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MONETARY AND MACROPRUDENTIAL POLICY COMPLEMENTARITIES: EVIDENCE FROM EUROPEAN CREDIT REGISTERS

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JEL Classification: E51, E52, E58, G21, G28

Keywords: E51, E52, E58, G21, G28

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Monetary and Macroprudential Policy Complementarities: evidence from European credit registers*

Carlo Altavilla **Luc Laeven** **José-Luis Peydró**

Abstract

We document that there are strong complementarities between monetary policy and macroprudential policy in shaping the evolution of bank credit. We use a unique loan-level dataset comprising multiple credit registers from several European countries and different types of loans, including corporate loans, mortgages and consumer credit. We merge this rich information with borrower and bank-level characteristics and with indicators summarising macroprudential and monetary policy actions. We find that monetary policy easing increases both bank lending and lending to riskier borrowers, especially when there is a more accommodative macroprudential environment. These effects are stronger for less capitalised banks. Results apply to both household and firm lending, but they are stronger for consumer and corporate loans than for mortgages. Finally, for firms, the overall increase in bank lending induced by an accommodative policy mix is stronger for more (ex ante) productive firms than firms with high ex ante credit risk, except for banks with low capital.

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Keywords: monetary policy, macroprudential policy, corporate and household credit, euro area.

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1 Introduction

The global financial crisis of 2007-08 resulted in the development of a macroprudential approach to bank regulation, with special emphasis on the financial stability risks arising from excessive credit growth (e.g. Freixas, Laeven and Peydró (2015)). The crisis also prompted a rethink of the role of financial stability in monetary policy, including whether changes in the monetary policy stance affect bank risk-taking that macroprudential policy may want to offset (e.g. Borio and Zhu (2008); Adrian and Shin (2010); Allen and Rogoff (2011); Acharya and Naqvi (2012); Stein (2012); Brunnermeier and Sannikov (2014)).

These developments have prompted theoretical research on the optimal combination of monetary and macroprudential policies in managing the business cycle and safeguarding financial stability (e.g. Benigno et al. (2012); Angelini et al. (2014); Farhi and Werning (2016); Brunnermeier and Sannikov (2016); Collard et al. (2017); Gelain and Ilbas (2017); Martinez-Miera and Repullo (2019); Van der Ghote (2019)). A key insight from this research is that macroprudential policy, by targeting financial stability, facilitates an effective transmission of monetary policy measures. An open empirical question is how macroprudential policy influences the transmission of monetary policy via credit. The amount of credit intermediated by banks plays a crucial role for monetary policy transmission (e.g. Bernanke and Gertler (1995); Diamond and Rajan (2006); Gertler and Karadi (2010)) but is also a key determinant behind the potential build-up of financial instability. For example, there is evidence that credit growth is a strong predictor of systemic financial crises (Schularick and Taylor (2012)), especially lending to households (Mian, Sufi and Verner (2017)).

In this paper, we contribute to this literature by studying whether the macroprudential environment influences the strength of the bank lending and risk-taking channels of monetary policy. We do so by using administrative loan-level data on both households and firms – corporate loans, consumer credit and mortgages – from a unique dataset comprising multiple credit registers from several European countries over the period 2012 to 2017. We merge this information with indicators of macroprudential and monetary policy action, information on banks' balance sheet characteristics and information on borrower credit risk and the productivity of firms.

We identify monetary policy shocks using high frequency surprises around central bank decisions (following Altavilla et al. (2019)).[1] The monetary policy shocks encompass both conventional and unconventional monetary policy, including large-scale asset purchases, negative policy rates and long-term refinancing operations. There is significant variation in monetary policy surprises in our sample (see Figure 5). We focus on euro area countries in order to have the same monetary policy shocks across countries, although there might be a heterogeneous transmission of the single monetary policy as business cycles might differ across countries (e.g. Taylor (1992)). We measure macroprudential policy using the aggregate index of macroprudential policy action from the European Central Bank's (ECB) Macroprudential Database. This database considers a broad range of macroprudential policy measures, ranging from countercyclical capital buffers to loan-to-value ratios. As macroprudential policy reacts to the business and credit cycle, we use the aggregate measure of macroprudential policy at the country-level purged by the effects of GDP growth and credit growth developments. There is significant variation in macroprudential policies in our sample (see Figure 4). Moreover, there is also significant variation in terms of credit dynamics in our period across different countries and across household and corporate loans (see Figure 1, Panels A and B).

[1] The event-study literature concerning monetary policy effects on asset prices goes back to Cook and Hahn (1988) and has flourished since Kuttner (2001) showed how to use Federal fund rate futures contracts to measure market-perceived monetary policy surprises. Gürkaynak et al. (2005) have shown how to extract market-based measures of monetary policy communication using high-frequency data and factor rotations.

Our household-bank and firm-bank loan-level dataset offers several key advantages. First, we can capture heterogeneous effects across different types of lending (e.g. mortgage loans versus consumer loans versus corporate loans) and types of borrowers (e.g. riskier borrowers versus safer borrowers, or more productive firms versus unproductive firms). Second, the structure of the data allows for the inclusion of a rich set of fixed effects to control for unobservables, e.g. country, time, borrower (household or firm) and lender (bank) fixed effects, and firm×time fixed effects. Moreover, saturating the model with high dimensional fixed effects allows us to meaningfully assess whether the estimated coefficients are stable despite substantial changes in the R-squared, and – based on tests developed by Oster (2019), following Altonji et al. (2005) – whether the results may be significantly biased by omitted variables and self-selection problems. Such robustness tests produce reassuring evidence on the validity of the results that we analyse throughout the paper.

We start with an analysis of whether and how the macroprudential regulatory environment affects the strength of the credit channel of monetary policy. The monetary policy stance can influence the amount of credit extended to firms and households, i.e. the "credit channel of monetary policy transmission" (Bernanke and Gertler (1989); Bernanke and Gertler (1995)). Similarly, the macroprudential regulatory environment can affect the availability of credit (Lorenzoni (2008); Bianchi (2011); Kashyap, Tsomocos and Vardoulakis (2014); Aikman, Nelson and Tanaka (2015); Farhi and Werning (2016); Bianchi and Mendoza (2018); Jeanne and Korinek (2019); Malherbe (2020)).

We find strong complementarities between the two policies: the increase in bank lending that follows monetary policy easing is larger if the macroprudential environment is also more accommodative. Effects are not only statistically significant but also economically strong. For loans to households, the estimated baseline marginal effect of a one standard deviation easing in both monetary and macroprudential policies on lending is 1.3%. This effect is 42% larger than the average increase in lending due to softer monetary policy alone (reduced to around 20% after the inclusion of a richer set of fixed effects). For corporate loans, the marginal effect of a one standard deviation easing in monetary and macroprudential policies on lending is 11% larger than the increase in lending from softer monetary policy alone, and this estimated effect remains nearly identical with a richer set of fixed effects. These are all relatively large effects compared with the average loan growth throughout the sample (0.63% for household loans and -0.53% for corporate loans).

We next consider the bank lending channel, which focuses on the financial frictions associated with the balance sheet strength of financial intermediaries (e.g. Bernanke and Blinder (1988 and 1992); Kashyap and Stein (2000)). Empirical studies generally show that the strength of monetary policy transmission is influenced by the balance sheet characteristics of financial intermediaries. Following monetary policy tightening, the transmission of monetary policy is found to be stronger for small (Kashyap and Stein (1995)), illiquid (Stein (1998); Kashyap and Stein (2000); Jiménez et al. (2012)), poorly capitalised banks (Peek and Rosengren (1995); Kishan and Opiela (2000); Van den Heuvel (2002); Jiménez et al. (2012)) or depending on bank deposit competition (Drechsler, Savov and Schnabl (2017)). Similarly, bank lending channels may arise from changes in the macroprudential policy stance. For instance, a relaxation of countercyclical capital buffers may increase the lending capacity of banks, prompting an increase in loan supply to firms (see, for example, Jiménez et al. (2017)), or affecting mortgage loans due to risk-weighted capital requirements (see, for example, Benetton (2018)).

Regarding the bank lending channel, we find that the complementarity between monetary and macroprudential policies is stronger for less (ex ante) capitalised banks. In other words, lower bank capital enhances the positive impact on lending of a more accommodative monetary policy stance in an environment of softer macroprudential policy. The effect is economically significant. For example, the marginal effect of a one standard deviation lower capital ratio on bank household (corporate) lending following an easing in both policies is about 1.7% (1%).[2] Therefore, the complementarity between the two policies strongly shapes the bank lending channel.

The analysis then focuses on how the macroprudential regulation influences the risk-taking channel of monetary policy. In principle, monetary policy accommodation might encourage banks to take more risks on their loan books, thereby potentially influencing the overall banking sector resilience to shocks (Rajan (2005); Dell'Ariccia et al. (2013); Brunnermeier and Sannikov (2012); Dell'Ariccia et al. (2014); Martinez-Miera and Repullo (2017)). Similarly, softer macroprudential policy may encourage banks to take more risks by lending to riskier borrowers (Kashyap, Tsomocos and Vardoulakis (2014); Aikman, Nelson and Tanaka (2015)). On the other hand, tighter macroprudential policy might be arbitraged and in practice increase risk-taking due to imperfect regulatory enforcement (e.g. Bengui and Bianchi (2018); Jiménez et al. (2017)).

In terms of the risk-taking channel of monetary policy, we find that monetary policy easing boosts lending to ex ante riskier borrowers, especially in a softer macroprudential policy environment. Moreover, these effects are stronger for banks with ex ante lower capital. We measure ex ante borrower risk based on borrowers' past credit history; in

[2] Depending on the vector of fixed effects used for model estimation, the marginal effect of a one standard deviation lower capital ratio on bank lending following a softening of both policy types is reduced to about 0.7% and 0.5% for household and corporate loans respectively.

practical terms, we label as having a high credit risk those borrowers (either firms or households) with at least an ex ante non-performing loan.[3]

We find that, for households, the marginal effect on lending of a one standard deviation easing in monetary policy and macroprudential policy is 1.8% larger for high credit risk borrowers than for low credit risk borrowers. A one standard deviation lower bank capital further enhances risk-taking by 0.8%. Interestingly, effects are stronger for consumer loans than for mortgages, which is consistent with consumer loans being substantially riskier than mortgages in Europe, as mortgages are not only more collateralised but are also protected by full recourse. For corporate loans, the increase in credit owing to a one standard deviation easing in both monetary policy and macroprudential policy on lending is 0.4% larger for high-risk firms than for low-risk firms. The additional contribution to risk-taking in corporate loans from a one standard deviation lower bank capital is large at 3.5%. In short, for the risk-taking channel of monetary policy and macroprudential policy, effects are larger for consumer and corporate loans than for mortgages.

A key, although empirically challenging question concerning the risk-taking channel of monetary policy is whether policy-induced risk-taking is excessive. Some argue that monetary policy influences not only risk-taking but also aggregate risk aversion and risk premia, and that an increase in risk-taking should not be necessarily interpreted as excessive (e.g. Brunnermeier and Sannikov (2012 and 2016); Drechsler, Savov and Schnabl (2017b)). Others argue that increases in risk-taking can become excessive when policy remains accommodative (e.g. Dell'Ariccia, Laeven and Marquez (2014)). To investigate this question, we extend our analysis of firms and empirically assess whether

[3] Results for firms are similar (non-reported) if we measure firm risk by the z-score, which is an ex ante measure of firm insolvency.

a policy-induced change in the composition of credit is directed to fewer or more ex ante productive firms. We match the firm-loan-level data to firms' balance sheet information and compute productivity using the same approach as in Gopinath et al. (2017). Based on the resulting measure, we label firms with productivity above the median (based on within-country and sector distribution) as highly productive. Moreover, we contrast this "good risk-taking" on borrowers with respect to higher ex ante productivity versus (a potentially "worse" risk-taking based on) lending to borrowers with current defaulted loans or a recent bad credit history.

We find that the combination of accommodative monetary policy and macroprudential policy not only increases overall lending but it also increases the volume of loans extended to firms with higher ex ante productivity. A one standard deviation easing in both monetary policy and macroprudential policy boosts lending to high ex ante productive firms by 3.5% (relative to low ex ante productive firms). Moreover, a one standard deviation lower bank capital further amplifies lending to productive firms by a 1.6%.

Comparing such results with those on lending to firms with high credit risk, it turns out that the overall increase in lending to productive firms dominates the higher lending for the high credit-risky companies (3.5% compared with 0.4% respectively). Moreover, the additional contribution of bank capital to the risk-taking is strong in both cases: the baseline findings would suggest, if anything, a larger "bad risk-taking" by low capitalised banks (a 3.5% relative increase for high credit risk companies versus 1.6% for highly productive firms), but the difference between the two channels is sensitive to the inclusion of fixed effects.[4]

[4] In general, results on corporate loans from models exploiting bank capital are statistically significant also when employing firm*time fixed effects, which control for time-varying unobserved firm fundamentals (proxying, for example, credit demand shocks), following Khwaja and Mian (2008). Furthermore, in terms

Taking all the results together, we find that monetary policy loosening tends to boost bank lending and risk-taking, and this is increased by a softer macroprudential policy environment. Moreover, these effects on lending and risk-taking are quantitatively stronger for weaker ex ante capitalised banks and for weaker capitalised banks lending to riskier borrowers. Interestingly, results apply to both households and firms, but there are stronger effects for consumer and corporate loans than for mortgages. Finally, for firms, the increase in bank lending induced by a more accommodative policy mix is, overall, stronger for more (ex ante) productive firms than for firms with a high ex ante credit risk, except in the case of less ex ante capitalised banks.

Contribution to the literature. Our paper relates to the literature on the credit channel of monetary policy, including the bank lending channel (Kashyap and Stein 2000; Jiménez et al. 2012; Drechsler, Savov and Schnabl 2017; Acharya et al. 2020; Gomez et al. 2020). We contribute to this literature by considering the influence of macroprudential policy. Moreover, this literature tends to provide evidence based on either more aggregate data from many countries or on loan-level data from a single country, limiting either identification or raising external validity concerns. We overcome these concerns by using loan-level data from multiple countries, with substantial variation in policy stance and in credit dynamics. Related to Chakraborty, Goldstein and MacKinlay (2020), we also find differential effects across mortgage and corporate loans. Moreover, unlike other studies drawing on credit register data, we exploit data on *both* household and firm loans and find different quantitative effects across loan types, especially consumer and corporate loans versus mortgages.

of economic significance, the relative increase in credit supply operated by banks with lower capital towards highly productive firms (in reaction to a combined monetary and macroprudential loosening) is more robust than the boost in credit supply by the same banks towards (high) credit-risky companies.

Our paper also contributes to the literature on the bank risk-taking channel of monetary policy. This literature tends to find that monetary policy easing tends to increase bank risk-taking and that this channel is more pronounced for highly levered banks (e.g. Adrian and Shin (2010); Maddaloni and Peydró (2011); Jiménez et al. (2014); Dell'Ariccia et al. (2015); Martinez-Miera and Repullo (2017)).[5] We contribute to this literature by considering how this risk-taking channel of monetary policy depends on the macroprudential policy environment. Moreover, we contribute to this literature by distinguishing between potentially "better versus worse risk-taking" and by considering whether loans are extended to more (versus less) ex ante productive firms. We also analyse the difference in lending origination to high (versus low) credit risky firms, or more generally between loans for household consumption and house purchases.

Our paper also relates to an emerging literature on the effectiveness of macroprudential policy. This literature focuses mainly on the effectiveness of different macroprudential measures to influence credit dynamics and on the limitations of macroprudential policy (see, for example, Cerutti, Claessens and Laeven (2017)). We contribute to this literature by analysing the interactions with monetary policy. In a related paper, Jiménez et al. (2017) study the impact of one specific macroprudential measure – dynamic loan loss provisioning – in one country – Spain – on the lending behaviour of banks using one specific set of loans (loan-level data for firms). Similarly, Acharya et al. (2019) show that borrower-based macroprudential measures affect the lending behaviour of banks in Ireland. Benetton (2018) shows that the pricing of mortgage loans in the United Kingdom is affected by risk-weighted capital requirements that vary across mortgage loans depending on their loan-to-value ratio. DeFusco, Johnson and Mondragon (2019) show that constraints on household leverage under the Dodd-

[5] See also Becker and Ivashina (2015) for reach for yield in other financial intermediaries.

Frank Act affect the cost and supply of US mortgages. Our paper differs from all these papers by considering the interactions with monetary policy. Moreover, our paper improves on external validity by analysing a wide range of macroprudential measures, multiple countries and both household and firm sectors.

Finally, there are a few studies on the interactions of monetary policy and macroprudential policy. The two closest papers use aggregate cross-country data (IMF (2013); Bruno et al. (2017)), and one uses bank-level data from a single country (Aiyar et al. (2016)). In our paper we use loan-level credit register data and multiple countries, and arrive at different results. Also related is Gambacorta and Murcia (2019), who perform a meta-analysis to take stock of various studies analysing macroprudential policies based on credit registry data for commercial loans from Latin American countries. Our focus, however, is different. We focus on the interaction between monetary and macroprudential policies, while their focus is solely on macroprudential policy. They do include one result on the interaction of macroprudential policy with interest rates but do not consider monetary policy shocks as we do. Other differences with respect to Gambacorta and Murcia (2019) are that, for the macroprudential and monetary policy mix, we exploit heterogeneity in borrowers and lenders and different types of loans, which generates a new set of results: (i) we analyse borrower and lender heterogeneity, as well as both household and corporate loans, and show that results crucially depend on these distinctions, with results being stronger for consumer and corporate loans and for weaker capitalised banks; (ii) we find that for firms, the increase in lending induced by a loose policy mix is stronger for (ex ante) more productive firms than for firms with high ex ante credit risk, except for banks with low capital.

The paper is structured as follows. Section 2 describes the data. Section 3 explains our empirical framework and presents the main results. Section 4 presents several extensions and robustness checks of our main analysis. Section 5 concludes.

2 Data and Descriptive Statistics

We match data from credit registries with lender and borrower information and combine this with information on macroprudential measures and monetary policy shocks to create a unique dataset for our analysis of the impact of policies on lending to households and firms.

2.1 Credit registries

Our analysis uses a unique, confidential dataset collected in the context of the preparatory phase of the AnaCredit project by the European System of Central Banks. The data are collected by the ECB from the national central banks in a harmonised manner to ensure consistency across countries. To the best of our knowledge, this is the first time that this dataset containing more than 140 million loan-level observations for households and more than 130 million loan-level observations for firms from many countries is employed in an empirical analysis. The household data are provided on an anonymous basis to make sure that individuals cannot be identified. The frequency of the data is biannual, with the sample period running from June 2012 to December 2017.[6]

Table A2.1 of Appendix 2 shows the number of total observations by country. The euro area countries included in the dataset are as follows: Belgium (BE), Germany (DE), Spain (ES), France (FR), Italy (IT), Latvia (LV), Lithuania (LT), Malta (MT), Austria (AT), Portugal (PT), Slovenia (SI) and Slovakia (SK). Together with these euro area countries, we also have information on Romania (RO) and the Czech Republic (CZ). Although the two countries belong to the European Union, they have not yet joined the

[6] Altavilla, Boucinha, Peydró and Smets (2020) use loans to firms but not for households.

Economic and Monetary Union (EMU) and therefore maintain independent monetary and supervisory authorities. We will use this different institutional setting in our robustness analysis to perform some placebo tests.

The dataset is constructed at the loan level and includes information on key bank and borrower characteristics, such as credit volume, type of borrower (household or firm), payment history and the sector of activity of the borrowers.

Figure 1 shows the evolution of the annual growth rate of total loans by country for households and non-financial firms. We see that there is substantial variation over time and across countries in the evolution of credit.

[Insert Figure 1]

In addition, we know for each loan the amount and type of loan. We use the information on payment history to identify risky borrowers, defined as borrowers who have at least one loan outstanding that is at least 90 days past due. This measure is available for each firm and household.

We match the credit register database with ECB IBSI data to obtain key bank characteristics for the banks in our sample. We have information on bank size, bank capital (i.e. equity over total assets) and the ratio of a bank's non-performing loans to total loans. We use the information on non-performing loans to construct a measure of borrower risk in our sample. Specifically, "NPE" is a dummy variable that indicates whether the borrower has experienced a non-performing exposure over the sample period. Figure 2 reports the average value of the non-performing exposure by country over time.

[Insert Figure 2]

Importantly, the dataset also allows us to track whether the individual units in our panel have single or multiple lending relationships. Table A2.2 of Appendix 2 shows that in all countries, a non-negligible share of household and firms do entertain lending relationships with more than one lender. The share is higher for firms and in certain jurisdictions. In Spain, France, Italy and Portugal, for example, the volume of lending originated to firms who have more than one bank is higher than 50%.

Overall, the rich cross-sectional and time variation of this unique dataset is crucial to assess the internal and external validity of the results obtained in the empirical analysis.

For firms, we can distinguish between "better" lending versus "worse" risk-taking using a measure of firm ex ante productivity. We match the credit register database with the Amadeus database to obtain information on firms' financial statements. Using this data, we calculate firm-level productivity using the approach in Gopinath et al. (2017). Specifically, we first estimate the factor shares of labour and capital at the (2-digit NACE) sector level. To do so, we use the Wooldridge (2009) extension to the Levinsohn and Petrin (2003) method for the estimation of production functions. All relevant variables – wage bill, material costs, value added and capital – are deflated.[7]

We then calculate firm-level log total factor productivity (TFP) from the log Cobb-Douglas production function, using the estimated sector-level factor shares as follows:

$$\log(TFP_f) = \log(Value\ added_f) - \hat{\alpha}_s \log(Wage\ bill_f) - \hat{\beta}_s \log(Capital_f) \tag{1}$$

where $\hat{\alpha}_s$ and $\hat{\beta}_s$ are the estimated factor shares of (deflated) labour and capital, respectively, from the first step, computed for each sector *s* over our sample period from 2012 to 2017. We then classify a firm *f* as "high-productive" if its log TFP is above the median log TFP of firms within the same country, sector and year. $Productivity_f$ is a

[7] The wage bill, material costs and value added variables are deflated with the industry-level price deflators for value added from EU Klems. The capital variable is deflated using a country-specific gross fixed capital formation deflator taken from the World Bank's World Development Indicators database.

dummy variable that takes a value of 1 if the firm is classified as "high-productive", and zero otherwise.

[Insert Figure 2]

Figure 2 shows the distribution of firm productivity estimates for our sample of firms. The left-hand panel shows that the large firms tend, on average, to be more productive than the small firms in our sample. The right-hand panel shows that there is much cross-firm dispersion in our productivity estimates.

[Insert Figure 3]

Figure 3 instead shows the evolution of non-performing exposures over time by country. We observe quite some variation across countries and over time in the proportion of non-performing loans on banks' balance sheets. In addition, there is substantial variation across delinquent loans for households and firms.

2.2 Macroprudential regulations

Since the global financial crisis, many countries including in Europe have introduced a wide range of macroprudential measures. Within the European Union, macroprudential measures are taken at the country level.[8] Consequently, macroprudential policy across the euro area shows much country heterogeneity.

The new macroprudential policy toolkit includes a wide range of instruments that can be broadly classified into three types of measure: capital-based, liquidity-based and borrower-based. Capital-based measures include countercyclical capital buffers (CCyB), time-varying/dynamic provisioning and restrictions on profit distribution (e.g. restrictions on dividends). As regards liquidity-based measures, the EU legal framework currently includes the liquidity coverage ratio (LCR) as a short-term liquidity measure, and it is expected that the net stable funding ratio (NSFR), which addresses longer-term liquidity

[8] The European Systemic Risk Board can, in principle, ask countries for such measures to be topped up.

risks, will be added to the framework in the context of the ongoing revision of the Capital Requirements Regulation (CRR) and the Capital Requirements Directive (CRD IV). Moreover, there are restrictions on borrower leverage, such as measures that include caps on the loan-to-value (LTV) ratio, and caps on the debt-to-income (DTI) and debt service-to-income (DTSI) ratios.

We obtain information on the adoption and implementation of country-specific macroprudential measures from the ECB's Macroprudential Database.[9] There are a broad range of prudential measures, including microprudential measures, that can be used for macroprudential purposes.

We create a simple index of macroprudential policy intensity (MAPI) based on the number of measures that are put in place at a given point in time. We consider nine categories of measure: minimum capital requirements; capital buffers; risk weights; lending standard restrictions; levy/tax on financial institutions and activities; limits on large exposures and concentration; liquidity requirements and limits on currency and maturity mismatch; leverage ratio; loan-loss provisioning; and limits on credit growth and volume. For each category, we add a value of 1 to the MAPI index if a measure is adopted and subtract a value of 1 if a measure is removed. We construct this index for the period 1994-2017, which is the period during which data was collected. We do not alter the value of the overall index if the policy action refers to a change in the level of an existing tool or maintains the existing level or scope of a policy tool. Further details on the construction of the index can be found in Appendix 1.

Contrary to monetary policy, macroprudential policy in our sample is country-specific. Macroprudential policy at the country level is likely endogenous to a country's economic and credit developments. For instance, national competent authorities are likely to tighten

[9] See Budnik and Kleibl (2018).

policy during a boom cycle and release buffers during a downturn. To purge our index of MAPI from such country forces, we regress it against real per capita GDP growth and real credit growth in the country (computed using the IMF's IFS Statistics). We then use the residuals from such regression, labelled as $MAP_{c,t}$, as our adjusted proxy of macroprudential policy.[10]

[Insert Figure 4]

Figure 4 shows the evolution of the macroprudential policy index over time for each country in our sample. We show both the original index and the index adjusted for economic and credit developments. We can see that over our sample period there is a general tightening of macroprudential policy, as many countries adopt new measures, but there is substantial variation in terms of both the timing and the intensity of these measures.

Some illustrative examples include: the adoption of a minimum liquidity coverage ratio in Austria in October 2015, the announcement of an increase in the capital surcharge for systemically important banks in Italy in March 2016 and the adoption of a countercyclical capital buffer in Latvia in January 2015. The interquartile range shows that some countries did not adopt macroprudential measures at all, while others were quite aggressive in the adoption of such measures over the sample period. There are also a few instances of a loosening of macroprudential policy, with countries relaxing or removing existing measures. Notable examples include Lithuania, which lowered its reserve requirements related to banks' liabilities in January 2015, and France, which lowered the rate of the systemic risk tax on banks' own funds requirements in January 2015. Interestingly, there is more variation in the index adjusted for economic and credit developments.

[10] Results are similar when we use credit gaps (relative to GDP) instead of credit growth.

For easing the interpretation of our results, we estimate regressions using our macroprudential indicator $MAP_{c,t}$ with inverted sign, so that an increase in the resulting variable, which we label as $MAP_{c,t-1}^{soft}$, denotes a macroprudential softening.

2.3 Monetary policy

Since the onset of the financial crisis, the ECB, as well as many other major central banks, has complemented its operating frameworks with a broad array of non-standard policy measures. These unprecedented policies include the fixed rate tender procedure with full allotment in the Eurosystem's euro credit operations, targeted and untargeted liquidity provision measures (such as the targeted longer-term refinancing operations (TLTROs)), quantitative easing measures (such as the expanded asset purchase programme (APP)) and negative interest rates.

Measuring the effects of monetary policy shocks in an environment where the central bank has announced and implemented both conventional and unconventional policies – affecting different segments of the yield curve – poses special challenges. Therefore, we capture the amount of monetary policy accommodation through high-frequency surprises, defined as the intraday changes of risk-free rates at various maturities around policy announcements (following Altavilla et al. (2019)). The methodology can handle both conventional and unconventional monetary policy.

In greater detail, we construct a variable, MP_t, that measures the principal component of all monetary policy surprises from high-frequency intraday data on risk-free (overnight index swap) rates with different maturities, ranging from one month to ten years. Jointly analysing a wide range of maturities is important as some policies (e.g. policy rate changes) may have a greater influence on the shorter spectrum of rates, while quantitative easing policies may have a greater influence on long-term rates. These surprises are calculated by measuring changes in risk-free rates in a narrow time window around official monetary policy communications. More precisely, for each Governing Council meeting, we first measure the realised policy surprise as the principal component of interest rate changes from 15 minutes before the press release to 15 minutes after the press conference, and then we cumulate them to match the frequency of the credit registers.

Figure 5 shows the estimated monetary policy surprises over our sample period. There were large negative (i.e. easing) monetary policy surprises in the first half of 2014, with the announcement of the liquidity provision programme, and again in the first half of 2015, when the ECB launched its large-scale APP to combat a decline in inflation expectations. Figure 5 also highlights the large positive (i.e. contractionary) surprises linked to the market disappointment following the Governing Council monetary policy meeting of December 2015, when financial markets had anticipated (and priced in) a lower policy rate and a larger increase in the volume of asset purchases. The recalibration of the non-standard measures in the first half of 2016 and the second half of 2017 also surprised markets.

[Insert Figure 5]

These monetary policy changes (surprises) are common across all euro area countries, as these countries have the same monetary policy. However, the stance of monetary policy varies across countries because of differences in (local) business cycles (Taylor (1992); Bernanke and Gertler (1995); and Kashyap and Stein (2000)).[11] This implies that there is a variation in the stance of monetary policy for every monetary policy surprise, despite a single monetary policy shock in each period (Maddaloni and Peydró (2011); and Jordá, Schularick and Taylor (2020)).

[11] The results of the paper are similar if we control for GDP growth and inflation expectations at the country level, the level of unemployment and estimates of output gaps (also at the country level).

To facilitate the interpretations of the estimated coefficients, we run regressions using monetary policy shocks, MP_t, with inverted sign, so that an increase in the resulting variable, which we label MP_t^{soft}, corresponds to a softening in monetary policy.

2.3 Descriptive statistics

Table 1 presents the summary statistics of our main regression variables. The sample period covers the years from 2012 to 2017 and the data frequency is biannual. The average credit commitment of a loan to households is about €28,000, while the average credit commitment of a loan to non-financial firms is much larger at about €100,000.[12] For households, mortgage loans for houses tend to be much bigger than other types of household loans. The share of borrowers that are non-performing (i.e. with outstanding loans that are in default and/or more than 90 days past due) is, on average, 3% for households and 13% for firms. Moreover, the average bank in our sample has a ratio of total equity to total assets of 8%, while the average TFP (in logs) of firms in our sample is 4.1 and the average z-score (in logs) is 3.0.

[Insert Table 1]

Our dataset covers a variety of loans. The vast majority of household loans are mortgage loans and other term loans that are mostly consumer loans, accounting for about 78% of loans for which the type of exposure is available (loan type information is missing for 29% of loans).

Multiple lending relationships are important for the identification of the bank lending channel. Table A2.2 of Appendix 2 shows the frequency of single and multiple lending relationships for loans to households and to firms by country. While the majority of households borrow from only one bank, about 20% of households have multiple banking

[12] Loan credit commitment in the database is expressed in thousands of euro.

relationships. For firms the number is much higher, with about 50% of firms having multiple banking relationships.

3 Results

Our empirical analysis focuses on the transmission channels of monetary and macroprudential policies to the lending behaviour of euro area banks. More specifically, we consider the following three channels in the analysis: the credit channel, the bank lending channel and the risk-taking channel.

Our analysis is divided into four parts. First, we study how the transmission of monetary policy on the volume of bank loans depends on the macroprudential environment. Second, we consider how monetary policy and macroprudential policy interact with the riskiness of borrowers and bank capital to influence the quantity of credit. We conduct both of these analyses separately for households and firms. Third, we differentiate between "better" lending versus "worse" risk-taking by considering the link between policy-induced risk-taking and ex ante firm productivity (in addition to lending to firms with current or past delinquent loans). Finally, we present several robustness checks.

For ease of explanation, we describe our estimation framework for households even though we apply the same framework subsequently also for firms. The terms household and firm – and therefore also the subscripts h and f in the equations that follow – can be used interchangeably for all practical purposes in the description of the estimation framework.

3.1 The credit channel of monetary and macroprudential policies

We start with an analysis of the transmission channels of monetary policy and macroprudential policy on the volume of lending of euro area banks.

Our first empirical exercise focuses on the existence of the broad credit channel and the interaction between monetary policy actions and macroprudential policies. The regression model is as follows:

$$Loans_{b,h,t} = \alpha^{FE} + \beta_1 MP_{t-1}^{soft} + \beta_2 MAP_{c,t-1}^{soft} + \beta_3 \left(MP_{t-1}^{soft} \times MAP_{c,t-1}^{soft} \right) + \epsilon_{b,h,t} \quad (2)$$

The dependent variable ($Loans_{b,h,t}$) is the (log-)credit granted (drawn and undrawn) by bank b to household h at time t. The variable MP_{t-1}^{soft} is the measure of monetary policy surprises lagged one period, while the variable $MAP_{c,t-1}^{soft}$ is the lagged measure of macroprudential policy changes (see the previous section). In both cases, higher values of either variable correspond to a softening of monetary policy and macroprudential policy respectively.

We progressively saturate the model in equation (2) with different sets of fixed effects (α^{FE}) that control for possible confounding factors. In particular, the most robust version of the model employs time and borrower fixed effects. Time fixed effects take care of all (observed and unobserved) shocks that are common across the euro area. Moreover, borrower fixed effects completely absorb the time-invariant borrower heterogeneity. In this setting, they are meant to capture, as best they can, potential differences in borrowers' fundamentals (e.g. proxying for demand). In fact, as we show below, the inclusion of such dummies explains a large share of the variation in the data, suggesting that most borrower-level variation stems from time-invariant idiosyncratic characteristics.

We use the specification in equation (2) to study the credit channel mechanism of monetary policy and the potential complementarities between monetary policy and macroprudential policy. More specifically, the above model can be used to test whether, following monetary policy easing, banks increase their credit ($\beta_1 > 0$) and whether a looser macroprudential environment reinforces this effect ($\beta_3 > 0$).We also analyse the direct effect of a softer macroprudential environment on higher lending ($\beta_2 > 0$).

We conduct this analysis separately through separate but otherwise identical models for households and firms. The results are presented in Table 2.[13]

[**Insert Table 2**]

We find strong evidence of the existence of credit channels of monetary policy and macroprudential policy across a wide range of fixed effects specifications of the model. Specifically, the positive coefficient estimates on the direct effects (β_1 and β_2) indicate that softer monetary policy and softer macroprudential policy each contribute to an increase in lending.

Moreover, the positive coefficient estimate on the interaction term (β_3) indicates that the two policies are complementary in the sense that softer monetary policy boosts lending more when the macroprudential policy environment is also softer. In other words, the two policies reinforce each other. We find qualitatively similar results for households (columns 1 to 3) and firms (columns 4 to 6).

The economic magnitude of our results is large. Based on the estimates in column (1) of Table 2 for household loans, we find that the marginal effect of a one standard deviation easing in monetary policy and macroprudential policy on lending is 1.3% (= 0.00514 × 4.16 × 0.60). This is 42% more than the average increase in lending due to softer monetary policy alone.[14] The additional effect from macroprudential policy falls to about 20% after the inclusion of a richer set of time and firm fixed effects in columns (2)

[13] Standard errors of this and all subsequent regression tables are clustered at the borrower level. Clustering at lender and country-time level does not alter the significant results. Likewise, results are robust to clustering standard errors at the borrower and country-time level. The related tables are available upon request. See also Appendix A2.
[14] A one standard deviation easing in monetary policy implies an increase in the volume of lending of 3.1% for households and 2.0% for corporate loans, while for softer macroprudential policies, these numbers are 9.8% and 2.3% respectively.

and (3). This suggests that our estimates are robust (from both a statistical and economic perspective), as the inclusion of firm fixed effects implies a large increase in the R-squared, by roughly 60% (see Altonji, Elder and Taber (2005); and Oster (2019)). Formally speaking, the estimated coefficient in column (3) survives the Oster (2019) test for selection along unobservables, as indicated by the resulting lower-bound for our coefficient of interest, which is strictly positive.[15]

For corporate loans, we find that a one standard deviation easing in monetary and macroprudential policies boost lending by 0.22% (based on the estimates in column (4)). This is 11% more than the increase in lending from softer monetary policy alone, and this estimated effect remains nearly identical with a richer set of fixed effects (columns (5) and (6)). All these are large effects compared with an average loan growth during the period from December 2012 to December 2017 of 0.63% for household loans and -0.53% for corporate loans.

3.2 The bank lending channel of monetary and macroprudential policies

Having assessed the existence of a credit channel, we now focus on the bank lending channel. We study the bank lending channel of monetary policy and the potential complementarities between monetary policy and macroprudential policy using the following specification:

$$\begin{aligned} Loans_{b,h,t} = {} & \alpha^{FE} + \gamma_1 MP_{t-1}^{soft} + \gamma_2 MAP_{c,t-1}^{soft} + \gamma_3 Equity_{b,t-1} + \Omega X_{b,h,t-1} \\ & + \gamma_4\left(MP_{t-1}^{soft} \times Equity_{b,t-1}\right) + \gamma_5\left(MAP_{c,t-1}^{soft} \times Equity_{b,t-1}\right) \\ & + \gamma_6\left(MP_{t-1}^{soft} \times MAP_{c,t-1}^{soft} \times Equity_{b,t-1}\right) + \epsilon_{b,h,t} \end{aligned} \tag{3}$$

[15] We compute the Oster bound under the usual assumption of equal selection among observables and unobservables ($\delta = 1$). In practice, we compare estimates from models in column 1 and column 3 and fix the maximum R-squared as the minimum between 1 and 1.3 times the R-squared obtained in the "robust" version of the model in column 3. We maintain these conventions throughout the paper.

where $Equity_{b,t-1}$ is a measure of the bank's capital position obtained as the ratio of total equity to total assets, and $X_{b,h,t-1}$ includes all remaining double interactions.

More specifically, the above model can be used to test whether, following monetary policy and macroprudential policy easing, weak banks increase their credit supply relatively more ($\gamma_6 < 0$).[16]

Consistent with the previous model, the most saturated version of the model includes borrower and time fixed effects. Potentially, we could also include borrower*time fixed effects to better control for time-varying unobserved firm fundamentals, including a proxy of firm credit demand shocks (Khwaja and Mian (2008)). Nonetheless, this procedure would lead to a drop of most observations in the models for household credit, as the vast majority of households just hold one loan at a time. Hence, we present our baseline results with consistent models across firms and households, therefore employing at most borrower and time fixed effects. However, in Table A2.4 we show that findings on firms' credit are robust to controlling for firm time-varying fixed effects.

The baseline results for household and firm loans are presented in Table 3 separately. Our results are consistent with the existence of a bank lending channel.[17] Monetary policy easing, combined with loose macroprudential policy, boosts lending especially for weakly capitalised banks. For instance, based on the estimates for households in column (1), we find that the marginal effect of a one standard deviation lower capital ratio on bank lending following a softening of each policy by one standard deviation is 1.7% (= -0.173 × 4.16 × 0.60 × -0.04). The estimated effect drops to 0.7% following the inclusion

[16] Moreover, when we saturate the model with borrower*time fixed effects (i.e. in robustness checks for commercial credit models exploiting bank-level time-varying heterogeneity), we can control for time-varying unobserved firm fundamentals (proxying for firm-level time-varying credit demand shocks à la Khwaja and Mian (2008)). We find that results are not qualitatively different from those retrieved from models employing firm fixed effects only; however the sample gets substantially reduced.

[17] Consistent with the findings in Peydró, Polo and Sette (forthcoming), after the crisis we find that softer monetary policy – by providing more liquidity to banks – increases lending if banks have more ex ante capital, i.e. for the results of monetary policy and capital without an interaction of macroprudential policy.

of household fixed effects, which absorbs most of the variation and is robust in the Oster (2019) sense.

[Insert Table 3]

We obtain qualitatively similar results for firms. Specifically, lower bank capital enhances the positive impact on lending of a more accommodative monetary policy when the macroprudential policy stance is softer. Moreover, effects for corporate loans are virtually unchanged (if anything, slightly magnified) after the inclusion of a richer set of fixed effects. For example, when we control for firm and time fixed effects in column (6), we find that the marginal effect of a one standard deviation lower capital ratio on bank lending to firms following a softening of each policy by one standard deviation is 1% (= -0.105 × 4.16 × 0.60 × -0.04).

3.3 The risk-taking channel of monetary and macroprudential policies

Next, we assess the existence of a risk-taking channel of monetary policy and macroprudential policy through which monetary authorities and macroprudential regulators affect the quality – not just the quantity – of bank credit. The regression model to study the risk-taking channel of monetary policy and the potential complementarities between monetary policy and macroprudential policy takes the following form:

$$\begin{aligned} Loans_{b,h,t} = {} & \alpha^{FE} + \lambda_1 MP^{soft}_{t-1} + \lambda_2 MAP^{soft}_{c,t-1} + \lambda_3 NPE_{h,t-1} + \Omega X_{b,h,t-1} \\ & + \lambda_4\left(MP^{soft}_{t-1} \times NPE_{h,t-1}\right) + \lambda_5\left(MAP^{soft}_{c,t-1} \times NPE_{h,t-1}\right) \qquad (4) \\ & + \lambda_6\left(MP^{soft}_{t-1} \times MAP^{soft}_{c,t-1} \times NPE_{h,t-1}\right) + \epsilon_{b,h,t} \end{aligned}$$

where the variable $NPE_{h,t-1}$ is a dummy variable that equals 1 if one of the household's loans is non-performing, and zero otherwise, and $X_{b,h,t-1}$ includes all remaining double interactions. $NPE_{h,t-1}$ captures the ex ante credit riskiness of the borrower based on the past (non-)performing loan status of the household.

The above model can be used to test whether, following a loosening of monetary policy and macroprudential policy, banks increase their lending to high credit risk borrowers ($\lambda_6 > 0$). Model estimation employs, at most, time and bank fixed effects. We avoid including borrower specific dummies, as this would imply the coefficient of main interest λ_6 being identified by within borrower heterogeneity across periods (characterised by performing and non-performing exposure respectively), whereas most of the variation in loan performing status occurs between borrowers.

The results are presented separately for households and firms in Table 4. We find evidence in support of the existence of a risk-taking channel of monetary policy and macroprudential policy. For both households and firms, we find that softer monetary policy, combined with softer macroprudential policy, boosts lending and that this effect is more pronounced for riskier borrowers.

The economic effects are sizeable. For instance, based on the estimates in column (1) of Table 4 for households, we find that the marginal effect of a one standard deviation easing in monetary policy and macroprudential policy on lending is 1.8% more for non-performing borrowers than for performing borrowers. Including either time or bank fixed effects does not significantly alter the size of the coefficient. The comparable effect for firms is smaller at 0.4% (column (4)) and more sensitive to saturating the model with additional fixed effects, and just marginally robust according to the Oster (2019) test diagnostics, which places the lower-bound very close to 0.

[Insert Table 4]

The strength of the risk-taking channel may depend on the bank's capital (Dell'Ariccia, Laeven and Marquez (2014)). For instance, there is evidence that the risk-taking channel of monetary policy is more pronounced for weakly capitalised banks (e.g.

Jiménez, Ongena, Peydró and Saurina (2014); Dell'Ariccia, Laeven and Suarez (2017)). To test for the differential effect of bank capital on the risk-taking channel of monetary policy and macroprudential policy, we estimate the following model:

$$\begin{aligned} Loans_{b,h,t} = \alpha^{FE} + \phi_1 MP_{t-1}^{soft} + \phi_2 MAP_{c,t-1}^{soft} + \Omega X_{b,h,t-1} \\ + \phi_3 \left(MP_{t-1}^{soft} \times Equity_{b,t-1} \times NPE_{h,t-1}\right) \\ + \phi_4 \left(MAP_{c,t-1}^{soft} \times Equity_{b,t-1} \times NPE_{h,t-1}\right) \\ + \phi_5 \left(MP_{t-1}^{soft} \times MAP_{c,t-1}^{soft} \times Equity_{b,t-1} \times NPE_{h,t-1}\right) + \epsilon_{b,h,t} \end{aligned} \quad (5)$$

where $Equity_{b,t-1}$ is our proxy for bank capital (given by bank equity over total assets) and $X_{b,h,t-1}$ includes all remaining double and triple interactions. The above model can be used to test whether the risk-taking channel identified in model (4) (as captured by a positive coefficient λ_6) is more pronounced for ex ante weakly capitalised banks ($\phi_5 < 0$), consistent with a risk-taking explanation of the risk-taking channel (Dell'Ariccia, Laeven and Marquez (2014)). Specifically, this would imply that, following monetary policy easing, there is an increase in the credit supply toward risky borrowers by weakly capitalised banks when the macroprudential policy environment is also softer.

The coefficient of interest ϕ_5 depends on interacted firm and bank heterogeneity. Hence, in line with the logic behind previous empirical models, we saturate the model with both bank and borrower specific fixed effects (and not with the interaction of the two, which would leave very little variation to identify ϕ_5).

The results are presented separately for households and firms in Table 5. Our results are consistent with a risk-taking effect from both monetary policy and macroprudential policy. The estimated coefficient on ϕ_5 is negative throughout specifications, for both households and firms, across the different model specifications. This suggests that macroprudential policy reinforces the risk-taking effect of monetary policy: a loosening in both policies will prompt especially weaker capitalised banks to lend to riskier borrowers.

[Insert Table 5]

The results are also economically significant. Based on the baseline estimates for households in column (1) of Table 5, we find that the marginal effect of a one standard deviation lower capital ratio on lending to non-performing borrowers following a softening of each policy by one standard deviation is 0.8% (= -0.0798 × 4.16 × 0.60 × 1 × -0.04). The comparable effect for loans to firms is larger and close to 3.5% (= -0.349 × 4.16 × 0.60 × 1 × -0.04). Both coefficients are remarkably stable across progressively saturated versions of the model and are strictly lower than zero based on the Oster (2019) test.

3.4 Risk-taking and firm productivity

We have shown that looser monetary and macroprudential policies induce greater bank risk-taking: banks respond to such loose policies by lending more to riskier borrowers (in terms of credit risk/history) and this risk-taking channel is more pronounced for weaker capitalised banks. An important question to ask is whether there is differential risk-taking in terms of better or worse firms. Thus far, a major shortcoming in the literature on the risk-taking channel of monetary policy is that this question has been left unanswered (see, for example, Dell'Ariccia, Laeven and Suarez (2017)).

To address this question, in this section we assess the extent to which induced lending by weaker capitalised banks flows to more or less productive firms. We use firm productivity as a proxy for the "efficiency" of credit allocation to distinguish between "better" and "worse" risk-taking. We limit this analysis to firms because we have no comparable measure of productivity for households.

We start with an analysis of how monetary policy, macroprudential policy and firm productivity combine to influence bank lending. Specifically, we first estimate the following model of the link between bank lending and firm productivity:

$$\begin{aligned} Loans_{b,f,t} = \alpha^{FE} + \phi_1 MP_{t-1}^{soft} + \phi_2 MAP_{c,t-1}^{soft} + \Omega X_{b,f,t-1} \\ + \phi_3 \left(MP_{t-1}^{soft} \times Productivity_f \right) \\ + \phi_4 \left(MAP_{c,t-1}^{soft} \times Productivity_f \right) \\ + \phi_5 \left(MP_{t-1}^{soft} \times MAP_{c,t-1}^{soft} \times Productivity_f \right) + \epsilon_{b,h,t} \end{aligned} \tag{6}$$

where our coefficient of interest is ϕ_5 and $X_{b,f,t-1}$ includes all remaining double interactions. A positive coefficient for ϕ_5 would indicate that the induced lending by looser monetary and macroprudential policies flows disproportionately to more ex ante productive firms. In line with previous analysis, we saturate the model with bank and time fixed effects.

The results are presented in columns (1) to (3) of Table 6. We indeed estimate a positive and statistically significant estimate for ϕ_5. This suggests that the policy induced boost in lending flows disproportionately to more productive firms.

[Insert Table 6]

The effect is economically meaningful. Based on the estimates in column (1) of Table 6, we find that the marginal effect of a softening of each policy by one standard deviation on bank lending is 3.5% (= 0.014 × 4.16 × 0.60 × 1) larger for productive firms than for non-productive firms.

Finally, we also consider the role of bank capital in the link between bank lending and firm productivity by estimating the following model:

$$\begin{aligned} Loans_{b,f,t} = \alpha^{FE} + \phi_1 MP_{t-1}^{soft} + \phi_2 MAP_{c,t-1}^{soft} + \Omega X_{b,f,t-1} \\ + \phi_3 \left(MP_{t-1}^{soft} \times Equity_{b,t-1}\right) + \phi_4 \left(MAP_{c,t-1}^{soft} \times Equity_{b,t-1}\right) \\ + \phi_5 \left(MP_{t-1}^{soft} \times MAP_{c,t-1}^{soft} \times Equity_{b,t-1}\right) \\ + \phi_6 \left(MP_{t-1}^{soft} \times Equity_{b,t-1} \times Productivity_f\right) \\ + \phi_7 \left(MAP_{c,t-1}^{soft} \times Equity_{b,t-1} \times Productivity_f\right) \\ + \phi_8 \left(MP_{t-1}^{soft} \times MAP_{c,t-1}^{soft} \times Equity_{b,t-1} \times Productivity_f\right) + \epsilon_{b,h,t} \end{aligned} \quad (7)$$

where our coefficient of interest is ϕ_8. A negative coefficient would indicate that the induced lending by weaker capitalised banks flows disproportionately to more productive firms. Consistent with our previous empirical strategy (for estimating the interaction of the bank-lending and the "bad risk-taking channel" based on firm credit risk), we saturate the model with country*time, firm and bank fixed effects.

The results are presented in columns (4) to (7) of Table 6. We find a negative and statistically significant estimate for ϕ_8. This suggests that macroprudential policy reinforces the bank lending channel of monetary policy and that such lending disproportionately flows to more productive firms, especially from more constrained banks.

This effect is economically large. Based on the estimates in column (4) of Table 6 we find that the marginal effect of a one standard deviation lower capital ratio on lending, following a softening of each policy by one standard deviation, is 1.6% (= -0.164 × 4.16 × 0.60 × -0.04 × 1) larger for more productive firms than for less productive firms.

Interestingly, taking stock of the analysis on corporate loans, the baseline results for firm productivity are, overall, stronger than those for high credit risk firms commented on in the previous sub-section, suggesting that the risk-taking induced by monetary-macroprudential complementarity is more prominently directed towards highly productive firms than towards very credit-risky ones. In addition, the interaction of the two channels (the "good" and "bad" risk-taking) with bank capital suggests that they are both significantly and largely strengthened by lower levels of bank capitalisation. In detail, the comparison of the coefficients stemming from this analysis would suggest that low-capital banks are relatively more responsive in increasing credit towards credit-risky firms rather than towards highly productive ones (following a combined macroprudential and monetary loosening). Nonetheless, the robustness exercises presented in the next section will highlight that such a difference is sensitive to applying higher-order fixed effects (see also Appendix A.2).

3.5 Mortgage loans versus consumer loans

Thus far, we have not conditioned the analysis on the type of loan. For households, the main category of loan is the mortgage loan. Mortgage loans tend to be larger and have longer maturities than non-mortgage loans, such as consumer loans. Moreover, mortgage loans are also always highly collateralised (and generally with full recourse), while consumer loans are substantially less well collateralised. The transmission channels of monetary policy and macroprudential policy may depend on the type of loan. On the one hand, we might expect the risk-taking channel to be less pronounced for mortgage loans than for non-mortgage loans because mortgage loans have higher collateral, tend to be longer-term and are often issued at fixed interest rates. Mortgage lending behaviour should therefore respond less to changes in the monetary policy stance. On the other hand, macroprudential policies that are borrower-based, such as LTV or DTI ratios, may be particularly binding for mortgage loans that tend to be larger in size than non-mortgage loans. Moreover, risk-taking may be greater with consumer loans, as this type of loan is substantially riskier.

[Insert Table 7]

To gauge the effect of different loan types, we re-estimate equation (5) separately for mortgage loans and non-mortgage loans. The results are presented in Table 7. In short, we find that the risk-taking channel is larger (and more robust) for non-mortgage loans, which are basically consumer loans, than for mortgages.

3.6 Further robustness

We consider whether results are driven by loan size by re-estimating equation (4) using weighted least squares, with the log of total credit commitment as a weight for each observation. Not only do these results serve as a robustness check, but they are also interesting from an aggregation perspective because, if results are largely driven by small loans that are quantitatively less important in the aggregate, then the aggregate effect will be quite different from the estimated effect at the loan level. The results are presented in Table A2.3 of Appendix 2. We find that results are insensitive to the weighting scheme, for both household loans and firm loans, and also when we breakdown household loans by loan type. Moreover, results are also robust to the weighting scheme when augmented with a more conservative clustering at the borrower and country*time levels.

Finally, we check that results on corporate loans exploiting bank heterogeneity are robust to employing firm*time fixed effects, which are commonly used in the literature to isolate credit supply shocks (Khwaja and Mian (2007)) and their interaction with monetary policy and macroprudential policy (Jiménez et al. (2012) and (2017)).[18] Results are presented in Table A2.4 of Appendix 2, where in each model we also include

[18] We cannot apply the same robustness check to household loans, as applying household*time fixed effects would substantially drop the number of observations owing to a vast majority of euro area households being indebted to one bank only.

firm*bank fixed effects to further control for endogenous matching between firms and banks. From a statistical perspective, all relevant findings go through, for example the baseline bank-lending channel (column (1)) or its interactions with firm credit risk (columns (2)) and productivity (columns (4)). Moreover, in columns (3) and (5), we additionally include bank*time fixed effects, which help in identifying risk-taking as given by the interaction of bank capital and proxies of firms' riskiness (Jiménez et al. (2014)), and find that results are nearly unaffected. To conclude, a comparison with the baseline results in Tables 5 and 6 reveals that the magnitude of the effects is more robust to the inclusion of interacted firm and time dummies in the case of "good risk-taking" based on firm productivity than in the case of "bad risk-taking" associated with firm ex ante credit risk.

4 Conclusions

We have studied how the interaction between monetary policy and macroprudential policy influences bank lending behaviour. Our main finding is that monetary policy accommodation in a softer macroprudential policy environment boosts lending. This effect is especially pronounced for less capitalised banks, consistent with a bank lending channel. Moreover, the effect is also stronger for riskier borrowers (based on credit risk), both households and firms, and for less capitalised banks lending to riskier borrowers. The latter finding is consistent with a risk-taking channel of monetary and macroprudential policies. Interestingly, there are stronger effects for consumer and corporate loans than for mortgages. Finally, for firms, the overall increase in bank lending induced by a loose policy mix is stronger for more (ex ante) productive firms than for firms with high ex ante credit risk, except for banks with low capital.

The empirical evidence provided in this paper points to strong complementarities between monetary policy and macroprudential policy. These results suggest that active coordination and mutual support of these two policies may enhance their overall effectiveness relative to a situation where each policy decision is taken by only considering their individual policy target.

In principle, there are multiple interactions between monetary policy, macroprudential policy and financial stability. There are several reasons to believe that coordination of these policies is desirable. By smoothing business cycles, keeping inflation expectations anchored and providing liquidity to solvent institutions, monetary policy may substantially strengthen financial stability, thereby reducing the need for macroprudential policies to be activated. In periods of stress, the bank lending channel of monetary policy can be strengthened by the activation of macroprudential buffers. Moreover, macroprudential policy can complement monetary policy in managing the build-up of financial imbalances and fragilities caused by excessive leverage and maturity transformation.

Our findings also have a bearing on the mix of current policy responses to developments in the COVID-19 crisis. Central banks and macroprudential authorities in many countries have responded to the ramifications of this crisis with a combination of accommodative monetary policy and relaxation of macroprudential measures. Our results show that close coordination of monetary policy measures and prudential measures generates an amplification effect on lending, with more credit extended towards more productive firms. The additional effects on lending from a coordinated intervention can be sizeable: when macroprudential policy is eased in a context of already accommodative monetary policy, the overall effect on lending may be as much as 40% greater.

Our study comes with a few caveats. First, we have focused on the role of banks. While banks continue to be the main source of funding for households and firms in the euro area, the increasing role of non-bank financing could limit the role played by macroprudential policy. Second, our reduced-form framework cannot determine whether bank risk-taking is excessive or whether past or present monetary policy is optimal, even though we attempt to address this issue by analysing the link between bank lending and firm productivity. At the very least, our finding that risk-taking is also directed towards more productive firms does question the idea that an increase in risk-taking is necessarily bad (sub-optimal). Third, we have abstracted from the implications for the institutional set-up of a coordination of policies. This is particularly important for the euro, where monetary policy is centralised and has a euro area-wide objective, while macroprudential policy is primarily conducted by national authorities and reflects country-specific credit dynamics. Our evidence of strong complementarities between monetary and macroprudential policies suggests that additional theoretical research is needed to consider the optimal degree of coordination between monetary policy and macroprudential policy.

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Tables

Table 1: Summary statistics

Variable	Observations	Mean	Std. Dev.	p25	p50	p75
Loan-level data						
ln(credit commitment to HHs)	99,475,542	3.34	1.90	2.61	3.95	4.61
ln(credit commitment to HHs for house purchases)	58,631,610	4.21	0.86	3.79	4.32	4.76
ln(credit commitment to HHs, other lending)	48,369,142	1.89	2.22	0.36	2.01	3.61
ln(credit commitment to NFCs)	90,415,238	4.59	1.72	3.64	4.60	5.63
Non-performing exposure to NFC - NPE(NFC)	90,415,238	0.13	0.39	0.00	0.00	0.00
Non-performing exposure to HH - NPE(HH)	99,475,542	0.03	0.16	0.00	0.00	0.00
Macroeconomic data						
Macroprudential index - MAP^{soft}	99,038,065	0.03	0.60	-0.61	-0.15	0.38
Monetary policy surprises - MP^{soft}	99,475,542	-0.24	4.16	-2.04	-0.27	4.33
Bank-level data						
Equity (total equity / total assets)	38,734,521	0.08	0.04	0.06	0.07	0.08
Firm-level data						
Productivity (dummy)	5,322,352	0.59	0.49	0.00	1.00	1.00
ln(TFP) -firm level measure of total factor productivity	5,322,352	4.09	1.37	3.00	4.00	5.00
median(lnTFP) by country-sector-date	5,322,352	3.95	1.25	3.00	4.00	5.00

Notes: The table reports the summary statistics of the variables used in the empirical analysis. **Loan-level data:** "ln(credit commitment to HHs)" is the overall credit amount provided by a bank to a household, expressed in logs. "ln(credit commitment to HHs for house purchases)" is the overall house-mortgage amount provided by a bank to a household, expressed in logs. "ln(credit commitment to HH, other)" is the amount of credit provided by a bank to a household for other purposes than house purchase (typically consumer loans), expressed in logs. "ln(credit commitment to NFCs)" is the overall credit amount provided by a bank to a firm, expressed in logs. The variables "Non-performing exposure to NFC" and "Non-performing exposure to HH" are dummies with a value of 1 if, respectively, the firm's or household's exposure is non-performing, and with a value of 0 otherwise. An exposure is defined as non-performing if it is in default and/or past due more than 90 days. **Macroeconomic data: "**MAP^{soft}" is a measure of macroprudential softening obtained as the residuals (with inverted sign) from the regression of a variable that for each country counts the implemented macroprudential policies on current GDP and credit growth. An increase in MAP^{soft} denotes a relaxation of macroprudential policy. "MP^{soft}" is the first principal component of the monetary policy surprises extracted from the high-frequency intraday yields at different maturities during all dates of policy announcements covered in the sample. We invert the sign of such principal component so that an increase in MP^{soft} corresponds to monetary policy softening. **Bank-level data: "**Equity" is a variable obtained as the ratio of bank total equity to total assets. **Firm-level data: "**Productivity" is a dummy variable with a value of 1 if a firm has TFP above the cross-sectional median of all firms within the same sector and country. TFP is measured at the firm level from the log Cobb-Douglas production function using the estimated sector-level factor shares. "ln(TFP)" is the resulting variable, expressed in logs.

Table 2: Monetary policy, macroprudential policy and the credit channel

	(1)	(2)	(3)	(4)	(5)	(6)
		Households			Firms	
MP^{soft}	0.00736***			0.00482***		
	(0.0000229)			(0.000198)		
MAP^{soft}	0.164***	0.0602***	0.00935***	0.00564***	0.00240***	0.0286***
	(0.000381)	(0.000721)	(0.000564)	(0.000626)	(0.000676)	(0.000504)
MP^{soft} x MAP^{soft}	0.00514***	0.00248***	0.00233***	0.000893***	0.000579***	0.000994***
	(0.0000377)	(0.0000719)	(0.0000469)	(0.0000485)	(0.0000469)	(0.0000362)
N	89,567,025	89,567,025	88,412,340	68,611,631	68,611,631	68,111,293
R^2	0.268	0.268	0.854	0.182	0.182	0.733
Country FE	Y	Y	-	Y	Y	-
Time FE		Y	Y		Y	Y
Borrower FE			Y			Y
Oster Beta-Bound (MP^{soft} x MAP^{soft})			0.00163			0.00103

Notes: The dependent variable is "(log-)credit granted (drawn and undrawn)" by bank "b" to households "h" (in columns 1 to 3) and to firms "f" (in columns 4 to 6) at time "t". "MP^{soft}" is the first principal component of the monetary policy surprises extracted from the high-frequency intraday yields at different maturities during all dates of policy announcements covered in the sample. We invert the sign of this principal component so that an increase in MP^{soft} corresponds to monetary policy softening. "MAP^{soft}" is a measure of macroprudential softening obtained as the residuals (with inverted sign) from the regression of a variable that for each country counts the implemented macroprudential policies on current GDP and credit growth. An increase in MAP^{soft} denotes a relaxation of macroprudential policy. Data are semi-annual for the period from the first half of 2012 to the second half of 2017. "Y" indicates that the respective fixed effects are included. "-" indicates that a group of fixed effects is entirely absorbed by other vectors of fixed effects. The reported "Oster Beta-Bound" is computed for the coefficient of the MP^{soft} x MAP^{soft} interaction following Oster (2019), comparing results from models in columns 1 and 3 for households and columns 4 and 6 for firms. Standard errors are clustered at the borrower level in parentheses. *, ** and *** denote statistical significance levels at 10%, 5% and 1% respectively.

Table 3: Policy interactions and the bank lending channel

	(1)	(2)	(3)	(4)	(5)	(6)
		Households			Firms	
MP^{soft}	0.00306***			0.00659***		
	(0.0000640)			(0.000383)		
MAP^{soft}	0.0588***	0.0814***	0.0634***	0.0123***	0.0320***	0.0426***
	(0.000777)	(0.00130)	(0.000894)	(0.000857)	(0.000960)	(0.000696)
Equity	1.901***	1.993***	1.108***	1.004***	0.677***	1.819***
	(0.0352)	(0.0357)	(0.0441)	(0.0377)	(0.0388)	(0.0384)
MP^{soft} x MAP^{soft}	0.00789***	0.00414*	0.000389**	0.00173***	0.00360***	0.00139***
	(0.00128)	(0.00242)	(0.000153)	(0.000110)	(0.000107)	(0.0000639)
MP^{soft} x Equity	0.132***	0.140***	0.0392***	0.0899***	0.0972***	0.0123***
	(0.00239)	(0.00261)	(0.00145)	(0.00282)	(0.00286)	(0.00199)
MAP^{soft} x Equity	-0.612***	-0.465***	-0.181***	-0.683***	-1.014***	-0.753***
	(0.0175)	(0.0182)	(0.0121)	(0.0479)	(0.0484)	(0.0341)
MP^{soft} x MAP^{soft} x Equity	-0.173***	-0.175***	-0.0713***	-0.0527***	-0.0941***	-0.105***
	(0.00324)	(0.00336)	(0.00183)	(0.00679)	(0.00688)	(0.00423)
N	20,837,941	20,837,941	19,695,844	29,306,538	29,306,538	28,890,546
R^2	0.290	0.291	0.906	0.166	0.167	0.789
Country FE	Y	Y	-	Y	Y	-
Time FE		Y	Y		Y	Y
Borrower FE			Y			Y
Oster Beta-Bound (MP^{soft} x MAP^{soft} x Equity)			-0.05578			-0.12271

Notes: The dependent variable is "(log-)credit granted (drawn and undrawn)" by bank "b" to households "h" (in columns 1 to 3) and to firms "f" (in columns 4 to 6) at time "t". "MP^{soft}" is the first principal component of the monetary policy surprises extracted from the high-frequency intraday yields at different maturities during all dates of policy announcements covered in the sample. We invert the sign of this principal component so that an increase in MP^{soft} corresponds to monetary policy softening. "MAP^{soft}" is a measure of macroprudential softening obtained as the residuals (with inverted sign) from the regression of a variable that for each country counts the implemented macroprudential policies on current GDP and credit growth. An increase in MAP^{soft} denotes a relaxation of macroprudential policy. The variable "Equity" is obtained as the ratio of bank total equity to total assets. Data are semi-annual for the period from the first half of 2012 to the second half of 2017. "Y" indicates that the respective fixed effects are included. "-" indicates that a group of fixed effects is entirely absorbed by other vectors of fixed effects. The reported "Oster Beta-Bound" is computed for the coefficient of the MP^{soft} x MAP^{soft} x Equity interaction following Oster (2019), comparing results from models in columns 1 and 3 for households and columns 4 and 6 for firms. Standard errors are clustered at the borrower level in parentheses. *, ** and *** denote statistical significance levels at 10%, 5% and 1% respectively.

Table 4: Policy interactions and risk-taking

	(1)	(2)	(3)	(4)	(5)	(6)
		Households			Firms	
MP^{soft}	0.00590***			0.00546***		
	(0.0000243)			(0.00209)		
MAP^{soft}	0.131***	0.0278***	0.0279***	0.0169***	0.0207***	0.0145***
	(0.000415)	(0.000733)	(0.000679)	(0.000704)	(0.000741)	(0.000727)
NPE	-0.0113***	-0.0107***	-0.173***	-0.211***	-0.210***	-0.212***
	(0.00159)	(0.00159)	(0.00140)	(0.00256)	(0.00257)	(0.00261)
MP^{soft} x MAP^{soft}	0.00446***	0.000906***	0.000987***	0.000680***	0.000487***	0.0000280
	(0.0000419)	(0.0000703)	(0.0000651)	(0.0000549)	(0.0000533)	(0.0000521)
MP^{soft} x NPE	0.000895***	0.000248***	0.00333***	0.00257***	0.00240***	0.00228***
	(0.0000725)	(0.0000724)	(0.0000689)	(0.0000599)	(0.0000599)	(0.0000582)
MAP^{soft} x NPE	0.0317***	0.0443***	0.0258***	0.0888***	0.0850***	0.0877***
	(0.00106)	(0.00106)	(0.000982)	(0.00157)	(0.00158)	(0.00152)
MP^{soft} x MAP^{soft} x NPE	0.00726***	0.00659***	0.00628***	0.00154***	0.000860***	0.000639***
	(0.000118)	(0.000117)	(0.000109)	(0.000120)	(0.000121)	(0.000117)
N	76,873,421	76,873,421	76,873,346	68,607,899	68,607,899	68,607,899
R^2	0.286	0.286	0.551	0.184	0.184	0.441
Country FE	Y	Y	-	Y	Y	-
Time FE		Y	Y		Y	Y
Bank FE			Y			Y
Oster Beta-Bound (MP^{soft} x MAP^{soft} x NPE)			0.00567			0.00018

Notes: The dependent variable is "(log-)credit granted (drawn and undrawn)" by bank "b" to households "h" (in columns 1 to 3) and to firms "f" (in columns 4 to 6) at time "t". "MP^{soft}" is the first principal component of the monetary policy surprises extracted from the high-frequency intraday yields at different maturities during all dates of policy announcements covered in the sample. We invert the sign of this principal component so that an increase in MP^{soft} corresponds to monetary policy softening. "MAP^{soft}" is a measure of macroprudential softening obtained as the residuals (with inverted sign) from the regression of a variable that for each country counts the implemented macroprudential policies on current GDP and credit growth. An increase in MAP^{soft} denotes a relaxation of macroprudential policy. "NPE" is a dummy variable with a value of 1 if the borrower has experienced a non-performing exposure over the sample period, and zero otherwise. Data are semi-annual for the period from the first half of 2012to the second half of 2017. "Y" indicates that the respective fixed effects are included. "-" indicates that a group of fixed effects is entirely absorbed by other vectors of fixed effects. The reported "Oster Beta-Bound" is computed for the coefficient of the MP^{soft} x MAP^{soft} x NPE interaction following Oster (2019), comparing results from models in columns 1 and 3 for households and columns 4 and 6 for firms. Standard errors are clustered at the borrower level in parentheses. *, ** and *** denote statistical significance levels at 10%, 5% and 1% respectively.

Table 5: Policy interactions, bank capital and the risk-taking channel

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Households				Firms			
MP^{soft}	0.00740***				0.00484***			
	(0.0000684)				(0.000207)			
MAP^{soft}	0.0661***	0.0896***			0.0177***	0.0133***		
	(0.000915)	(0.00133)			(0.00385)	(0.00389)		
Equity	2.253***	2.372***	2.581***	0.375***	0.0197	0.214***	0.640***	0.373***
	(0.0400)	(0.0406)	(0.0416)	(0.0323)	(0.0421)	(0.0430)	(0.0279)	(0.0442)
NPE	-0.162***	-0.165***	-0.169***		-0.251***	-0.248***		-0.249***
	(0.00247)	(0.00247)	(0.00247)		(0.00293)	(0.00294)		(0.00294)
MP^{soft} x MAP^{soft}	0.0125***	0.0114***			0.0117***	0.0155***		
	(0.000295)	(0.000358)			(0.000544)	(0.000551)		
MP^{soft} x Equity	0.115***	0.104***	0.160***	0.00319*	0.0738***	0.0810***	0.0462***	0.0992***
	(0.00251)	(0.00270)	(0.00324)	(0.00167)	(0.00308)	(0.00311)	(0.00170)	(0.00351)
MP^{soft} x NPE	0.0112***	0.0109***	0.00960***	0.00173***	0.00415***	0.00333***	0.00215***	0.00304***
	(0.000168)	(0.000169)	(0.000170)	(0.000102)	(0.000502)	(0.000503)	(0.000243)	(0.000549)
MAP^{soft} x Equity	-1.170***	-1.150***	-0.969***	-0.0716***	-0.269***	-0.554***	-0.299***	-0.340***
	(0.0209)	(0.0220)	(0.0306)	(0.0155)	(0.0565)	(0.0571)	(0.0278)	(0.0585)
MAP^{soft} x NPE	0.0762***	0.0777***	0.0935***	0.0467***	0.170***	0.159***	0.0601***	0.200***
	(0.00197)	(0.00197)	(0.00199)	(0.00125)	(0.00746)	(0.00747)	(0.00380)	(0.00755)
Equity x NPE	-2.269***	-2.278***	-2.234***	-0.182*	-3.304***	-3.233***	-2.825***	-3.295***
	(0.0664)	(0.0664)	(0.0665)	(0.0938)	(0.0929)	(0.0930)	(0.0539)	(0.0934)
MP^{soft} x MAP^{soft} x Equity	-0.144***	-0.123***	-0.149***	-0.00748***	-0.163***	-0.197***	-0.0495***	-0.141***
	(0.00349)	(0.00360)	(0.00473)	(0.00222)	(0.00805)	(0.00817)	(0.00274)	(0.00851)
MP^{soft} x MAP^{soft} x NPE	0.0121***	0.0116***	0.00926***	0.00488***	0.0182***	0.0191***	0.00578***	0.0115***
	(0.000362)	(0.000363)	(0.000368)	(0.000180)	(0.00103)	(0.00103)	(0.000353)	(0.00105)
MAP^{soft} x Equity x NPE	2.237***	2.251***	2.127***	0.399***	-1.185***	-1.092***	-0.432***	-1.573***
	(0.0448)	(0.0448)	(0.0450)	(0.0289)	(0.112)	(0.112)	(0.0571)	(0.113)
MP^{soft} x Equity x NPE	-0.0834***	-0.0953***	-0.0776***	-0.0322***	0.109***	0.102***	0.0659***	0.0973***
	(0.00564)	(0.00562)	(0.00565)	(0.00354)	(0.00741)	(0.00742)	(0.00349)	(0.00793)
MP^{soft} x MAP^{soft} x Equity x NPE	-0.0798**	-0.118***	-0.0863**	-0.101***	-0.349***	-0.356***	-0.108***	-0.271***
	(0.0365)	(0.0366)	(0.0367)	(0.0159)	(0.0152)	(0.0152)	(0.00539)	(0.0153)
N	17,779,921	17,779,921	17,779,921	16,773,836	29,304,078	29,304,078	28,527,111	29,304,078
R^2	0.341	0.342	0.342	0.922	0.169	0.170	0.170	0.923
Country FE	Y	Y	-	-	Y	Y	-	-
Time FE		Y	-	-		Y	-	-
Country*Time FE			Y	Y			Y	Y
Borrower FE				Y				Y
Bank FE				Y				Y
Oster Beta-Bound (MP^{soft} x MAP^{soft} x Equity x NPE)				-0.10385				-0.26303

Notes: The dependent variable is "(log-)credit granted (drawn and undrawn)" by bank "b" to households "h" (in columns 1 to 4) and to firms "f" (in columns 5 to 8) at time "t". "MP^{soft}" is the first principal component of the monetary policy surprises extracted from the high-frequency intraday yields at different maturities during all dates of policy announcements covered in the sample. We invert the sign of this principal component so that an increase in MP^{soft} corresponds to monetary policy softening. "MAP^{soft}" is a measure of macroprudential softening obtained as the residuals (with inverted sign) from the regression of a variable that for each country counts the implemented macroprudential policies on current GDP and credit growth. An increase in MAP^{soft} denotes a relaxation of macroprudential policy. "NPE" is a dummy variable with a value 1 if the borrower has experienced a non-performing exposure over the sample period, and zero otherwise. The variable "Equity" is obtained as the ratio of bank total equity to total assets. Data are semi-annual for the period from the first half of 2012 to the second half of 2017. "Y" indicates that the respective fixed effects are included. "-" indicates that a group of fixed effects is entirely absorbed by other vectors of fixed effects. The reported "Oster Beta-Bound" is computed for the coefficient of the MP^{soft} x MAP^{soft} x Equity x NPE interaction following Oster (2019), comparing results from models in columns 1 and 4 for households and columns 5 and 8 for firms. Standard errors are clustered at the borrower level in parentheses. *, ** and *** denote statistical significance levels at 10%, 5% and 1% respectively.

Table 6: Policy interactions and firm productivity

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
				Firms			
MP^{soft}	0.00170***			0.00151***			
	(0.000276)			(0.000353)			
MAP^{soft}	0.0845***	0.0693***	0.0500***	0.0587***	0.0355***		
	(0.00585)	(0.00608)	(0.00577)	(0.00733)	(0.00759)		
Equity				0.259	0.202	0.355	0.607***
				(0.238)	(0.241)	(0.244)	(0.147)
Productivity	0.681***	0.681***	0.640***	0.670***	0.670***	0.670***	0.00329
	(0.00591)	(0.00591)	(0.00564)	(0.00698)	(0.00699)	(0.00698)	(0.00327)
MP^{soft} x MAP^{soft}	0.0146***	0.0121***	0.0117***	0.00465***	0.00463***		
	(0.000622)	(0.000629)	(0.000599)	(0.000908)	(0.000900)		
MP^{soft} x Equity				0.0713***	0.0890***	0.0793***	0.0247**
				(0.0249)	(0.0252)	(0.0254)	(0.0116)
MP^{soft} x Productivity	0.00448***	0.00479***	0.00635***	0.000784*	0.000739	0.00104**	0.0000544
	(0.000368)	(0.000368)	(0.000352)	(0.000471)	(0.000470)	(0.000471)	(0.000211)
MAP^{soft} x Equity				-4.849***	-4.540***	-4.635***	-0.453**
				(0.374)	(0.375)	(0.378)	(0.183)
MAP^{soft} x Productivity	0.0494***	0.0518***	0.0599***	0.0582***	0.0626***	0.0607***	0.00231
	(0.00775)	(0.00774)	(0.00728)	(0.00981)	(0.00979)	(0.00978)	(0.00494)
Equity x Productivity				0.394	0.395	0.423	0.572***
				(0.298)	(0.298)	(0.298)	(0.154)
MP^{soft} x MAP^{soft} x Equity				-0.0347	-0.00106	-0.0352	-0.0531***
				(0.0488)	(0.0489)	(0.0495)	(0.0197)
MP^{soft} x MAP^{soft} x Productivity	0.0140***	0.0135***	0.0124***	0.00363***	0.00318***	0.00335***	0.00318***
	(0.000870)	(0.000871)	(0.000830)	(0.00123)	(0.00123)	(0.00123)	(0.000455)
MAP^{soft} x Equity x Productivity				-4.113***	-4.154***	-4.017***	-0.186
				(0.482)	(0.482)	(0.482)	(0.224)
MP^{soft} x Equity x Productivity				-0.0468	-0.0486	-0.0573*	-0.0330**
				(0.0328)	(0.0328)	(0.0329)	(0.0145)
MP^{soft} x MAP^{soft} x Equity x Productivity				-0.164**	-0.172***	-0.170**	-0.231***
				(0.0659)	(0.0660)	(0.0660)	(0.0256)
N	2,576,547	2,576,547	2,576,530	1413834	1413834	1413834	1304122
R^2	0.0731	0.0734	0.157	0.0723	0.0729	0.0736	0.902
Country FE	Y	Y	Y	Y	Y	-	-
Time FE		Y	Y		Y	-	-
Country*Time FE						Y	Y
Bank FE			Y				Y
Borrower FE							Y
Oster Beta-Bound (MP^{soft} x MAP^{soft} x Productivity)			0.0115				
Oster Beta-Bound (MP^{soft} x MAP^{soft} x Equity x Productivity)							-0.23891

Notes: The dependent variable is "(log-)credit granted (drawn and undrawn)" by bank "b" to firms "f" at time "t". "MP^{soft}" is the first principal component of the monetary policy surprises extracted from the high-frequency intraday yields at different maturities during all dates of policy announcements covered in the sample. We invert the sign of this principal component so that an increase in MP^{soft} corresponds to monetary policy softening. "MAP^{soft}" is a measure of macroprudential softening obtained as the residuals (with inverted sign) from the regression of a variable that for each country counts the implemented macroprudential policies on current GDP and credit growth. An increase in MAP^{soft} denotes a relaxation of macroprudential policy. "Productivity" is a dummy variable with a value of 1 if a firm has TFP above the cross-sectional median of all firms within the same sector and country. "Equity" is a variable obtained as the ratio of bank total equity to total assets. Data are semi-annual for the period from the first half of 2012 to the second half of 2017. "Y" indicates that the respective fixed effects are included. "-" indicates that a group of fixed effects is entirely absorbed by other vectors of fixed effects. The reported "Oster Beta-Bound" for the coefficient of the MP^{soft} x MAP^{soft} x Productivity interaction compares results from models in columns 1 and 3 following Oster (2019). Applying the same methodology, the reported "Oster Beta-Bound" for the coefficient of the MP^{soft} x MAP^{soft} x Equity x Productivity interaction compares results from models in columns 4 and 7. Standard errors are clustered at the borrower level in parentheses. *, ** and *** denote statistical significance levels at 10%, 5% and 1% respectively.

Table 7: Policy interactions, bank capital and the risk-taking channel: household mortgages *vs.* consumer loans

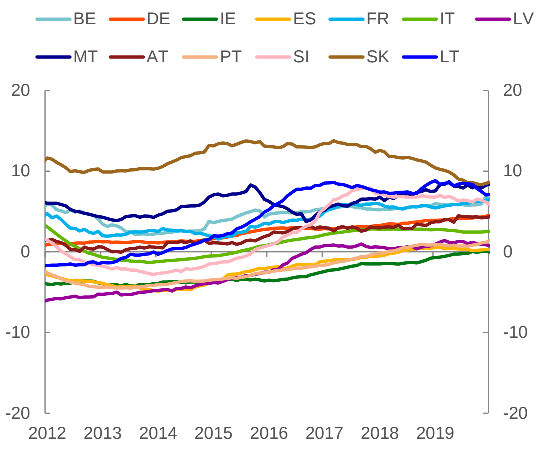
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Mortgages				Consumer Loans			
MP^{soft}	0.00280***				0.00444***			
	(0.0000589)				(0.000228)			
MAP^{soft}	0.0313***	0.0623***			0.0779***	0.000811		
	(0.000760)	(0.00173)			(0.00234)	(0.00247)		
Equity	0.650***	0.713***	0.947***	0.281***	0.826***	0.868***	0.229***	0.823***
	(0.0380)	(0.0386)	(0.0397)	(0.0195)	(0.0363)	(0.0368)	(0.0306)	(0.0387)
NPE	-0.168***	-0.174***	-0.187***	-0.0990***	-0.591***	-0.589***	-0.238***	-0.588***
	(0.00958)	(0.00958)	(0.00957)	(0.00421)	(0.0157)	(0.0157)	(0.00943)	(0.0157)
MP^{soft} x MAP^{soft}	0.00164***	0.000191			0.0189***	0.0111***		
	(0.000115)	(0.000303)			(0.000389)	(0.000417)		
MP^{soft} x Equity	-0.124***	-0.114***	-0.169***	-0.0300***	-0.0720***	-0.108***	-0.0499***	-0.132***
	(0.00247)	(0.00273)	(0.00347)	(0.00167)	(0.00297)	(0.00324)	(0.00223)	(0.00401)
MP^{soft} x NPE	0.0248***	0.0248***	0.0246***	0.00267***	0.0281***	0.0303***	0.0173***	0.0314***
	(0.00118)	(0.00118)	(0.00118)	(0.000430)	(0.00196)	(0.00197)	(0.00120)	(0.00199)
MAP^{soft} x Equity	-0.528***	-0.419***	-0.426***	-0.0196**	-1.165***	-0.863***	-0.136***	-1.045***
	(0.0215)	(0.0227)	(0.0340)	(0.0041)	(0.0232)	(0.0242)	(0.0199)	(0.0354)
MAP^{soft} x NPE	0.0474***	0.0613***	0.0835***	0.0924***	0.0311*	0.0450***	0.600***	0.0539***
	(0.0110)	(0.0110)	(0.0110)	(0.00415)	(0.0162)	(0.0162)	(0.00986)	(0.0166)
Equity x NPE	5.035***	5.026***	5.009***	0.427***	-1.976***	-1.977***	-0.267***	-1.964***
	(0.232)	(0.232)	(0.232)	(0.137)	(0.111)	(0.111)	(0.0722)	(0.111)
MP^{soft} x MAP^{soft} x Equity	-0.146***	-0.145***	-0.417***	-0.0337***	-0.159***	-0.161***	-0.0274***	-0.198***
	(0.00340)	(0.00351)	(0.00559)	(0.00180)	(0.00407)	(0.00424)	(0.00304)	(0.00556)
MP^{soft} x MAP^{soft} x NPE	0.0333***	0.0333***	0.0293***	0.00206***	0.0368***	0.0354***	0.0272***	0.0367***
	(0.00225)	(0.00225)	(0.00226)	(0.000699)	(0.00308)	(0.00308)	(0.00183)	(0.00312)
MAP^{soft} x Equity x NPE	0.285	0.315	0.498**	1.111***	0.869***	0.831***	3.064***	0.746***
	(0.213)	(0.213)	(0.212)	(0.0910)	(0.124)	(0.124)	(0.0788)	(0.125)
MP^{soft} x Equity x NPE	0.0437	0.0376	0.0323	0.0528***	-0.303***	-0.314***	-0.0869***	-0.303***
	(0.0315)	(0.0315)	(0.0314)	(0.0123)	(0.0211)	(0.0211)	(0.0134)	(0.0212)
MP^{soft} x MAP^{soft} x Equity x NPE	-0.0465	-0.0367	-0.0510	-0.0113	-0.415***	-0.406***	-0.124***	-0.394***
	(0.0413)	(0.0413)	(0.0411)	(0.0148)	(0.0282)	(0.0283)	(0.0180)	(0.0284)
N	8638301	8638301	8638301	7897307	12448795	12448795	12448795	11858623
R^2	0.215	0.215	0.216	0.915	0.265	0.265	0.265	0.883
Country FE	Y	Y	-	-	Y	Y	-	-
Time FE		Y	-	-		Y	-	-
Country*Time FE			Y	Y			Y	Y
Borrower FE				Y				Y
Bank FE				Y				Y
Oster Beta-Bound (MP^{soft} x MAP^{soft} x Equity)				-0.02006				-0.20538
Oster Beta-Bound (MP^{soft} x MAP^{soft} x NPE)				-0.00173				0.03668
Oster Beta-Bound (MP^{soft} x MAP^{soft} x Equity x NPE)				-0.00703				-0.39002

Notes: The dependent variable is "(log-)credit granted (drawn and undrawn)" by bank "b" to households "h" at time "t", either in the form of mortgages (columns 1 to 4) or consumer loans (columns 5 to 8). "MP^{soft}" is the first principal component of the monetary policy surprises extracted from the high-frequency intraday yields at different maturities during all dates of policy announcements covered in the sample. We invert the sign of this principal component so that an increase in MP^{soft} corresponds to monetary policy softening. "MAP^{soft}" is a measure of macroprudential softening obtained as the residuals (with inverted sign) from the regression of a variable that for each country counts the implemented macroprudential policies on current GDP and credit growth. An increase in MAP^{soft} denotes a relaxation of macroprudential policy. "NPE" is a dummy variable with a value of 1 if the borrower has experienced a non-performing exposure over the sample period, and zero otherwise. The variable "Equity" is obtained as the ratio of bank total equity to total assets. Data are semi-annual for the period from the first half of 2012 to the second half of 2017. "Y" indicates that the respective fixed effects are included. "-" indicates that a group of fixed effects is entirely absorbed by other vectors of fixed effects. All the reported "Oster Beta-Bound(s)" are computed comparing the relevant coefficient in models 1 and 4 for mortgages and 5 and 8 for consumer loans following Oster (2019). Standard errors are clustered at the borrower level in parentheses. *, ** and *** denote statistical significance levels at 10%, 5% and 1% respectively.

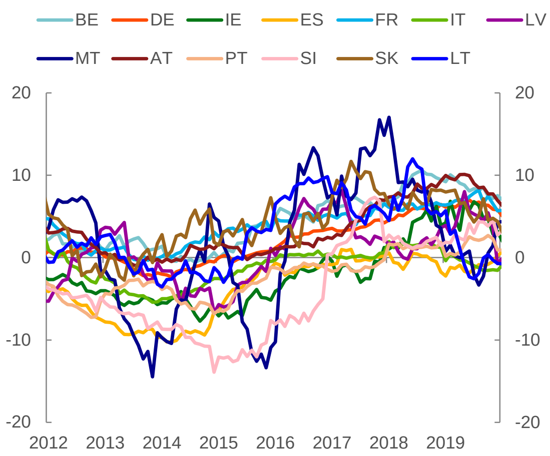
Figures

Figure 1: Evolution of the growth rate of total loans to households and non-financial corporations by country

Panel A: Households



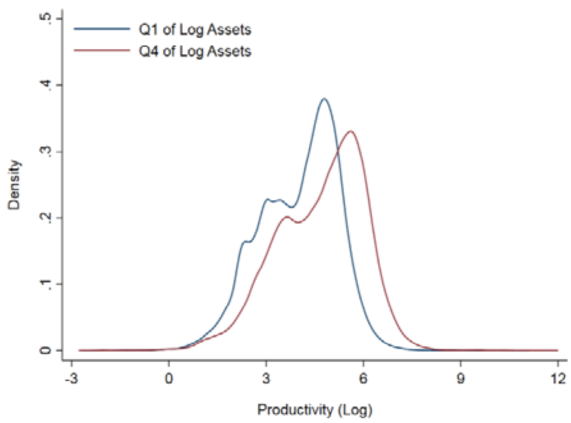
Panel B: Non-financial corporations



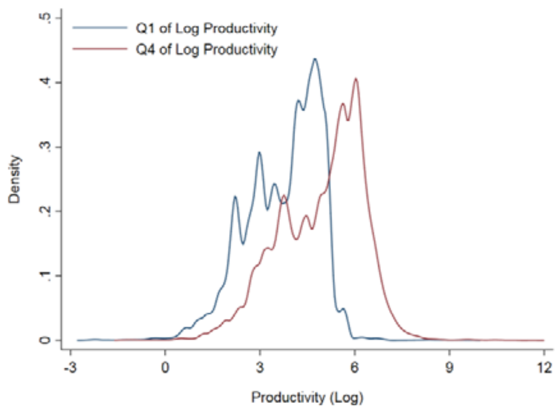
Note: The chart shows the time series of annual growth of loans to households (Panel A) and non-financial corporations (Panel B) across countries.

Figure 2: Productivity

Panel A: Size



Panel B: Quartiles of firm distribution

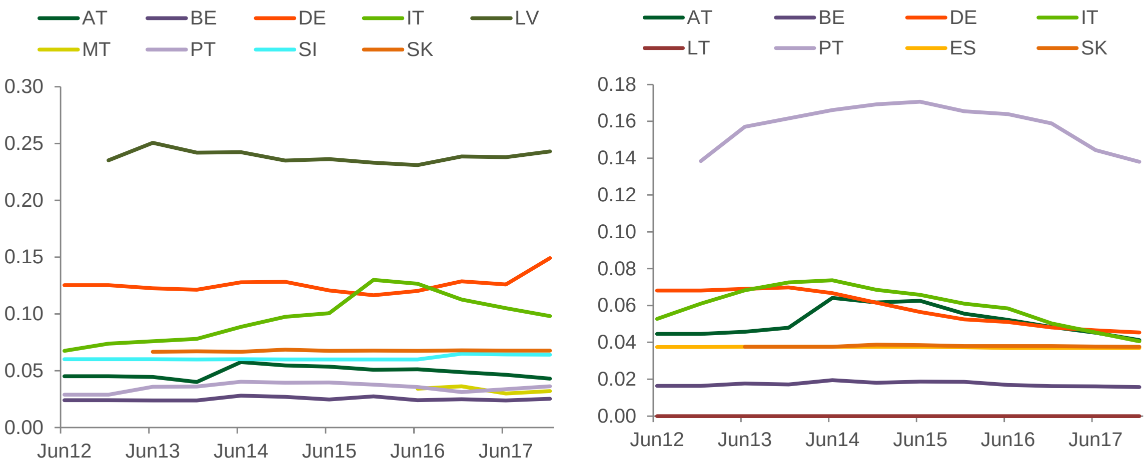


Note: The figure shows the first and fourth quartile of the distribution of firm size (Panel A) and firm productivity (Panel B) for the sample of firms used in the estimation.

Figure 3: Non-performing exposures (NPE)

Panel A: Households

Panel B: Non-financial corporations

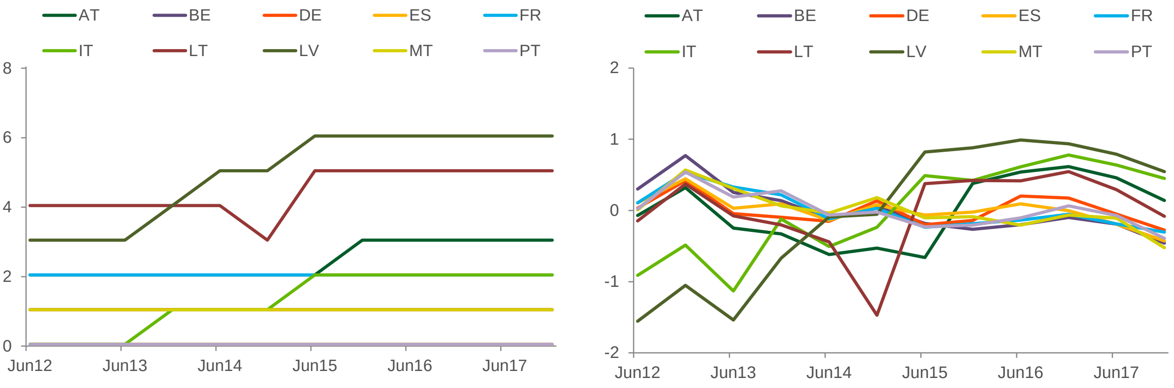


Note: The chart shows the time series of the average non-performing exposure, i.e. exposure in default and/or past due by more than 90 days, for households (Panel A) and non-financial corporations (Panel B) across countries.

Figure 4: Macroprudential index

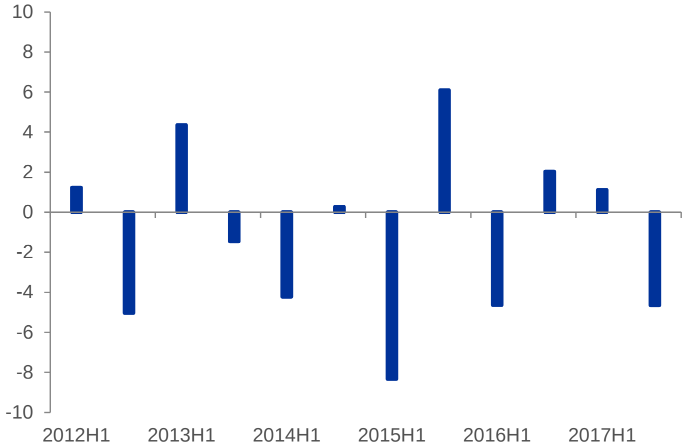
MAPI index

MAP index adjusted for economic developments



Notes: The left-hand panel reports the index of macroprudential policy intensity (MAPI) based on the number of measures that are being put in place at a given point in time. The index adds (subtracts) 1 if a new measure that is implemented tightens (loosens) macroprudential policy. Further details on the construction of the index are reported in Appendix 1. The right-hand panel reports the MAP variable, obtained as the residuals of a regression of the MAPI index against current GDP and credit growth. In contrast, in regression tables we use the MAP^{soft} variable, which corresponds to the MAP variable depicted here on the right-hand panel but with inverted sign, so that an increase in MAP^{soft} corresponds to a relaxation of macroprudential policy.

Figure 5: Monetary policy surprises



Notes: The figure reports the monetary policy surprise constructed as a principal component of all monetary surprises from high-frequency intraday data on risk-free (overnight index swap) rates with different maturities, ranging from one month to ten years. These surprises are calculated by measuring changes in risk free rates in a narrow time window around official monetary policy communications. In contrast, in regression tables we use the monetary policy surprise with inverted sign, labelled as MP^{soft}, so that an increase of MP^{soft} denotes monetary policy softening.

Appendix 1 – Construction of the Macroprudential Policy Index

The underlying data source for the construction of the Macroprudential Policy Index (MAP index) is Budnik and Kleibl (2018), who construct a comprehensive dataset on policies of a macroprudential nature in the banking sectors of the 28 EU Member States between 1995 and 2014. The database encompasses ten distinct categories of macroprudential policies:[19]

1. Minimum capital requirements
2. Capital buffers
3. Risk weights
4. Leverage ratios
5. Lending standard restrictions
6. Levy/tax on financial institutions and activities
7. Limits on large exposures and concentration
8. Liquidity requirements and limits on currency and maturity mismatches
9. Loan-loss provisioning
10. Limits on credit growth and volume

Following the literature on macroprudential policy instruments, we construct two versions of the MAP index. First, we construct an index encompassing all policy measures, both borrower-based and lender-based, indicating the overall strength of macroprudential regulation in each country. Second, we construct a sub-index of solely borrower-based policy measures, encompassing limits to the loan-to-value, loan-to-income, debt-to-income and debt-service-to-income ratios. These policies all fall into the category of "Lending standards restrictions". We construct two versions of each index based on the "Announcement date" and the "In force since" date.

The dataset by Budnik and Kleibl (2018) collects policy measures based on both the "Announcement date" and the "In force since" date, i.e. the date from which a specific policy measure has been in force. Since we are interested in the construction of an index spanning the same time period for each country, we fill in any missing time periods. We thus construct a bi-annual "balanced" panel dataset for the 28 EU countries running from the first half of 1994 to the second half of 2017.[20]

The index we build takes a value of between 1 and 10 and captures the extensive margin of macroprudential policy, i.e. whether or not at least one tool within each of the above

[19] We focus on macroprudential measures exclusively and, hence, disregard the category "Other measures", which include other crisis management tools and structural measures.
[20] Note that we fill in the missing observations just to have consecutive dates. All missing policy variables are filled in and, hence, enter the calculation of the index values, with the default value of zero.

categories has been in force. The index does not capture the intensity, i.e. the number of distinct tools in place within each category.

The two indices are constructed following the same logic outlined in the following steps:

- For each country, we count the number of policies in place within each category. To do so, we assign values {-1, 0, +1} for each category according to the following rules:[21]
    - We assign a value of +1 for each new activation of a tool that led to policy tightening or that had an ambiguous impact depending on the state of the business cycle;
    - We assign a value of 0 for each policy measure that constituted a change in the level of an existing tool or maintained an existing level or scope of a policy tool;
    - We assign a value of -1 in the case of (i) the deactivation of an existing tool, and (ii) the activation of a new tool that led to policy loosening.
- We add up the values obtained in 1) for each half-year, category and country. This indicates the net addition of policy measures to the policy mix within each category relative to the preceding half-year.
- For each country, we calculate the cumulative sum over the sample period within each category. This indicates the evolution of the total number of measures (both previously and newly activated tools) in place within each category over time.
- As mentioned above, we are interested in the *extensive margin* of macroprudential regulation only. In this step, we hence assign a value of 1 if the number calculated in step 3) is positive for each country, category and half-year.[22]
- We calculate the value of the MAP index in any half-year as the sum of the values obtained in step 5) across all ten categories. As indicated above, the index can thus take values of between zero and 10, where zero indicates that there were no measures active in any of the ten considered categories and 10 means that within each category at least one measure has been active.

[21] Note that we set the default value to zero and replace the observations according to the criteria. In some cases a new policy leading to the deactivation or the change of an existing tool cannot be traced to a previous activation of the tool. In these instances, we assume the respective policy has been in place since the beginning of the sample period, i.e. the first half of 1994.

[22] It is worthwhile emphasizing that we are not interested in the *intensity* of regulation in place and thus do not consider the total number of distinct policies that have been in place within each category.

Appendix 2 – Additional information on the dataset and further robustness

Table A2.1: Number of observations by country

	Households		Firms	
	Number of observations	Number of households	Number of observations	Number of firms
Country				
Austria	452,532	73,177	695,743	68,539
Belgium	4,681,811	460,860	8,205,390	537,834
Germany	689,330	122,618	5,384,682	560,334
Spain	-	-	23,629,274	1,096,536
France	6,110,020	535,653	29,599,290	2,193,441
Italy	97,742,566	9,538,577	48,954,134	1,505,793
Lithuania	-	-	378,435	24,885
Latvia	11,715,836	911,564	-	-
Malta	394	101	-	-
Portugal	101,669	8,952	8,543,131	373,673
Slovenia	226,297	89,516	-	-
Slovakia	351,116	41,348	729,465	66,614
Czech Republic	2,386,470	237,924	2,760,874	182,348
Romania	16,542,279	1,751,993	3,556,894	200,233
Total	141,000,320	13,772,283	132,437,312	6,810,230

Notes: The table reports the total number of observations and the number of unique cross-sectional units for firms and households in each country. Note that, in addition to euro area countries, the table also reports numbers for Romania and the Czech Republic. Although these two countries belong to the European Union, they have not yet joined the Economic and Monetary Union (EMU) and therefore maintain independent monetary and supervisory authorities.

Table A2.2: Single and multiple lending relationships by country

	Single	Multiple	Total	% multiple lending	
				number of multiple relationships	volume of multiple relationships
Panel A) Household					
Austria	393,403	59,129	452,532	13%	24%
Belgium	3,724,823	927,214	4,652,037	20%	25%
Germany	585,349	103,981	689,330	15%	30%
France	5,078,031	1,031,989	6,110,020	17%	19%
Italy	77,165,035	20,577,531	97,742,566	21%	22%
Latvia	6,035,247	5,680,589	11,715,836	48%	49%
Malta	386	8	394	2%	1%
Portugal	50,911	50,758	101,669	50%	52%
Slovenia	180,066	46,231	226,297	20%	47%
Slovakia	313,750	37,366	351,116	11%	17%
Czech Republic	1,764,193	291,688	2,055,881	14%	20%
Romania	14,540,163	2,002,116	16,542,279	12%	15%
Panel B) Firms					
Austria	376,594	319,149	695,743	46%	59%
Belgium	4,389,058	3,699,631	8,088,689	46%	62%
Germany	3,206,467	2,178,215	5,384,682	40%	58%
Spain	6,934,882	16,694,392	23,629,274	71%	76%
France	18,314,138	11,285,152	29,599,290	38%	66%
Italy	11,178,256	37,775,878	48,954,134	77%	87%
Lithuania	264,138	114,297	378,435	30%	41%
Portugal	2,045,832	6,497,299	8,543,131	76%	80%
Slovakia	531,426	198,039	729,465	27%	50%
Czech Republic	1,712,357	1,048,517	2,760,874	38%	52%
Romania	1,369,022	2,187,872	3,556,894	62%	66%

Notes: The table summarises the number of single and multiple lending relationships for households (Panel A) and firms (Panel B) in each country. The last two columns show the percentage of multiple lending for firms in terms of number of relationships and volume of outstanding amount of lending. Note that, in addition to euro area countries, the table also reports numbers for Romania and the Czech Republic. Although these two countries belong to the European Union, they have not yet joined the Economic and Monetary Union (EMU) and therefore maintain independent monetary and supervisory authorities.

Table A2.3: Estimation using weighted least squares and different clustering

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	Households			Consumer Credit			Mortgage			Firm		
	OLS	WLS	WLS clustered SE	OLS	WLS	WLS clustered SE	OLS	WLS	WLS clustered SE	OLS	WLS	WLS clustered SE
MP^{soft}	0.00736***	0.0115***	0.0115***	0.00693***	0.00708***	0.00708***	0.00357***	0.00323***	0.00323***	0.00482***	0.00514***	0.00514***
	(0.0000229)	(0.0000380)	(0.0000181)	(0.000153)	(0.000149)	(0.0000794)	(0.0000248)	(0.0000238)	(0.0000124)	(0.000198)	(0.0000441)	(0.0000284)
MAP^{soft}	0.164***	0.123***	0.123***	0.0270***	0.0276***	0.0276***	0.0230***	0.0249***	0.0249***	0.00564***	0.00571***	0.00571***
	(0.000381)	(0.000283)	(0.000364)	(0.000675)	(0.000676)	(0.000714)	(0.000191)	(0.000183)	(0.000231)	(0.000626)	(0.000426)	(0.000547)
MP^{soft} x MAP^{soft}	0.00514***	0.00607***	0.00607***	0.00747***	0.00947***	0.00947***	0.000595***	0.000680***	0.000680***	0.000893***	0.00687***	0.00687***
	(0.0000377)	(0.000700)	(0.000338)	(0.000171)	(0.000171)	(0.0000821)	(0.0000473)	(0.0000455)	(0.0000229)	(0.0000485)	(0.0000921)	(0.0000598)
N	89,567,025	89,567,025	89,567,025	44,322,141	44,322,141	44,322,141	58,631,610	58,631,610	58,631,610	68,611,631	68,611,631	68,611,631
R^2	0.268	0.131	0.131	0.0104	0.0129	0.0129	0.00614	0.00644	0.00644	0.182	0.122	0.122
Country FE	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y

Notes: The dependent variable is "total (log-)credit granted (drawn and undrawn)" by bank "b" to households "h" (in columns 1 to 3) - broken down into consumer loans (columns 4 to 6) and mortgages (columns 7 to 9) – and "total (log-)credit granted (drawn and undrawn)" by bank "b" to firms "f" (in columns 10 to 12). In columns 1, 4, 7 and 10, the table reports the results obtained with simple OLS and clustering at the borrower level. In columns 2, 5, 8 and 11, the table reports the results obtained with weighted least squares and clustering at the borrower level. The weighting scheme is built using the log of total credit commitment as a weight for each observation. In columns 3, 6, 9 and 12, the table reports the results obtained with weighted least squares and clustering at the borrower and country*time level. "MP^{soft}" is the first principal component of the monetary policy surprises extracted from the high-frequency intraday yields at different maturities during all dates of policy announcements covered in the sample. We invert the sign of the principal component so that an increase in MP^{soft} corresponds to monetary policy softening. "MAP^{soft}" is a measure of macroprudential softening obtained as the residuals (with inverted sign) from the regression of a variable that for each country counts the implemented macroprudential policies on current GDP and credit growth. An increase of MAP^{soft} denotes a relaxation of macroprudential policy. *, ** and *** denote statistical significance levels at 10%, 5% and 1% respectively.

Table A2.4: Estimation for corporate loans using firm*time fixed effects

	(1)	(2)	(3)	(4)	(5)
			Firms		
Equity	0.461***				
	(0.0410)				
MP^{soft} x Equity	0.0259***				
	(0.00270)				
MAP^{soft} x Equity	-0.293***				
	(0.0423)				
MP^{soft} x MAP^{soft} x Equity	-0.0303***				
	(0.00421)				
MP^{soft} x MAP^{soft} x Equity x NPE		-0.0668***	-0.0458***		
		(0.00889)	(0.00890)		
MP^{soft} x MAP^{soft} x Equity x Productivity				-0.145***	-0.139***
				(0.0465)	(0.0162)
N	12,557,322	12,557,314	12,557,314	741,400	741,400
R^2	0.948	0.948	0.948	0.936	0.943
Bank*Firm FE	Y	Y	Y	Y	Y
Firm*Time FE	Y	Y	Y	Y	Y
Bank*Time FE			Y		Y

Notes: The dependent variable is "(log-)credit granted" by bank "b" to firms "f" at time "t". "MP^{soft}" is the first principal component of the monetary policy surprises extracted from the high-frequency intraday yields at different maturities during all dates of policy announcements covered in the sample. We invert the sign of this principal component so that an increase in MP^{soft} corresponds to monetary policy softening. "MAP^{soft}" is a measure of macroprudential softening obtained as the residuals (with inverted sign) from the regression of a variable that for each country counts the implemented macroprudential policies on current GDP and credit growth. An increase of MAP^{soft} denotes a relaxation of macroprudential policy. "NPE" is a dummy variable that takes a value of 1 if the firm has experienced a non-performing exposure over the sample period, and zero otherwise. "Productivity" is a dummy variable with a value of 1 if a firm has TFP above the cross-sectional median of all firms within the same sector and country. "Equity" is obtained as the ratio of bank total equity to total assets. Data are semi-annual for the period from the first half of 2012 to the second half of 2017. "Y" indicates that the respective fixed effects are included. "-" indicates that a group of fixed effects is entirely absorbed by other vectors of fixed effects. Standard errors are clustered at the borrower level in parentheses. *, ** and *** denote statistical significance levels at 10%, 5% and 1% respectively.