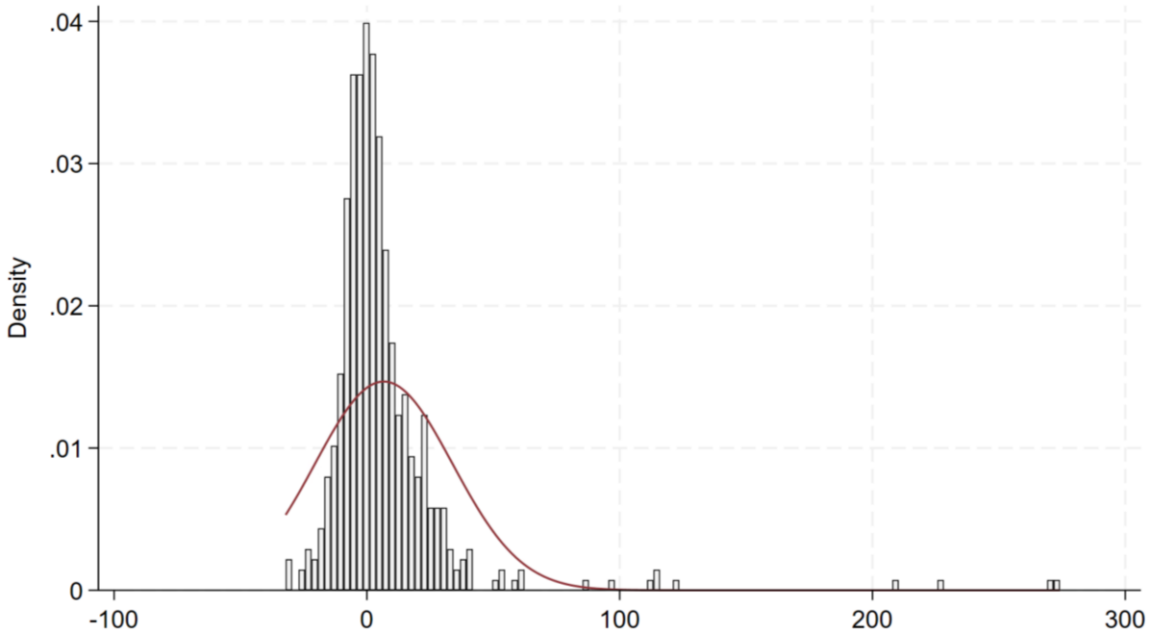
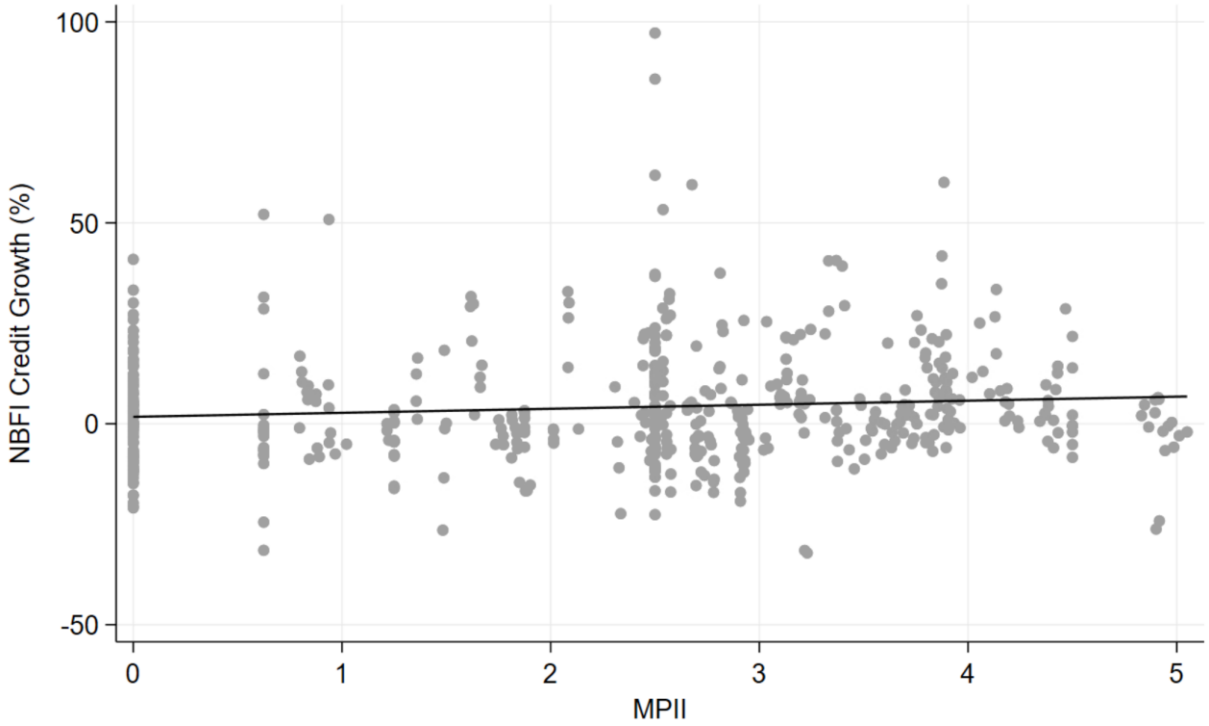


Table 3. Summary statistics

	Mean	St. Dev.	Min.	Max.
NBFI credit growth, y-o-y % change	4.04	14.72	–32.14	97.25
Real GDP growth, y-o-y % change	3.38	4.90	–20.88	21.39
3M Interbank Rate	–0.25	0.22	–0.54	0.31
Yield Slope	1.26	0.48	0.45	2.58
MPII	2.30	1.46	0.00	5.05
Number of countries	18			
Time Period	2014Q1 – 2021Q2			
Observations	532			

Before diving into the models and attempting to estimate the causal relation between macroprudential shocks and non-banks, I first present the correlation between the growth rate of non-bank credit and the macroprudential policy index across the sample (Figure 5). It is positive (equal to 0.0995) and statistically significant for a confidence level of 5%.

Figure 5. Correlation between macroprudential measures and non-bank credit growth



4. Methodology

4.1. Baseline model

I start by studying how macroprudential policy affects the share of credit lent by non-banks. The baseline model uses as dependent variable the share of non-bank credit over total credit in country i at quarter t. The coefficient of interest is β, which describes the relation between macroprudential shocks and the share of non-bank credit.

$$Share_{i,t} = \beta MPII_{i,t} + \lambda GDP_{i,t} + \theta Interbank_{i,t} + \eta Slope_{i,t} + \phi X_{i,t} + \alpha_i + \delta_t + \epsilon_{i,t}$$

Besides the macroprudential variable, I include as regressors GDP growth (year-on-year), the 3-month interbank deposit rate and the slope of the yield curve. $X_{i,t}$ is a vector of two dummy variables, one that signals systemic crisis and another for Covid-19 (health crisis). To account for unobservable characteristics, I also include country and time fixed effects.

4.2. Credit growth

Although a market share is informative about the relative importance of institutions, it can hide important details that I am interested in studying. In this case, even if the share of credit granted by non-banks increases, we are left without knowing whether that change was because non-banks expanded their credit after the implementation of a new macroprudential policy, or simply because bank credit growth decreased in response to the policy action.

The hypothesis that I want to study is if non-bank credit grows with macroprudential shocks, i.e., the evolution of non-bank credit controlling for the evolution of bank credit. Thus, I estimate the following model using OLS:

$$\hat{Nonbank}_{i,t} = \beta MPII_{i,t} + \mu \widehat{Bank}_{i,t} + \lambda GDP_{i,t} + \theta Interbank_{i,t} + \eta Slope_{i,t} + \phi X_{i,t} + \alpha_i + \delta_t + \epsilon_{i,t}$$

The dependent variable, $\hat{Nonbank}$, is the annualized growth rate of non-bank credit, while $\widehat{Bank}$ is the annualized growth rate of bank credit. The remaining variables are the ones that have been explained in the previous section.

4.3. Endogeneity

Policymakers react to market conditions and expected outlook, which means that policy changes are endogenous and "cannot be used at face value to identify exogenous changes" (Buch et al. (2018)). This poses a challenge in identifying the causal effect of macroprudential policy in credit growth, as it can lead to either an over or under-estimation of the effect of macroprudential policy, depending on the phase of the financial cycle where the policy action takes place (Biljanovska et al. (2023)): in the upward phase of the cycle, the accumulation of vulnerabilities would dampen the effect of macroprudential policy, while in the downward phase, when credit is already declining, the effectiveness of macroprudential policy would be exaggerated.

Several approaches have been adopted in the literature to counteract this issue. Some techniques include lagging the macroprudential variable (Cerutti et al. (2017), Forbes (2021)), considering only policy actions where the announcement and enforcement date fall in the same period of analysis (Schryder and Opitz (2021)) and employing propensity score matching techniques (Alam et al. (2019), Cizel et al. (2019)).

I follow another approach, which consists of obtaining the surprise/shock component of macroprudential policy actions. This methodology assumes that policy decisions are related to specific macroeconomic variables following a "rule", and when these relations are purged from the policy measure, what is left is the exogenous shock. It has been applied in many policy areas, such fiscal policy (Auerbach and Gorodnichenko (2012)), monetary policy (Taylor (1993), Brandão-Marques et al. (2020), Furceri et al. (2018)), and macroprudential policy (Boar et al. (2017), Chari et al. (2021), Ahnert et al. (2021)). Thus, to address endogeneity concerns, I ran the following regression:

$$MPII_{i,t} = \lambda GDP_{i,t} + \theta CLIFS_{i,t} + \beta SRI_{i,t} + \mu SystemicCrisis_{i,t} + \eta HealthCrisis_{i,t} + \alpha_i + \delta_t + \varepsilon_{i,t}$$

where $MPII$ is the macroprudential intensity index, GDP stands for GDP growth, SRI is the systemic risk indicator, $CLIFS$ is the country-level indicator of financial stress, $SystemicCrisis$ is a dummy variable equal to 1 when a country is experiencing a systemic crisis (Lo Duca et al. (2017)) and $HealthCrisis$ is a dummy variable equal to 1 during the Covid-19 pandemic.

GDP growth accounts for the business cycle. Both the SRI and the CLIFS are measures of the financial cycle, but they cover different aspects of it: the SRI is an indicator for the accumulation of systemic risk (upward phase of the cycle), while the CLIFS signals its materialization (downward phase of the cycle). The macroprudential toolkit encompasses two categories of instruments: cyclical and structural. The variables mentioned previously capture cyclical variations, so it is necessary to control for structural effects. Country fixed effects are included to account for this. Time fixed effects are included to account for unobserved time-varying factors.

Since there are variables that are not statistically significant in the model to explain policy actions, I estimated the model without including these variables as regressors until I was left only with variables that were significant. The results for both models are presented in Table 4. The estimates, standard errors and p-values are very similar to the ones obtained initially. Therefore, I used this second specification to calculate the residuals, $\varepsilon_{i,t}$, my measure of exogenous macroprudential shocks.

Table 4. Macroprudential policy decomposition

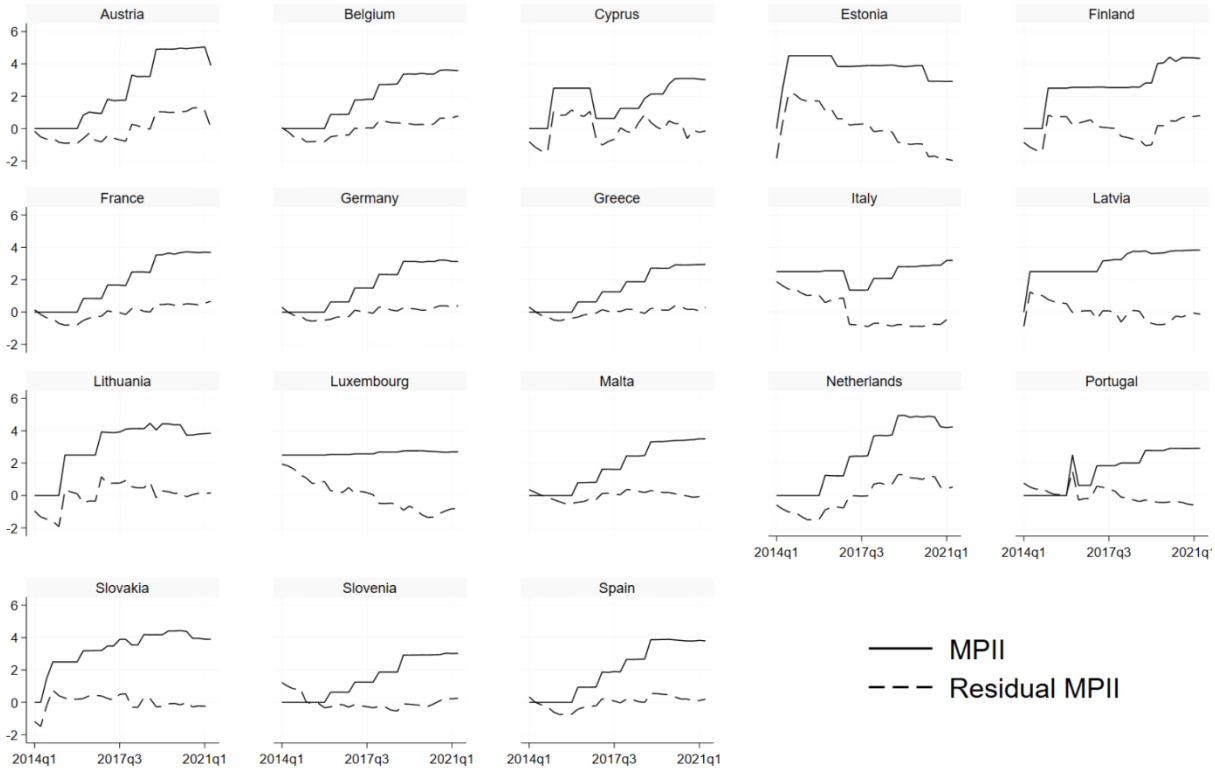
	(1) MPII	(2) MPII
GDP Growth Rate	0.0200	
	(0.0169)	
SRI	0.806***	0.881***
	(0.0964)	(0.0985)
CLIFS	0.744	
	(0.627)	
Systemic Crisis	-0.327**	-0.494***
	(0.158)	(0.171)
Health Crisis	0.0557	
	(0.431)	
Observations	510 [7]	540
R-squared	0.814	0.781
Country FE	Yes	Yes
Quarter FE	Yes	Yes

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

[7] The country-level index of financial stress (CLIFS) was last reported for Estonia in December 2010. Therefore, the first specification does not include Estonia, while the second does, since the CLIFS is found to be not statistically significant.

Figure 6 presents a comparison between the residuals and the original MPII, which have a correlation of 0.47. For some countries, like Austria, Belgium and Lithuania, the residuals follow closely the pattern of the macroprudential index, while for others, e.g., Luxembourg, the residuals evolve differently. For the remaining countries, e.g., Portugal, the resemblance depends on the period.

Figure 6. Macroprudential residuals obtained from specification (2)



As described before, the idea behind this methodology is to obtain a measure of exogenous macroprudential shocks by removing developments in financial conditions that drive policy decisions. The majority of the countries did not implement a macroprudential instrument right away, i.e., there was a gap between the CRD IV/CRR implementation and the first macroprudential decision. Therefore, there are periods where the residual is positive/negative while the index is zero. While this methodology provides an econometric measure of macroprudential shocks, it is still interesting to think if it makes sense to give an economic meaning to the residual. It can be seen as a measure of inaction bias by the policymakers, meaning that, given the market conditions and expected outlook, and given the existing instruments designed to address financial stability concerns, there should have been policy actions.

5. Results

5.1. Does macroprudential policy spillover to non-banks?

Following the literature on spillovers of macroprudential policy to non-banks, it is expected that a tightening, reflected in an increase in the MPII, leads to an increase in non-bank lending (Cizel et al. (2019), Hodula and Ngo (2021)). Intuitively, if one institution that serves a segment of a market is constrained by a newly implemented policy, it can be argued that another would take its place. For this substitution effect to be verified in my results, the sign associated with the index must be positive.

The results for the baseline model are shown in Table 5. Contrary to what has been found in previous studies (Claessens et al. (2021))[8], positive macroprudential shocks have a negative effect on the share of non-bank credit, but this effect is not significant. It is worth noting that the sample from this study is very different compared to the one from Claessens et al. (2021), which includes advanced and emerging market economies around the world, and it also focuses on financial assets, while I consider only loans.

Table 5. Baseline model estimates

	(1) NBFI Share
Macroprudential Shock	-0.0732
	(0.113)
GDP Growth	-0.0621***
	(0.0223)
Interbank Rate	-0.619
	(0.583)
Slope	-0.188
	(0.253)
Systemic Crisis	-0.375
	(0.425)
Health Crisis	-0.907***
	(0.333)
Observations	532
R-squared	0.986
Country FE	Yes
Quarter FE	Yes

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

[8] The difference in results may be driven by different countries and sample period.

This does not mean, however, that macroprudential shocks cannot be associated with an increase in non-bank credit, as explained in the previous section. To shed light on this, the second model attempts to explain the growth rate of both non-bank and bank credit (Table 6). Positive macroprudential shocks, i.e., tightening shocks, are associated with a decrease in the growth rate of non-bank credit, but this effect is not statistically significant. For bank credit, however, positive shocks lead to a statistically significant increase in credit growth, which explains the sign associated with macroprudential shocks for the share of non-bank credit.

Table 6. Estimates for non-bank and bank credit growth

	(1) NBFI Credit Growth	(2) Bank Credit Growth
Macroprudential Shock	-0.358	0.771**
	(0.816)	(0.351)
Bank Credit Growth	0.264***	–
	(0.102)	
NBFI Credit Growth	–	0.0494***
		(0.0191)
GDP Growth	0.113	0.157**
	(0.161)	(0.0692)
Interbank Rate	-8.053*	-12.78***
	(4.399)	(1.822)
Slope	0.492	0.616
	(1.819)	(0.786)
Systemic Crisis	17.85***	-0.296
	(3.050)	(1.362)
Health Crisis	-4.597*	5.854***
	(2.462)	(1.036)
Observations	532	532
R-squared	0.265	0.564
Country FE	Yes	Yes
Time FE	Yes	Yes

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

5.2. Is the private non-financial sector affected differently?

The results from the previous section pointed out that macroprudential shocks do not affect non-bank credit intermediation. This includes loans granted to all sorts of borrowers, ranging from other financial institutions to non-financial corporations and households. However, the effect of policies can be very heterogeneous across borrowers.

In its report on non-bank financial intermediation (2021), the ECB points out that non-banks have "increased their direct financing provision to euro area NFCs relative to banks"[9]. While financing to NFCs can come in many different channels, one of the possibilities is through loans.

In this section, I test whether macroprudential policy impacts non-bank credit to the private non-financial sector. I take advantage of the data granularity of the ECB data and re-run the analysis but considering different groups of borrowers: 1) the private non-financial sector (PNFS), 2) non-financial corporations (NFC) and 3) households (HH). To the best of my knowledge, this is the first study that looks into spillovers from macroprudential policy to non-banks focusing on the private non-financial sector. I follow the same methodology described in Section 4.2., and instead of using the growth rate of total non-bank credit, I use the growth rate of credit of corresponding sector (Table 7). Similar to what happened when studying total non-bank credit, macroprudential shocks appear to have no effect on the private non-financial sector, although the sign associated with the coefficient is positive.[10]

Running the same models but for bank credit indicates that macroprudential shocks are not significant in explaining credit developments, but the sign observed in the coefficient is the same as for non-banks to non-financial corporations, and the opposite for household credit and the total of the private non-financial sector. These findings can suggest that macroprudential shocks do not impact the current loan growth rate of banks but constrain their ability to expand more than that (i.e., increase the growth rate), which leads to non-banks stepping in as an alternative source of funding.

It is worth noting that in this study I am only considering loans as credit. The ECB paper mentioned in the beginning of this sections states that there has been a shift in relative importance of loans in the financing structure of non-financial corporations, where debt securities have been gaining ground. This can suggest that besides cross-sector substitution effects, there may also exist substitution between financial instruments.

[9] Insurance companies and pension funds are included as NBFI in this report.

[10] The ECB classification of sectors considers both money market funds and banks as monetary financial institutions (MFI). When considering credit granted to the whole economy, there is data available for MFI and money market funds, meaning that it is possible to obtain bank credit by subtracting one by the other. However, when narrowing down to credit granted to the private non-financial sector, there is no data available for money market funds, which implies that I have to consider credit granted by MFI, i.e., money market funds plus banks.

Table 7. Estimates for non-bank credit to the private non-financial sector

	(1) NBFI PNFS Credit Growth	(2) NBFI NFC Credit Growth	(3) NBFI HH Credit Growth
Macroprudential Shock	2.533	3.501	6.938**
	(2.611)	(3.635)	(3.394)
MFI PNFS Growth	1.203**	–	–
	(0.604)		
MFI NFC Growth	–	0.311	–
		(0.548)	
MFI HH Growth	–	–	-1.014
			(0.751)
GDP Growth	0.108	-0.144	-1.024
	(0.520)	(0.734)	(0.648)
Interbank Rate	5.570	-4.837	-19.50
	(13.89)	(19.20)	(17.38)
Slope	-7.452	-5.350	-0.270
	(5.845)	(8.120)	(7.371)
Systemic Crisis	51.50***	71.44***	0.582
	(9.856)	(13.72)	(12.40)
Health Crisis	-8.001	-11.68	-24.33**
	(7.763)	(10.80)	(9.744)
Observations	532	532	528
R-squared	0.165	0.144	0.175
Country FE	Yes	Yes	Yes
Time FE	Yes	Yes	Yes

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

6. Robustness tests

Model misspecification can lead to biased results. For this reason, I explore in this section different specifications of the model that are often adopted in the literature and compare the results to the ones I initially obtained.

6.1. Non-contemporaneous effects

While capital buffers are binding, i.e., institutions have to comply with them or face legal repercussion, there may be a lag between the enforcement and when the effect is felt on credit. Given that the time dimension in my analysis is quarterly, and not a lower frequency, I considered that it was long enough so that the reaction was contemporaneous. Here, I challenge

this assumption by including the macroprudential shock lagged by one period, similar to previous studies (Cizel et al. (2019) and Hodula and Ngo (2021)).

The results are robust to this specification. Macroprudential shocks continue not having a significant effect on total non-bank credit growth (Table A1), as well as on credit to the private non-financial sector. I also run another specification, where I lag all regressors except bank credit (so that the model captures contemporaneous substitution effects between bank and non-bank credit) Cizel et al. (2019), but the results are still similar (Table A1).

As discussed in Section 4.3., lagging the macroprudential variable is a common method to deal with endogeneity. To test differences between my method of endogeneity correction and this one, I run the model using the original MPII, and then do it again lagging the MPII (Table A2). In the first specification, macroprudential shocks have a significant impact on total non-bank credit. However, as soon as the MPII enters in the model lagged, the coefficient associated with it is no longer statistically significant.

6.2. Persistence of credit growth

Many studies consider the persistence of credit growth (for example, Cerutti et al. (2017), Cizel et al. (2019)) to explain the evolution of its growth rates. If a sector is booming in a quarter, it is expected that this effect will be felt in the following one, unless there exists a drastic event to counteract it.

To test if this effect can be a key driver in non-bank growth, I run the model used previously, but include the lagged dependent variable as a regressor:

$$Y_{i,t}^{NB} = \gamma Y_{i,t-1}^{NB} + \beta MPII_{i,t} + \lambda Y_{i,t}^{B} + \mu GDP_{i,t} + \theta Interbank_{i,t} + \eta Spread_{i,t} + \phi X_{i,t} + \alpha_i + \epsilon_{i,t}$$

The dependent variable, Y, is the growth rate of credit. The remaining variables are the ones that have been explained in the section 4.2. Estimating this equation using OLS would lead to biased results, as the model includes a lagged dependent variable. To correct this, I estimate it with Arellano and Bond (1991) GMM estimator. The GMM estimator is also a common method used in the literature of macroprudential policy (for example, Akinci and Olmstead-Rumsey (2018)) to address endogeneity concerns.

The results obtained are in line with the ones obtained initially, and also hold if the macroprudential variable is lagged, i.e., macroprudential shocks have no statistically significant impact on non-bank credit growth.

6.3. Non-bank definition

As this study is the first, to the best of my knowledge, that follows the definition of non-banks of the ESRB, and the results obtained up to now point to the non-existence of spillovers to non-bank credit, I test another definition of non-banks that has been used before. Hodula and Ngo (2021) use an even narrower definition of non-banks. They consider only financial auxiliaries and other financial intermediaries, two of the three sub-sectors that compose other financial institutions. They exclude captive financial institutions and money lenders, which, according to the ECB classification, are mainly holding companies and intra-group entities that raise funds in open markets to be used by their parent corporation. Additionally, the Financial Stability Board has stated that these institutions have low engagement in any investment or borrowing with entities external to the group.

To see if my results are robust to these change in definition, I ran the same models but considering loans from financial auxiliaries and other financial intermediaries[11]. In line with the previous result, I find no evidence of spillovers from macroprudential shocks to non-banks, although the sign of the coefficient is now positive (Table A4), which suggests that this result in not being driven by the definition of non-banking.

6.4. Standard "–1/0/+1" index

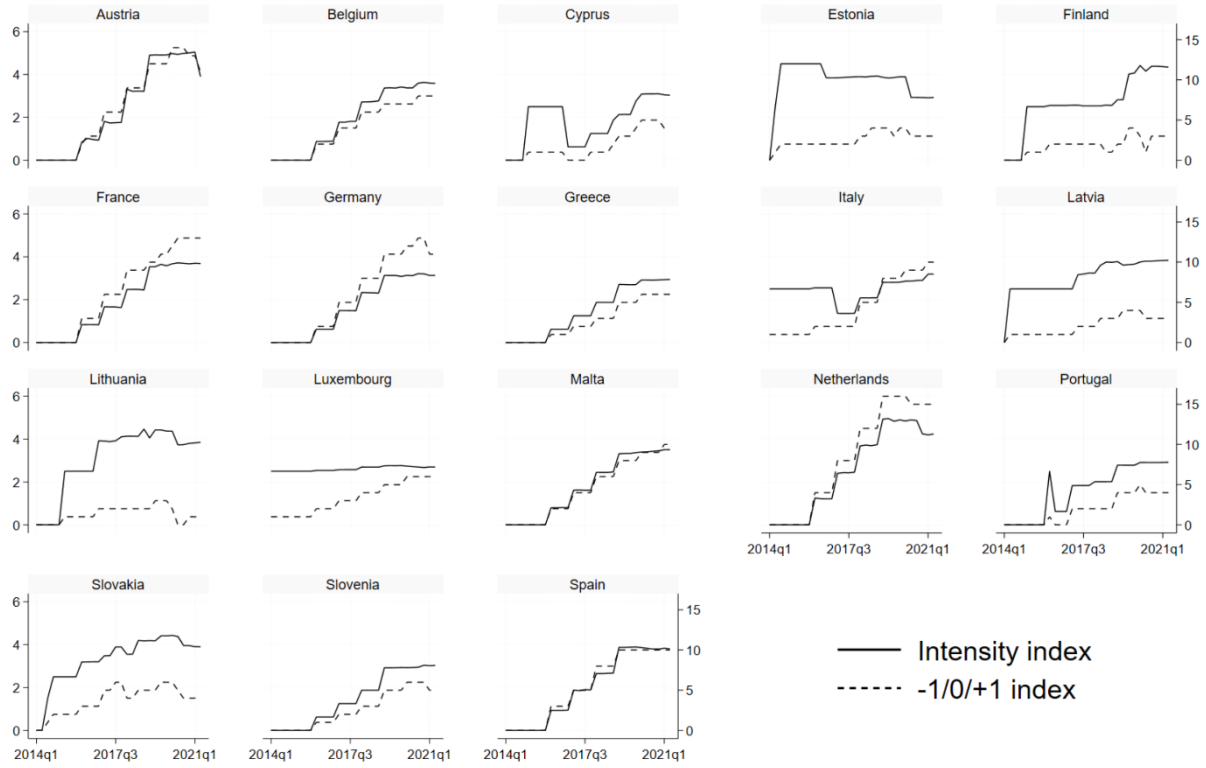
Intensity indices are more demanding to build, as they require more data since it is necessary to weight the instrument by the exposures it targets. For more general instruments, like the countercyclical capital buffer, which applies to all domestic loans, this data is easily accessible. However, for measures targeting specific exposures, there may not be able data available, which leaves two choices: using a proxy, which will not capture the real intensity, or not considering the measure altogether. This is not an issue for the standard "–1/0/+1" index, which is one of

[11] While before I was considering only domestic loans, to exclude possible cross-border effects, there is only data on global loans for these institutions separately. It is also not possible to choose the private non-financial sector as the counterparty sector, which is why I only do the analysis for aggregate credit.

its advantages. This section aims comparing the results of both approaches. While each one yields a different value for the index, it can happen the results are not far from each other.

The "–1/0/+1" index is simply the cumulative sum of policy actions, where tightening ones are assigned a value of +1 and loosening ones –1. Figure 7 displays the evolution of both indices. Although both indices are in different scales, for some countries the path they follow is not that different (e.g., Belgium and Greece); while for others, it depends on the period (e.g., Lithuania and Slovakia).

Figure 7. Comparison between the MPII and the "–1/0/+1" index



The model and its different specifications described in Section 4 were followed in the same way using the "–1/0/+1" index. Similarly to the intensity index, only the systemic risk indicator was significant in explaining variations in policy actions (Table A5).

The "–1/0/+1" index points to no effects of macroprudential shocks on non-bank , both on total credit and on credit to the private non-financial sector, which is in line with the results of the intensity index (Table A6 and A7). It is also worth noting that the value of the coefficients is not directly comparable, as the indices are in different scales, so we can only compare in terms of direction (sign) and significance.

These results highlight how the approach used when measuring macroprudential policy can lead to varying results. Despite the caveats mentioned previously on the intensity indices, I argue that this measure seems more appropriate for studying the impact of macroprudential policy, as they add an important dimension in the characterization of the policies. Meanwhile, the "–1/0/+1" approach only signals the number of policy action and if they represent a tightening or an easing in the overall macroprudential policy actions. This means that it can vastly overstate the relevance of a buffer in the system, if, for example, the amount of loans affected is residual.

6.5. Capital conservation buffer

The capital conservation buffer requires banks to hold 2.5% of total exposures, in addition of the minimum capital requirement, made up of Common Equity Tier 1 capital. If a bank does not meet this buffer, restrictions on capital distribution, such as dividends and bonus payments, immediately apply. While it is a macroprudential capital requirement, it has a microprudential nature, in the sense that it is set equal for all countries and constant over time.[12]

The macroprudential intensity index across the panel ranges between zero and five percent, while the capital conservation buffer accounts for around half of it. Since this represents a significant portion of macroprudential intensity, and it does not depend on each country's cyclical and structural factors, it can be influencing the estimates obtained. To test for this, I run the same models, but excluding the capital conservation buffer from the macroprudential intensity index.

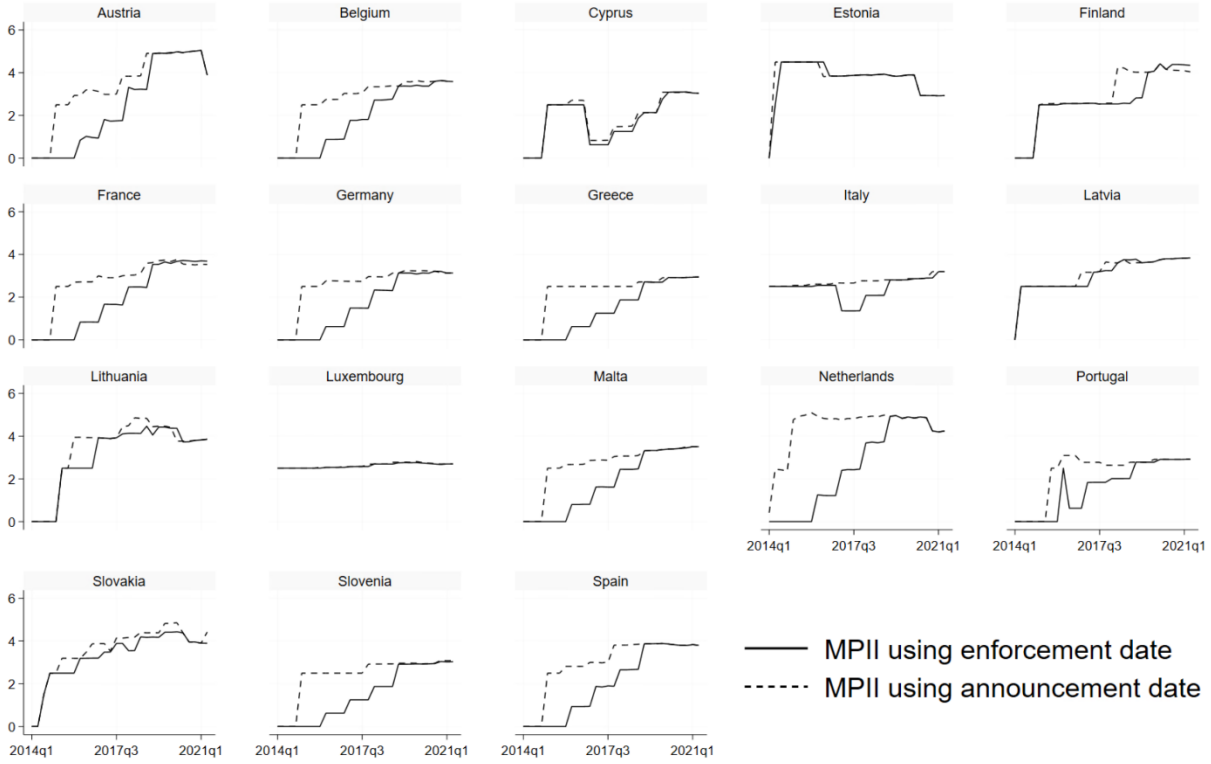
The first difference when excluding the capital conservation buffer is that the CLIFS is now also significant in explaining macroprudential intensity, while before only the SRI was significant (Table A8). However, the results are robust with the previous obtained – macroprudential shocks have a positive but not significant effect on non-bank credit (Table A9).

[12] Macroprudential authorities only chose the timing of application: it could either be phased-in during four years, up until 2019, where each year it increased in equal steps, or implemented right away.

6.6. Announcement date

In this section I build the indices using the announcement date of each measure, instead of considering the date that banks had to comply with them (Figure 8). The main difference in the indices is seen on countries that implanted the capital conservation buffer with a phase-in period. While with the enforcement date the evolution of the indices goes in steps, with the announcement date there is a jump.

Figure 8. Comparison of intensity using the enforcement or announcement date



When addressing endogeneity concerns, the change in the date considered leads to the systemic crisis dummy being significant in explaining developments in the macroprudential index, besides the systemic risk indicator. However, this change does not affect the sign and statistical significance obtained when using the enforcement date for the macroprudential policy, adding further evidence of no spillovers from macroprudential shocks to non-bank loans.

6.7. Heterogeneity between countries

There is a high dispersion of the share of non-bank credit across the countries in the sample. Cizel et al. (2019) find stronger substitution effects between bank and non-bank credit in countries with more developed non-bank credit markets.

To test whether heterogeneity in the share of non-bank credit relative to total credit in a country is a driving factor in the results, I split the countries in two groups, based on their share of non-bank credit. The threshold to be included in each group is defined arbitrarily, and I progressively decrease it until both groups have the same number of countries.

Throughout all thresholds defined, there are no statistically significant spillovers caused by macroprudential shocks to total non-bank credit, no matter if it is the group with a relatively higher or lower share of non-bank credit, although sometimes the sign associated with the macroprudential shock coefficient turns positive, instead of negative. This suggests that the size of the non-bank sector does not play a role in the presence of spillovers.

7. Conclusion

This dissertation studies if, and how, regulatory differences introduced by macroprudential policy impact non-bank financial intermediation across 18 Euro Area countries. To do so, I built a database on non-bank loans following the European Systemic Risk Board definition of NBFI, which encompasses institutions that generate similar risks and vulnerabilities as banks – namely, investment funds and other financial institutions –, and developed intensity measures of macroprudential policy, by weighting the capital requirements by the share of exposures that it covers.

Given that the majority of analyses on non-banks is based around market shares, I start with a model that studies how macroprudential shocks affect the share of credit lent by non-banks and find that there is not statistically significant impact. Since this ratio may hide the separate impact of macroprudential policy on banks and non-banks, I also study the growth rate of non-bank and bank credit individually. The results indicate that macroprudential shocks do not have a significant effect on the growth rate of non-banks, but they statistically increase the growth rate of bank credit.

These results can be explained by the nature of capital requirements and the mechanisms by which they affect banks' activities. Aiyar et al. (2014) point to one necessary condition for capital reserves affecting bank credit – they must be binding. If banks have ample capital headroom above regulatory requirements, i.e, the buffer is not binding, they can use that headroom to satisfy an increase in a macroprudential capital buffer, without distorting their decision on credit supply.

The granularity of the credit database allows to study replicate the analysis but considering only non-bank credit granted to the private non-financial sector. I also find no evidence of macroprudential spillovers to non-bank credit.

I run different robustness tests to check whether the results are being driven by different factors, namely the model specification (lagging the macroprudential variable and including credit growth persistence), the definition of non-banks, and the macroprudential index (excluding the capital conservation buffer from the macroprudential intensity index and considering the announcement date, as well as using the standard dummy-coded index). The results obtained initially are robust to these specifications.

These results are overall good news for macroprudential authorities, as the objective of macroprudential policy is to create a resilient financial system. The results obtained point to the increase of available capital to absorb losses in the event of adverse shocks, without disrupting loans granted by banks. Additionally, as there are no spillovers to the non-bank sector, this increase in resilience is not accompanied by trade-offs that reduce the effectiveness of policies.

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Appendix A. Tables

Table A1. Estimates for non-contemporaneous effects

	(1) NBFI Credit Growth	(2) NBFI Credit Growth
Lagged Macroprudential Shock	-1.017	-1.190
	(0.786)	(0.786)
Bank Credit Growth	0.266***	0.311***
	(0.0998)	(0.101)
GDP Growth	0.111	–
	(0.154)	
Interbank Rate	-9.606**	–
	(4.252)	
Slope	0.219	–
	(1.818)	
Systemic Crisis	16.91***	–
	(3.067)	
Health Crisis	-5.018**	–
	(2.423)	
Lagged GDP Growth	–	0.509***
		(0.188)
Lagged Interbank Rate	–	-6.866*
		(4.052)
Lagged Slope	–	0.0253
		(1.727)
Lagged Systemic Crisis	–	15.53***
		(2.927)
Lagged Health Crisis	–	-1.204
		(2.352)
Observations	510	510
R-squared	0.295	0.296
Country FE	Yes	Yes
Time FE	Yes	Yes

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table A2. Estimates when using the MPII original value

	(1) NBFI Credit Growth	(2) NBFI Credit Growth
MPII	1.122*	–
	(0.648)	
Lagged MPII	–	0.194
		(0.634)
Bank Credit Growth	0.253**	0.251**
	(0.101)	(0.0995)
GDP Growth	0.140	0.118
	(0.161)	(0.155)
Interbank Rate	-3.923	-8.923*
	(5.003)	(4.939)
Slope	0.784	0.295
	(1.822)	(1.849)
Systemic Crisis	18.25***	17.09***
	(3.051)	(3.082)
Health Crisis	-4.512*	-4.917**
	(2.456)	(2.429)
Observations	532	510
R-squared	0.269	0.293
Country FE	Yes	Yes
Time FE	Yes	Yes

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table A3. Estimates when including the credit growth persistence

	(1) NBFI Credit Growth
Macroprudential Shock	-0.0255
	(0.888)
Lagged NBFI Credit Growth	0.630***
	(0.0348)
Bank Credit Growth	0.147*
	(0.0828)
GDP Growth	0.292**
	(0.119)
Interbank Rate	-2.166
	(6.447)
Slope	0.838
	(1.447)
Systemic Crisis	1.741
	(4.648)
Health Crisis	0.331
	(1.931)
Observations	489
Country FE	Yes

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table A4. Estimates for non-bank growth following Hodula and Ngo (2021) definition of non-banks

	(1) NBFI Credit Growth
Macroprudential Shock	0.375
	(5.730)
MFI Credit Growth	-3.167***
	(0.743)
GDP Growth	2.427**
	(1.076)
Interbank Rate	96.73***
	(29.47)
Slope	-4.715
	(12.40)
Systemic Crisis	-32.02
	(22.30)
Health Crisis	47.34***
	(16.66)
Observations	514
R-squared	0.188
Country FE	Yes
Time FE	Yes

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table A5. Macroprudential policy decomposition for the "–1/0/+1" index

	(1) "–1/0/+1" index	(2) "–1/0/+1" index
GDP Growth Rate	-0.0402	
	(0.0461)	
SRI	1.732***	1.919***
	(0.263)	(0.240)
CLIFS	1.947	
	(1.706)	
Systemic Crisis	-0.218	
	(0.430)	
Health Crisis	0.172	
	(1.172)	
Observations	510	540
R-squared	0.748	0.729
Country FE	Yes	Yes
Time FE	Yes	Yes

Standard errors in parentheses

Table A6. Estimates for non-bank credit growth using the "–1/0/+1" index

	(1) NBFI Credit Growth
Macroprudential Shock	0.291
	(0.329)
Bank Credit Growth	0.259**
	(0.102)
GDP Growth	0.120
	(0.161)
Interbank Rate	-8.064*
	(4.396)
Slope	0.467
	(1.818)
Systemic Crisis	17.97***
	(3.051)
Health Crisis	-4.529*
	(2.462)
Observations	532
R-squared	0.266
Country FE	Yes
Time FE	Yes

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table A7. Models for private non-financial credit growth using the "–1/0/+1" index

	(1) NBFI PNFS Credit Growth	(2) NBFI NFC Credit Growth	(3) NBFI HH Credit Growth
Macroprudential Shock	0.142	0.119	0.183
	(1.061)	(1.470)	(1.354)
MFI PNFS Growth	1.209**	–	–
	(0.606)		
MFI NFC Growth	–	0.350	–
		(0.547)	
MFI HH Growth	–	–	-1.137
			(0.757)
GDP Growth	0.120	-0.118	-1.019
	(0.521)	(0.735)	(0.652)
Interbank Rate	5.449	-4.744	-21.69
	(13.90)	(19.22)	(17.44)
Slope	-7.370	-5.250	-0.144
	(5.849)	(8.127)	(7.401)
Systemic Crisis	51.59***	71.64***	1.307
	(9.876)	(13.74)	(12.45)
Health Crisis	-7.840	-11.38	-24.46**
	(7.774)	(10.81)	(9.794)
Observations	532	532	528
R-squared	0.163	0.143	0.168
Country FE	Yes	Yes	Yes
Time FE	Yes	Yes	Yes

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table A8. Macroprudential policy when excluding the CCoB from the MPII

	(1) MPII	(2) MPII
GDP Growth Rate	-0.00223	
	(0.00887)	
SRI	0.105**	0.110**
	(0.0505)	(0.0465)
CLIFS	1.197***	1.165***
	(0.328)	(0.326)
Systemic Crisis	0.0567	
	(0.0827)	
Health Crisis	0.217	
	(0.226)	
Observations	510	540
R-squared	0.750	0.749
Country FE	Yes	Yes
Time FE	Yes	Yes

Standard errors in parentheses

Table A9. Models for credit growth when excluding the CCoB from the MPII

	(1) NBFI Credit Growth
Macroprudential Shock	-1.491
	(1.793)
Bank Credit Growth	0.299***
	(0.106)
GDP Growth	0.0244
	(0.166)
Interbank Rate	-8.778*
	(4.591)
Slope	0.00489
	(1.886)
Systemic Crisis	18.42***
	(3.090)
Health Crisis	-5.386**
	(2.561)
Observations	532
R-squared	0.276
Country FE	Yes
Time FE	Yes

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Appendix B. Macroprudential policy index

B1. Macroprudential policy intensity index

This section provides more detail on the construction of the indices for each category of capital-based measures. Since each buffer has its own incidence, it is necessary to weight it by it in order to not overestimate the impact it has in the system. The only exception is the capital conservation buffer, as it applies to all banks and exposures.

B1.1. Market share

The GSII and OSII are applied to a subset of institutions that are identified as such. The SyRB can also be applied to specific institutions. Therefore it is necessary to weight the requirements by the market share of affected entities.

The market share is computed as the ratio of the bank's assets to total assets. Bank assets data was extracted from Bank Focus. The majority of periods was covered, having only around 10% of missing values. Since the market share is necessary to compute the MPII, I computed the missing values using linear interpolation. Although the evolution of assets may not be linear, given that the percentage of missing values is residual, I expect that the estimation errors that can happen are not significant in changing the results. As for total assets by country, I used the ECB Statistical Data Warehouse (SDW) series on loans (stocks) granted by MFIs excl. ESCB (counterpart area: world).

B1.2. Exposures

The CCyB applies to credit granted to the private non-financial sector. To obtain this measure, I used the series loans to the private-non-financial-sector (stocks) reported by MFIs excl. ESCB, and weighted by total loans (stocks) reported by MFIs excl. ESCB, from the ECB SDW.

The SyRB framework allows for more complexity in its application, particularly with regards to the exposures. The ones available in the ESRB notification templates are the following:

a. All exposures located in the Member State that is setting the buffer;
b. The following sectoral exposures located in the Member State that is setting the buffer:
    i. All retail exposures to natural persons that are secured by residential property;

ii. All exposures to legal persons that are secured by mortgages on commercial immovable property;
iii. All exposures to legal persons excluding those specified in point (ii);
iv. All exposures to natural persons excluding those specified in point (i).

c. Subsets of any of the sectoral exposures identified in point (b);
d. All exposures located in other Member States;
e. Exposures located in third countries.

When the buffer is applied to all exposures, no exposure-adjustment is required. If applied to domestic exposures, I weighted by the share of domestic loans to total loans, using the series on domestic loans (stocks) reported by MFIs excl. ESCB, and total loans (stocks) reported by MFIs excl. ESCB. As for the remaining cases, i.e., the ones that are covered by point (b) and (c) of the ESRB template, I would have to exclude from the sample, due to not having access to data that allowed me to build weights. However, since the period being analysed ends in 2021Q3, no measures of this type have yet been announced, so in this study I don't have to exclude any policy from any country.

B2. "–1/0/+1" Index

The "–1/0/+1" index is built only considering the direction of the change in the value of the requirement. If it increases, it is assigned a "+1", and if it decreases, it is assigned a "–1". When there are no changes, it is seen as a "0". For each period, the macroprudential index (MPI) is given by the cumulative sum of the changes.

It is worth noting that for buffers that are given by an unique value, e.g., the CCyB and the CCoB, this characterization is easy to do. However, the GSII, OSII and SyRB (applied to specific institutions) can take different values for different institutions, so it is not as clear if the policy is being tightening or loosened. To overcome this, I sum the buffers for all institutions applied at a given period and when the sum increases it represents a tightening, "+1", and if it decreases, it is a loosening, "–1".