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The Link between Financial Stability, Macroprudential Policy and Heterogeneity in the Euro Area[1] (1)

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THE LINK BETWEEN FINANCIAL STABILITY, MACROPRUDENTIAL POLICY AND HETEROGENEITY IN THE EURO AREA (1)
This thesis establishes the link between financial stability, macroprudential policy, and heterogeneity in the euro area by positing first that the underlying heterogeneity in $t-2$, to the extent that it is proxied by the cumulative sum of percentage point deviation of inflation index of countries from the euro area level with the base year 2003, impacts the application of macroprudential policy in $t-1$, represented by the average loan-to-value (LTV) limits. In turn, the resulting heterogeneous calibration of macroprudential policy entails different financial stability outcomes in t, which are captured by the growth rate of real household credit. This relationship is formalised by the instrumental variable fixed effects model, while the data run from 2003 to 2019. In that way, this framework addresses not only the endogeneity problem present in the policy-outcome set-up, but also builds upon and provides insight into the conceptual foundation of this model, which is the real interest rate transmission mechanism: Countries with higher cumulative sums of inflation deviation will systemically experience lower real interest rates, i.e. more favourable borrowing conditions. Macroprudential tightening in the form of lower LTV limits follows, especially in light of the parallel force of expansionary (un)conventional monetary policy during this time frame. Finally, those countries experience a decrease in real household credit growth, the financial stability indicator.

JEL F30, G15, G21

1 Introduction, Research Question & Hypotheses

This section introduces the research issue of heterogeneity, financial stability and macroprudential policy in the context of the euro area, explores their interdependence and highlights their relevance. It further continues with positing the research question and the hypotheses.

Country heterogeneity can pose a significant threat to systemic financial stability. When divergence across several economic dimensions is present, such as economic growth, inflation, borrowing costs, trading balances and similar, a shock or policy is not transmitted symmetrically across the union, thereby impacting its regions disproportionately (Brissimis & Skotida, 2008; Coudert, Couharde, Grekou, & Mignon, 2020; Stiglitz, 2017). In the event of a negative shock on economic growth, not only is this politically unsustainable in the long run, but it ultimately requires contrasting responses from policymakers in the area of monetary policy, which is unified by construction (Coudert et al., 2020). This may further dampen the divergence, making the union unstable economically in the sense that countries in contrasting economic conditions need contrasting policies, and politically in the sense of risking public perception of favouring certain countries with conducted unified policies, and therefore sustainability and optimality of a union as a whole (Stiglitz, 2017).

Furthermore, when countries in a monetary union experience systematically different inflation levels, a unified nominal policy rate will result in systematically contrasting real interest rates across countries. This, once again, implies different economic conditions wherein it entails different borrowing and lending incentives to households, businesses, and the government. So, it is not that monetary policy leads to these contrasting economic conditions, it is the underlying heterogeneity, coupled with unified monetary policy,

[1] This paper is based on a master's thesis with the same title, which was prepared under the supervision of Univ. Prof. Dr. Guido Schäfer, Vienna University of Economics and Business.

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that further amplifies different economic and financial outcomes (Brissimis & Skotida, 2008). In other words, monetary policy that is unified leads to different effects against the background of heterogeneity, that way making the union as a whole even more vulnerable to financial fragility, due to asymmetric shock propagation, and then spillover effects via other channels. Since economic conditions which are, in reverse causality terms, also determined by borrowing costs, these diverge even further when country risk levels are perceived to be different (Georgoutsos & Migiakis, 2013). Since in the context of a monetary union, different risks are associated with the same currency, spillover effects may occur to other member states, as the 2012–2014 sovereign debt crisis revealed (Stiglitz, 2017). Ultimately, heterogeneity then makes the euro area, via several channels, more prone to financial instability.

The euro area responded to the turmoil of the 2008 global financial crisis and the sovereign debt crisis in the following years by introducing more regulation aimed at prudency, transparency, comparability and cohesiveness, first in 2010 with the establishment of the European Systemic Risk Board to monitor macroeconomic risks to financial stability, and then further in 2012 with the establishment of the banking union (ECB, 2022; ESRB, 2020). In parallel, the role of macroprudential policy as a key policy tool to pursue the objective of financial stability was developed (Schäfer, 2020). It is to be noted that in contrast to monetary policy, macroprudential policy, while there exist minimum levels pertinent to all countries, can be applied heterogeneously, that is, based on country specifics (Buch, 2021; Cabral et al., 2019). This way, it monitors financial stability across countries precisely by addressing contrasting conditions with contrasting policies.

Against this backdrop, the thesis interlinks euro area heterogeneity, financial stability and macroprudential policy. The research question is: Can macroprudential policy, in its aim to address heterogeneous financial conditions and outcomes of countries, be therefore predicted by the underlying heterogeneity itself; and if so, does it have the capacity to influence financial stability outcomes.

It follows that the hypotheses are:

1. Heterogeneity in the euro area, to the extent that it is captured by systemic build-up of inflation differences, influences heterogeneous outcomes in the application of macroprudential policy measures, specifically, different levels of LTV ratio caps. Specifically, the higher the inflation build-up over the years, the lower the LTV ratio cap.
2. Macroprudential policy has the capacity to influence financial stability outcomes. Specifically, the tighter, i.e. lower, the LTV ratio cap, the more sustained, i.e. lower, the growth rate of real household credit.

Further sections will present methodology and data, literature overview, and finally, the results and some robustness tests. The thesis concludes with a discussion.

2 Methodology & Data

This section describes the methodological approach and empirical specification, transmission mechanism, which underpins it, and how endogeneity is tackled within this set-up. Further, it outlines which variable proxies were used to study the concepts in the research question and describes the data.

2.1 Methodology

To study the research question of establishing the link between the three elements, instrumental variable regression is employed. The reason for this is that it empirically provides for a neat economic interpretation where differences in built-up inflation can to an extent predict differences in heterogeneous macroprudential policy, which in turn influences financial stability outcomes. In addition, since there is the issue of endogeneity present in the relationship between macroprudential policy and financial stability, it avoids it by presenting, via arguments outlined in further sections, exogenous instrument of euro area heterogeneity (Schäfer, 2020). Sections below describe the instrumental variable approach in theory and in application of this case.

2.1.1 Instrumental Variable and Fixed Effects Approach

To estimate the change in financial stability associated with the change in macroprudential policy, a country fixed effects regression model is used so as to control for country-specific time-invariant confounders, where each country acts as its own control. In addition, time-varying variables are included to control for the time-varying confounding. Next, the instrumental variable approach represents a way to obtain an unbiased estimate in set-ups where endogeneity is present (Schmidheiny, 2016). This occurs if one or more of the independent variables is correlated with the error term u_{it} (equation 2.2), making grounds for causality interpretation blurry, since the estimator becomes biased. While this is elaborated more on in the following section on endogeneity, let us note for now that reverse causality (as well as omitted variables) is one of the scenarios which lead to endogeneity, and policy-objective set-up is a typical instance of it (Schäfer, 2020). The essence behind obtaining unbiased estimates lies in introducing a new, exogen-

ous variable acting as an instrument to the endogenous variable (Schmidheiny, 2016).
The IV method is executed in a two-stage process. In the first stage, the impact of an instrument z on the endogenous regressor x is estimated, along with other exogenous independent variables and controls (see equation 2.1 below; note that fixed effects and other confounding factors not shown).

$$X_{it} = \gamma_0 + \gamma_1 Z_{it} + v_{it} \tag{2.1}$$

In the second stage, the prediction of an endogenous independent variable by an instrument is used in assessing its effect on the dependent variable (see equation 2.2 below).

$$Y_{it} = \beta_0 + \beta_1 X_{it} + u_{it} \tag{2.2}$$

That way, only exogenous variation is used and, provided instrument assumptions are met, which is outlined in further sections, the case for causality can be made (Schüwer, 2021). In addition to introducing an instrument to tackle endogeneity, time-invariant confounding is controlled for by using fixed-effects, as well as time-varying confounding by including several controls (Milner et al., 2017). To jointly conduct these two approaches, `xtivreg` command was used in Stata 16.1. The following sections contextualise the analysis within the scope of the problem at hand.

2.1.2 The Model

The first two sections outline the rationale behind the selected methodology of instrumental variable fixed-effects (IV FE) regression: First reason being the transmission mechanism, the economic interpretation of which the selected empirical approach neatly captures, and the second being the need to attend to issues created by the endogeneity problem. In addition, the second section makes the case for instrument validity. The third section presents the empirical specification.

2.1.2.1 Transmission Mechanism

The main specification aims to capture the following process: Underlying heterogeneity in $t-2$, built-up over previous periods, influences the heterogeneous application of macroprudential policy across euro area in $t-1$. In turn, different calibrations of policy result in different financial stability outcomes across countries in t. Specifically, inflation differences are taken as a measure of euro area heterogeneity, while loan-to-value (LTV) ratio is taken as a borrower-based macroprudential measure to influence the financial stability outcome of growth rate of real household credit.

The transmission channel operates through the real interest rate in the following way: In a currency union where heterogeneity is present in the form of persisting divergent inflation rates, different real interest rates will emerge against the backdrop of single monetary policy (Esposito, 2014). This sets the stage for contrasting lending conditions, which subsequently emerge across the union. Macroprudential policymakers, equipped with the ability to apply heterogeneous macroprudential policy in contrast to monetary policy, will calibrate the measures to best fit economic circumstances of regions across the union (Cabral et al., 2019). Specifically, regions with systematically higher inflation rates will thus in the same systemic fashion experience lower real interest rates, i.e., more favourable lending conditions (Toussaint, 2013). That way, household credit booms and associated house price bubbles are more likely to emerge in regions associated with perpetuating patterns of higher inflation, because the lower the real interest rate, the more expansionary the effect, and the incentive for more prudent measures is obvious. In contrast, regions with relatively lower persistent inflation experience higher real interest rates against the single monetary policy, and thus, macroprudential intervention is less necessary in curbing financial conditions. Therefore, this established the link between single monetary policy and heterogeneous macroeconomic conditions, which drive financial stability outcomes, and subsequently, macroprudential policy.

2.1.2.2 Endogeneity Problem and Instrument Validity

However, the IV methodology was selected not only because it fits the narrative of the set-up economically, but also since it addresses the present endogeneity problem empirically (Schüwer, 2021). Namely, much like in the monetary policy tool-inflation stability outcome case, whether the calibration of policy causes the change of an outcome, or the changed outcome results in the calibration of policy, it is not clear, causing the attenuation bias (Alam et al., 2019). In such a set-up, causality cannot be proven since the policy regressor is correlated with the error term, i.e., $Cov(x,u) \neq 0$. In other words, it is endogenous. However, in policy analysis, proving causality is crucial in order to determine its effectiveness and thus, against the backdrop of potentially costly implementation, justify policy use. The IV method addresses the endogeneity problem since it replaces the endogenous regressor with an exogenous instrument (Schüwer, 2021). Then, provided that the endogenous regressor and exogenous instrument are sufficiently correlated, and that the instrument itself is exogenous, it can

act in place of the endogenous regressor, thereby avoiding the endogeneity problem (Schmidheiny, 2016). In the context of the thesis, since the growth rate of real household credit responds to different levels of LTV ratio caps, but also LTV ratio changes with differently paced growth rate of real household credit, the endogeneity problem is present, and the causality of LTV policy cannot be established in curbing household credit (Alam et al., 2019). Instead, it is possible to imagine that different levels of LTV ratio caps correlate with another variable, inflation, via the real interest rate process. Then, to the extent that the level of LTV ratio limit can be predicted by an inflation measure, it is deemed exogenous in its impact on the real growth of household credit. In other words, provided it is sufficiently argued that inflation is exogenous in this set-up, we can thus consider the variation of LTV ratio cap, to the degree that it is predicted by variation in inflation, exogenous. In absence of other problems, we can therefore consider the effect of LTV ratio limit on real growth of household credit unbiased, consistent and, importantly, causal.

However, there are two conditions for the instrument of inflation to be deemed valid, and in turn, for an IV estimator of LTV ratio caps to be considered unbiased and consistent (Schüwer, 2021). First, the instrument needs to be sufficiently correlated with the endogenous regressor, that is, inflation and LTV ratio, respectively, i.e. $Cov(z,x) \neq 0$. This condition demands instrument relevance. If this is not the case, we have a weak instrument and problems associated with it, which are high standard errors of estimators, as well as bias and inconsistency of estimators, emerge. The more correlation between the endogenous regressor and the instrument, LTV ratio and inflation, the more efficient the IV estimator[1]. Relevance can easily be tested and is tested for in the section Robustness tests 4.3.

The second condition stipulates instrument exogeneity. This entails no correlation between the instrument and the error term, i.e. $E(u|z) = 0 \Rightarrow Cov(z,u) = 0$. Because this condition can in general not be tested, it needs a strong theoretical argument. In this aim, Schmidheiny (2016) presents the following three dimensions to be considered: First, any direct effects of the instrument on the dependent variable, or any effects running through omitted variables, need to be convincingly ruled out. This requirement is called exclusion restriction. In other words, the instrument affects the outcome only through the endogenous regressor, and is not associated with uncontrolled factors that cause the outcome. Second, reverse effects of the dependent variable on the instrument need to be convincingly ruled out. Finally, it needs to be convincingly described why the instrument influences the endogenous regressor, i.e. relevance must be proven.

Then, in the context of this thesis, in order to fulfil the exclusion restriction, inflation as a measure of heterogeneity is to have an effect on the growth rate of real household credit as a measure of financial stability only through the LTV ratio cap as a measure of macroprudential policy, and not directly. It can be argued that inflation rates do not directly influence the growth rate of real household credit, but rather through their impact on real interest rates, which manifest themselves in imbalanced lending conditions across the euro area. Only these, in turn, produce different financial stability scenarios, which is then tackled through and thus reflects heterogeneous macroprudential policy (Cabral et al., 2019). Moreover, via employing within-country fixed effects analysis, between-country time invariant differences are controlled for (Milner et al., 2017). In addition, many time-varying confounders, like monetary policy, economic growth, and other macroprudential policy measures, are included in controls, to ensure the instrument impacts the outcome only through the endogenous macroprudential policy variable.

Next, to the extent that household credit fuels the rise in house prices, it can impact inflation. The growth of house prices is another proxy measure of financial stability often used in literature, however, because of its direct connection to inflation, without an effect running through macroprudential policy, this thesis refrains from employing it. In that way, not only the problem of direct effects, but also the problem of reverse effects of the outcome variable on the instrument is avoided, since the connection operates through house prices and is not directly linked to the inflation measure (which is a price index of various goods), which is, as such, less direct as if using the measure of house prices itself to measure financial stability. Since on top of that, monetary policy with broad impacts on a range of economic prices, including house prices, and borrowing costs, including bank lending rates, is controlled for, the problem of an effect running through an omitted variable is limited. Therefore, for the purposes of this analysis, this thesis uses a financial stability proxy of growth rate of real household credit and a heterogeneity proxy of inflation, with an effect of the latter on the former running directly through macroprudential policy with underlying real interest rate mechanism, and that way ensures that the second condition holds. Moreover, it distinguishes between two inflation instruments, one that gauges built-up systemic heterogeneity, and

[1] If $Cov(z,x) = 1$, efficiency of the IV estimator is that of the OLS estimator, since $\beta_{IV} = Cov(y,x)$, while $\beta_{OLS} = Cov(y,x)/Cov(x,x)$. Of course, the covariance of two different variables in the denominator, as is the case of IV estimator, will normally be less than 1, and the estimator will be less efficient. The higher the $Cov(z,x)$, the more mitigated this problem, and the more efficient the IV estimator.

one that captures per period real interest rates, thus measuring period-to-period heterogeneity in lending conditions.
Last, it has been argued already that inflation influences the LTV ratio cap through altering lending conditions and subsequent financial stability outcomes, which it targets. Taken all together, it is thus taken by assumption further on that the inflation measure is exogenous. Together with a demonstrated relevance in further sections, it is a valid instrument in the context of this analysis.

2.1.2.3 Empirical Specification

This section introduces the concepts which are studied in each methodological stage. Please refer to the next section Data 2.2 to learn about details on measures and data behind the variables.
Equation 2.3 depicts the first stage. Please note that all variables are implicitly assumed to be of c, referring to country, and *t*, referring to period, specification. One lag denotes $t-1$, and two lags denote $t-2$ period.

The main specification is on a quarterly basis. That is, the change in the LTV limit level is modelled to be influenced by built-up inflation differences up until a quarter before, while it is to influence the real growth of household loans in the subsequent quarter. In the Robustness section, this mechanism is verified on a yearly basis, thereby capturing policy effects that may linger for longer.

2.2 Data

The data run from January 2003 to December 2019 (unless explicitly noted). Financial stability is the dependent variable, and it is measured by the growth rate of real household loans (by banks to households), indexed to 2015, and denoted as $g\_hhloans$. The source of household loans is the ECB Statistical Data Warehouse, whereas the euro area 2015 deflator was obtained from the Federal Reserve Economic Data database. Macroprudential policy is the endogenous independent variable. Since the target outcome variable is the growth of real household credit, a borrower-based measure LTV ratio cap appeared

First stage:

$$\begin{aligned} ltv\_lag \; &= \gamma_0 + \gamma_1 cumsum\_inflation\_inx\_dev\_lagtwo + \\ &+ \gamma_2 inflation\_rates\_lagtwo + \gamma_3 interest\_rate\_lagtwo + \\ &+ \gamma_4 interest\_rate\_lag + \gamma_5 g\_gdp\_lag + \\ &+ \gamma_6 mpp\_sum\_lag + v_{ct} \end{aligned} \tag{2.3}$$

In the first stage, built-up heterogeneity in $t-2$ impacts macroprudential policy in the following period $t-1$. Specifically, inflation measures predict the levels of LTV ratio caps, measured by $cumsum\_inflation\_inx\_dev\_lagtwo$ and $inflation\_rates\_lagtwo$, and ltv_lag, respectively, along with controlling for monetary policy, economic growth and other macroprudential policy in $t-1$, measured by $interest\_rate\_lag$, g_gdp_lag and mpp_sum_lag, respectively.

most fitting as it regulates mortgage loan demand, a category of which is the most significant in household credit. Therefore, macroprudential policy is captured by the average loan-to-value (LTV) ratio limits in 19 euro area countries, obtained from the IMF iMaPP macroprudential database (Alam et al., 2019), and it is lagged since policy effect materialises only in subsequent periods. It is denoted as ltv_lag.
Furthermore, heterogeneity in the euro area has to, importantly, be of systemic nature. Therefore, it is measured by the cumulative sum of percentage point deviation of inflation index of countries from the euro area level in each period with base year of 2003, the start of the times series, thus measuring build-up heterogeneity. Equation 2.5 formalises this process. Countries with systemically higher inflation rates (and therefore indices) than the euro area average in the period from 2003 to 2019 will score high

Second stage:

$$\begin{aligned} g\_hhloans = \beta_0 + \beta_1 \widehat{ltv\_lag} + \\ + \beta_2 interest\_rate\_lagtwo + \beta_3 interest\_rate\_lag + \\ + + \beta_4 g\_gdp\_lag + \beta_5 mpp\_sum\_lag + u_{ct} \end{aligned} \tag{2.4}$$

In the second stage, macroprudential policy in $t-1$, to the extent that it is predicted by heterogeneity in previous periods $t-2$, influences financial stability in the following period t. Specifically, the level of LTV ratio limits, predicted beforehand by inflation measures and thus denoted as $\widehat{ltv\_lag}$, influence the growth rate of real household loans, measured by $g\_hhloans$, while controlling for monetary policy, economic growth, and other macroprudential policy in $t-1$.

absolute values of this measure, while countries with systemically relatively lower inflation rates will score low. Inflation index data is obtained from the ECB Statistical Data Warehouse for the 2015 index, and calculated for the 2003 index. Then, euro area values are subtracted from country values to obtain the deviation. Finally, cumulative sum is performed until 2019. Then, the first exogenous instrument is denoted $cumsum\_inflation\_inx\_dev\_lagtwo$.

Except for the GDP, all data is of monthly basis. To convert them to quarterly and yearly basis, the following approach was undertaken: First, for household loan stocks, the last value most accurately summarises the loans issued until that relevant time period, and thus to calculate the growth rate from one period to another, the last value within the respective period was compared to the previous one. For the level of LTV ratio limit, the minimum of the respective period

$$cumsum\_inflation\_inx\_dev = \sum_{t=2003}^{2019} (inflation\_index_{c,t} - inflation\_index_{EA,t}) \tag{2.5}$$

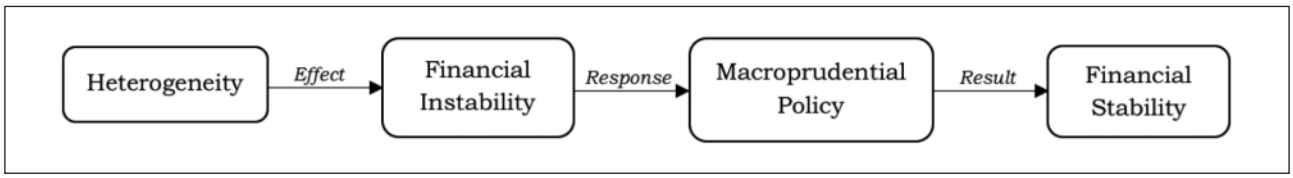
was considered since the aim is to capture any potential tightening during the specified time range. Further, the average of inflation rates and interest rates was taken according to standardised approach. Similarly, after the inflation deviation had been calculated as the difference between country and euro area inflation index for each month, the average of inflation index deviation was taken for quarterly and yearly basis, after which it was cumulatively summed up on respective basis. Further, the sum of macroprudential policy sum measure was taken, so as to capture the total net tightening or easing effects during relevant periods. Finally, to calculate the yearly growth rate of real GDP, last real stock value in a year was compared to the one in the previous.

The purpose of a second exogenous instrument is to capture the real interest rate mechanism, and it is simply inflation rates of euro area countries in each period, obtained from the ECB Statistical Data Warehouse and denoted as $inflation\_rates\_lagtwo$. That way, together with monetary policy in the same periods, appearing as a control and denoted $interest\_rate\_lagtwo$, obtained from the Deutsche Bundesbank statistics, the underlying real interest rates are controlled for in the specification. Therefore, a combination of two inflation measures acts as a predictor of LTV policy. Once again, the above specification allows for the following mechanism: Heterogeneity in $t-2$, to the extent that it is measured by inflation deviation build-up, translates into heterogeneous measures of macroprudential policy (in the field of household debt), i.e. different levels of LTV ratio caps, in the following period $t-1$, which in turn finally impacts the growth rate of real household loans in t.
Last follow the controls. Along with aforementioned monetary policy in $t-2$ controlling for the real interest rate manifestation, monetary policy in $t-1$, denoted $interest\_rate\_lag$, controls for nominal interest rate effects to the growth rate of real household credit in t.
Further, g_gdp_lag is the lagged growth rate of real economic growth, indexed to 2015 and obtained from Eurostat, and last, mpp_sum_lag is a sum of 17 macroprudential measures, obtained from the IMF iMaPP macroprudential database, wherein 1 is assigned to signal tightening and −1 to signal loosening, and thus controls for other macroprudential policies in $t-1$ in a crude way.

3 Theoretical Part: Literature Review

This section introduces the concepts of heterogeneity, financial stability and macroprudential policy first separately and then connecting them, while substantiating their interconnectedness with historical cases. It continues with outlaying the distinctions between macroprudential and monetary policy, and highlights the respective different set of tools for achieving financial vis-à-vis economic stability, while acknowledging that there may be some conflict in their interplay with respect to the targets. Figure 3.1 illustrates the interlinking of the three elements in a stylised way.
First, the channels of how heterogeneity can drive financial instability are examined. Then, in response to or as prevention to increased financial instability, prudent policies, with

Figure 3.1: Stylised depiction of the link between financial stability, macroprudential policy and heterogeneity



Source: Own diagram.

the focus on macroprudential policies, is analysed. Finally, the findings are merged in order to illuminate the mechanisms of the interplay between heterogeneity, financial stability and macroprudential policy.

3.1 The Link between Heterogeneity and Financial Stability

Heterogeneity can be manifested across several economic indicators, for example economic growth, inflation, borrowing costs, public sector finances, trading balances and similar. However, according to the optimal currency area theory, divergence is an undesirable feature of monetary unions because it entails asymmetric propagation of a shock (Mundell, 1961). By addressing this situation with unified policies, which may be unavoidable given the financial trilemma dictating trade-offs, and therefore economic establishments of such unions[2], the existing heterogeneity can even further be dampened since policies lead to different effects pertaining to different national economic conditions. Unified policies assume homogeneous conditions. To arrive there, several mechanisms can be established. First, a functioning fiscal union increases the resilience of monetary unions, since it facilitates the remaining economic and political discrepancies by fiscal policy absorbing country-level shocks (Berger, Dell'Ariccia, & Obstfeld, 2019; Cooper & Kempf, 2004). Furthermore, a banking union harmonises the supervision and resolution of banks across the union by applying common rules and standards and by decreasing the dependence and thus financial health between banks and sovereign countries, in which they are located (ECB, 2022). Last, to complement the banking union, capital markets union integrates the fragmented capital markets across the union, thus creating a single market for capital, that way decreasing the dependence of corporates to national banks and thus to sovereigns (Lannoo & Thomadakis, 2019).

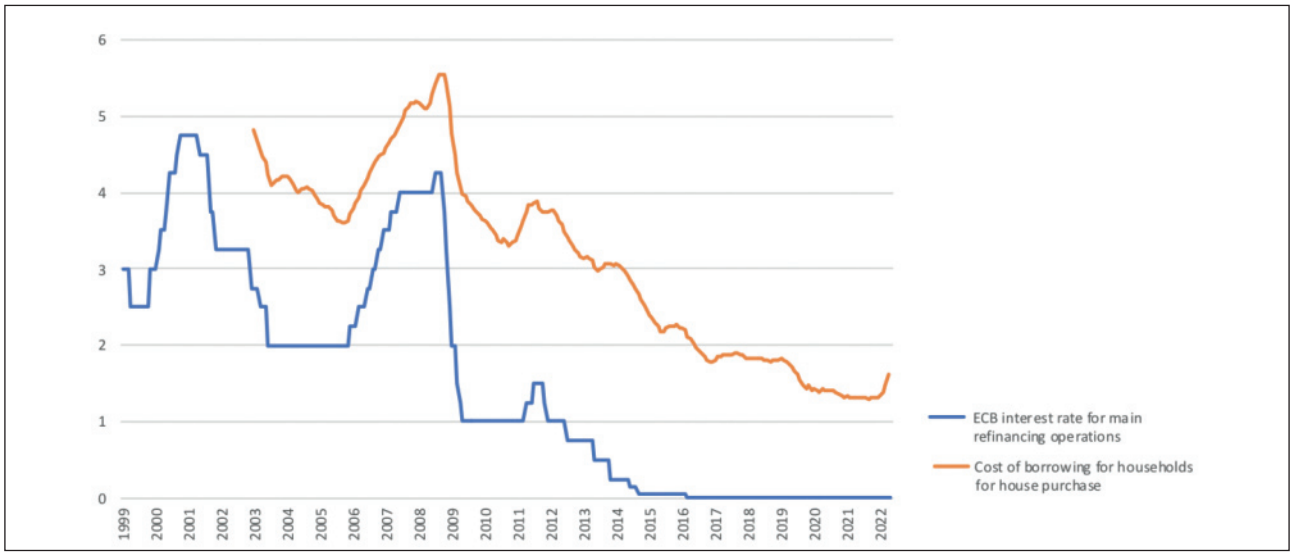
While the Economic and Monetary Union, of which the euro area is the last stage, relies on sovereigns to implement fiscal policy, a banking union was initiated in 2012 as a response to the 2008 global financial crisis and the subsequent sovereign debt crisis, which revealed and dampened the underlying heterogeneity in the euro area (EC, 2014). The connection between heterogeneity and financial stability became apparent as in several countries, banking system bailouts led to the transformation of private debt to sovereign debt, with the former being a consequence of the housing bubble. Conversely, fragility in sovereign debt resulted in the deterioration of the balance sheet positions of banks, notably because of high domestic sovereign exposures of the banks, resulting in the so-called "bank-sovereign vicious cycle" (EC, 2014). This reliance is to be limited further with the establishment of the capital markets union, which was launched in 2015 but still not functioning, with the European Commission adopting the CMU action plan in 2020 and delivering on several key commitments in 2021 (EC, 2022).

Before going further, let us note the following: the period from 2014 to 2022 saw unconventional expansionary monetary policy[3], executed in response to the 2008

[2] Financial trilemma stipulates that out of three economically favourable conditions, monetary independence, fixed exchange rate and free movement of capital, only two can be pursued simultaneously. See Aizenman, Chinn, and Ito (2010) for further reading.

[3] Asset purchase programmes (APP) responded to the sovereign debt crisis, while pandemic emergency purchase programme (PEPP) responded to the COVID-19 pandemic.

Figure 3.2: Bank lending rates for households for house purchase and ECB interest rate, in %



Source: ECB, own calculations.

financial crisis and the subsequent sovereign debt crisis, which revealed and amplified the underlying heterogeneity which existed in the area prior (see charts below) (Praet, 2012). Therefore, monetary policy can be executed heterogeneously and, in that way, address the underlying imbalances (Coudert et al., 2020; Praet, 2012). However, the conventional policy rate is the nominal interest rate and, in the context of our analysis it is worth noting that bank lending rates for households for house purchases ultimately determine lending conditions for households, which strongly correlate with the main refinancing operations rate[4] (see Figure 3.2).

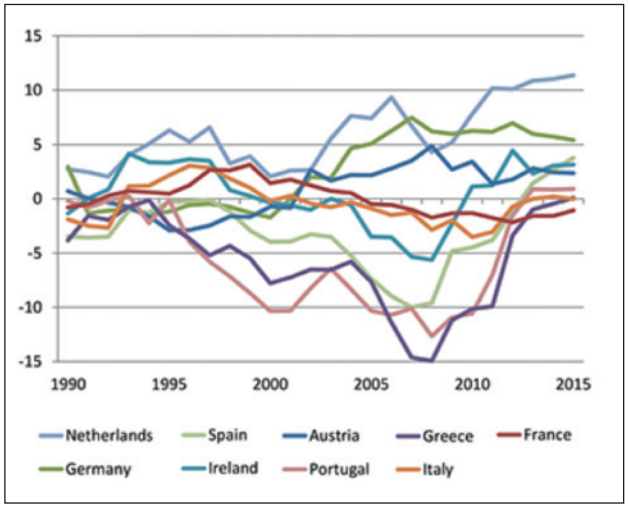
Let us now inspect some historical charts of heterogeneity in the euro area. First, Figure 3.3 depicts current account evolutions of selected euro area countries, which reflect their contrasting competitiveness. Figure 3.4, showing government debt levels, follows next.

In association to Figure 3.4, Figure 3.5 illustrates long term government bond yields of euro area countries, reflecting massive heterogeneity which followed the 2008 global financial crisis and spiralled in the subsequent sovereign debt crisis. These yields reveal country risk premiums associated with specific euro area countries, which can be discerned due to currency risk absence, since all debt is denominated in euro. It was only after the ECB[5] introduced the first rounds of quantitative easing that the rates converged again.

[4] The correlation between these two variables, for the period depicted from January 2003 to April 2022, is 91.4%.

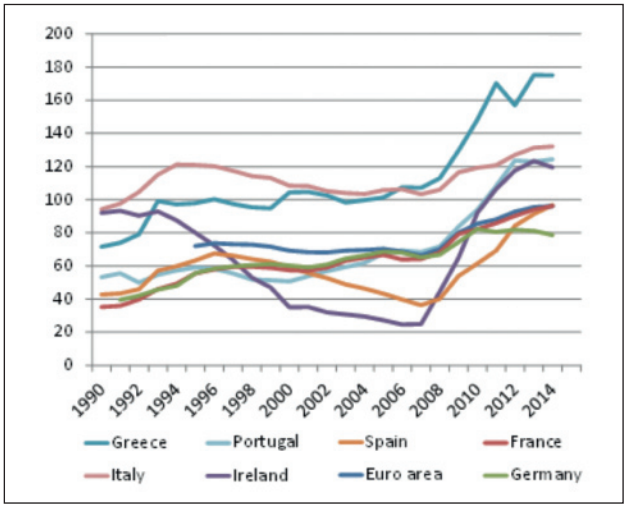
[5] On 26 July 2012, Mario Draghi, the functioning president of the ECB at the time, announced support for the euro and the initiation of unprecedented unconventional monetary policy at the Global Investment Conference in London by famously noting "Within our mandate, the ECB is ready to do whatever it takes to preserve the euro. And believe me, it will be enough". See ECB (2012) for full speech.

Figure 3.3: Current account, in % of GDP



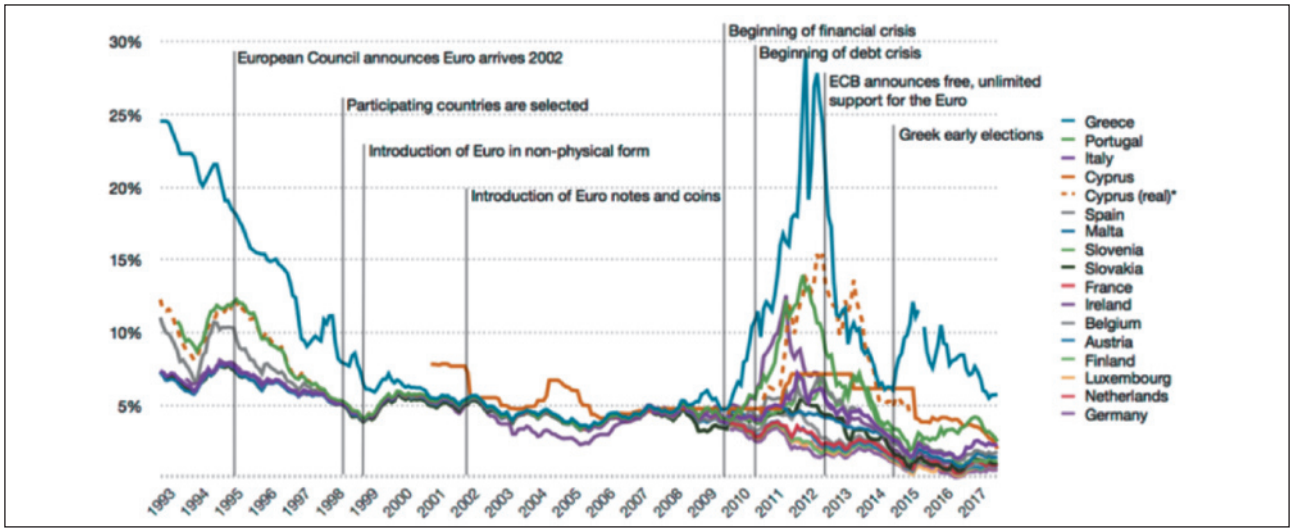
Source: Robert Schuman Foundation.

Figure 3.4: Government debt, in % of GDP



Source: Robert Schuman Foundation.

Figure 3.5: Long term government bond yields, in %

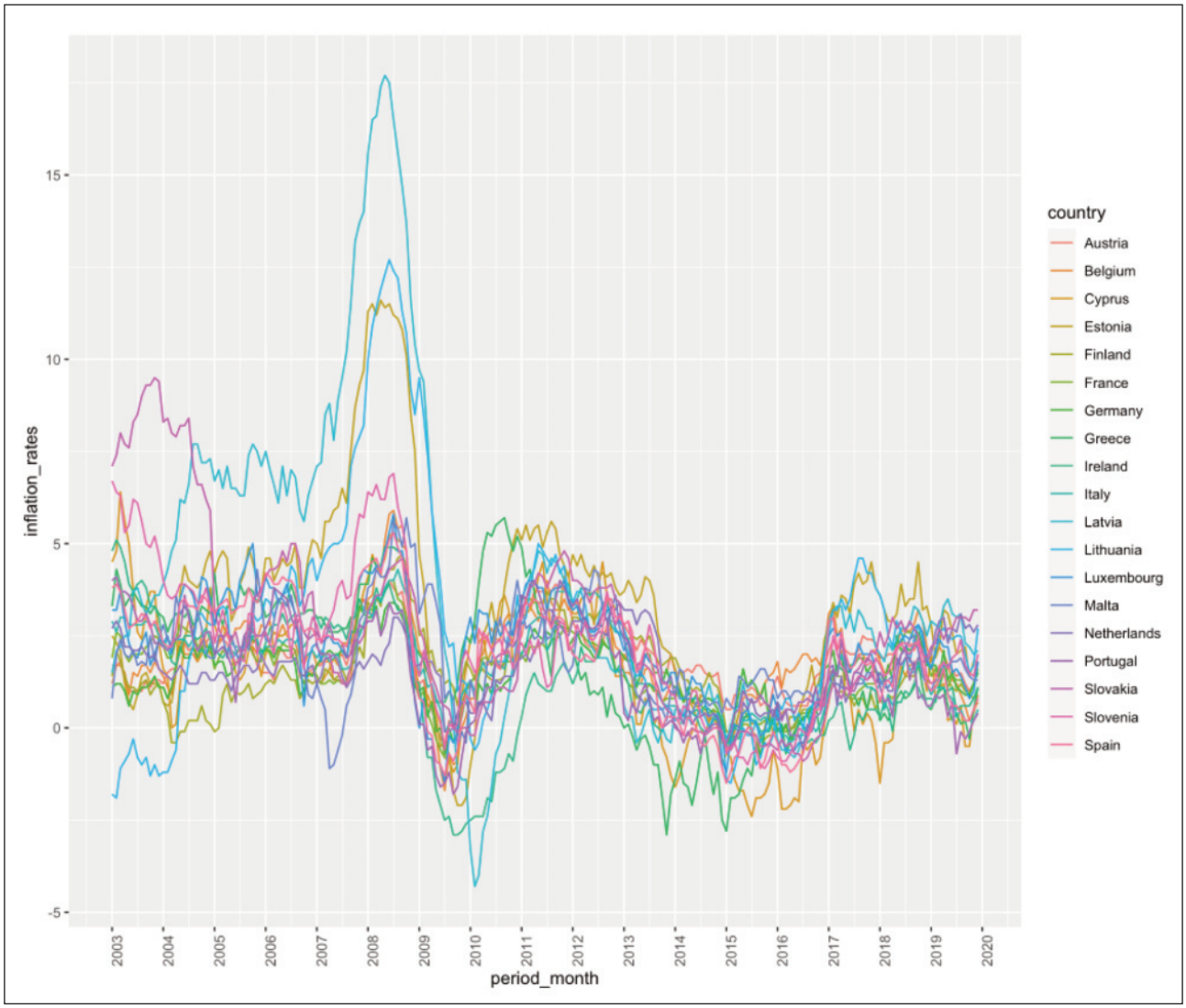


Source: ECB.
Notes: Obtained from Wikimedia Commons.

Next, Figure 3.6 depicts inflation rates of euro area countries, which in similar fashion exhibit a trend towards convergence only after 2008. Figure 3.7 takes long term interest rates and inflation, Figures 3.5 and 4.4, respectively, together to produce long term real interest rates. Countries are grouped for easier detection of contrasting trends: Until the 2008 financial crisis, bottom-left country group in Figure 3.7, with bottom-right country group to an extent, exhibits on average lower real interest rates than the upper-left country group, and some of the countries in upper-right, speaking to different lending and borrowing incentives in these country groups during this time. After 2016, real interest rates of the upper-left country-group propel into the negative.

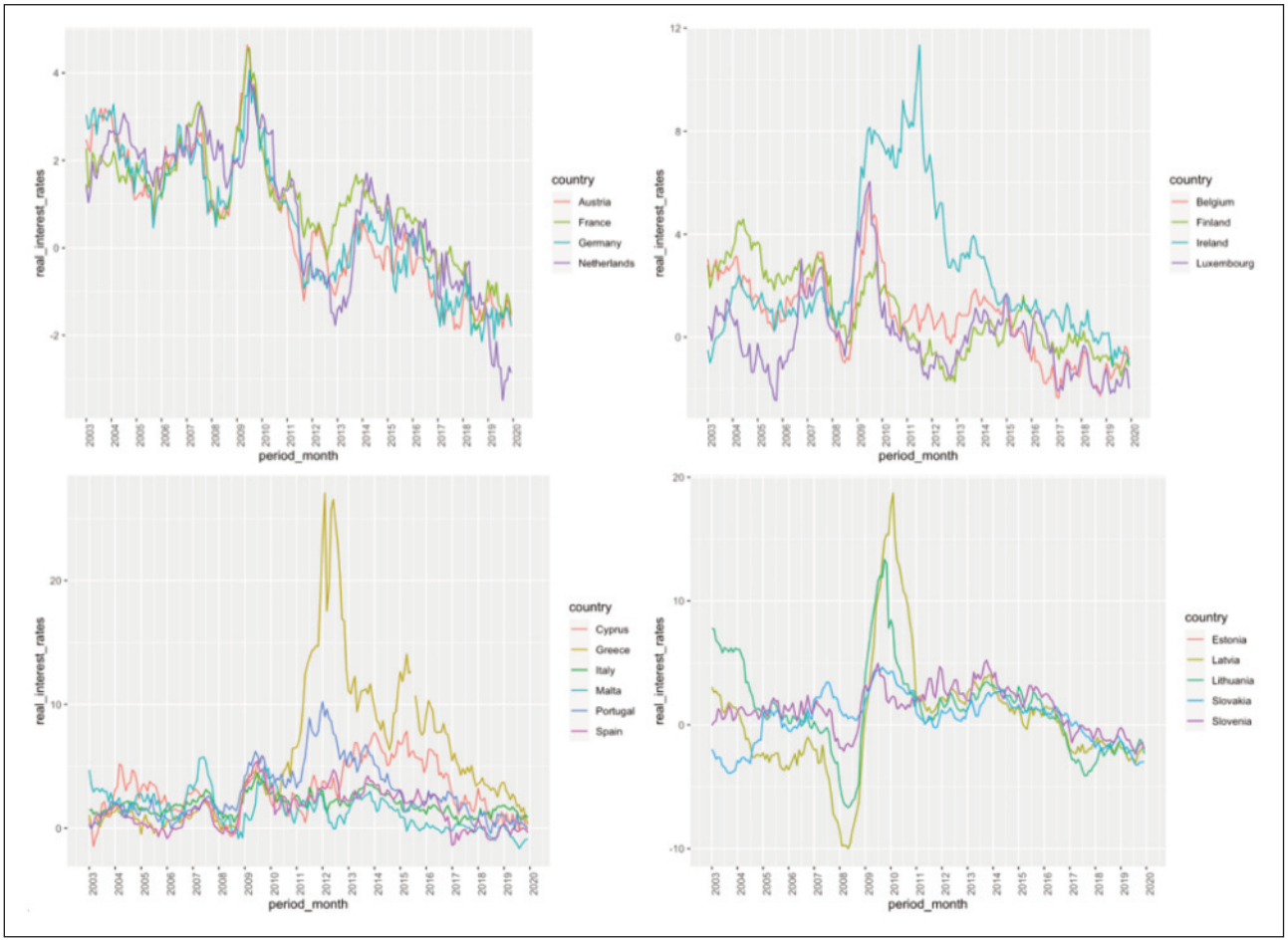
Let us turn to the other side of the equation now, and revisit the discussed heterogeneity later in connection to the following. Financial stability stands for a sound and resilient financial system, both of individual financial institutions as well as the system as a whole (Cabral et al., 2019). While these concepts are related, micro stability alone, regulated by microprudential policy, does not lead to macro stability, regulated by macroprudential policy, when presented with systemic risks affecting all financial institutions, regardless of their individual soundness levels (Danielsson, Fouché, & Macrae, 2015). To capture systemic financial stability, indicators that affect the system as a whole must be considered. Therefore, financial stability is often proxied by credit growth, household credit and house prices, since credit risk and related non-performing loans often accompany credit growth that is unsustainable, which often results in financial crises (Akinci & Olmstead-Rumsey, 2018; Alam et al., 2019; Eller, Martin, Schuberth, & Vashold, 2020). Moreover, household credit in particular tends to present the greatest vulnerability to financial stability both since the

Figure 3.6: Inflation rates, in %



Source: ECB, own calculations.
Notes: Depicted is monthly frequency.

Figure 3.7: Long term real interest rates, in %



Source: ECB, own calculations.
Notes: Depicted is monthly frequency.

respective loans are of longer maturities and therefore riskier, and because of its direct capacity to spillover from financial to the real sector (Jin, Lenain, & O'Brien, 2014). Furthermore, it should be emphasised that economic stability is not synonymous and therefore does not guarantee financial stability, as was widely thought prior to the global financial crisis in 2008 (Schäfer, 2020). As its aftermath demonstrated, if crises originate in the financial sector, which is crucial for financing the real sector, spillovers to real growth and economic productivity may ensue. Hence, including financial sector in economic models is crucial so as to endogenously identify financial risks (Schäfer, 2020). Then, against the backdrop of above charts and connecting then the two concepts of heterogeneity and financial stability, it can be discerned that heterogeneity, which presented a systemic financial stability risk for the euro area, dated back to the early years of the euro introduction. Because countries with traditionally higher inflation were no longer able to compensate for the loss of competitiveness by currency devaluations, the competitiveness of countries with traditionally lower inflation, such as Germany (see Figure 4.4), increased, which in turn fuelled current account divergence (Figure 3.3). With simultaneous unified monetary policy and different inflation rates, real interest rates were significantly lower in certain areas of the union (bottom-left country group in Figure 3.7), and hence, different economic incentives prevailed. Therefore, in Spain, for instance, on top of high inflation and relatively lower competitiveness, the situation was exacerbated by over-consumption and under-investment associated with lower real interest rates, further feeding the property bubble which burst in 2008 (Esposito, 2014; Toussaint, 2013). In that way, heterogeneity in the union fuelled heterogeneity, which spilled over from national to supranational and in that way, presented a systemic risk for the euro area as a whole[6].
Finally, it should be acknowledged that any financial structure is a response to some financial friction, and in turn,

[6] Another instance of these spillover effects is the sovereign debt crisis, a contagion which started with Greece. Provopoulos (2013) and Piekutowska and Ku elewska (2015) argue that Greece did not comply with convergence criteria when it entered the euro area, playing a factor in what later evoked the political turmoil and largely undermined the confidence in the euro system and the euro itself. For further reading, see Fernández-Rodríguez, Gómez-Puig, and Sosvilla-Rivero (2015) and Antonakakis and Vergos (2013).

Figure 3.8: Inflation rates by country groups, in %

Source: ECB, own calculations.
Notes: Depicted is monthly frequency.

financial instability as related to the former should be considered (Schäfer, 2020). Importantly, systemic risks associated with banks are relevant in bank-based economic systems such as the euro area (Pagano et al., 2014). For instance, banks emerged as a response to information asymmetry and transaction costs between lenders and borrowers, thereby providing real economic sector with liquidity and acting as delegated monitors on behalf of the lenders (Diamond, 1984; Diamond & Dybvig, 1983). However, while taking on the function of transforming liquid liabilities to illiquid assets, in times of crises, banks can be faced with unanticipated liquidity demands which can result in bank runs and ultimately lead to large losses and negative shocks to productivity of the real sector (Acharya, Engle, & Pierret, 2014). Furthermore, they expose themselves to interest rate risk while performing the function of financing long-term assets by short-term liabilities, as well as subject themselves to credit risk when transforming riskless deposits to risky loans. Then, these are all functions that address financial frictions present in the economy, however, they can manifest in systemic financial instability which can spillover to economic instability. Therefore, to mitigate these risks by forcing banks and other financial agents to act prudently in good times so as to emerge resilient in bad times, a fairly new discipline of macroprudential policy has been institutionalised (Cabral et al., 2019).

3.2 The Link between Macroprudential Policy and Financial Stability

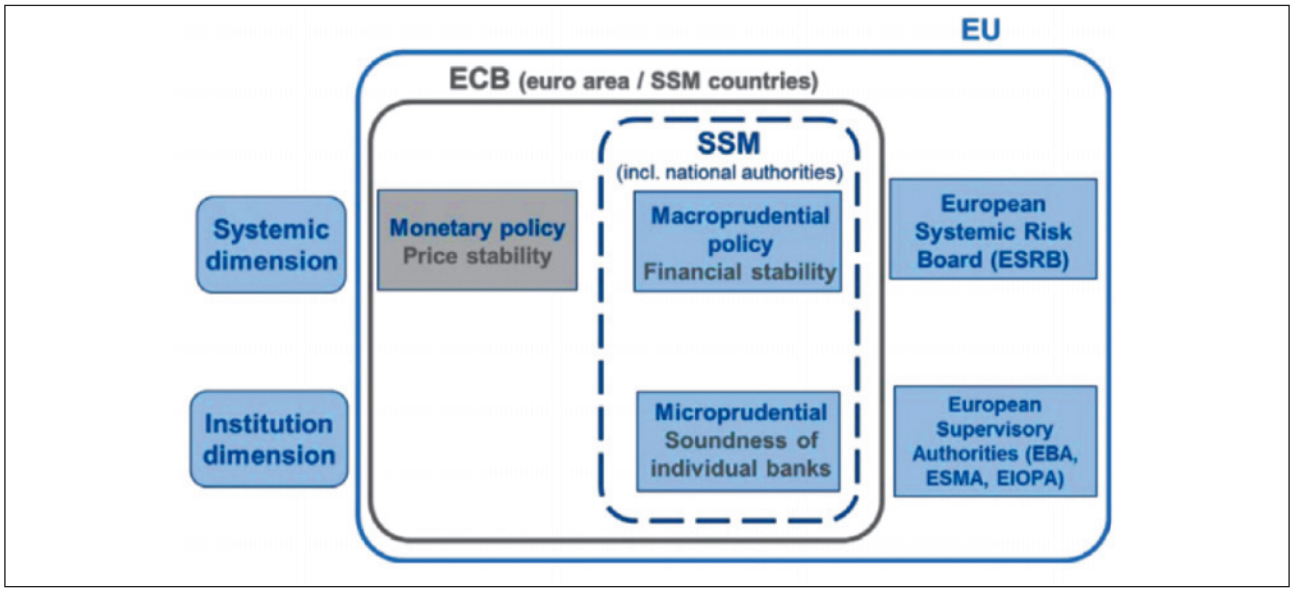
This section presents macroprudential policy as a new policy area, connects it to financial stability and contrasts it to monetary policy.

3.2.1 Macroprudential Policy as a New Policy Area

After the 2008 recession had established financial stability as a separate objective to economic stability, it became clear that there is a need to identify a toolset with which it will be pursued and draw the associated institutional architecture to avoid the dual role of monetary policy[7] (Schäfer, 2020). Therefore, after the global financial crisis with the focus to reregulate (BIS, 2016; Danielsson et al., 2015), the European Systemic Risk Board (ESRB) emerged in

[7] Indeed, already in 1952, Tinbergen highlighted that there can only be a one-to-one correspondence between instruments and targets.

Figure 3.9: Monetary and prudential policies at the ECB



Source: Cabral et al. (2019).
Notes: The ECB's powers are exercised in coordination with other EU institutions, notably the ESRB for macroprudential issues, and the European Supervisory Authorities (European Banking Authority, European Insurance and Occupational Pensions Authority and the European Securities and Markets Authority) for microprudential issues.

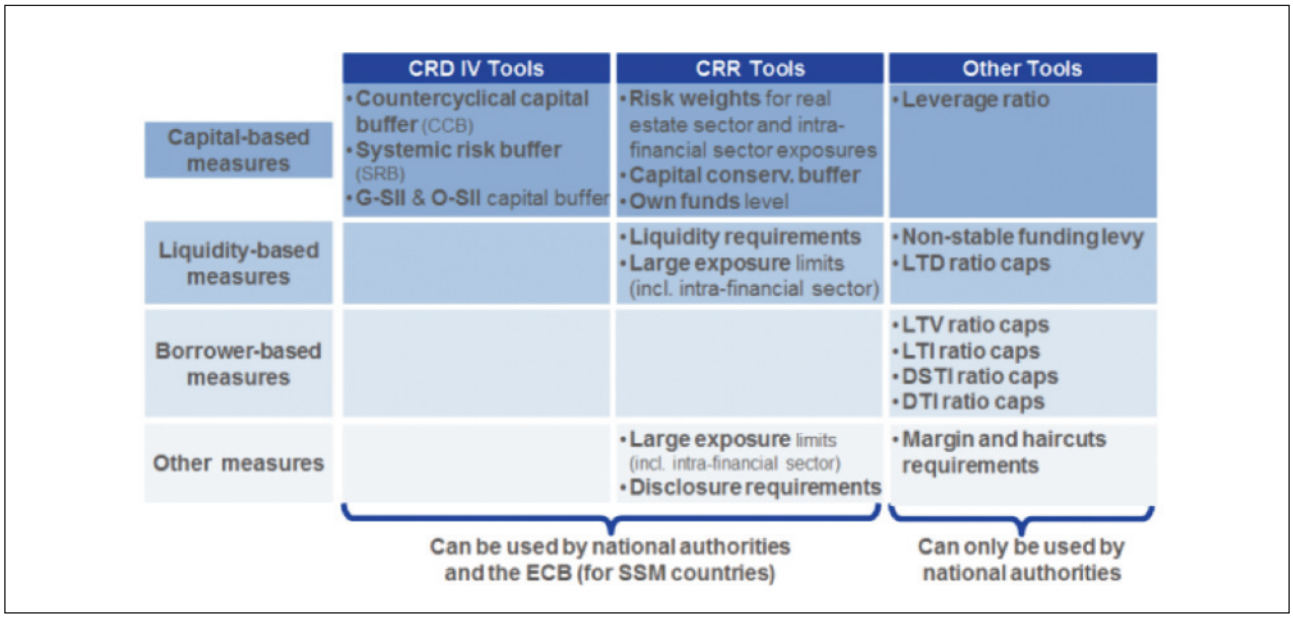
2010 as a key watchdog of systemic risks, and macroprudential policy was identified to better fit the role of the instrument because of its more direct effects to financial stability, whereas monetary policy has wider economic effects (Schäfer, 2020). Figure 3.9 summarises the interaction between European institutions which implement monetary and prudential polices in the EU.

Prior to the global financial crisis of 2008, most prudential policy was microprudential, regulating individual institutions (Cabral et al., 2019; Danielsson et al., 2015). The global financial crisis unveiled the systemic component of financial distress, and financial regulation needed to be adjusted accordingly. A set of new policies was created and calibrated to increase the resilience of the financial system, address systemic risk, and moderate the financial cycle. Financial regulation mainly focuses on strengthening bank capital, limiting leverage and improving liquidity positions, and policy measures can be broadly categorised as capital-based, liquidity-based and borrower-based (Figure 3.10), and either of structural (static) or a time-varying dimension (Cabral et al., 2019). To highlight the difference to microprudential policy: While measures outlined in Figure 3.10 target the health of individual institutions, they are mainly designed to avoid the accumulation of excessive risk over time so as to smooth the financial cycle (Dietsch & Welter-Nicol, 2014).

The first group of capital-based measures is aimed at strengthening the resilience of financial institutions so that they have sufficient loss-absorbing capacity. They are divided in (1) hard requirements, for instance minimum own funds level, and (2) buffers, such as the countercyclical capital buffer and the systemic risk buffer, which address cyclical and structural risks, respectively. Next, liquidity-based measures target risks from maturity mismatches in institutions' balance sheets, for instance the liquidity coverage ratio. Finally, borrower-based measures target borrowers directly, for instance by enforcing a cap on a down payment for obtaining a mortgage (loan-to-value ratio cap), or one on debt service, depending on borrower's income (debt service-to-income ratio cap). Additionally, several reforms target risks stemming from non-bank financial institutions, for instance the 2022 money market fund reform (ECB, 2021).

Connecting the tool to the target now, the concept of financial stability became less elusive empirically after the 2008 financial crisis, as De Graeve, Kick, and Koetter (2008) claim that it is in late 2000s, and several proxies had been considered since. The most common argument is one that Jin et al. (2014), for instance, outlines, namely that the greatest systemic vulnerability is household debt, which represents the most significant bank loan category. What is more, price bubbles, especially in the real estate, have played a central role in the global financial crisis (for instance, in the 2008 global financial crisis or the 90s Japanese crisis). Accordingly, most commonly used proxies are household credit, bank credit and house prices. Several studies find significant effects of macroprudential policy on financial stability (Acharya et al., 2014; Akinci & Olmstead-Rumsey, 2018; Alam et al., 2019; Claessens, Mihet,

Figure 3.10: Classification of macroprudential instruments for the banking sector



Source: Cabral et al. (2019).
Notes: CRD IV stands for Capital Requirements Directive, current consolidated version of 2021, while CRR stands for Capital Requirements Regulation. Together, they provide a legal basis for prudential rules, intended to implement the Basel III framework, an international regulatory framework for banks. G-SII stands for global systemically important institution, while O-SII stands for other systemically important institution. These are buffers, intended to address the "too-big-to-fail" problems. LTD stands for loan-to-deposit, LTV stands for loan-to-value, LTI stands for loan-to-income, DSTI stands for debt service-to-income and DTI stands for debt-to-income.

& Ghosh, 2014; Eller et al., 2020; Jin et al., 2014). Specifically, Akinci and Olmstead-Rumsey (2018), for instance, find that that macroprudential policy tightening lowered bank credit growth, lowered housing credit growth, and lowered house price appreciation. Eller et al. (2020), using intensity-adjusted macroprudential policy index, confirm the findings of Akinci and Olmstead-Rumsey (2018), additionally finding that borrower-based macroprudential policy, like LTV and DTI ratio limits, tended to have a larger and most robust impact on credit growth.

3.2.2 Macroprudential Policy vs. Monetary Policy

Perhaps the best way to illustrate the characteristics of macroprudential policy is to contrast it to monetary policy. Monetary policy which is not adequately responsive to economic conditions is linked to crises. Japan, for instance, suffered a so-called 'lost decade' after monetary policy, which was too expansionary relative to economic conditions in the late 80s, contributed to the emergence of the housing price bubble (Yoshino & Taghizadeh-Hesary, 2015). If inapt policy is further coupled with different perceived country risk levels, which is the case for the euro area (see long term government bond yields in Figure 3.5), it leads to a divergence of borrowing costs for countries who share the same currency. As the sovereign debt crisis demonstrated, this in addition presents a systemic risk because of spillover effects to the rest of the union. To stress again, heterogeneity then makes the union more prone to financial instability.

The above emphasises two dimensions in which macroprudential policy is distinct from monetary policy. First, if financial instability can arise from the simultaneous elements of country heterogeneity and a unified monetary policy, macroprudential policy can, in contrast, be applied relative to specific national economic conditions and financial cycles. In that way, macroprudential policy is additionally responding to and addressing the divergence, instead of dampening it. Second, while monetary policy is reactive in its nature and should be conducted in that fashion only, as the case of Japan demonstrates, macroprudential policy is intrinsically preventive and countercyclical (Buch, 2021; Cabral et al., 2019). That is because, for instance, raising required capital may be harsh and even too late when a crisis already arrives, and so it is necessary to tighten regulatory conditions in "good times". In that way, macroprudential tools increase system's resilience a priori (Cabral et al., 2019).

However, the interplay between these two objectives and their respective targets is not always clear-cut. While monetary policy is not used to target financial stability, it has significant implications for financial outcomes (Schäfer, 2020). For instance, monetary policy contributed to the emergence of the price bubble both in Spain in the early years of the euro introduction and in Japan in the late 80s

via its implications for credit growth, and monetary policymakers determining liquidity conditions. Moreover, according to Borio, Disyatat, Juselius, and Rungcharoenkitkul (2017), unconventional expansionary monetary policy contributed to the low interest rate environment which prevailed in the last decade, bearing significant implications for channels that determine financial stability outcomes, for instance the risk-taking channel, which influences the conditions under which banks issue loans and affects how other financial institutions operate. Specifically, the low interest rate conditions, created by the expansionary unconventional monetary policy, compress banks' margins, the main source of bank profitability, thereby increasing the incentives for risk-taking, which can manifest in lower lending credit conditions, an example of which is issuing riskier long-term loans (Neuenkirch & Nöckel, 2017). These could be housing loans, a quintessential type of long-term loans, which are considered most risky (Jin et al., 2014). Moreover, business models from institutions such as pension funds rely on the term spread, which again was compressed due to the objective of unconventional expansionary monetary policy to reduce long term interest rates (see Figure 3.7) and caused the subsequent search-for yield behaviour (ESRB, 2020).

The fact that macroprudential measures can have adverse effects in times of crises illustrates their preemptive nature. If restrictions on lending standards as a way to counteract banks' risk-taking behaviour are to manifest in lower lending margins during the time of low interest rates as a result of monetary policy, banks will take on more risk, which could increase, rather than decrease, instability in the financial system (Neuenkirch & Nöckel, 2017). In similar fashion, risk weights to limit investment in riskier assets may cause overexposure in other assets, which can perversely increase vulnerability due to overconcentration (Acharya et al., 2014).

Then, the success of policy-making can be evaluated contingent on which perspective is taken: That of monetary policymakers or financial stability regulators. Namely, as much as some degree of risk-taking can be a desired policy outcome for stimulating a depressed economy out of a recession which was the objective of unconventional monetary policy in the previous decade, it may, in fact, pose a threat to financial stability, thereby conflicting monetary policy and macroprudential policy objectives.

Following then the Diagram 3.1, this chapter demonstrated the link between financial stability, macroprudential policy and heterogeneity theoretically. The following chapter presents evidence that supports it empirically.

To be continued

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