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**The performance of macroprudential regulation
in the European Union**

April 2019

Master thesis

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Abstract

This study aims at analysing the macroeconomic performance of macroprudential regulation in the European Union over the last 20 years. By assessing the impact of prudential instruments over four segments of the economy, findings indicate that tightening regulation has a negative and significant effect. In contraposition, loosening instruments do not achieve their goal, rather they seem likely to leave a greater degree of action to other financial instruments. Member states with capital controls and less financial freedom are subject to greater impact of macroprudential policies, whereas nations with greater financial liberty and more open capital markets appear not to be affected by these instruments. This result must take into considerations that, on average, countries with a minor degree of financial freedom have applied a greater number of policies in a shorter period of time. Narrowly targeted macroprudential categories do not accomplish their objective and act differently depending on the segment investigated. Findings suggest that macroprudential regulation does not have a central impact at the macro level on the economy.

Keyword: macroprudential regulation, European Union, financial openness

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1. Introduction

The multitude of structured products and loose financial regulation are often criticised as main rotten causes of modern financial breakdowns. Central banks, nationwide regulatory bodies, and international authorities are constantly under pressure in order to promote safer capital markets, defend consumers' rights, avoid crack downs and punish inconsiderate misconduct. Several policies are being experimented and implemented over the years, but growing consideration is being given to macroprudential regulation as the best way to protect the financial system from internal and external shocks.

The adoption of prudential regulation in the financial system is still an innovative practice, which experienced an upsurge after the global financial crisis of 2008; moreover, implementation is driven by ineffective monetary policies, which were not able to properly correct the economic cycle, and the backing of central banks' governors, who consider this type of instruments suitable to join the modern toolkit of policies and to counteract shock ex-ante.

This study aims at analysing the macroeconomic performance of macroprudential regulation for the 28 member states of the European Union over a 20 years period. To investigate the impact of these regulatory measures, four different macroeconomic indicators are chosen to reflect multiple aspects of a country's economy: credit to non-financial sector from all sectors, residential property prices, gross fixed capital formation, and household final consumption. These factors proxy the level of credit, investments, consumption and of the housing market of a nation. Macroprudential regulation is studied on its short term effectiveness from different angles: a fresh new database is decomposed, starting from the aggregation of all its macroprudential categories in a single universal index, subsequently the numerous regulatory groups are sorted according to their nature, scope and target as to identify differences in the final outcome. Starting from quantity, this paper converges to quality as it is recreating a pyramid: the intention is inspecting first whether a greater overall number of instruments have any sort of impact, and later whether those single groups of financial tools with a narrow target effectively accomplish their mandate.

The main findings show that macroprudential instruments demonstrate a tightening impact, independently of their real nature. The creation of a macroprudential index signals that a greater quantity of instruments reduces the growth rate in all four sectors, although only a tiny effect is present and not always significant. Whether an instrument has a dampening or relaxing objective, it steers towards tightening results; however, it seems that its interaction with other financial instruments changes. Measures focusing on different targets do not appear to have different strength, they negatively impact the economic cycle. By dividing the countries' sample into two groups, data confirm previous literature as macroprudential instruments produce a greater impact on financially developing countries, and depending on the variable at question, this impact is either more positive or negative; in opposition, financially developed economies show their prudential regulation being ineffective and closer to zero.

By analysing specific macroprudential instruments, limp effects discriminate effective and ineffective instruments: by implementing what are thought to be the appropriate tools over their field of action, results indicate that sector-oriented measures do not perform better than more general tools. These dissimilarities are reflected as well in the relationship between the diverse sectors and the main monetary tool of the European Central Bank. Macroprudential and monetary policies seem not to agree: the two policy instruments push towards different directions with exception for their impact on credit growth, which is in both cases negative.

The paper is structured as follows. The following section presents a literature overview of the topic and former studies, individuating contrasting point of view and results. Section 3 presents the data and methodology utilized, by presenting and decomposing the database of this study. Section four depicts the general results accompanied by countries' difference, backed by a robustness analysis. Section 5 concludes, with references to prospects and future research.

2. Literature Review

The global financial crisis exploded in 2008 and its repercussions over the following years prompted the research of new instruments and policy actions towards the stabilization of the financial system. This necessity resulted in a growing literature over the topic of prudential regulation, with a surge in popularity for the word “macroprudential” which counts almost 16,000 academic references between the years 2008-2017, compared to the 1,790 citations between the period 2000-2007¹. Many different tools have been proposed and applied over decades, even before the financial breakdown, but their use must be targeted to specific objectives. De Nicolò, Favara and Ratnovski (2012) argue that economic analysis of macroprudential instruments should first identify market failures before realistically apply them. The authors classify three externalities leading to systemic risk: externalities related to strategic complementarities causing vulnerabilities during economic expansionary phase, externalities related to fire sales arising from decline in asset prices and balance sheets deterioration in contractionary periods, and externalities related to interconnectedness caused by the propagation of shocks through financial systems. Correction can be implemented by main macroprudential proposals such as capital requirements, liquidity requirements and restriction on bank activities and taxation.

In one of the first studies using cross-country regressions, Lim et al. (2011) present a wide evaluation of macroprudential instruments in reducing system risks over time and across markets by addressing the effectiveness of loan-to-value (LTV), debt-to-income (DTI), and of other tools such as ceilings on credit growth, reserves requirements (RRs), countercyclical capital requirements and time-varying/dynamic provisioning to decrease pro-cyclicality of the economic cycle, although their impact

¹ The number of citations is extrapolated from Google Scholar.

is sensitive to the type of shock. Furthermore, limits on net open currency positions and on maturity mismatch can help reduce common exposures across markets. Subsequent results of regression analyses show that macroprudential measures may have a mitigating effect on systemic risk of credit growth, liquidity, leverage and capital flows; additionally, it is addressed the fact that the effectiveness of these instruments neither does depend on the type of exchange rate regime nor on the stage of the economic development. It is stated that few policies contribute to stop downturn in adverse periods, in accord with the forward-looking nature of these tools and the urgency to adjust them at the proper moment in time before stress arises.

Following this study, consideration has been put on differential effects across macroprudential tools (IMF, 2012). By testing the direct effects of macroprudential instruments on financial outputs, analysing the side effects on economic growth, and investigating whether policy actions' impact may differ with regards to economic and financial cycles, a fixed-effect dynamic panel regression has delivered the following results: capital requirements and RRs have shown statistically significant effects on credit growth, while LTV and capital requirements have proved to be significant on house prices appreciation. Next, LTV appears to have a negative impact on output growth, reducing investments in construction, but little evidence is present regarding a direct effects of these tools on output and there is no signal of any stimulus to capital inflows.

Different identification has been carried out and proposed (for example see: Schoenmaker & Wiert, 2011) with a stricter classification of these tools, identifying the goal of various type of policies and the targets and methods covered. Claessens, Gosh and Mihet (2013) analyse the use of macroprudential policy actions aimed at reducing vulnerabilities in the banking systems with a special attention to their use in and for emerging markets. Their research tries to answer three questions: what macroprudential policies are available and which one countries actually use, is there any evidence to date on the effectiveness of these different procedures, what are the experiences of these policies regarding the reduction of banking systems' vulnerabilities. Their analysis regards macroprudential instruments in limiting vulnerabilities in single banks by looking at annual changes in leverage, assets and noncore to core liabilities. According to the authors, a country's degree of openness can affect its vulnerability, since financial cycles can depend on international factors, and also the level to which macroprudential policies are subject to circumvention. By using a Generalized Methods of Moments (GMM) panel regressions, results show that many policies help in controlling banking system vulnerabilities since many coefficients are negative; instruments such as loan to-value ratios (LTV), caps on debt-to-income (DTI) and limits on foreign lending (FC) appear indirectly effective in limiting banking vulnerabilities. On the other side, reserve requirements, dynamic provisioning and profit distribution help mitigate increases in banking leverage and asset. However, the authors evidence that macroprudential policies are more effective in expansionary phases compared to contractionary periods, and thus should be used as *ex-ante* tools to lessen decline when the cycle turns and to avoid perverse

effects. Still, it is stressed that, even though some instruments appear significantly effective, they could be easily avoided through a looser financial regulation, thus they must not be associated with a reduction in financial cycles. Furthermore, emerging markets and closed capital account nations have implemented more frequently these instruments, proving to be more effective in these states.

Further in new evidence (Cerutti, Claessens, & Laeven, 2017) it is acknowledged the need of a macroprudential approach to discipline large financial institutions, externalities or market failures. Again, a GMM estimation model is used to study the effects of macroprudential policies (besides a baseline OSL), utilizing data from the IMF survey called Global Macroprudential Policy Instruments (GMPI), a comprehensive database collecting macroprudential policy actions used by most of the academic studies on this topic. The authors also create a macroprudential index (MPI), that is the sum of scores on all the 12 macroprudential policies reported. Results indicate that the overall MPI index is negatively and statistically significant with regards to real credit growth, proving a mitigating effect in credit developments, with a relative more decisive impact for closed economies. In particular, analysing individual measures depicts that borrower-based measures are associated with lower credit growth to households in emerging markets, even though not always statistically significant but consistent with findings that it is difficult to control house prices growth with these measures. With regards to credit growth in the corporate sector, a negative relationship with macroprudential policies arise as well, but weaker than for household.

A new dataset has been introduced by Budnik and Kleibl (2018): their Macroprudential Policies Evaluation Database (MaPPED, which is the one used in this research) depicts an overview of policy measures, which are either macroprudential or microprudential, adopted by European member states since 1995 and likely to have a significant impact on the banking system. Covering almost 2,000 policy actions, divided in 11 categories and 53 subcategories. Analysis shows a large degree of variation among EU member states in the adoption of macroprudential actions over the past 20 years; the application of some instrument such as limits on credit growth, lending standard restriction, sectoral risk weights or liquidity requirements, seems to have responded to the financial cycle or crisis events. Instead, other measures such as capital requirements and limits on large exposures have been more correlated with institutional regulatory initiatives. The working paper provides a wide descriptive analysis of the data gathered with also few insights; for example, a noteworthy number of tightening measures have been adopted in the booming years after the financial crisis, suggesting a countercyclical pattern of adoption in line with the role of instruments such as risk weights and lending standards in curbing house cycle growth to avoid bubbles. Furthermore, by running a bivariate analysis of the policy tools' effectiveness on credit growth, the authors find that growth in monetary financial institutions (MFI) credit to non-financial corporations (NFCs) and households declined remarkably after the introduction of new minimum capital requirements, capital buffers or new loan-loss-provisioning standards. In most cases, this decay started one year prior the enforcement of the measures, a fact that could be attributed to the

announcement dates. The average credit growth of credit to NFCs declined after the introduction or recalibration of LTV, loan-to-income (LTI) ratio, DTI ratio or debt-service-to-income (DSTI) limits, adding evidence to the mitigating effect of macroprudential tools.

The transmission of macroprudential effects from financial to real variables vary across instruments; constraints to borrowing and thus consumption in a single or multiple sectors can affect a country's output or have a more singular impact on a particular sector. Countercyclical requirements (CTC) and RR may affect total lending, whereas LTV limits may present more sectoral impacts. By focusing on specific risks or market segments in single countries, it has been found, for example, that LTV and DTI effectively moderate the mortgage credit growth in South Korea (Igan & Kang, 2011) and policies appear effective also in reducing real estate cycles in Hong Kong (Wong, Fong, Li, & Choi, 2011). Jiménez et al. (2012) study the effects of dynamic provisioning on the supply of credit to firms in Spain in the period between 1999-2010; their results support consistently countercyclical capital buffers, which mitigate credit supply in banking pro-cyclicality and support bank lending in adverse periods with a minor requirement for expansive monetary policy, endorsing Basel III guidelines on countercyclical bank capital buffers. However, in other countries such as Canada and Sweden, where low interest rates have shaped the economic environment, macroprudential policies have not effectively managed to freeze the strong increase in house prices and household debt over the years (Claessens, 2015). In Switzerland, where taxes are administered differently in every canton, macroprudential instruments sorted an inverse effect; higher capital gains taxes have been found to aggravate housing prices dynamics, making these administrative procedures not appropriate to prevent a disproportionate house price growth (Aregger, Brown, & Rossi, 2013).

Significant importance has been highlighted over the relationships between macroprudential and monetary policies, both advantageous for countercyclical management: if the former is aimed at financial stability, the latter focuses at price and economic stability. The issue is whether an inefficient work of macroprudential policies can affect monetary policies, and vice versa. Tinbergen (1952) put forth that policymakers should use one independent policy tool for each policy objective, thus monetary and financial stability should be separated. Nevertheless, different policy instruments and objectives are interrelated; monetary policy affects financial stability both *ex-ante* and *ex-post*, and it is possible that constraints to borrowing may affect overall output, and hence investment and consumption. Academic literature finds that side effects have no major implications for the conduct of both policies simultaneously when they work perfectly (Claessens, 2015); both strategies can intervene in case the other one is constrained, as with economies pegging their exchange rate or in currency unions such as the case of the Eurozone, where booms that are not mitigated at national level may cause the propagation of economic and financial risks.

Nonetheless, the argument of a monetary response to adverse financial conditions is disputable. Claessens, Ghosh and Mihet (2013) argue that monetary policy seems to play no role in curbing banking risks, proving to be reliable with the academic literature on the topic, which considers large raises in interest rates as the necessary tool to stop credit boom and price bubbles. Another analysis (IMF, 2013) finds that with an ideal perfect targeting of macroprudential policies, monetary policy remains focused on price and output stability; in practice policies face restrictions and monetary measures may take a greater role in preserving financial stability and accept the related trade-off, although this is rarely optimal. Former chairman of the Federal Reserve Janet Yellen argued in 2014 that monetary policy faces substantial limitations as a tool to endorse financial stability, since it could increase volatility of inflation and employment, and, as a result, it is clear that a macroprudential approach to supervision and regulation represents a more direct method to address weaknesses. Results of a quantitative evaluation of trade-offs between policies (Crowe, Dell'Ariccia, Igan, & Rabanal, 2011), using a dynamic stochastic general equilibrium (DSGE) model to assess which policy (among monetary, fiscal and macroprudential) regime can better stabilize pressing fluctuations in the housing market, prove that macroprudential measures appear as the best candidates to curb real estate prices and leverage for their ability to contrast vulnerabilities at their source. Precisely, institutions can reduce the acceleration of house prices by lowering maximum LTV, hence increasing the spread between lending and deposit rates. Moreover, the instrument appears to bring welfare gains, thanks to the fact that output gap volatility is reduced.

Following the same pathway, Angelini, Neri and Panetta (2012) study the consequences of macroprudential policies and their interaction with monetary policy in order to assess the influence between them and the macroeconomic performance of these instruments, to plan a possible general regulatory framework and to provide further consistent evidence. By modelling a DSGE model where macroprudential policy cooperates with monetary policy and responds to technology, financial and housing shocks, results show that in an economy in normal times (when economic dynamics are driven by supply shocks) the active use of capital requirements has little consequence over the macroeconomic stability, and cooperation may generate conflict between authorities. However, an environment where financial shocks create great fluctuations, macroprudential policy plays an added value in the macroeconomic stability.

Despite the outcomes of these researches, caveats are pinpointed, as the implementation of these policies is still considered juvenile. Longer time series, better quality data, and more specific factors are required to deepen further the analysis of these banking procedures. In addition, attention must be taken to avoid one-size-fits-all: definite tools should be applied to specific risks that are considered systemic such as credit-related instruments to address credit growth risks or asset price inflation; limits on liquidity mismatch or a stable funding ratio are candidates to address systemic liquidity risks, while capital requirements provide a buffer against excessive leverage. Indeed, the peculiarity of these

instruments is their potential precision on targeting menaces; nonetheless, such precision requires granular data and high quality information, whose costs may counterweight the instruments' effectiveness (Lim, et al., 2011). In conclusion, it is agreed that macroprudential policies should be specifically addressed to target definite and precise sectors of financial markets, primarily to increase the resilience of the banking system.

3. Data methodology

3.1 Data and variables

The analysis is performed using a panel dataset of macroprudential policies implemented over the period 1999-2018. The analysis involves the 28 countries members of the European Union, reported in table 1 below.

Table 1: List of countries considered in the analysis.

<p>Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxemburg, Malta, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, United Kingdom.</p>

The impact of these macroprudential tools will be examined over four dependent variables: Credit to non-financial sector from all sector, Residential property prices, Gross Fixed Capital Formation, and Household and NPISH final consumption expenditure. Each variable has been chosen to represent a different characteristic of a country's economy:

- *Credit to non-financial sector from all sectors (Credit)*: it captures the borrowing activity of private and government sectors, whose former one comprehends non-financial corporations and households (including NPISH). The financial instruments considered are currency and deposits, loans and debt securities. The sum of these is defined as core debt, while the core of government debt is generally represented as bulk of total debt. Data are collected from the Bank of International Settlements at market value in US Dollar, adjusted for breaks. Data are reported quarterly; subsequently growth rate, year over year, was computed.
- *Residential property prices (RPP)*: this variable is indexed with 2010 as reference year (2010 = 100) and it measures the prices change of residential housing units. House prices data indicate whether there is a shift in household wealth, which could hint at further changes in household consumption. Data were gathered from the Bank of International Settlements, with quarterly frequency, and later transformed in percentage value representing the growth rate.

- *Gross Fixed Capital Formation (GFCF)*: it consists of resident producers' investments, deducting disposals, of fixed tangible or intangible assets. It does not measure total investment but only new additions, specifically it covers investments in machinery, computer software, intellectual original works, equipment, vehicles, dwellings, buildings and structures. It does exclude consumption of fixed capital and land purchases. By being a component of the gross domestic product of a country it illustrates an aspect on how much new added value is invested rather than consumed. Data are extrapolated from Eurostat and are in current prices in euros, unadjusted and at quarterly frequency, and then growth rate is computed.
- *Household and Non-profit Institutions serving Households (NPISH) final consumption expenditure (Household consumption)*: it measures the level of expenditure incurred domestically or abroad by resident institutional units on goods or services that are utilized for the satisfaction of individual or collective needs of the community. Private final consumption embraces both households' and NPISHs' respective consumption; the latter group consists of separate legal entities such as trade unions, professional societies and political parties, but also churches, charity organisations and sport associations which serve households. Data for this variable are in current prices in euros, unadjusted and with quarterly frequency, taken from Eurostat. The growth rate is computed, year over year.

These four dependent variables are regressed over multiple independent variables. These variables are all lagged one year and are the following: the gross domestic product rate of growth, the Main Refinancing Operations (MRO) rate and the Macroprudential Index (MPI). Furthermore, the MPI is decomposed into sub-groups: tightening and loosening, borrower and financial institutions targeting measures. Lastly, six specific macroprudential instruments are selected to test their performance. The purpose of these elements is to grasp the general trend of the economy of each country by including the GDP, which it should also guarantee the independence of the effect of the macroprudential policies. Moreover, the MRO rate gives a perspective of the policy decisions taken by the European Central Bank by weighting the variation in the interest rate over years, a value affecting all the 28 countries. Its presence can be expected to affect the country's financial cycle, including both the degree of risk taken and the effectiveness of policies (Claessens, Ghosh, & Mihet, 2013). Indeed, even though not all countries have joined the Single Currency, they all are affected by the ECB's decisions starting from shifts in the main instrument of the central institution. More precisely, the explanatory factors considered are:

- *Gross Domestic Product (GDP)*: it is a monetary measure of all final goods and services produced domestically in a country. It is the sum of output, expenditure and income at current prices in euros. The variable is in real term, unadjusted data were extrapolated from Eurostat at quarterly frequency and subsequently the growth rate, year over year, was constructed.
- *Main Refinancing Operations rate (MRO)*: it is the bulk of liquidity of the banking system, set by the Governing Council of the ECB as key rate for policies for the euro area. Considered as one of

the most significant monetary policy instruments used to steer liquidity in the money market and to signal monetary policies' stances. MRO is a term used to denote weekly open market operations, such as short-term collateralized loans provided by the Euro system to banks. Source is the European Central Bank website.

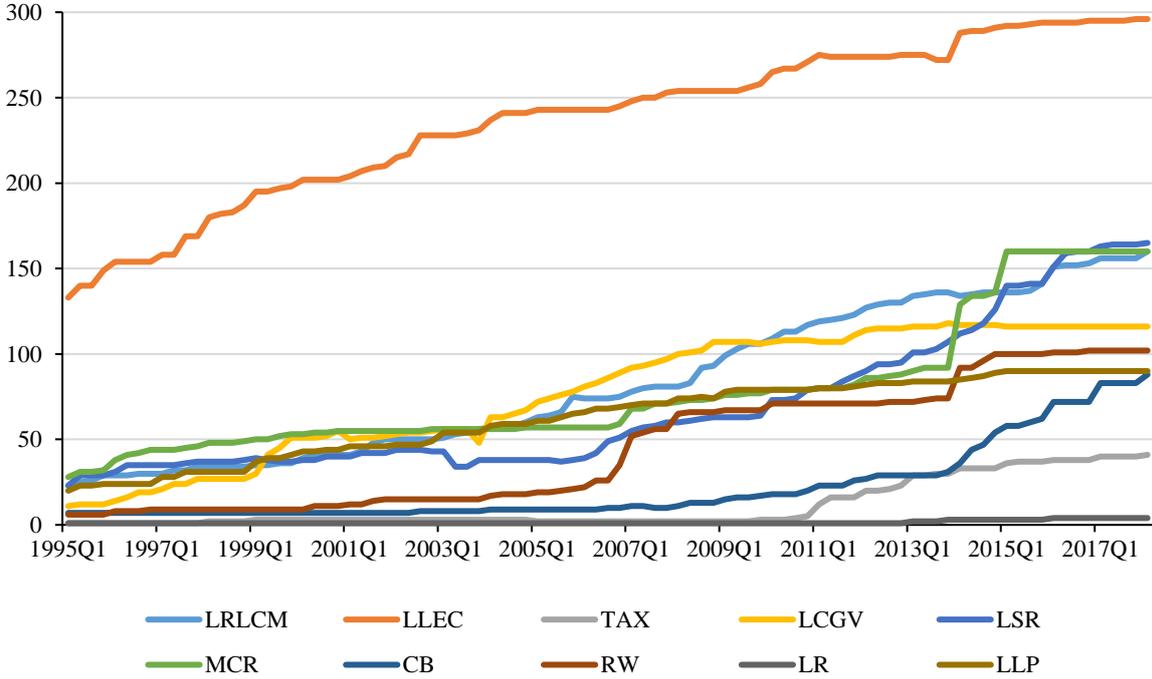
- *Macprudential Index (MPI)*: it aggregates ten of eleven categories of macroprudential policies which have been used over the years by each country, ranging from a minimum value of zero, in case a country has never adopted a macroprudential instrument, and increasing every time a new instrument is implemented. In case a policy measure is dropped, the MPI decreases by one. Each category gathers together multiple distinct subcategories, ranging from one single measure for the leverage ratio (LR), to 9 diverse measures for lending standard restrictions (LSR). In total, these instruments embrace 53 subcategories of policy actions, which have been collected by Budnik and Kleibl (2018) in their Macroprudential Policies Evaluation Database (MaPPED). This comprehensive dataset gives an overview on policy instruments of macroprudential character in the banking industry of the 28 member states of the European Union from 1995 to nowadays. One category is dropped (other measures, OM) as it does not identify any specific regulatory restrictions.
- *TIGHT, LOOSE, BORROWER TARGET, FIs*: these sub-groups are extrapolated from the MPI by separating observations according to their nature and scope. The nature of instruments embraces all ten categories and aggregates them by policy tightening and loosening over time; TIGHT refers to those instruments which have a tightening purpose whereas LOOSE policies have a relaxing one (this difference does not coincide with cyclical or countercyclical design). Diverse is the scope of measures, which divides categories according to their target; BORROWER comprehends borrower-based measures (3 categories in total), aiming at the demand side of the financial sector, while FIs focus on financial institutions-targeted actions (6 classes in total), whose point of attention are liquidity and capital-based policies.
- *Six macroprudential categories*: the chosen instruments for the final model are risk weights (RW), lending standard restrictions (LSR), loan-loss provisioning (LLP), limits on large exposure and concentration (LLEC), limits on credit growth and volume (LCGV), liquidity requirements and limits on currency and maturity mismatch (LRLCM). They have been selected according to their market segment, exposure and description and later connected to the dependent agent.

None of the macroprudential variables considered in this study is a dummy. The necessity to distance from the previous literature is twofold: first, the datatype these instruments does not allow for a dummy, as a huge number and variety of actions have been taken over the years and because the duration of most of the instruments is indefinite, it would be limiting to tag them just with zero or one. Furthermore, it is rational to experiment new typologies as to expand the analysis on the topic under different lenses of observation.

3.2 Descriptive statistics

Figure 1 below depicts the total number of macroprudential measures implemented by the 28 member states over the period considered. These measures are gathered in ten different categories: liquidity requirements and limits on currency mismatches (LRLCM), limits on large exposures and concentration (LLEC), levy/tax on financial institutions and activities (TAX), limits on credit growth and volume (LCGV), lending standard restrictions (LSR), minimum capital requirements (MCR), capital buffers (CB), risk weights (RW), leverage ratio (LR), and loan-loss provisioning (LLP).

Figure 1: Use of Macroprudential instruments.



As it is visible, LLEC is the most used class by far and with almost 300 actions over the years it has been extensively applied. Such vigorous execution has not been given to other instruments, like MCR and LSR, which have seen swelling interest by regulators but not with similar rate. Unlikely, LR has been applied only four times by United Kingdom and Belgium; its scarce utilization can be partially explained by the fact that it is a new measure introduced with the Basel III regulation, whose expected introduction was planned between 2013 and 2015. However, legal binding has been delayed and extended to March 2019, thus countries and financial authorities may be still in the process of applying this it. Overall, there is a positive trend among all variables, with an increasing application over time of macroprudential instruments.

Table 2 provides a summary statistics of the dependent and independent variables used in the analysis: it presents the total number of observations, the mean value, standard deviation, minimum and maximum value for each variable. Over the period analysed, GFCF has seen a stark change rate with minimum and maximum values greater than the others, followed by the GDP and household and NPISH final consumption expenditure. Indeed, GFCF has a mean of 6.45 but because of a huge standard deviation it varies greatly; GDP as well has a mean value of 5.5 but it presents stark differences among countries. Residential property prices have a small mean of 1.64 but it has a high standard deviation of 9.27.

Table 2: Summary statistics of dependent and independent variables.

Variables	Observations	Mean	Std. Dev.	Min.	Max.
Countries	28				
Years	1999-2018				
Credit to non-financial sector from all sectors (YoY) %	1,327	7.52	13.36	-25.09	89.21
Residential property prices (YoY) %	1,501	1.64	9.27	-44.86	59.58
GFCF (YoY) %	2,423	6.45	20.02	-84.14	379.71
Household and NPISH final consumption expenditure (YoY) %	2,423	5.14	7.62	-65.74	122.20
GDP (YoY) %	2,423	5.50	7.88	-57.27	132.77
MRO rate %	2,156	1.92	1.51	0	4.75
MPI	2,604	24.59	19.79	1	93
TIGHT	2,604	20.71	16.03	0	86
LOOSE	2,604	3.88	4.91	0	21
BORROWER	2,604	7.48	77.54	0	60
FIs	2,604	17.05	10.41	0	54
RW	2,604	1.62	1.81	0	8
LLP	2,604	2.24	3.22	0	16
LSR	2,604	2.48	5.36	0	32
LCGV	2,604	2.77	5.79	0	27
LLEC	2,604	8.40	4.48	0	26
LRLCM	2,604	2.97	3.90	0	21

Notes: the table provides the number of observations, mean, standard deviation, minimum and maximum values for the presented variables.

The mean value of MPI is 24.59 describes an abundant utilization of macroprudential categories, but it does not tell however which policy actions have been precisely taken by each country. The reasoning behind the index is to study whether a determined quantity of instruments have an impact or not, independently of their characteristics. Within the database, features start to be visible: TIGHT measures are on average used much more than LOOSE, with a mean value which is more than 6 times higher. It should be considered that rather than adding new relaxing measures, authorities may as well decide not to trigger regulations or to drop existing ones, but they still may be able to reach the goal of relaxing the financial system. Hence, it looks reasonable that TIGHT actions outnumber LOOSE.

The scope of these instruments shifts from borrowers to financial institutions: the latter group is reasonably more at the centre of experts' attention as demonstrated by the higher mean value and lower standard deviation compared to those of BORROWER, suggesting that similar degree of attention and consistent actions have been taken by each nation. The six categories in questions have all similar means, except for LLEC which is applied 4 four times more on average than the others. Raw data tell that at least one action concerning exposures and concentration was been adopted by every state by January 1996.

Differences between the countries considered are expected, not only among the dependent variables and GDP, but also on their level of financial development and openness. This differentiation is later run in the analysis, with a division of the countries considered. The partitioning measure adopted is the Chinn-Ito index (KAEPOEN), an index which gauges a country's degree of capital account openness and it has been applied to divide the countries into two categories: financially developed and financially developing. The former category counts 15 countries, whereas the latter one counts 12. The index did not present any data for Luxemburg, which thus has been taken out from this more specific analysis, thus the nations are for this part 27. Moreover, the variable Credit to non-financial sector from all sectors is excluded because its data embrace only 18 countries, therefore not complete enough to provide robust results.

Table 3 delivers the summary statistics for the two countries' groups. The table highlights distinct values for the two groups: apart from the RRP, whose mean value is higher for the financially developed countries, the other dependent variables and GDP (MRO is equal for everyone) have greater means for the developing nations. GDP rate shows a positive overall average change of 6.6% by the developing group, compared to the 4.64% for the developed one.

Nonetheless, developing countries demonstrate a higher standard deviation for each of the aforementioned fields, entailing a greater degree of volatility of these factors. Macroprudential variables clearly depict a higher degree of implementation by financially developing countries: MPI and TIGHT have a mean value more than double compared to developed nations, LOOSE and BORROWER present even starker gaps. Furthermore, standard deviation indicates ample ranges of variations within each

variable. These data support previous findings (Cerutti, Claessens, & Laeven, 2017) that new member states on average are more active users of macroprudential policies.

Table 3: Summary statistics by country's group.

Variable	Financially developed countries					Financially developing countries				
	Obs.	Mean	Std. Dev.	Min	Max	Obs.	Mean	Std. Dev.	Min	Max
Countries	15					12				
Years	1999-2018					1999-2018				
Residential property prices (YoY) %	934	2.09	8.43	-44.86	45.88	528	0.79	10.83	-34.80	59.58
GFCF (YoY) %	1,334	5.35	12.99	-48.57	109.01	1,000	8.02	26.88	-84.14	379.71
Household consumption (YoY) %	1,334	4.31	5.85	-23.15	42.29	1,000	6.34	9.60	-65.74	122.20
GDP (YoY) %	1,334	4.64	6.31	-27.20	36.69	1,000	6.6	9.66	-57.27	132.78
MRO rate %	1,155	1.92	1.51	0	4.75	924	1.92	1.51	0	4.75
MPI	1,395	15.98	9.13	3	52	1,116	36.23	23.87	1	93
TIGHT	1,395	14.18	7.77	3	42	1,116	29.49	19.67	0	86
LOOSE	1,395	1.81	2.10	0	10	1,116	6.74	6.01	0	21
BORROWER	1,395	2.49	4.06	0	23	1,116	14.31	14.41	0	60
FIs	1,395	13.39	6.79	3	39	1,116	21.91	12.31	0	54
RW	1,395	1.58	1.64	0	6	1,116	1.72	2.03	0	8
LLP	1,395	0.83	1.58	0	6	1,116	4.17	3.78	0	16
LSR	1,395	1.14	2.08	0	11	1,116	4.33	7.44	0	32
LCGV	1,395	0.52	1.71	0	10	1,116	5.80	7.63	0	27
LLEC	1,395	6.85	2.53	1	15	1,116	10.63	5.54	0	26
LRLCM	1,395	1.57	2.05	0	9	1,116	4.77	4.92	0	21

Notes: the table provides the number of observations, mean, standard deviation, minimum and maximum values for the presented variables. The two sub groups are derived through the Chinn-Ito index classification applied as a measure of discrimination among countries.

Looking deeper at the principal regression variables between the 28 countries as presented in table A1 in the appendix, it is possible to see how differently nations enacted policies: Germany has an average of 8 macroprudential policies, in opposition to Greece that used more than 40 instruments on

average. Generally, there is a higher average growth rate of credit among financially developing countries, apart from the case of Ireland, which has the greatest average value of 12.24% among those present (Luxembourg has an even higher value, but it is not classified neither as developed nor developing). Average residential property price change rates are overall low and close to zero, where some cases are negative (Croatia, Greece, Hungary, Ireland, Latvia, Poland and Slovenia). GFCF and household final consumption expenditure have as well contrasting mean change rates among the 28 members; for example, Bulgaria and Estonia position themselves above the median, while others such as Denmark, Italy and Germany are situated below the average benchmark.

To further investigate the relationship between variables, correlation is analysed to check for multicollinearity problems. Table 4 presents the correlation matrix between the seven main variables; it is clear from the table that there is a high correlation between the growth rates of GDP and GFCF rate (0.62), and again GDP and households' consumption (0.84). Clearly, both dependent variables represent a specific subcategory of a country's gross domestic product and hence the output of a nation relies partially on them. Nonetheless, it has been considered useful to include the GDP growth rate in all cases as a proxy for the state of the country's business cycle (Claessens, Ghosh, & Mihet, 2013).

Table 4: Correlation matrix.

	Credit growth	RPP growth	GFCF growth	Household c. growth	GDP growth	MRO	MPI
Credit growth	1.00						
RPP growth	0.11	1.00					
GFCF growth	0.11	0.42	1.00				
Household c. growth	0.31	0.45	0.53	1.00			
GDP growth	0.25	0.48	0.62	0.84	1.00		
MRO	0.44	0.10	0.05	0.19	0.09	1.00	
MPI	-0.17	-0.18	-0.08	-0.14	-0.11	-0.37	1.00

Notes: Table presents correlation coefficients among dependent and independent variables. MPI is applied for brevity reasons.

Interestingly, this variable shows a negative correlation with all the other variables, ranging from a moderate negative relationship with RPP (-0.18) to a soft downhill with the GFCF rate (-0.08). In opposition, the MRO rate is positively correlated with all four dependent variables; the implications of it will be further analysed and discussed in regression results. In table A2 of the appendix, which presents the correlation matrix for the other explanatory instruments it is noteworthy to mention that all four new explanatory variables involving either the nature and scope have a negative correlation with

the dependent variables. This precludes to inquiry into loosening measures, whose unpredicted output is indeed questioned.

3.3 Empirical model

The purpose of the analysis is to assess the effects of macroprudential policies on four dependent variables, each of whom expresses a distinct aspect of a nation's economy. Initially, the analysis will be held with an aggregate measure of the policy actions, the Macroprudential Policy Index, in order to assess whether a greater quantity of these instruments provoke a greater impact. Later, the nature and scope of these financial instruments are analysed. The empirical model used is Ordinary Least Squares (OLS) panel regressions. The models include country fixed-effects to account for differences between nations, and time fixed-effects to avoid that time trends can influence results. Indeed, over the time period considered, the global financial crisis took place and spread over Europe, as called the sovereign debt crisis, and for this reason, controlling for time shocks appears reasonable. The following equation is the base regression model:

$$Y_{i,t} = \beta_0 + \beta_1 Y_{i,t-1} + \beta_2 GDP_{i,t-1} + \beta_3 MRO_{t-1} + \beta_4 MPI_{i,t-1} + \gamma_i C_i + \delta_t T_t + \varepsilon_{i,t} \quad (1)$$

Where i identifies the country and t the time period. $Y_{i,t}$ represents the specific dependent variable: credit, residential property prices, GFCF or final consumption expenditure growth rate. On the other side of the equal sign, there are the constant term and the independent variables, which are all lagged one year: $Y_{i,t-1}$ is the dependent variable, $GDP_{i,t-1}$ is the gross domestic product growth rate, MRO_{t-1} is the marginal refinancing operation rate, which is equal for each nation, $MPI_{i,t-1}$ is the Macroprudential Policy Index. From one side, country fixed-effects are represented by $\gamma_i C_i$ to assess the impact of single state members; on the other side, time fixed-effects at the quarter level are embodied by $\delta_t T_t$, as measure to gauge time's differences over the sample period. Moreover, in order to avoid correlation, to obtain more robust outcomes, and to confirm assumption of independence, standard errors are clustered at the country level because some observations are related to each other. Finally, $\varepsilon_{i,t}$ expresses the error term.

Furthermore, MPI is decomposed into TIGHT and LOOSE. Consequently, the explanatory variable $MPI_{i,t-1}$ is dropped and substituted by $TIGHT_{i,t-1}$ first, and subsequently by $LOOSE_{i,t-1}$, which are both built by identifying the nature of the policy actions taken by country i at time t . These two new variables comprehend all ten categories, but actions are not divided evenly as seen in descriptive tables:

$$Y_{i,t} = \beta_0 + \beta_1 Y_{i,t-1} + \beta_2 GDP_{i,t-1} + \beta_3 MRO_{t-1} + \beta_4 TIGHT_{i,t-1} + \gamma_i C_i + \delta_t T_t + \varepsilon_{i,t} \quad (2)$$

In equation 2 country fixed-effects and time fixed-effects are still present and standard errors are clustered at the country level as well. Subsequently, the division of MPI takes another approach; rather than separating single policy actions, two new variables are constructed by distinguishing the ten macro-categories according to their target. $BORROWER_{i,t-1}$ and $FIS_{i,t-1}$ represent two proxies, respectively of the demand and the supply of financial markets. These variables focus their attention on borrower-based measures, and capital and liquidity-based measures which indeed target financial institutions. Both new factors are entered into the model one at the time with GDP and MRO rates, as presented in equation 3:

$$Y_{i,t} = \beta_0 + \beta_1 Y_{i,t-1} + \beta_2 GDP_{i,t-1} + \beta_3 MRO_{i,t-1} + \beta_4 BORROWER_{i,t-1} + \gamma_i C_i + \delta_i T_t + \varepsilon_{i,t} \quad (3)$$

The study concludes with an even more capillary examination by implementing six macroprudential categories over the four dependent variables; for each sector the impact of two categories is assessed (three categories are chosen for credit) along with the other standard explanatories. The model is applied with the appropriate modifications as below:

$$Y_{i,t} = \beta_0 + \beta_1 Y_{i,t-1} + \beta_2 GDP_{i,t-1} + \beta_3 MRO_{i,t-1} + \beta_4 CATEGORIES_{i,t-1} + \gamma_i C_i + \delta_i T_t + \varepsilon_{i,t} \quad (4)$$

where $CATEGORIES_{i,t-1}$ is indeed just a vector comprehending either two or three macroprudential variables, all activated by country i at time t and later lagged one-year. For credit, the three variables considered are LLP, LCGV and LLEC; for housing prices are RW and LSR; for GFCF are LCGV and LLEC; for households' consumption are LSR and LRLCM.

At this point, some clarification regarding the choices for this model must be explained: the application of fixed-effects serves to explore the relationship between predictors and outcome variables among countries and over time. Because each nation has its individual characteristics, that may have a strong, weak or null influence over the dependent variables; by using fixed-effects it is assumed that these characteristics do have an impact and thus it is necessary to control them. This enables the assessment of net effects of explanatory variables. Moreover, these features are also supposed to be unique and not correlated with the others. Time provides element of concern as well: quarterly data span over almost 20 years and idiosyncratic and structural differences, which should be considered in the analysis.

4. Results

4.1 Base model

Table 5 reports the results obtained with the macroprudential index (MPI) over base model with the four dependent variables. MPI shows negative coefficients in all four cases: the explanatory variable

seems to have similar power in three cases, with a value of -0.03, and greater dampening effect on GFCF. These results are in line with previous findings in the literature (Cerutti, Claessens, & Laeven, 2017) where the macroprudential index results in a negative coefficient; however only one in four coefficients is statistically significant. Dependent-lagged variables are statistically significant and positive, although with different intensity. GFCF shows the lowest strength among the four: this can be reasonably explained by the high standard deviation and the extremely wide range amid its minimum and maximum values, numbers that stands out compared with those of the other variables. This result is visible in subsequent table as well.

Table 5: Results of the effects of MPI on base model.

	Credit growth	RPP growth	GFCF growth	Household consumption growth
	(1)	(2)	(3)	(4)
GDP	-0.06**	-0.01	0.79***	0.15***
growth _(t-1)	(0.02)	(0.04)	(0.24)	(0.04)
MRO	-4.93***	0.12	0.94	0.19
rate _(t-1)	(0.52)	(0.26)	(1.38)	(0.31)
MPI _(t-1)	-0.03	-0.03	-0.09	-0.03***
	(0.02)	(0.02)	(0.06)	(0.01)
Credit	0.83***			
growth _(t-1)	(0.16)			
RPP		0.87***		
growth _(t-1)		(0.02)		
GFCF			0.27*	
growth _(t-1)			(0.15)	
Household consumption				0.66***
growth _(t-1)				(0.04)
Constant	10.92***	1.23	1.13	1.61***
	(0.96)	(0.89)	(4.79)	(0.43)
Observations	1,284	1,417	2,095	2,095
Adjusted-R ²	0.93	0.86	0.40	0.77

Notes: The coefficient estimates are provided using OLS. The explanatory variables are all one-year lagged and are the growth rate of GDP, the Marginal Refinancing Operation rate, the macroprudential index (MPI) and the dependent variable. The four dependent variables are (1) the growth rate of credit to non-financial sector from all sectors, (2) the growth rate of residential property prices, (3) the growth rate of gross fixed capital formation, and (4) the growth rate of households and non-profit institutions serving households final consumption expenditure. Country and year fixed-effects are applied to control for individual trends. Robust standard errors at the country level are reported in brackets. 10%, 5% and 1% significance levels are respectively indicated by: *, **, ***.

In opposition to the sum of macroprudential policies, the MRO indicates negative and significant effect only for credit to non-financial activities, whereas positive and not significant effects are present for the other dependent variables. Monetary and macroprudential policies have contrasting effects for residential property prices, investments and households' final expenditure, while accord is present for credit. Moreover, the lagged GDP rate coefficient depicts negative effects on credit and RPP;

this could be driven by the contrast of financial measures and by the fact that a great quantity of policies gathered in the MPI may partially distort effects of the individual tools and the other variables. Thus, the 10 categories must be further analysed by looking into more depth at their nature and scope.

Table 6 reports the four dependent variables regressed over tightening and loosening measures: by looking at the first four columns it results that tightening macroprudential measures dump the economic cycle from 0.03% in credit to 0.12% in investments with statistical significance in three out of four cases. Loosening policies appear to have a boosting effect only on credit to non-financial sector with an increase of 0.09% for each new measure implemented, whereas these instruments appear to produce an even stronger limiting effect on the remaining dependent variables.

Table 6: Regression results of the base model for tightening and loosening macroprudential instruments.

	Tightening				Loosening			
	Credit growth	RPP growth	GFCF growth	Household c. growth	Credit growth	RPP growth	GFCF growth	Household c. growth
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
GDP growth _(t-1)	-0.06*** (0.02)	-0.01 (0.04)	0.79*** (0.24)	0.15*** (0.04)	-0.06*** (0.02)	-0.01 (0.04)	0.79*** (0.24)	0.15*** (0.04)
MRO rate _(t-1)	-5.13*** (0.68)	0.14 (0.28)	0.88 (1.26)	0.18 (0.32)	-4.79*** (0.50)	0.22 (0.24)	1.59 (0.24)	0.36 (0.31)
TIGHT _(t-1)	-0.04** (0.02)	-0.03 (0.03)	-0.12* (0.06)	-0.03*** (0.01)				
LOOSE _(t-1)					0.09** (0.04)	-0.08 (0.06)	-0.18 (0.23)	-0.05* (0.33)
Credit growth _(t-1)	0.83*** (0.17)				0.83*** (0.02)			
RPP growth _(t-1)		0.87*** (0.02)				0.87*** (0.02)		
GFCF growth _(t-1)			0.27* (0.15)				0.28* (0.15)	
Household c. growth _(t-1)				0.66*** (0.04)				0.66*** (0.04)
Constant	11.32*** (0.91)	1.06 (0.91)	1.36 (4.23)	1.64*** (0.47)	9.60*** (0.57)	0.68 (0.48)	-1.94 (4.46)	0.80** (0.34)
Observations	1,284	1,417	2,095	2,095	1,284	1,417	2,095	2,095
Adjusted-R ²	0.93	0.86	0.40	0.77	0.93	0.86	0.40	0.76

Notes: The coefficient estimates are provided using OLS. The explanatory variables are all one-year lagged and are the growth rate of GDP, the Marginal Refinancing Operation rate, loosening and tightening macroprudential measures, and the dependent variable. The four dependent variables are (1) the growth rate of credit to non-financial sector from all sectors, (2) the growth rate of residential property prices, (3) the growth rate of gross fixed capital formation, and (4) the growth rate of households and non-profit institutions serving households final consumption expenditure. Country and year fixed-effects are applied to control for individual trends. Robust standard errors at the country level are reported in brackets. 10%, 5% and 1% significance levels are respectively indicated by: *, **, ***.

Coefficients for RPP, GFCF and household consumption are all negative: negative effects for RPP are -0.03 and -0.08 for each policy implemented, for TIGHT and LOOSE respectively, even though neither of the two are statistically significant. For GFCF, coefficients decrease from -0.12 to -0.18 when passing from tightening and loosening effects, but it drops significance, as well as for Households and NPISHs expenditure in which the negative coefficients slightly differ, with -0.03 for TIGHT and -0.05 for LOOSE. Overall, loosening measures seem to have lower econometric significance, however it is evident that loosening macroprudential policies are not promoting the effect intended for them, but rather they deviate towards opposite consequences.

In both cases, the MRO rate shows to have absolute greater effect for all dependent variables, with respect to the MPI model; moreover, MRO coefficients, although statistically insignificant except for credit, almost double their strength when the nature of the policies is taken into consideration. With a positive value of 0.14 when tightening policies are implemented, MRO rate passes to 0.22 for loosening measures; as the TIGHT variable for GFCF is accompanied by a 0.88 value of the MRO, as the LOOSE one has a coefficient of 1.59. A similar result appears for households' consumption, where the MRO coefficient is 0.18 in the former case and 0.36 in the latter one. MRO's impact on credit is highly negative but it loses strictness with the implementation of looser macroprudential policies. At first glance, relaxing measures seem not to accomplish their objective of giving a breath of fresh air to the economic cycle and their effects appear indeed harsher; nonetheless, monetary policy's more positive degree of impact can be considered as a potential side effect of these policies.

Further analysis is carried on the target of these macroprudential instruments. The categories of instruments considered target borrowers and financial institutions. The former one mainly considers instruments aimed at credit such as LTV, LTI, DTI, and other lending standard restrictions. The latter group of instruments considers capital-based, large exposure limits and liquidity-based measures. These actions taken by regulators focus on the opposite sides of the financial sectors, namely the demand of services and resources represented by individuals, firms and organisations, the borrowers, and the supply of these needs embodied by financial institutions, which span from credit institutions, money market funds, insurances or pension funds.

Table 7 present results of the two models including borrower-based and financial institutions targets as explanatory variables, along with the GDP, MRO and the lagged dependent variable in question. In both models, the new explanatory variables inserted produce negative coefficients for all four dependent variables: measures targeting borrowers appear to affect more severely new investments as visible in column 3 of the table, where an additional borrower-targeting tool implemented could reduce capital formation by 0.21%, a value being significant at the 5% level, compared to the 0.09% decrease caused by financial institutions targeting measures. Coefficient on final expenditure shows less

downturn strength but greater econometrical significance, while credit and housing prices report to be both slightly affected and statistically irrelevant.

Table 7: Regression results of the base model with macroprudential measures targeting borrower side and FIs.

	Borrower targeting				FIs targeting			
	Credit growth	RPP growth	GFCF growth	Household c. growth	Credit growth	RPP growth	GFCF growth	Household c. growth
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
GDP growth _(t-1)	0.05 (0.03)	-0.01 (0.05)	0.96*** (0.28)	0.15*** (0.04)	-0.06*** (0.02)	-0.01 (0.04)	0.79*** (0.24)	0.15*** (0.04)
MRO rate _(t-1)	0.66*** (0.09)	-0.52*** (0.12)	-0.89*** (0.23)	0.30 (0.32)	-4.88*** (0.53)	-0.07 (0.23)	1.22 (1.32)	0.23 (0.29)
BORROWER FIs _(t-1)	-0.04 (0.06)	-0.04 (0.06)	-0.21** (0.2)	-0.05*** (0.01)	-0.04 (0.04)	-0.07** (0.03)	-0.09 (0.09)	-0.03* (0.02)
Credit growth _(t-1)	0.74*** (0.02)				0.83*** (0.16)			
RPP growth _(t-1)		0.92*** (0.03)				0.87*** (0.02)		
GFCF growth _(t-1)			0.29* (0.16)				0.28* (0.15)	
Household c. growth _(t-1)				0.23 (0.22)				0.66*** (0.04)
Constant	0.96 (0.59)	1.26* (0.68)	2.43* (1.22)	1.07*** (0.29)	10.94*** (1.21)	2.16** (0.79)	-0.18 (4.62)	1.43* (0.69)
Observations	1,284	1,417	2,095	2,095	1,284	1,417	2,095	2,095
Adjusted-R ²	0.61	0.85	0.36	0.77	0.93	0.86	0.40	0.77

Notes: The coefficient estimates are provided using OLS. The explanatory variables are all one-year lagged and are the growth rate of GDP, the MRO rate, macroprudential measures targeting borrowers and financial institutions, and the dependent variable. The four dependent variables are (1) the growth rate of credit to non-financial sector from all sectors, (2) the growth rate of residential property prices, (3) the growth rate of gross fixed capital formation, (4) the growth rate of households and non-profit institutions serving households final consumption expenditure. Country and year fixed-effects are applied to control for individual trends. Robust standard errors at the country level are reported in brackets. 10%, 5% and 1% significance levels are respectively indicated by: *, **, ***.

On the other half of the table, results appear similar but not identical: macroprudential instruments targeting FIs seem to draw their attention to GFCF compared to the other sectors analysed, but statistically yields not relevance. Stronger dampening outcome and significance is reached by residential property prices coefficient with a -0.07 value, whereas FIs target for households' consumption mildly moves positively to -0.03. Credit's coefficients appear equal for both borrower and FIs targeting measures and neither are significant.

Outcomes suggest that regulation of the financial sector tries to embrace both side of the spectrum, and the planned trend smooths the path towards mitigation in the real economy with detached presence. If from one side, credit is reported as being under great control and scrutiny over the literature (Cerutti, Claessens, & Laeven, 2017), on the other side, the narrow case of credit to non-financial institutions seem to be minorly taken under control due to the fact that macroprudential regulation seems not to target effectively this field. In contrast to this, gross fixed capital formation is depicted as the most efficiently target case out of the four revised, although the outcome still appears too thin for it and for the other sectors as well.

Worth to notice, it is the role that MRO assumes over the last two cases. Previous results identify a marginal role for monetary policy, both because of statistical irrelevance and because it is not placed as main character of this research, and its positive value covers RPP, GFCF and final expenditure. Nonetheless, in table 3 MRO shows negative coefficients in columns 2, 3, 5, and 6, thus respectively for residential property prices, GFCF and credit. Its role appears contrasting for credit in columns 1 and 5, respectively 0.66 and -4.88, where value steer in opposite directions but both result statistically significant at 1% level. Considering the adjusted R-squared measure, the model including FIs TARGET is depicted as stronger and closer to this analysis; still, it is not free of doubts, such as negative and irrelevant coefficients of GDP over credit and RPP.

Table 8 reports a more granular scrutiny of macroprudential policies by looking at the effect of them: table reports the effect of 6 macroprudential categories assigned to credit, RPP, investments and final expenditure. MaPPED initially reports 11 categories, however, it has been decided to narrow this part of the study to 6 as the remaining ones, namely LR, OM, CB, TAX, and MCR, have neither many observations nor specific scope to be considered. The fragmentation has been decided by applying each financial instrument to the category which can potentially be more affected.

Column 1 pictures the effect of LLP, LCGV, and LLEC on credit to non-financial sector from all sectors: measures ideated to target credit growth result present different outcomes: from one side, loan-loss provisioning policies steer to pause credit growth, whereas limits on credit growth and large exposure concentration measures push the credit sector positively. To understand these outcomes, it is noteworthy to check peculiarities of these measures. Among the three instruments, LCGV is the only statistically significant instrument, with the greatest implementation of loosening measures (42% out of 124 total actions) and with almost 72% of measures with a countercyclical design, compared to much tighter and cyclical policies as LLP and LLEC. These elements may help explain why this positive and relevant outcome appears. Weights are still small, as only LLP has an impact greater than 1 percent.

Column 2 depicts the effects of risk weights and lending standard restrictions on RPP: these two prudential policies are those with the greatest focus on residential and commercial real estate, compared to the eleven on scope. Both measures seem to have tiny impact on residential property prices and are

irrelevant; LSR looks surprising, since 70% of the instruments applied have a tightening nature and target domestic exposure, and Budnik and Kleibl (2018) report how their role in curbing cycles has been appreciated in preventing housing market bubbles. Still, this impact is not visible here. Similarly, RW's policies implemented focus narrowly on credit institutions' exposure into real estate, thus it would be expected to effectively focus on this sector. Hitherto these two policy instruments seem to add little to control and prevent shocks in prices of residential properties.

Table 8: Regression results for model comprehending all macroprudential instruments.

	Credit growth	RPP growth	GFCF growth	Household consumption growth
	(1)	(2)	(3)	(4)
GDP growth _(t-1)	-0.06*** (0.02)	0.00 (0.04)	0.78*** (0.24)	0.15*** (0.04)
MRO rate _(t-1)	-4.33*** (0.27)	0.33 (0.32)	1.66 (1.19)	0.32 (0.31)
Credit growth _(t-1)	0.82*** (0.02)			
RPP growth _(t-1)		0.87*** (0.02)		
GFCF growth _(t-1)			0.27* (0.15)	
Household consumption growth _(t-1)				0.66*** (0.04)
RW _(t-1)		0.06 (0.25)		
LSR _(t-1)		-0.02 (0.05)		-0.01 (0.02)
LRLCM _(t-1)				-0.08* (0.05)
LLP _(t-1)	-1.14 (0.11)			
LCGV _(t-1)	0.18*** (0.05)		-0.44** (0.17)	
LLEC _(t-1)	0.05 (0.15)		0.21 (0.13)	
Constant	9.48*** (1.56)	0.03 (0.79)	-3.40 (3.72)	0.93** (0.36)
Observations	1,284	1,417	2,095	2,095
Adjusted-R ²	0.93	0.86	0.41	0.77

Notes: The coefficient estimates are provided using OLS. The explanatory variables are all one-year lagged and are the growth rate of GDP, the MRO rate, six macroprudential categories, and the dependent variable. The four dependent variables are (1) the growth rate of credit to non-financial sector from all sectors, (2) the growth rate of residential property prices, (3) the growth rate of gross fixed capital formation, (4) the growth rate of households and non-profit institutions serving households final consumption expenditure. Country and year fixed-effects are applied to control for individual trends. Robust standard errors at the country level are reported in brackets. 10%, 5% and 1% significance levels are respectively indicated by: *, **, ***.

The impact of LCGV and LLEC on gross fixed capital formation is scrutinized on column 3: the former category does not match the same outcome of credit and it presents here a negative and significant coefficient of -0.44. The latter one, LLEC, indeed result in a positive but insignificant coefficient. Precedent reasoning for LCGV seem not to apply here as it curbs investment successfully; it may appear that policies targeting credit growth and volume are more effective in restricting new investments, therefore limiting the birth of new credit from the beginning.

Results for last column are the only ones in table 4 where two macroprudential variables show impacts with similar effects: lending standard restrictions' coefficient of -0.01 is timidly negative, whereas the impact of limits of currency mismatches is slightly stronger -0.08. LSR's characteristics are defined to delimit consumer loans, including durable goods and services. In addition, by considering that LSR policy actions are implemented by 70% of tightening measures, it would be expected to curb this sector more efficiently. LRLCM has been selected as foreign exchanges are daily movements of cash to buy and sell goods and services with foreign dealers; indeed, this type of measures target both domestic and foreign exposures, both from a macro- and microprudential insight. Nonetheless, the policy targets credit institutions and it does not present a clear transparent segment but it leaves open boundaries as being classified as "general measure". Although it may be reasonable to think that a narrower design may give greater power to LRLCM, it is shown by LSR actions that a more precise focus may not always be effective.

4.2 Country sample division

To study the potential different effects of macroprudential policy instruments among the countries considered, the EU members' sample is divided into sub-groups. Because of many similarities among the state members, the parameter chosen to create this distinction is intended to discriminate countries according their regulatory controls over current or capital account transactions. The *KAOPEN* index of Chinn and Ito (Chinn & Ito, 2006) is an index measuring a country's degree of capital account openness and it is based on the reverse values of dummy variables that collect the tabulation of limitations on cross-border financial transactions reported in the AREAER² of IMF. These variables indicate: the presence of multiple exchange rates, restrictions on current account transactions, restrictions on capital account transactions and requirement of the surrender of export proceeds. It is a *de jure* measure of financial openness, which evaluates the extensity of controls on capital as a proxy for the degree of intensity of capital controls.

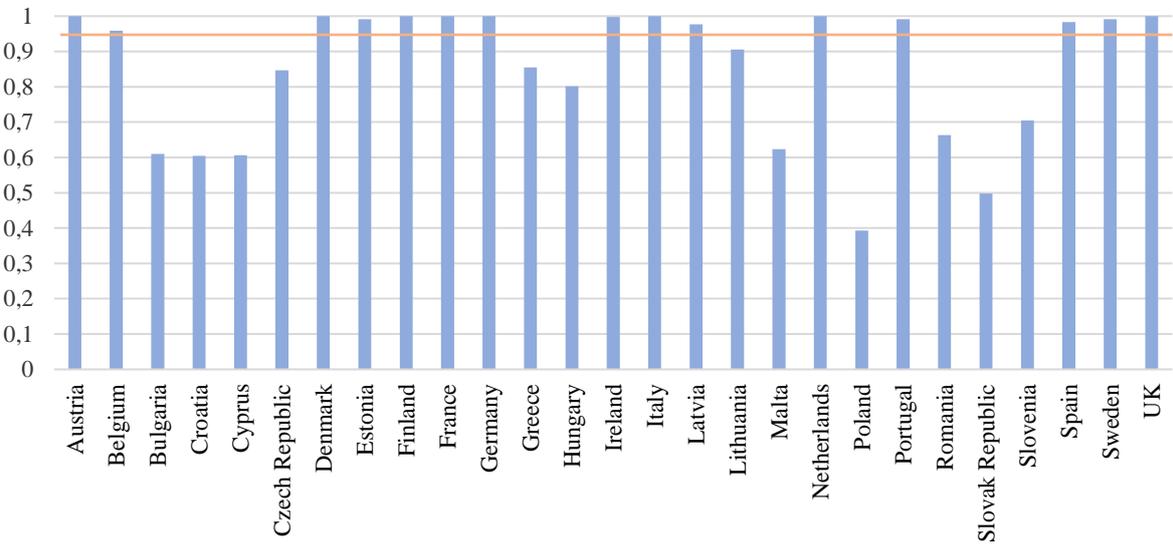
A review of many indicators of financial openness and integration by Quinn, Schindler, and Toyoda (2011) identify as disadvantages some structural breaks in the time sample of *KAOPEN*, the use of dummy variables and the combination of different types of restrictions. However, the sample for this

² Annual Report on Exchange Arrangements and Exchange Restrictions.

analysis is free of any time interruptions and the peculiarity of this index is that it provides existing information on prudential regulations, an aspect not captured by other indices and considered fundamental for this study.

Figure 2 depicts the mean values for each EU member states: eight countries have a mean value of 1 which entails the greater degree of financial openness, while only two states (Poland and Slovak Republic) do not reach the median of 0.5. Since a high concentration of countries with an elevate indicator, the benchmark chosen for the division was 0.95 in order to include only those countries with the least level of capital controls. The 15 member states above the black line are catalogued as financially developed, the others 12 are labelled under financially developing countries.

Figure 2: Average values for each country of the KAOPEN index.



Notes: The figure reports the average of index values, normalized from zero to one, at annual frequency over the period 1999-2016.

Different studies that argue capital account liberalization can affect economic growth through financial development: financial liberalization can mitigate repression and allow the interest rate to arise to its competitive market equilibrium (McKinnon, 1973), while eradication of capital controls permits investors to enhance their portfolio diversification. These points lead to the reduction of capital costs and to wider capital availability for borrowers, and the progression would increase the efficiency of the financial system by eradicating unproductive financial institutions and by pressuring for further structural reforms (Claessens, Djanky, Fan, & Lang, 2001). Following this literature, the index of financial openness is applied in order to find diverging effects of macroprudential instruments, according to the level of capital control of a country.

Table 9 depicts the econometric model incorporating the MPI variable with the country division between financially developed and developing. The lagged MPI coefficient presents different results for each variable: columns 1 and 2 for RPP show MPI values of 0.03 for developing and 0.01 for developed countries. These not significant positive values contrast with table 4, in which the MPI for RPP in the full sample is -0.03.

Table 9: Regression results of MPI on the model for developing and developed countries.

	RPP growth		GFCF growth		Household consumption growth	
	(1)	(2)	(3)	(4)	(5)	(6)
	Developing	Developed	Developing	Developed	Developing	Developed
GDP growth _(t-1)	0.01 (0.05)	-0.07 (0.06)	0.84** (0.28)	0.58** (0.25)	0.24*** (0.04)	0.07 (0.05)
MRO rate _(t-1)	-1.62*** (0.46)	0.22 (0.35)	2.44 (2.87)	-0.55 (1.01)	0.54 (0.90)	0.02 (0.22)
MPI _(t-1)	0.03 (0.03)	0.01 (0.05)	-0.10 (0.07)	-0.07 (0.07)	-0.01 (0.01)	-0.04* (0.2)
RPP growth _(t-1)	0.81*** (0.03)	0.92*** (0.02)				
GFCF growth _(t-1)			0.21 (0.17)	0.45*** (0.15)		
Household consumption growth _(t-1)					0.55*** (0.05)	0.78*** (0.05)
Constant	-1.79 (2.11)	0.09 (1.19)	0.14 (8.95)	2.33 (3.31)	1.12 (1.04)	1.31** (0.55)
Observations	516	863	880	1,139	880	1,139
Adjusted-R ²	0.89	0.90	0.36	0.56	0.77	0.82

Notes: The coefficient estimates are provided using OLS. The explanatory variables are all one-year lagged and are the growth rate of GDP, the MRO rate, the macroprudential index, and the dependent variable. The three dependent variables are: (1) and (2) the growth rates of residential property prices, (3) and (4) the growth rates of gross fixed capital formation, (5) and (6) the growth rates of households and non-profit institutions serving households final consumption expenditure. Financially developing and developed countries have been divided arbitrarily according to their value in the Chinn-Ito index of financial openness. The first group comprehends 12 countries, while the second one is made of 15 countries. Country and time fixed-effects are applied to control for individual trends. Robust standard errors are reported in brackets. 10%, 5% and 1% significance levels are respectively indicated by: *, **, ***.

Nonetheless MPI coefficients show negative values for GFCF and households' consumption: in the former case, the variables hits more heavily the developing countries sample, in the latter case, it is more negative and significant for developed countries. There is no clear trend visible in this first sample partitioning; both group of countries see positive coefficients in the housing market, whereas a greater application of macroprudential instruments seem to better limit investment growth in developing countries and consumption in developed nations.

The MRO coefficient seems to be less effective for developed member states as their coefficients are closer to zero; however, the only significant value is present in column 1, proving that the interest rate generally has a countercyclical effect on growth. Apparently, more divergences are present when the sample is narrowed down rather than better explaining the overall picture: this could be driven by the fact that all implemented measures are considered in MPI, thus potential muddle may arise and not a clear effect can be seen. It results thus necessary to analyse also the multiple sub-sample categories as previously presented.

Table 10 shows the regression results of the model having as explanatory variable TIGHT on the two country sub-samples: results confirm table 6 and present different patterns of strengthening macroprudential measures for the three different dependent variables. The TIGHT coefficients act similarly for RPP and households' final expenditure, where values are more negative for developed nations, whereas GFCF is contrastingly affected as indeed developing countries perceive more negative outcomes from this variable. This time, however, none value of TIGHT is significant.

Table 10: Regression results of variable TIGHT on the model for developing and developed countries.

	RPP growth		GFCF growth		Household consumption growth	
	(1)	(2)	(3)	(4)	(5)	(6)
	Developing	Developed	Developing	Developing	Developed	Developing
GDP growth _(t-1)	0.01 (0.05)	-0.07 (0.06)	0.84** (0.28)	0.58** (0.25)	0.24*** (0.04)	0.08 (0.05)
MRO rate _(t-1)	-1.81*** (0.39)	0.17 (0.35)	2.19 (2.49)	-0.39 (1.06)	0.59 (0.94)	0.03 (0.22)
TIGHT _(t-1)	0.03 (0.04)	-0.01 (0.05)	-0.15 (0.08)	-0.05 (0.09)	-0.01 (0.01)	-0.05 (0.03)
RPP growth _(t-1)	0.81*** (0.03)	0.92*** (0.02)				
GFCF growth _(t-1)			0.21 (0.17)	0.46*** (0.15)		
Household consumption growth _(t-1)					0.55*** (0.05)	0.78*** (0.05)
Constant	-1.08 (1.91)	0.36 (1.17)	1.09 (7.18)	1.63 (3.65)	0.89 (1.13)	1.31* (0.69)
Observations	5160	863	880	1,139	880	1,139
Adjusted-R ²	0.89	0.89	0.36	0.56	0.77	0.82

Notes: The coefficient estimates are provided using OLS. The explanatory variables are all one-year lagged and are the growth rate of GDP, MRO rate, TIGHT, and the dependent variable. The three dependent variables are:(1) and (2) the growth rates of residential property prices, (3) and (4) the growth rates of gross fixed capital formation, (5) and (6) the growth rates of households and non-profit institutions serving households final consumption expenditure. Financially developing and developed countries have been divided arbitrarily according to their value in the Chinn-Ito index of financial openness. The first group comprehends 12 countries, while the second one is made of 15 countries. Country and time fixed-effects are applied to control for individual trends. Robust standard errors are reported in brackets. 10%, 5% and 1% significance levels are respectively indicated by: *, **, ***.

Noteworthy to notice is the GDP variable which shows that its coefficient for RPP is positive for developing countries and negative for developed ones; as developed countries are present in greater number and thus in overall observations, it looks clear why until now GDP growth showed negative values. The housing market of residential properties mildly follow the growth of the economy on developing countries and countercyclically act in more developed states, but overall it can be stated that according to this results no strong correlation is present between the two variables in the study.

Following, on table 11 the effect of macroprudential loosening instruments is presented over the two sub-division. The impact of LOOSE variable depicts a clear path. Coefficients are positively greater on developing countries than developed ones: respectively 0.16 and 0.08 for RPP, which is the only positive case for LOOSE, -0.1 and -0.28 for GFCF, -0.02 and -0.07 for consumption. As seen before, loosening measures seem not to directly implement sectorial growth, but rather they give greater boost to other elements. If compared to table 10, it is possible to individualize the different impact that MRO has on the specific sectors: again, LOOSE coefficients allow for greater movement and scope of actions to other financial instruments by indirectly supporting them.

Table 11: Regression results of variable LOOSE on the model for developing and developed countries.

	RPP growth		GFCF growth		Household consumption growth	
	(1)	(2)	(3)	(4)	(5)	(6)
	Developing	Developed	Developing	Developing	Developed	Developing
GDP growth _(t-1)	0.01 (0.05)	-0.07 (0.05)	0.85** (0.28)	0.57** (0.25)	0.24*** (0.04)	0.07 (0.05)
MRO rate _(t-1)	-1.36** (0.46)	0.22 (0.25)	3.66 (2.98)	-0.36 (0.71)	0.55 (0.83)	0.22 (0.23)
LOOSE _(t-1)	0.16 (0.09)	0.08 (0.14)	-0.10 (0.28)	-0.28 (0.16)	-0.02 (0.03)	-0.07 (0.05)
RPP growth _(t-1)	0.81*** (0.03)	0.92*** (0.02)				
GFCF growth _(t-1)			0.21 (0.17)	0.46*** (0.15)		
Household consumption growth _(t-1)					0.55*** (0.05)	0.78*** (0.05)
Constant	-1.77 (1.48)	0.03 (0.43)	-5.27 (9.38)	1.38 (1.84)	1.09 (0.67)	0.35 (0.35)
Observations	516	863	880	1,139	880	1,139
Adjusted-R ²	0.89	0.89	0.36	0.56	0.77	0.82

Notes: The coefficient estimates are provided using OLS. The explanatory variables are all one-year lagged and are the growth rate of GDP, MRO rate, LOOSE, and the dependent variable. The three dependent variables are:(1) and (2) the growth rates of residential property prices, (3) and (4) the growth rates of gross fixed capital formation, (5) and (6) the growth rates of households and non-profit institutions serving households final consumption expenditure. Financially developing and developed countries have been divided arbitrarily according to their value in the Chinn-Ito index of financial openness. The first group comprehends 12 countries, while the second one is made of 15 countries. Country and time fixed-effects are applied to control for individual trends. Robust standard errors are reported in brackets. 10%, 5% and 1% significance levels are respectively indicated by: *, **, ***.

However, their direct impact remains negative in most of the cases: coefficients for developed countries result more negative compared to table 6, for GFCF and household expenditure. Relaxing values for residential property prices are positive, despite negative coefficients resulting in table 2. Decomposing the country sample proved to be useful: TIGHT measures seem not sufficient to stop the housing market and less stringent policies may help causing undesired growth (although none value is significant).

By looking at the other coefficients, LOOSE effects are still more impressing than TIGHT; value are negative and keener on impacting developed countries. As it is reasonable to imagine, the imposition of policies measures with the aim to control, either by restricting the scope of action or by somehow leaving more opportunities, on capital markets free of any barrier and burden shows greater effect rather than on money markets where restrictions and capital controls still apply, and for which the implementation of new regulatory measures may not indeed change the course of action. Despite minor significance, EU member states classified as more financially open seem to be superiorly affected by macroprudential instruments. What has to be controlled now is how these implications are reflected on society: following tables present results of macroprudential measures targeting either borrowers or banking institutions.

Table 12 presents results for BORROWER target over the two country groups. Coefficients for residential property prices appear positive but insignificant. GFCF and households' consumption values are negative; as previously seen, measures targeting investments from the borrowers' side are the most effective and dampening, reducing new opportunities by 0.21% and 0.14% for debtors in developing and developed states respectively. Consumption is negatively more affected and statistically significant at the % percent level in developed countries. Indeed, these numbers tendentially confirm previous findings: from one side, RPP coefficients before look as the mild and least effective, and now once the sample has been broken down econometric relevance does not change but it is visible the positive impact on both country groups. On the other side, dampening effects are more clearly seen on GFCF and households' final consumption, where coefficients show more statistical importance and depict overall expenditure, both durable and non-durable as the most affected.

New investments and consumption variables experience similar but more tenuous impact when connected with financial institutions' targeting measures. Table 13 shows that same trends, but poorer, are present: coefficients on columns 3 and 6 for FIs targets are more negative compared to their relative peers, whereas an opposing situation for RPP arises, as now minute inhibition impacts developed countries. In opposition, developing member states register a positive 0.08 value for tools targeting financial bodies. Hitherto, the country division led to the following inferences: macroprudential instruments show comparable patterns for residential property prices and household and NPISH expenditure growths, as developing countries result more depressingly affected than developing ones.

Table 12: Regression results of variable BORROWER on the model for developing and developed countries.

	RPP growth		GFCF growth		Household and NPISH growth	
	(1)	(2)	(3)	(4)	(5)	(6)
	Developing	Developed	Developing	Developed	Developing	Developed
GDP growth _(t-1)	0.00 (0.04)	-0.07*** (0.05)	0.85** (0.28)	0.58** (0.25)	0.24*** (0.04)	0.07 (0.05)
MRO Rate _(t-1)	-2.00*** (0.32)	0.31 (0.28)	2.69 (2.86)	-0.30 (0.77)	0.49 (0.91)	0.18 (0.23)
BORROWER _(t-1)	0.02 (0.05)	0.15 (0.14)	-0.21* (0.12)	-0.14 (0.09)	-0.02 (0.02)	-0.07** (0.02)
RPP growth _(t-1)	0.81*** (0.03)	0.92*** (0.02)				
GFCF growth _(t-1)			0.21 (0.17)	0.46*** (0.15)		
Household consumption growth _(t-1)					0.55*** (0.05)	0.78*** (0.05)
Constant	-0.19 (1.45)	-0.40 (0.67)	-1.09 (8.51)	1.07 (2.09)	1.32 (0.73)	0.79 (0.32)
Observations	516	863	880	1,139	880	1,139
Adjusted-R ²	0.89	0.89	0.36	0.56	0.77	0.82

Notes: The coefficient estimates are provided using OLS. The explanatory variables are all one-year lagged and are the growth rate of GDP, MRO rate, BORROWER, and the dependent variable. The three dependent variables are: (1) and (2) are the growth rates of residential property prices, (3) and (4) are the growth rates of gross fixed capital formation, (5) and (6) are the growth rates of households and non-profit institutions serving households final consumption expenditure. Financially developing and developed countries have been divided arbitrarily according to their value in the Chinn-Ito index of financial openness. The first group comprehends 12 countries, while the second one is made of 15 countries. Country and time fixed-effects are applied to control for individual trends. Robust standard errors are reported in brackets. 10%, 5% and 1% significance levels are respectively indicated by: *, **, ***.

This outcome can be explained by the broader level of financial openness in the first group, which experiences the implementation more directly. A different case is made for gross fixed capital formation, in which dampening outcomes appear existing for developing nations. However, the application of new measures does not necessarily imply negative effects on open financial markets, but it can turn to inhibiting behaviours as well; in fact, for residential property prices and new investments, financially developed nations are influenced by the least strong coefficients. In both sectors, in four out of five explanatory variables concerning macroprudential instruments the financially modern group see undeveloped results which stick closer to the zero. Consequently, values with more visible power highlights growing capital markets, where measures are more tightening and loosening, more effective on financial institutions and borrowers.

The trend is not visible in the sector of final consumption. This happens because macroprudential measures appear to act depressing in both categories. Although developed nations present more negative results for all five prudential variables, for both sub-samples the coefficients are

negative but still very close to zero, as in columns 5 and 6 over five tables values range from -0.01 to -0.07 and only one number appears significant. It is evident that consumer staples and alike are a category “too distant” from financial instruments and its conduct is determined by other economic drivers not present in this analysis.

Table 13: Regression results of variable FIs on the model for developing and developed countries.

	RPP growth		GFCF growth		Household and NPISH growth	
	(1)	(2)	(3)	(4)	(5)	(6)
	Developing	Developed	Developing	Developing	Developed	Developing
GDP growth _(t-1)	0.01 (0.05)	-0.07 (0.06)	0.84** (0.29)	0.58** (0.25)	0.24*** (0.04)	0.07 (0.05)
MRO Rate _(t-1)	-1.17* (0.64)	0.02 (0.27)	3.26 (2.78)	-0.29 (0.88)	0.68 (0.86)	0.14 (0.25)
FIs _(t-1)	0.08 (0.06)	-0.03 (0.04)	-0.08 (0.13)	-0.04 (0.07)	0.01 (0.03)	-0.03 (0.02)
RPP growth _(t-1)	0.80*** (0.03)	0.92*** (0.02)				
GFCF growth _(t-1)			0.21 (0.17)	0.46*** (0.15)		
Household consumption growth _(t-1)					0.55*** (0.05)	0.78*** (0.05)
Constant	-3.00 (2.38)	1.04 (0.85)	-3.53 (8.75)	1.19 (2.84)	0.47 (1.44)	0.78 (0.48)
Observations	516	863	880	1,139	880	1,139
Adjusted-R ²	0.89	0.89	0.36	0.56	0.77	0.82

Notes: The coefficient estimates are provided using OLS. The explanatory variables are all one-year lagged and are the growth rate of GDP, MRO rate, FIs measure, and the dependent variable. The three dependent variables are: (1) and (2) the growth rates of residential property prices, (3) and (4) the growth rates of gross fixed capital formation, (5) and (6) the growth rates of households and non-profit institutions serving households final consumption expenditure. Financially developing and developed countries have been divided arbitrarily according to their value in the Chinn-Ito index of financial openness. The first group comprehends 12 countries, while the second one is made of 15 countries. Country and time fixed-effects are applied to control for individual trends. Robust standard errors are reported in brackets. 10%, 5% and 1% significance levels are respectively indicated by: *, **, ***.

The same reasoning can be seen in the MRO rate coefficients: the highest positive values are all stacked among developing countries for GFCF, while the lowest ones affect again developing members over the residential property prices. These latter outcomes are the only side statistically significant. Furthermore, EBC refinancing rate is less effective and inhibited for developed countries, in which the coefficients for all three dependent variables are closer to zero (when compared to the developing counterpart) and insignificant. Households' consumption remains the least altered category, whose MRO coefficients remain positive for both developing and developed member states, but stick near zero,

with the greatest values of 0.68 for developing countries, when macroprudential instruments targeting financial institutions are implemented, and 0.18 for developed nations, when measures targeting borrowers are in use.

Table 14: Regression results of macroprudential measures for developing and developed countries.

	RPP growth		GFCF growth		Household and NPISH growth	
	(1)	(2)	(3)	(4)	(5)	(6)
	Developing	Developed	Developing	Developed	Developing	Developed
GDP growth _(t-1)	0.01 (0.04)	-0.07 (0.06)	0.85** (0.29)	0.57** (0.24)	0.24*** (0.04)	0.08 (0.05)
MRO rate _(t-1)	-1.02** (0.43)	0.18 (0.31)	3.48 (2.31)	-0.13 (0.73)	0.67 (0.87)	0.17 (0.23)
RPP growth _(t-1)	0.79*** (0.03)	0.92*** (0.02)				
GFCF growth _(t-1)			0.21 (0.17)	0.46*** (0.15)		
Household consumption growth _(t-1)					0.55*** (0.05)	0.77*** (0.05)
RW _(t-1)	0.99** (0.45)	-0.04 (0.27)				
LSR _(t-1)	-0.08 (0.06)	0.05 (0.11)			-0.01 (0.02)	0.01 (0.06)
LRLCM _(t-1)					0.04 (0.05)	-0.18*** (0.05)
LLP _(t-1)			-0.41* (0.21)	-0.42** (0.14)		
LCGV _(t-1)			0.19 (0.19)	0.18 (0.20)		
LLEC _(t-1)	-2.94* (1.56)	0.29 (0.68)	-5.59 (6.02)	-0.61 (2.51)	0.57 (0.79)	0.59* (0.33)
Constant	516	863	880	1,139	880	1,139
Adjusted-R ²	0.89	0.89	0.36	0.56	0.77	0.82

Notes: The coefficient estimates are provided using OLS. The explanatory variables are all one-year lagged and are the growth rate of GDP, MRO rate, 6 macroprudential categories, and the dependent variable. The three dependent variables are: (1) and (2) the growth rates of residential property prices, (3) and (4) the growth rates of gross fixed capital formation, (5) and (6) the growth rates of households and non-profit institutions serving households final consumption expenditure. Financially developing and developed countries have been divided arbitrarily according to their value in the Chinn-Ito index of financial openness. The first group comprehends 12 countries, while the second one is made of 15 countries. Country and time fixed-effects are applied to control for individual trends. Robust standard errors are reported in brackets. 10%, 5% and 1% significance levels are respectively indicated by: *, **, ***.

At last, table 14 presents the impact of five macroprudential categories over RPP, GFCF and final expenditure. Risk weights and lending standard restrictions resemble previous findings as both

oscillate around zero; RW is positive and significant for developing countries but it falls below zero for developed ones, respectively with values of 0.99 and -0.04. LSR presents inverted coefficients as it results negative for the first group and positive for second one. GFCF is impacted likewise by LCGV and LLEC, as the former financial tool present negative and significant results for both nations' groups, and the latter one positive but insignificant values.

Over the last dependent variable, Households' final expenditure, LSR again does not show noteworthy coefficients, whereas restrictions to currency and liquidity mismatches proves to affect negatively developed countries. MRO coefficients confirm previous inferences as its highest and lowest values are held for RPP and GFCF coefficients of developing countries. Conformingly, the other coefficients stay close to zero and remain insignificant.

Country sample division reinforces earlier findings of table 8 as LSR and LLEC instruments seem to be ineffective over the sectors analysed; at the same time, RW and LRLCM seem to have some degree of implication but their effect is confined to one sub-sample group and the direction of their intervention is unclear. The results obtained depict a miserable image of macroprudential measures adopted by European member states over the last years.

This outcome can be viewed from two different perspectives: the former one, by considering macroprudential procedures as goal-oriented instruments which precisely have been narrowed down to their financial targets and which effectively act on them, thus a limited direct impact on the real economy seems reasonable; the latter viewpoint indeed perceives these banking-safety tools as unproductive and the given outcomes are just distortions outside capital markets. This study cannot judge whether macroprudential measures are effective or not, as an examination of their main objective is set aside and focus is given to subordinate elements. Still, it can be stated that some macroprudential measures effectively target and hit their final purpose by overstepping financial institutions.

4.3 Robustness analysis

Next, robustness checks are conducted on both the base model with MPI and all the macroprudential instruments over the entire sample period, over the two time intervals and the two country divisions. This control study follows previous literature (Cerutti, Claessens & Laeven (2017); Claessens, Ghosh & Mihet (2013)) which utilizes the Arellano-Bond generalized method of moments (GMM) panel regressions for studying macroprudential policy actions. Results provide greater statistical significance for some of the coefficients presented but these do not always confirm OLS results.

Table 15 presents the first robustness analysis results for the base model containing the MPI variable: the macroprudential index negatively acts on all the four dependent variables with similar strength and more relevant under the statistical side, hence confirming the outcome of table 1. What indeed differs is the impact of the MRO rate, as this times it turns positive for credit and negative with respect to the other three variables. The refinancing rate is now in opposition to previous findings; although it has been chosen as representative of European monetary policies stances, this result casts doubts on its role in a direct macro-environment as the one in question.

Table 15: Results of the GMM regression with MPI coefficient.

	Credit growth	RPP growth	GFCF growth	Household c. growth
	(1)	(2)	(3)	(4)
GDP growth _(t-1)	0.08** (0.04)	-0.01 (0.05)	0.96*** (0.27)	0.18*** (0.04)
MRO rate _(t-1)	0.48*** (0.13)	-0.87*** (0.21)	-1.09*** (0.26)	-0.33*** (0.11)
MPI _(t-1)	-0.08*** (0.02)	-0.08*** (0.03)	-0.10** (0.05)	-0.06*** (0.01)
Credit growth _(t-1)	0.72*** (0.02)			
RPP growth _(t-1)		0.92*** (0.03)		
GFCF growth _(t-1)			0.29** (0.15)	
Household consumption growth _(t-1)				0.66*** (0.05)
Constant	2.73*** (0.54)	3.84*** (1.16)	3.85* (2.06)	3.02*** (0.59)
Observations	1,266	1,389	2,067	2,067

Notes: The coefficient estimates are provided using Arellano-Bond GMM dynamic estimation. The explanatory variables are all one-year lagged and are the growth rate of GDP, the MRO rate, MPI and the dependent variable. The four dependent variables are (1) is the growth rate of credit to non-financial sector from all sectors, (2) is the growth rate of residential property prices, (3) is the growth rate of gross fixed capital formation, (4) is the growth rate of households and non-profit institutions serving households final consumption expenditure. Robust standard errors at the country level are reported in brackets. 10%, 5% and 1% significance levels are respectively indicated by: *, **, ***.

The coefficients for gross domestic production resemble earlier findings for RPP, GFCF and households' consumption, whereas for credit the impact now turns positive (and still significant). This time the state of the real business cycle seems to positively affect credit growth, following prior literature (Cerutti, Claessens, & Laeven, 2017). Said so, authorities report how growth in credit in an economy is considered as an indicator of financial instability and henceforth additional capital is suggested to be hold by banks (Kelly, McQuinn, & Stuart, 2013). Then, it can be expected that a surge in growth would

reduce the rate of credit and its progress, as initial results suggested. Besides from this, the lagged dependent variables maintain strength and statistical power in the robustness test as well.

Table 16 depicts robustness analysis for tightening and loosening measures: macroprudential impacts are again confirmed by Arellano-Bond regressions, with coefficients that have deeper effects for GFCF as previously seen and where the only discordant value is the negative LOOSE factor for credit of -0.14, which resulted positive in OLS regression but it looks now not significant. It is central to highpoint that relaxing macroprudential measures seem indeed to depress the economy cycle more than strengthening tools; however, again the MRO rate applied to each dependent variable results less negative, or closer to zero, in the robustness analysis.

Table 16: Results of the GMM regressions with TIGHT and LOOSE variables.

	Tightening				Loosening			
	Credit growth	RPP growth	GFCF growth	Household c. growth	Credit growth	RPP growth	GFCF growth	Household c. growth
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
GDP growth _(t-1)	0.08** (0.04)	-0.01 (0.05)	0.96*** (0.27)	0.18*** (0.04)	0.08** (0.04)	-0.02 (0.05)	0.96*** (0.27)	0.18*** (0.05)
MRO rate _(t-1)	0.49*** (0.13)	-0.86*** (0.20)	-1.08*** (0.26)	-0.34*** (0.11)	0.72*** (0.09)	-0.69 (0.18)	-0.82*** (0.23)	-0.14 (0.09)
TIGHT _(t-1)	-0.08*** (0.02)	-0.09*** (0.03)	-0.12** (0.05)	-0.08*** (0.02)				
LOOSE _(t-1)					-0.14 (0.08)	-0.26*** (0.09)	-0.31 (0.23)	-0.15*** (0.05)
Credit growth _(t-1)	0.72*** (0.02)				0.73*** (0.02)			
RPP growth _(t-1)		0.92*** (0.03)				0.92*** (0.02)		
GFCF growth _(t-1)			0.29* (0.15)				0.29* (0.15)	
Household c. growth _(t-1)				0.66*** (0.05)				0.66*** (0.05)
Constant	2.55*** (0.59)	3.74*** (1.09)	3.73** (1.86)	3.07*** (0.61)	0.85*** (0.27)	2.39*** (0.80)	1.86 (1.57)	1.59*** (0.44)
Observations	1,266	1,389	2,067	2,067	1,266	1,389	2,067	2,067

Notes: The coefficient estimates are provided using Arellano-Bond dynamic estimation. The explanatory variables are all one-year lagged and are the growth rate of GDP, the MRO rate, TIGHT and LOOSE variables and the dependent variable. The four dependent variables are (1) the growth rate of credit to non-financial sector from all sectors, (2) the growth rate of residential property prices, (3) the growth rate of gross fixed capital formation, (4) the growth rate of households and non-profit institutions serving households final consumption expenditure. Robust standard errors at country level are reported in brackets. 10%, 5% and 1% significance levels are respectively indicated by: *, **, ***.

Despite the continuing incongruent outcome of the ECB rate with former OLS tests, differentiation of MRO effects between TIGHT and LOOSE is visible as well in the validating examination: MRO depicts a 0.49 factor in column 1 and .72 in column 5, -0.86 for RPP in column 2 and -0.69 in column 6. Similar results are shown for the two remaining instances. GDP coefficients corroborate findings, except, again, for the case of credit, whose coefficients are again of 0.08 and significant in both tight and loose regression models.

In table 17 confirming results are observable: policies targeting borrowers have all negative effects and close resemblance to OLS coefficients, with greater strictness on GFCF; measures aiming at financial institutions maintain results with greater downsizing and significant values. From one side, MRO rate put near BORROWER presents alike results to OLS regressions; on the other side, MRO accompanied by FIs takes a new path, distancing from former results.

Table 17: Results of the GMM regression of BORROWER and FIs targeting measures.

	Borrower targeting				FIs targeting			
	Credit	RPP	GFCF	Household c.	Credit	RPP	GFCF	Household c.
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
GDP growth	0.07** (0.04)	-0.01 (0.05)	0.95*** (0.27)	0.18*** (0.05)	0.08** (0.03)	-0.01 (0.05)	0.96*** (0.27)	0.19*** (0.04)
MRO rate	0.71*** (0.11)	-0.59*** (0.16)	-0.91*** (0.22)	-0.17** (0.08)	0.37*** (0.13)	-0.95*** (0.23)	-1.05*** (0.28)	-0.38*** (0.11)
BORROWER	-0.05 (0.06)	-0.07 (0.06)	-0.22** (0.09)	-0.09*** (0.02)				
FIs					-0.14*** (0.03)	-0.14*** (0.04)	-0.13* (0.08)	-0.10*** (0.02)
Credit	0.73*** (0.02)				0.72*** (0.02)			
RPP growth		0.92*** (0.03)				0.92*** (0.02)		
GFCF growth			0.29* (0.15)				0.29* (0.16)	
Household consumption				0.66*** (0.05)				0.66*** (0.05)
Constant	0.87* (0.46)	1.59** (0.74)	2.51* (1.32)	1.83*** (0.37)	3.49*** (0.75)	4.29*** (1.19)	3.42 (2.11)	3.29*** (0.62)
Observations	1,266	1,389	2,067	2,067	1,266	1,389	2,067	2,067

Notes: The coefficient estimates are provided using Arellano-Bond dynamic estimation. The explanatory variables are all one-year lagged and are the growth rate of GDP, the MRO rate, BORROWER and FIs variables and the dependent variable. The four dependent variables are (1) the growth rate of credit to non-financial sector from all sectors, (2) the growth rate of residential property prices, (3) the growth rate of gross fixed capital formation, (4) the growth rate of households and non-profit institutions serving households final consumption expenditure. Robust standard errors at the country level are reported in brackets. 10%, 5% and 1% significance levels are respectively indicated by: *, **, ***.

The new outcome conforms to GMM structures as positive coefficient for credit and negative factors for the other three variables. This change of direction of the MRO rate contaminates all robustness results. What is surprising is that confirmation arises from the diverse macroprudential angles analysed, those cases where more volatility was initially expected, whereas varying coefficients of MRO (and GDP) update the latest tables. These were supposed to be a strong part of the analysis, chosen to represent a specific part of the financial and economic environment and to set limits to the potential outcomes

Indeed, their mutation put lights into new potential implication that macroprudential instruments may have; as already mentioned, differences have been noticed among TIGHT and LOOSE policies, not mainly on their macroeconomic performance but on the MRO's performance. Thus, it would be reasonable to further articulate a hypothesis of contamination in forthcoming studies (of course such argument must be first supported by further analysis and backing of the structure and implementation of this study, which may not be exempt of biases and procedural errors.

At last, table 18 below shows regression models incorporating the chosen six macroprudential categories. Column 1 depicts results for credit to non-financial sector: LCGV is positive and significant with a value of 0.28, whereas coefficients for LLP and LLEC are negative and significant only in the latter. RPP values create contrasts, as from one hand LSR is again negative and not significant, from the other hand, RW drifts towards depressing effects with statistical relevance at one per cent level. Eventually, this instrument assumes the impact that was expected from the beginning, thus moderating the housing sector in order to prevent market bubbles. In the case of new investments, LCGV and LLEC again support previous findings as their impact is negative and positive, respectively. GFCF thus sees opposing forces acting in its interest, however, it seems as contacting effects prevail. Final expenditure's coefficients again present reassuring points, where LSR still wanders around a weak negative value and LRLCM remains negative and significant.

The financial instruments analysed tend to optimistically repeat earlier findings: LSR and LLP seem to be ineffective in curbing growth, at the same time LLEC appears to unsuccessfully boost the economic cycle. RW does not find according results as they change both sign and statistical significance, depending on the case; a reasonable explanation is that differences lay among countries, hence this prudential instrument imprints enhancing effects on developing member states but unproductively operates in countries with broader capital markets. On the other side, LCGV and LRLCM present strong results. The former tool actively increases credit growth and decreases investments growth, whereas the latter effectively dampens the growth rate of consumption.

Table 18: Results of the GMM regression of all macroprudential policies.

	Credit growth	RPP growth	GFCF growth	Household consumption growth
	(1)	(2)	(3)	(4)
GDP growth	0.09** (0.03)	-0.01 (0.05)	0.95*** (0.27)	0.18*** (0.04)
MRO rate	0.55*** (0.11)	-0.84*** (0.19)	-0.77*** (0.23)	-0.21** (0.09)
Credit growth	0.73*** (0.02)			
RPP growth		0.91*** (0.03)		
GFCF growth			0.28* (0.16)	
Household c. growth				0.66*** (0.05)
RW		-0.66*** (0.22)		
LLP	-0.01 (0.23)			
LSR		-0.01 (0.07)		-0.02 (0.03)
LCGV	0.28*** (0.03)		-0.51*** (0.18)	
LLEC	-0.59*** (0.16)		0.05 (0.17)	
LRLCM				-0.23*** (0.07)
Constant	5.24*** (1.28)	2.97*** (0.77)	1.65 (1.81)	1.89*** (0.45)
Observations	1,266	1,389	2,067	2,067

Notes: The coefficient estimates are provided using Arellano-Bond dynamic estimation. The explanatory variables are all one-year lagged and are the growth rate of GDP, the MRO rate, six macroprudential categories and the dependent variable. The four dependent variables are (1) the growth rate of credit to non-financial sector from all sectors, (2) the growth rate of residential property prices, (3) the growth rate of gross fixed capital formation, (4) the growth rate of households and non-profit institutions serving households final consumption expenditure. Robust standard errors at the country level are reported in brackets. 10%, 5% and 1% significance levels are respectively indicated by: *, **, ***.

5. Conclusion

This study tries to investigate the macroeconomic effects of macroprudential measures adopted by European member states in the last twenty years from multiple perspectives. These financial regulatory measures are extrapolated from the MaPPED, an innovative and comprehensive macroprudential database from the European Central Bank, and later analysed and implemented over four dependent variables. 10 macroprudential categories are considered first together as an index, further separated according to their nature and scope, and concluding with an analysis of 6 specific group of instruments over the growth rates of credit to non-financial sector from all sectors, residential property prices, the level of new investments, and households' final consumption.

The analysis is performed initially with an OLS model which adopts different explanatory variables and sub-groups of the same country sample. GMM regression models are later adopted in order to see if the implementation of another statistical model can help reduce distortions and confirm previous results. Macroprudential variables survey the intensity and frequency of the employed policy actions at quarterly level, constructed by adding new implemented measures over the years; in total, 5 variables are created and 6 macroprudential categories are individually employed, accompanied by the Main Refinancing Operations rate of the ECB, as proxy of monetary policy.

Results indicate that macroprudential regulation has an overall negative impact, independently of their original design. Incrementation of deployed measures appears to diminish the growth rate of the inspected sectors, albeit statistical power is low. When instruments are divided between tightening and loosening, both groups show dampening effects; however, the latter group seems to leave a greater degree of freedom to monetary policy, whose impact is thus amplified. Borrower-based and financial institutions-targeting measures appear to have similar effects, in particular they both dampen more negatively GFCF, whose econometrical strength is not always sufficient. Among the 6 specific instruments, it is worth to highlight that confident results support LCGV, which is the strongest, whereas RW and LSR appear ineffective and there's discordance among their results. Country group sub-division delineates that financially developing countries are subject to greater impact and statistical significance. For developed countries, effects seem to be less effective and closer to zero. It appears as greater financial openness and a minor level of restrictions create a buffer against regulatory instructions. Still this must consider the greater number of macroprudential policy actions taken by

Future research could focus on the long term effects of these instruments and their correlation with monetary policies; whether this collaboration is productive or not, it requires deeper understanding. Additionally, attention should be conducted on microprudential instruments as to see how they impact differ from their macro counterpart.

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Appendix

Table A1: Summary statistics of the main regression variables by country.

Country	Category	Mean (Standard deviation)					
		Credit	RPP	GFCF	Household consumption	GDP	MPI
Austria	Developed	5.63 (10.07)	1.87 (3.62)	2.99 (3.93)	2.99 (1.57)	3.26 (1.99)	15.69 (5.94)
Belgium	Developed	5.69 (10.54)	1.38 (2.71)	3.70 (5.40)	2.94 (1.76)	3.15 (1.97)	14.61 (6.07)
Bulgaria	Developing	.	0.49 (11.38)	21.27 (64.87)	9.06 (19.19)	8.93 (20.23)	42.14 (21.90)
Croatia	Developing	.	-2.92 (4.16)	5.09 (11.52)	4.11 (5.28)	4.52 (5.34)	48.43 (30.31)
Cyprus	Developing	.	2.33 (9.76)	6.12 (36.96)	4.94 (5.46)	4.43 (4.54)	37.09 (17.34)
Czech Republic	Developing	9.86 (15.63)	0.61 (4.99)	5.79 (9.22)	6.89 (7.07)	7.05 (7.26)	11.69 (6.11)
Denmark	Developed	5.46 (11.73)	2.95 (9.49)	3.81 (6.84)	2.96 (1.99)	3.28 (2.51)	15.46 (8.35)
Estonia	Developed	.	3.99 (18.98)	10.89 (19.98)	10.11 (9.95)	10.22 (8.89)	15.90 (4.77)
Finland	Developed	6.47 (10.42)	0.82 (3.49)	4.65 (6.81)	3.94 (2.08)	3.68 (3.29)	14.55 (6.49)
France	Developed	6.29 (10.81)	3.32 (5.46)	3.52 (4.31)	2.85 (1.93)	2.91 (1.89)	20.82 (8.03)
Germany	Developed	3.28 (10.48)	1.09 (2.39)	1.81 (5.14)	2.01 (1.40)	2.33 (2.29)	8.05 (1.97)
Greece	Developing	7.55 (14.83)	-5.25 (4.69)	1.36 (15.44)	2.69 (5.86)	2.62 (6.02)	76.05 (15.89)
Hungary	Developing	9.83 (16.45)	-0.39 (8.59)	6.66 (10.46)	5.74 (7.92)	6.12 (7.32)	25.28 (16.69)
Ireland	Developed	12.24 (13.39)	-1.02 12.69	11.75 (23.21)	5.87 (6.48)	8.52 (9.31)	20.02 (7.13)
Italy	Developed	5.13 (11.60)	0.12 (3.83)	2.79 (5.78)	3.20 (3.43)	3.06 (3.65)	15.39 (2.22)
Latvia	Developed	.	-0.57 (16.66)	13.87 (25.19)	9.11 (10.65)	9.50 (11.66)	30.97 (14.75)
Lithuania	Developing	.	7.28 (18.69)	11.69 (19.54)	10.45 (10.03)	10.56 (10.88)	41.31 (14.09)
Luxemburg	.	15.09 (21.68)	2.46 (2.55)	5.51 (15.18)	4.03 (2.48)	5.77 (4.70)	13.82 (5.86)
Malta	Developing	.	3.87 (8.35)	7.13 (23.60)	3.63 (2.86)	5.69 (3.57)	12.55 (3.79)
Netherlands	Developed	4.53 (10.59)	2.86 (6.43)	4.38 (15.31)	3.06 (2.61)	3.55 (2.64)	12.69 (8.73)
Poland	Developing	11.50 (13.85)	-1.26 (3.95)	6.02 (13.79)	5.11 (10.01)	5.96 (9.92)	36.23 (18.65)
Portugal	Developed	7.16 (13.18)	0.08 (6.05)	2.20 (8.81)	3.57 (3.47)	3.53 (3.38)	19.35 (8.22)
Romania	Developing	.	-3.67 (8.51)	11.37 (22.89)	9.22 (12.97)	9.48 (11.79)	33.81 (17.40)

Table A1 continued

Slovakia	Developing	.	2.48 (11.26)	8.17 (15.57)	8.67 (7.25)	8.33 (7.27)	44.79 (17.12)
Slovenia	Developing	.	-2.13 (5.84)	4.05 (10.01)	4.08 (3.59)	4.69 (4.02)	35.39 (13.79)
Spain	Developed	7.45 (12.77)	-2.59 (7.92)	4.33 (9.13)	4.03 (3.74)	4.29 (3.93)	13.67 (2.51)
Sweden	Developed	6.40 (12.61)	6.19 (4.59)	5.51 (8.77)	3.78 (6.35)	4.18 (6.98)	12.43 (7.99)
U.K.	Developed	5.87 (9.77)	4.57 (7.34)	4.12 (10.64)	4.29 (9.13)	4.17 (1.51)	10.19 (9.47)

Notes: Data reported are the mean value of the variable for each country, with standard deviation in brackets. The number of observations does include the measurements of the ten macroprudential categories, which are the same for each country (10 categories, 93 observations per category).

Table A2: Correlation matrix.

	Credit growth	RPP growth	GFCF growth	Household c. growth	TIGHT	LOOSE	BORRO- WER	FIs
Credit growth	1.00							
RPP growth	0.11	1.00						
GFCF growth	0.11	0.42	1.00					
Household c. growth	0.31	0.45	0.53	1.00				
TIGHT	-0.17	-0.18	-0.08	-0.14	1.00			
LOOSE	-0.15	-0.18	-0.07	-0.07	0.71	1.00		
BORRO- WER	-0.11	-0.21	-0.14	-0.15	0.92	0.70	1.00	
FIs	-0.21	-0.11	0.01	-0.08	0.86	0.67	0.60	1.00

Notes: Table presents correlation coefficients among dependent and independent variables.