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DOES BANK COMPETITION MATTER FOR THE EFFECTS OF MACROPRUDENTIAL POLICY ON PROCYCLICALITY OF LENDING?

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Key words: loans growth, macroprudential policy, competition intensity, procyclicality of lending

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Does bank competition matter for the effects of macroprudential policy on procyclicality of lending?

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Abstract

Competition is an inherent and natural environment under which banks operate and extend loans. Despite the extensive debate on the impact of bank competition on risk-taking and procyclicality, there is no evidence of its role in the effects of macroprudential policy on loans' growth and on the sensitivity of lending to the business cycle. Using over 70,000 bank-level observations in 109 countries in 2004-2015 we find that increased competition strengthens the countercyclical effects of MPI in terms of reduced loans' growth. Bank lending is procyclical in perfectly competitive industry. However, any decrease in the intensity of competition in countries not applying macroprudential policy instruments is related with increased procyclicality of lending. Sensitivity of lending to business cycle in countries implementing macroprudential policy depends on the type of macroprudential policy instrument and on the length of the use of instruments. We show that extended duration of use of cyclical macroprudential instruments is associated with increased procyclicality of lending. In a perfectly competitive environment we find increased procyclicality of credit in countries using cyclical instruments and decreased procyclicality of credit in countries applying balance-sheet oriented instruments. Under imperfectly competitive banking sector we find the opposite effects of macroprudential instruments on procyclicality of credit.

Key words: loans growth, macroprudential policy, competition intensity, procyclicality of lending

JEL classification: E32, G21, G28, G32

1. Introduction

Macroprudential policies aim to enhance financial stability by reducing the risks resulting from excessive procyclicality of the financial sector and from interconnectedness between financial intermediaries. Procyclicality denotes the financial systems' tendency to amplify financial fluctuations, and the core of this mechanism is the self-reinforcing interaction between funding constraints, asset prices, and risk-taking (Borio et al., 2001, 2014). One of the goals of macroprudential policy instruments is to limit excessive procyclicality of bank lending. To counteract this procyclicality macroprudential instruments are expected reduce credit growth and to smooth the sensitivity of credit to business cycle (ESRB, 2014; IMF-FSB-BIS, 2016).

Empirical research shows heterogeneity in bank cyclicality across countries and provides some evidence about its underlying factors (Albertazzi and Gambacorta, 2009; Lim et al., 2011; Bouvatier et al., 2012; Bertay et al., 2015; Olszak et al., 2018; Leroy and Lucotte, 2018). Albertazzi and Gambacorta (2009) find that the profits of banks in Anglo-Saxon countries are more procyclical than are those of euro-area banks. However, this study does not show why there is difference in procyclicality across country groups. Lim at al. (2011), show that growth and procyclicality of aggregated credit in 49 countries depends on the use of macroprudential policy

instruments. Bertay et al. (2015) suggest that procyclicality of credit depend on the characteristics of shareholders (state owned versus privately owned banks). Bouvatier et al. (2012) show that credit in 17 OECD countries is procyclical, but it does not seem to be affected by the structure of the banking market. Olszak et al. (2018) show that some of macroprudential policy instruments, are effective in reducing the procyclicality of LLP of individual banks. Leroy and Lucotte (2019), using individual bank data, show that the lending of 16 European banks is more procyclical in economies where bank competition is weak. As can be seen from the previous empirical work, the procyclicality of lending is affected by many factors, including macroprudential policies, and by competition. These studies focus on each of these factors individually. Thus, we do not know either if there is any interaction between macroprudential policy and competition or its potential effects on the procyclicality of credit in micro-level data.

The present study aims to fill a gap in the literature by examining whether and how competition in the banking sector interacts with macroprudential policies in shaping credit growth and sensitivity of credit growth to business cycle. To the best of our knowledge this issue has so far been neglected in the empirical literature. In theory, both the competition and macroprudential policy are external factors that shape the cyclicality of bank lending activity, as they operate in the risk-taking channel of the banking activity (Danielsson et al., 2016). Depending on different factors, competition may both increase (in line with competition-fragility view) and decrease (in line with the competition-stability view) bank risk-taking (see Section 2). Macroprudential policy is expected to reduce bank risk (IMF-FSB-BIS, 2016). However, evidence in this respect is mixed, and provides support to this view for some instruments (Altunbas et al., 2018; Gaganis et al., 2020). As competition does matter for bank risk taking, it may also shape the effects of macroprudential policy on cyclicality of lending. This issue, however, has not been under empirical scrutiny, thus we do not know what is the association between competition and the effects of macroprudential policy.

The research on the role of competition in cyclicality of bank lending shows that procyclicality is reduced in countries with more competitive banking sectors (Leroy and Lucotte, 2019). This finding is however, limited to a small sample of 12 European banking sectors. Thus we do not know whether these results hold generally for a larger sample of countries. The research on the role of macroprudential policy in bank credit growth shows diversified, but reduced, growth of credit in countries using macroprudential policy instruments. This research, however, omits the role of competition in the banking sector. The evidence for the links between sensitivity of lending to busines cycle and macroprudential policies is not convincing, and provides mixed conclusions (Lim et al., 2011; Cerutti et al., 2017), and even support the warning by Danielsson et al. (2016), that macroprudential policies can end up being procyclical (Gambacorta and Murcia, 2020).

Therefore, several questions arise as for how competition in the banking sector and macroprudential policies work together and whether they are complements or substitutes. For example, if competition in the banking sector is, in general, intense, is there a need to introduce macroprudential regulations? Similarly, if macroprudential regulations can effectively reduce credit growth or procyclicality of credit, does intense competition enhance these effects? Alternatively, if the use of macroprudential policies is related with increased (decreased) procyclicality of credit, what is needed to modify this procyclicality, is it low or high competition?

Answering these questions is important from both academics and policy decision-makers. The academic research on this topic has not focused thus far on the role of competition for the conduct of macroprudential policy. As competition in the banking sector is diversified across countries, and also those applying macroprudential policy, empirical research in this area is needed to find whether some degree of market power is beneficial for the effects of prudential tools applied from the macro-level perspective. Regulators and supervisory authorities responsible for the implementation of the objectives of this policy should take into account the degree of market-power in the banking sector, because it affects both bank risk-taking [and fragility, see Beck et al. (2013)] and the procyclicality of lending [see Leroy and Lucotte (2019)].

In this study, we use a large panel of bank-level financial data from 109 countries in 2004–2015. Following Leroy and Lucotte (2019) to assess the role of competition in individual bank credit procyclicality and its diversity in countries using macroprudential policy we use macro-level data of the business cycle and of bank competition and bank-level data on loans growth. Our main findings are as follows. First, we show that competitive environment does essentially matter for the link between loans growth and macroprudential policy. In particular, we find that increased competition strengthens the countercyclical effects of MPI in terms of reduced loans' growth. Second, bank lending is procyclical in perfectly competitive industry. However, any decrease in the intensity of competition in countries not applying macroprudential policy instruments is related

with increased procyclicality of lending. Third, the sensitivity of lending to business cycle in countries implementing macroprudential policy depends on the type of macroprudential policy instrument. In particular, we find increased procyclicality of credit to business cycle in countries using cyclical instruments and for dynamic provisions and interbank limits. Thus, our results, in particular for cyclical instruments, are in line with the hypothesis that use of macroprudential policy is associated with increased procyclicality. Fourth, the association between the macroprudential policy and procyclicality does depend on the duration of the use of instruments. Our general finding is in line hypothesis that extended duration of use of macroprudential instruments, is associated with increased procyclicality of lending. This effect is especially true of such cyclical instruments as Ltv_cap, Dti and Rr_rev. Fifth, competitive environment shapes the link between the loans growth and business cycle in countries using macroprudential policy instruments. Sixth, the association between competition and sensitivity of credit to business cycle depends substantially on the length of use of particular instruments as well as on the type of instruments.

The rest of this paper is structured as follows. We describe our sample and research methodology in Section 2. We discuss results in Section 3. Robustness checks are presented in Section 4. Section 5 concludes our work.

2. Literature review and hypotheses development

This paper aims to determine the role of competition in the effects of macroprudential policy on cyclicality of individual bank lending. Thus, it is directly linked to the following research areas: (1) procyclicality of credit and its sources; (2) macroprudential policy and its effects on cyclicality of credit; (3) competition and its channels in affecting cyclicality of lending.

2.1. Theoretical aspects

Understanding the factors that affect procyclicality of credit is critically important in designing effective regulatory, supervisory, and macroeconomic policy frameworks. Credit multiplier (or financial accelerator) theoretical research has argued that endogenous developments in the financial markets can amplify greatly the effects of relatively small income shocks through the economy (Bernanke et al., 1996, 1999; Kiyotaki and Moore, 1997). The key idea behind this concept is the notion that changes (shocks) to the net worth of non-financial firms and households have a procyclical effect on their borrowing capacity. This can result from information asymmetries that bring about countercyclical movements in the cost gap between external and internal finance [the so called external finance premium, see Bernanke and Gertler (1989)] or from positive effects of the changes in the value of collateral on the external financing capacity (Kiyotaki and Moore, 1997). Consequently, credit becomes more expensive and less accessible in economic downturns, even for high quality borrowers, whereas the opposite is true during economic upturns and booms (Almeida et al., 2006). Financial accelerator theory is generally applicable to explaining large swings in the economic activity and the occurrence of financial crises. Alternate theories attribute procyclicality to either mismeasurement or inadequate responses to risks over the business cycle (see Minsky, 1987; Borio at al., 2001; Borio, 2014), and see risk-taking as a *causa* of procyclicality and, thus, financial crises, not merely as an amplifying mechanism. Under these theories, banks underestimate and take-on excessive risks during economic expansions and overestimate them and reduce risk-taking during recessions. In effect, credit booms and busts emerge. According to these risk-mismeasurement and inadequate risk-response views, excessive procyclicality (in particular) of bank credit increases the probability of the occurrence of a financial crisis (Reinhart and Rogoff, 2009; Borio, 2014).

Many factors can affect this inherent procyclicality of the banking sector. Borio et al. (2001) indicate that the "wrong model of the economy" and assumption of the rational behavior of economic agents is applied in designing policy-decisions. Instead, in the decision-making, economic agents follow cognitive biases, identified in behavioral finance (see Berberis and Thaler, 2003), and this is ignored in the standard model of the economy. Athanasoglou et al. (2014) point to the drivers either enhancing or mitigating this mismeasurement of, and wrong responses to, risks of the business cycle (see also Borio et al., 2001). These factors include, e.g., the regulatory and supervisory framework, credit agency ratings and automated credit risk modelling, and assumed exogeneity of the business cycle.

The goal of our paper is to address these issues by analyzing the impact of the degree of banking competition on the effects of macroprudential policy on loans' growth and procyclicality of credit of individual

banks. We look at both credit growth and sensitivity of lending to business cycle because these two areas are important intermediate objectives of macroprudential policy. To build hypotheses about the links between competition and the role of macroprudential policy in cyclicality of credit we look at two streams of the literature. The first one is the classical economic theory about the role of competition in shaping procyclicality of credit. These papers are however, mainly focusing on macroeconomic dimensions of procyclicality. As in our study we are interested in loans growth of individual bank, we need to look at the finance literature focusing on the role of competition in risk-taking and financial stability of banks. Therefore the second stream of theoretical research used in our study will us insights into the links between risk-taking and competition. As we have already mentioned, risk-taking is important factor behind procyclicality. Considering that competition is a affecting risk-taking, it can also shape the cyclicality of lending.

The economic literature building on classical theories offers some insights on the effects of selected macroprudential policy instruments and on the role of competition in the inherent credit procyclicality. Andres and Arce (2012) look at the role of increased competition in the banking sector for economic fluctuations. Their model shows that stronger competition among banks raises output over the long run. As they suggest, the effects of banking competition on the economy's short-run dynamics are more complex. In particular, in face of a contractionary monetary shock, both housing prices and total output exhibit a larger and more persistent fall as the banking sector becomes more competitive. Their model shows that, in the face of monetary shocks, stronger banking competition works as an amplification mechanism of net worth effects — and, therefore, might weaken the countercyclical stabilization policy. Thus, the study by Andres and Arce (2012) suggests that competition intensity is exogenous with respect to macroeconomic policy (here, the contractionary monetary policy). Therefore, we might expect that it shapes the impact of macroprudential policy on credit growth and its procyclicality. Ravn (2016) assumes that the banks' loan market operates under monopolistic competition and shows that the presence of lending relationships between firms and banks gives rise to endogenous fluctuations in interest rate margins and collateral requirements. In particular, this study demonstrates that endogenous credit standards amplify business cycles and suggests that a countercyclical loan-to-value ratio is an effective macroprudential tool to combat the effects of endogenous credit standards on macroeconomic volatility. Thus, looking at Ravn's model, we might expect that macroprudential policy can potentially affect the sensitivity of the lending to business cycle under a given competitive environment; i.e., it may potentially alter the effect of competition on procyclicality. These two studies imply that the interaction between competition and macroprudential policy might be analyzed from two perspectives. On the one hand, looking at the model of Andres and Arce, the increased degree of competition might reduce the countercyclical effects of macroeconomic stabilization policy. As a result, we expect that more competitive banking sector decreases countercyclical effects of macroprudential policy. On the other hand, Ravn's model suggests that, under given monopolistic competition in the banking industry, macroprudential tools, such as loan-to-value ratios, are effective in reducing the procyclicality of bank lending resulting from endogenous credit standards. In effect, we expect that macroprudential policy might reduce the procyclicality of lending in economies with low competition intensity. However, as our paper is focusing on the micro-level sensitivity of credit to the business cycle, the implications of the macro-level models may not be applicable to our study. Considering the lack of clear guidance in this bank-level procyclicality of credit, and the effects of competition on this procyclicality in economies that apply macroprudential policy tools, we aim to test what the role of competition is for effects of macroprudential policy on bank lending.

2.2. The role of competition and of macroprudential policy in bank risk-taking

Competition may shape the association between macroprudential policy and cyclicality of lending through the risk-taking channel of banking activity. The literature on the role of competition in the stability/fragility of banks has a long tradition [see Beck (2008) for the pre-crisis literature summary]. Theory well supported in empirical research generally provides two lines of explanations about the links between bank risk-taking and competition. On the one hand, the competition-fragility points to a positive relationship between bank competition and stability (Keeley, 1990). This hypothesis predicts that more concentrated and less competitive banking systems are more stable, because profits provide banks with a buffer against fragility and discourage banks from excessive risk-taking. Empirical support for this view is presented in Cipolini and Fiordelisi (2012), Mirzaei et al. (2013), Beck et al. (2013), Craig and Dinger (2013), Leroy and Lucotte (2017). Beck et al. (2013) show that the competition–fragility hypothesis is present in a wider cross-country context (covering 79 banking sectors),

but is heterogenous, and at an individual bank level depends on deposit insurance, development of stock exchanges, and on effectiveness of credit information sharing. On the other hand, the competition-stability hypothesis suggests that more competitive banking sectors are more stable. In a theoretical paper, Boyd and De Nicolo (2005) show that as low competition increases loan rates, borrowers tend to shift to riskier projects. Consequently, banks will face lower credit risk on their loan portfolio in more competitive markets, which should lead to increased banking sector stability. This theory is supported in several recent empirical papers (Schaeck and Cihák, 2014; Leroy and Lucotte, 2017; Noman et al.; 2018; Saif-Alyousfi et al., 2020).

The empirical evidence on the effects of macroprudential policy on bank risk-taking in a cross-country context is limited. There are two such papers which deal with this issue (Altunbas et al., 2018; Gaganis et al., 2020). Altunbas et al. (2018) investigate the effects of macroprudential policies on bank risk through a large panel of banks operating in 61 advanced and emerging market economies. They find that macroprudential tools have a significant impact on bank risk. This effect is diversified and depends on balance sheet characteristics, such as bank size, capitalization and liquidity. Gaganis et al. (2020) using a sample of up to 356 banks from 50 countries over the period 2002–2017 examine whether and how macroprudential policies and corporate governance interact in shaping bank risk. Their results show that the impact of bank corporate governance on risk-taking depends critically on the macroprudential policies in force. In more detail, bank corporate governance has a negative or insignificant impact on bank stability when none or only a few macroprudential policies are in place. However, this impact becomes positive and statistically significant as the number of macroprudential policies increases. The results presented in this study also show that increased number of macroprudential instruments is related with increased risk-taking of banks, if there are no bank corporate governance rules implemented.

2.3. Empirical research on the links between macroprudential policy and cyclicality of lending

The recent interest in macroprudential policies is related with now quite extensive research on the assessment of their impact on a wide array of economic variables of interest (Galati and Moessner, 2018, Gomez et al., 2020). However, considering the interest of our study, we will look only at the literature focusing on bank credit growth and on the links between credit growth and business cycle.

The literature on the effects of macroprudential policy on loans growth consists of micro-level research, mostly applying individual-country case studies and macro-research, covering cross-country studies. Starting with the first group, the overall findings of this literature are that macroprudential policy instruments in place or tightening of macroprudential policy are related with a decline in credit growth (Zhang and Zoli, 2014; Claessens et al., 2014; Gomez et al., 2020). Papers in the second group, mainly apply cross-country aggregated data, and also show that the use of macroprudential policy instruments or tightening of macroprudential policy is associated with lower credit growth (Lim et al., 2011; Bruno et al., 2017; Cerutti et al., 2017; Akinci and Olmstead-Rumsey, 2018; Poghosyan, 2020; Garcia Revelo et al., 2020). These studies also highlight the role of additional factors which affect the strength of change in the credit growth, such as: (1) income-group (emerging versus advanced economies, Cerutti at al., 2017, Akinci and Olmstead-Rumsey, 2018); (2) monetary policy stance (Bruno et al., 2017; Gomez et al., 2020; Garcia Revelo et al., 2020); (3) economic integration (EURO area versus other European Union countries; Poghosyan, 2020). These papers however, do not focus on the role of competition intensity in the link between bank credit growth and macroprudential policy.

The literature on the role of macroprudential policy in procyclicality of bank credit is not very extensive (Lim et al., 2011; Cerutti et al., 2017; Gambacorta and Murcia, 2020). In this research procyclicality of lending is defined as sensitivity of credit growth to GDP growth, which is in line with other studies looking at procyclicality of individual banks activity and its heterogeneity (Leroy and Lucotte, 2019; Olszak et al., 2018, 2017). Lim et al. (2011) using quarterly aggregated data covering 48 countries in 2000-2010 show that lending is procyclical. This procyclicality is reduced statistically significantly in countries using loan-to-value caps, caps on debt-to-income, reserve requirements and countercyclical capital requirements. The implications of this study are, however, limited due to the reduced number of data on the use of macroprudential instruments.

Cerutti et al. (2017, p. 216) apply the same approach to a larger sample of 116 countries – with more extended data on the use of macroprudential instruments, and show that countries which apply macroprudential policy instruments exhibit increased procyclicality of lending. Cerutti at al. (2017) also show that diversity of procyclicality of credit growth in countries using macroprudential instruments maybe associated with economic development (advanced, emerging, developing) and capital account openness (open versus closed account).

Gambacorta and Murcia (2020) test the impact of macroprudential policy in five Latin America countries using bank-level data at quarterly frequency, in different periods, depending on the country and data accessibility. They find that coefficient on the interaction term between macroprudential and business cycle is positive and statistically significant. This means that credit is more procyclical in countries using macroprudential instruments. As they show these coefficients tend to be particularly positive and significant for cyclical measures. Their results thus suggest that cyclical macroprudential instruments are not effective in taming booms.

The increased procyclicality of credit in countries using macroprudential instruments – as shown by Cerutii et al. (2017) and Gambacorta and Murcia (2020), may look surprising and counterintuitive at first impression, because in general macroprudential policy is expected to reduce procyclicality. However, in fact the usage of macroprudential policy instruments is directly linked with observed increased positive sensitivity of lending to business cycle. Therefore, we may observe a positive association between credit growth and business cycle in those countries which apply macroprudential policy instruments. Another explanation of such a result suggested by Danielsson et al. (2016) is that macroprudential instruments which are used in a discretionary way – with the aim of adjusting risk-taking across the financial cycle, may even amplify the procyclicality. As Danielsson et al. (2016) assert, if supervisory authorities smooth out the credit cycle, they contribute to a perceived low-risk environment that in turn encourages further risk-taking. Therefore, we expect that extended use of macroprudential policy instruments may be associated with increased procyclicality of credit. However, the literature does not give us a guidance what instruments work this way.

2.4. Empirical research on the role of competition in cyclicality of lending

There is only one study investigating the impact of the degree of competition on the sensitivity of bank-level credit to the business cycle conducted on a panel of 16 European countries (Leroy and Lucotte, 2018). This paper suggests that increased market power for banks (i.e., decreased competition) enhances the financial accelerator mechanism by showing that less competition in the banking sector makes credit more procyclical. However, due to limited country coverage, this study does not look at the potential heterogeneity of the effects on competition on the procyclicality of credit, and, thus, does not provide evidence of the factors that explain why, in some countries, more competition is associated with less procyclicality. In particular, it does not consider the role of competition on loan-growth and the impact of competition on the sensitivity of lending to the business cycle in countries applying macroprudential policy instruments.

2.5. Hypotheses

Merging the literature on the effects of macroprudential policy on bank-level activity as well as on the role of competition for risk-taking (in particular the competition–fragility view) and the procyclicality of lending, we can put forward several testable hypotheses. Empirical literature points at two facts as for the role of macroprudential policy for cyclicality of credit. First, it shows that the use of macroprudential instruments is associated with reduced credit growth (Zhang and Zoli, 2014; Claessens et al., 2014; Gomez et al., 2020). Second, cross-country research points at the diversity of effects of macroprudential policy on cyclicality of credit. However, the recent research shows that macroprudential instruments – in particularly cyclical instruments, are not effective in taming boom, thus their use is associated with increased procyclicality of credit (Gambacorta and Murcia, 2020; Cerutti et al., 2017). We therefore do not make definite predictions on the effects of business cycle on lending growth in countries using macroprudential policy instruments, as we expect both increased and weakened procyclicality, depending on the instruments applied. Additionally, following Danielsson et al. (2016) we expect that the duration of use of macroprudential instruments may be important for the responses of lending to business cycle under a given competitive environment.

Our first set of hypotheses will attempt to answer the question how competition shapes the impact of macroprudential policy on credit growth. Competition is a part of a natural environment in which banks operate. As previous research shows, it matters for bank risk taking. Depending on theory, more intensive competition may be related with increased fragility of banks (consistent with competition – fragility view) or with a declined risk of banks (which is in line with competition - stability view). We therefore will test in our paper which of these two theories is important for macroprudential policy conduct. Thus, we put two alternate hypotheses:

Hypothesis H1: Increased competition weakens the effect of macroprudential policy on credit growth.

Hypothesis H2: Increased competition strengthens the effect of macroprudential policy on credit growth.

With the other set of our hypotheses, we try to determine how competition is related with cyclicality of credit in countries using macroprudential policy instruments. Here we ask following questions:

(i) Is increased competition associated with decreased procyclicality of credit?

(ii) Are macroprudential policy instruments associated with decreased (or increased) procyclicality of credit? Does the link between the macroprudential policy and procyclicality depend on the duration of the use of instruments?

(iii) How competitive environment shapes the link between the loans growth and business cycle in countries using macroprudential policy instruments?

(iv) Does link between competitive environment and the sensitivity of lending to business cycle in countries using MPI depend on the duration of the use of macroprudential tools?

Following Andres and Arce (2012) and Ravn (2016) we expect that macroprudential policy (in particular the use of loan to value caps) might reduce the procyclicality of lending in economies with low competition intensity. This explanation is also rooted in the competition-fragility view. Therefore, we hypothesize that:

Hypothesis 3: More competitive environment is associated with increased procyclicality of credit in countries using macroprudential policy instruments (hypothesis H3).

However, alternatively, looking at the competition-stability view, we may also expect that:

Hypothesis 4: More competitive environment reduces procyclicality of credit in countries using macroprudential policy instruments.

Existing evidence (Cerutti et al., 2016, Gambacorta and Murcia, 2020) shows procyclicality of lending in countries using macroprudential policy instruments. Following Danielsson et al. (2016) we expect that extended use of some of cyclical macroprudential instruments will be important for the sensitivity of loans growth to business cycle. We therefore put forward additional hypothesis, that the cyclicality of credit to business cycle in countries applying macroprudential policy instruments depends on the duration of the use of this particular instrument (Hypothesis H5).

3. Empirical strategy and methodology

To investigate whether the data support the view that competition might drive the effects of macroprudential policy on the cyclicality of lending, we have to apply accurate indicators of banking competition, macroprudential policy, and credit procyclicality. The empirical procedure is as follows. First, we measure the competition intensity across banking sectors using the market power proxy applied widely in the literature (Berger et al., 2009; Turk-Ariss, 2010; Beck et al., 2013; Anginer, 2014; Leroy and Lucotte, 2017, 2018; Fungáčová et al., 2017), i.e., the Lerner index, with a higher value indicating less market competition. This indicator varies over time and, thus, may be used to analyze the impact of competition on loans' growth. We apply an industry level indicator of competition because our task is to assess how competitive environment in the banking industry and changes in this environment shape bank-level loans growth and the sensitivity of loans growth to business cycle in countries which apply macroprudential policy tools. Second, we apply macroprudential policy variables collected for a wide range of countries in the Global Macroprudential Policy Instruments survey by the International Monetary Fund (IMF), and thoroughly presented in Cerutti et al. (2015, 2017). This database is the most comprehensive datasets on the use of macroprudential instruments and covers over 100 countries. It shows detailed information on the use of 12 specific macroprudential instruments, many of which are targeted to deal with the procyclicality of the financial (and, in particular, banking) sector, stemming from both borrower capability to take on credit and bank capacity to extend credit. Cerutti et al. (2017) assign the value of one in each one of these twelve cases that a certain policy is in force, and the value of zero otherwise. With this database, we are able to look at not only the cross-country diversity of effect of macroprudential policy on the sensitivity of credit to the business cycle but also the how the use of macroprudential tools affects credit growth. Third, regarding credit procyclicality, we follow Bouvatier et. (2012), Bertay et al. (2015), and Leroy

and Lucotte (2018) by defining credit procyclicality as the response of credit to real Gross Domestic Product Growth (GDPG).

3.1. Impact of macroprudential tools on growth of lending and the role of competition

Our main interest is the relationship between competition and the effect of macroprudential policy on loans' growth and between the impact of macroprudential policy on the procyclicality of loans' growth of a bank. We start with the estimation of the following base specification (Bertay et al., 2015):

$$\Delta LogLoans_{i,k,t} = \alpha + \beta_1 MPI_{k,t} + \beta_2 COMP_{k,t-1} + \beta_3 GDPG_{k,t} + \gamma BSOC_{i,k,t-1} + \varepsilon_{i,t}$$

Eq. (1)

Our empirical specification is designed primarily to test how bank competition shapes the association between loans' growth and macroprudential policy. Therefore, in the second step we use the model that tests the role of competition in the link between macroprudential policy and loans growth. It reads as:

$$\Delta LogLoans_{i,k,t} = \alpha + \beta_1 MPI_{k,t} + \beta_2 COMP_{k,t-1} + \beta_3\, MPI_{k,t} \times COMP_{k,t-1} + \beta_4 GDPG_{k,t} + \gamma BSOC_{i,k,t-1} + \varepsilon_{i,t}$$

Eq. (2)

where i=1…N , k=1…109, and t=1….T. N denotes the number of banks, k denotes the country, and T denotes the total number of years. In our model, $\Delta LogLoans_{i,k,t}$ denotes the real loan growth rate of the i-th bank operating in country j in moment t (it is the first difference of the logarithm of value of loans); f expresses the operator of function;

- $MPI_{k,t}$ denotes the macroprudential policy index (i.e., either aggregated or individual macroprudential policy instruments) and is a dummy variable taking the value of one (zero) if the macroprudential policy instrument is applied (not applied) in a given country at moment *t*. A negative β_1 would suggest that the use of macroprudential policy instruments is associated with reduced loans' growth rate [as has been found by Lim et al. (2011), Cerutti et al. (2017), Akici and Olmstead-Rumsey (2018), Gomez et al., (2020); Gambacorta and Murcia (2020)]. As in eq. (2) we include interaction term between MPI and competition, the coefficient on $MPI_{k,t}$ informs about loans growth rate in countries using macroprudential tools in a perfectly competitive banking industry (i.e. the Lerner is equal 0).
- $COMP_{k,t-1}$ indicates the competition intensity in the banking sector in country k at moment t-1, computed at the industry (i.e., country) level. As we apply Lerner index with lower values indicating increased competition, a positive (negative) coefficient on this variable, inform about weakened (increased) credit growth in more competitive environment.
- $MPI_{k,t} \times COMP_{k,t-1}$ is the interaction term that measures how competition is affecting the link between macroprudential policy and loans' growth rate. The β_3 regression coefficient on this variable is of interest to our study, because it informs how changes in competition shape the effect of macroprudential policy on loans' growth. As in our study we apply Lerner index as a competition intensity measure, a positive (negative) coefficient on this interaction means that increased competition in related with reduced (increased) credit growth in countries using macroprudential policy instruments.
- $BSOC_{i,k,t-1}$ denotes bank-specific and other control variables. In our selection of bank-specific variables, we look at the bank lending channel literature [see, e.g., Kim and Sohn (2017), Gomez et al., (2020), Gambacorta and Murcia (2020)], and at studies focusing on the procyclicality of lending (Bertay et al., 2015, Leroy and Lucotte, 2019). Drawing on this literature, we include five bank-specific characteristics that could influence bank supply shifts: equity capital ratio (denoted as Cap), which measures the role of capital constraints on loan growth; net interest margin over total assets (denoted as Nim), which accounts for the profitability of bank lending activity; access to funding (thus, a proxy for bank liquidity) from the banking sector and from non-financial retail depositors, measured as a sum of bank deposits to total assets and retail deposits to total assets (denoted as Dep); net costs of previous lending activity related to loan–loss provisions, captured as ratio of net loan–loss provisions over total average loans (denoted as Llp); bank size, measured as a logarithm of total assets (denoted as Size). Following Leroy and Lucotte (2019), we also introduce the monetary policy stance, as another control variable, to take into account the role of general adjustments in interest rates (denoted as ΔMP). In one

of the baseline regressions, we also include the squared competition intensity to take into account non-linearity of the effect of competition on bank risk-taking and, thus, on loans' growth (see, e.g., Tabak et al., 2012).

- $GDPG_{k,t}$ is our business cycle measure, i.e. the growth of real gross domestic product of a country.

This model, and all other models applied in this study also include the intercept, to incorporate the fact bank may extend lending when other explanatory variables are equal 0.

3.2. Macroprudential instruments, competition and cyclicality of lending

The third step of analysis is to evaluate how the use of macroprudential policy instruments alters sensitivity of lending to business cycle. This is a necessary intermediary stage, before we go on to our test of hypotheses 3 and 4 (section 3.3.) For this, we have included in the baseline equation interaction terms between macroprudential tools and real GDP growth:

$$\Delta LogLoans_{i,k,t} = \alpha + \beta_1 MPI_{k,t} + \beta_2 GDPG_{k,t} + \beta_3\, MPI_{k,t} \times GDPG_{k,t} + \beta_4 COMP_{k,t-1} + \gamma BSOC_{i,k,t-1} + \varepsilon_{i,t}$$

Eq. (3)

To identify whether the sensitity of credit growth to business cycle is changed due to the use of macroprudential policy, we can analyse the derivative of $\frac{\delta L_{i,k,t}}{\delta GDPG_{k,t}} = \beta_2 + \beta_3\, MPI_{k,t}$. Since the coefficient β_2 is expected to be positive in countries which do not apply macroprudential instruments (MPI equal 0), we focus on the sign and significance of $\beta_3\, MPI_{k,t}$. If it is positive, the use of macroprudential instruments is associated with increased procyclicality of credit (as suggested by Danielsson et al., 2016). On the contrary, if it is negative, macroprudential instruments reduce procyclicality of credit. Further, to assess whether the effects of macroprudential policy depend on the duration of the use instruments (as we might expect following Danielsson et al., 2016), we introduce additional models with dummy variables. We consider two time periods to include the dummies. The first is the shortened business cycle period of at least 4 years, and the other is the lengthened period of at least 9 years. Therefore, depending on the duration of use of an instrument, our dummy variable takes the value of one, if the instrument is used at least 4 (9) years , and is denoted as MPImin4 (MPImin9). In this step we include additional interaction terms, i.e. by multiplying double interaction term of MPI×GDPG by MPImin4 (MPImin9).

The next step in this analysis is to assess the association between competition and procyclicality of lending. We test this by introducing in Eq (1) interaction terms between GDPG and competition:

$$\Delta LogLoans_{i,k,t} = \alpha + \beta_1 GDPG_{k,t} + \beta_2 COMP_{k,t-1} + \beta_3 COMP_{k,t-1} \times GDPG_{k,t} + \gamma BSOC_{i,k,t-1} + \varepsilon_{i,t}$$

Eq.(4)

To identify how the sensitity of credit growth to business cycle is associated with changes in competitive environment, we analyse the derivative of $\frac{\delta L_{i,k,t}}{\delta GDPG_{k,t}} = \beta_1 + \beta_3 COMP_{k,t-1}$. If the coefficient β_1 is positive in this equation, it implies that under perfect competition (Lerner=0), bank lending is procyclical. Such evidence is found in Leroy and Lucotte (2019). The sign and significance of $\beta_3 COMP_{k,t-1}$ is expected to be positive, if decreased competition is associated with amplified procyclicality of credit. On the contrary, if it is negative, increased competition is associated with more procyclicality than decreased competition.

3.3. Interaction between the competition and the effects of macroprudential policy on procyclicality of lending

In the fourth step of our analysis, we aim at evaluating whether the effects of macroprudential policy instruments on procyclicality of lending have been amplified or diminished by competitive environment (as presented in hypotheses 3 and 4). We test this by introducing interaction terms in Eq. (3) between our macroprudential policy instrument variable, business cycle measure (GDPG) and a competition indicator (i.e. the Lerner index):

$$\Delta LogLoans_{i,k,t} = \alpha + \beta_1 MPI_{k,t} + \beta_2 GDPG_{k,t} + \beta_3\, MPI_{k,t} \times GDPG_{k,t} + \beta_4 COMP_{k,t-1} \times MPI_{k,t} \times GDPG_{k,t} + \beta_5\, MPI_{k,t} \times COMP_{k,t-1} + \beta_6 COMP_{k,t-1} \times GDPG_{k,t} + \gamma BSOC_{i,k,t-1} + \varepsilon_{i,t}$$

Eq. (5)

The effect of a change in business cycle on lending in Eq. (5) can be expressed by the first derivate with respect to GDPG $\frac{\delta L_{i,k,t}}{\delta GDPG_{k,t}} = \beta_2 + \beta_3\, MPI_{k,t} + \beta_4 COMP_{k,t-1} \times MPI_{k,t}$. Also in this case we expect β_2 to be positive when macroprudential policies are not applied (MPI=0) and under perfect competition (Lerner =0). β_3 informs about the effect of business cycle on loans growth in countries with perfectly competitive environment (Lerner=0). The $\beta_3 MPI$ informs about the sensitivity of loans growth to business cycle in countries applying macroprudential policy instrument (i.e. MPI=1) under perfectly competitive environment. We expect a positive coefficient if perfect competition amplifies procyclicality of credit. In contrast, a negative regression coefficient is expected if perfect competition reduces procyclicality of lending. $\beta_4 COMP_{k,t-1} \times MPI_{k,t}$ informs about the effect of business cycle on lending in countries using MPI with consideration of competition intensity. Due to the use of Lerner index, the values used in the analysis are over 0 and below 1, with greater levels denoting less competition. Therefore, the positive sign on this interaction term denotes increased procyclicality of lending with decreasing competition in the banking industry. We expect a negative coefficient if weakened competition is associated with decreased procyclicality of lending.

In further analysis of equation Eq.(5) we test our additional hypothesis H5, that the sensitivity of lending to business cycle in countries applying macroprudential instruments and under given competitive environment depends of the duration of use of these instruments. In this case we are interested in lengthened use of macroprudential instruments, therefore we will extend Eq. (5) by inclusion of interaction terms with MPImin9 dummy variable.

3.4. Competition intensity measurement

The literature on industrial organization offers several indicators of competition, based on different methodological approaches. They can be categorized under two headings. The first applies the traditional Structure-Conduct-Performance model, whereby indicators of market structure are used to measure the degree of competition. The second category of competition measures is based on the empirical industrial organization and develops non-structural indicators of competition that take into consideration bank conduct and financial data. In our study, we apply such a non-structural indicator of the degree of market competition, i.e., the Lerner index (Lerner). This indicator has been used widely in bank research (Claessens and Leaven, 2004; Berger et al, 2009., Fu et al., 2014; Fungáčová et al., 2017; Alam et al., 2018; Leroy and Lucotte, 2019). The Lerner index captures the capacity of price power by calculating the difference between price and marginal costs as a percentage of price. Prices ($P_{A_{i,t}}$) are calculated as total bank revenue over assets, whereas marginal costs ($MC_{A_{i,t}}$) are obtained from an estimated translog cost function with respect to output. Lerner as a competition intensity it very suitable for the clarity of our analysis due to the values it takes. Higher values of the Lerner index indicate less bank competition. In particular, the degree of competition is given by the range 0<Lerner index< 1. In the case of perfect competition, the Lerner index =0; under a pure monopoly it is 1; values ranging between 0 and 1 indicate monopolistic competition; a Lerner index below 0 implies pricing below the marginal costs and could result from non-optimal bank behavior. For the purposes of our analysis and the use of interaction terms the fact that under perfectly competitive environment Lerner=0, give us clear guidance on the effect of macroprudential policy and of business cycle on loans growth in a perfectly competitive banking industry. The formula of the Lerner index is calculated as follows:

$$Lerner_{i,t} = \frac{P_{A_{i,t}} - MC_{A_{i,t}}}{P_{A_{i,t}}}$$

(Eq. 4)

For the purpose of our study, as explained in the general description of empirical strategy, we need a country-level Lerner index. We draw this variable from the World Bank's Global Financial Development Database, in

which it is calculated from underlying bank-by-bank data from Bankscope database, following the methodology described in Demirgüç-Kunt et al. (2010).

Previous research on competition shows that the banking industry operates under monopolistic competition, although there is a high level of heterogeneity across countries (see, e.g,. Beck et al., 2011; Tabak et al., 2012; Weil, 2013; Ventouri, 2018, Leroy and Lucotte, 2019). In our study, we apply three approaches to construction of competition intensity. The first one uses the country-level time-series value of Lerner ($COMP_{k,t-1}$), in equations 1-5. In the second approach (in the robustness checks section), we construct the average country-level value of the Lerner index (denoted as $COMP^{indaver}$)– one value for each country.

And finally, to acquire results that are clearer and more robust, we add specifications in which we employ competition dummies rather than the values of the Lerner index. We differentiate between more intense monopolistic competition (and, thus, banks with less market power) and less intense competition (and, in effect, more market power in the banking sector), by applying either the median value of the average Lerner index (and, thus, lower market power) or 30% of countries with low values of the average Lerner index (and denotes a more competitive banking sector). To identify banking sectors with intense competition, we introduce the dummy variable taking the value of 1 in 30% of countries with lowest Lerner. We denote this measure as *high-competition.* Competition is a dynamic phenomenon and, thus, may change from one period to another. We control for these changes by analyzing the rolled average Lerner index computed for a period of six years (to cover the full business cycle), with a start date in 1999 (to include 5 years' of data before the start date of our sample in 2005). This analysis shows that, even if there are changes in competition intensity from year to year, the average diversity of competition intensity is persistent across countries [as is found for European banks by Weill (2013)]; i.e., countries classified as having a more (less) competitive banking industry stay consistently in the same cluster.

The literature also shows that competition may be assessed using the Panzar–Rosse H-statistic (see, e.g., Beck et al., 2011; Olivero et al., 2011; Fungáčová et al., 2017; and Jayakumar et al., 2018). Generally, the values of this index range between 0 (monopoly) and 1 (perfect competition). The empirical research using the H-statistic shows a huge heterogeneity of monopolistic competition in the banking industry across countries. The H-statistic is usually negatively correlated with the Lerner index. However, the countries defined as exhibiting high competition under the average Lerner index and Panzar–Rosse do not necessarily overlap. We consider this challenge in the robustness checks' section, by running additional models in which we apply the average value of the H-statistic. High competition countries are those that overlap in two clusters of a low average Lerner index and of a high average H-statistic, differentiated by the median values of the respective indices.

In Table A2 in the Annex, we present the average values of the Lerner index and the H-statistic for countries covered in the study. Competition is highly diversified across countries, with a median Lerner index of 0.27 and H-statistic of 0.59, indicating monopolistic competition in the banking industry. The maximum and minimum average Lerner index are -1.06 (in China) and 0.77 (in Singapore), respectively. The H-statistic ranges between 0.07 (in Ireland) and 1.05 (in Cyprus). Looking now at the average Lerner index, we find that the 10 most competitive countries include China (-1.06), Germany (-0.11), Canada (-0.02), Montenegro (0.01), Lebanon (0.04), Finland (0.09), Dominican Republic (0.12), Netherlands (0.14), Belgium (0.14), and Italy (0.14). The H-statistic also exhibits varying degrees of competition across countries, with the 10 most competitive markets covering Cyprus (1.05), Jamaica (0.97), Belarus (0.97), Lithuania (0.94), Honduras (0.92), Germany (0.90), Italy (0.89), Malaysia (0.87), Singapore (0.86), and Romania (0.85).

3.5. Macroprudential policy instruments applied in the study

To measure the impact of macroprudential policy instruments on loans' growth and on the sensitivity of bank loans growth rate to business cycle, we need to have access to data on the actual use of macroprudential policy instruments across countries. This information will be accessed from the data collected recently for over 100 countries by the IMF (see Cerutti et al., 2017) for the 2000–2017 period. Due to the time span of our bank specific variables, we look at those macroprudential policy instruments, which were applied in the years 2004–2015. Considering this, we look at ten MPIs covered in the database by Cerutti et al. (2017) that provide information on 10 individual macroprudential policy instruments: (1) Ltv_cap, which restricts loan-to-value to being used as a strictly enforced cap on new loans, as opposed to a supervisory guideline or merely a determinant of risk weights; (2) Dti, which constrains household indebtedness by either enforcing or encouraging

a limit; (3) Conc, which limit the fraction of assets held by a limited number of borrowers; (4) limits on interbank exposures (Inter), which limit the fraction of liabilities held by the banking sector or by individual banks; (5) leverage ratio (Lev), which limits banks from exceeding a fixed minimum leverage ratio; (6) limits on foreign currency loans (Fc), which limits banks' foreign currency loans, as a way to reduce vulnerability to foreign-currency risks; (7) levy/tax on financial institutions (Tax), which taxes revenues of financial institutions; (8) Rr_rev is a reserve requirement which either i) imposes a wedge of on foreign currency deposits, or ii) is adjusted countercyclically; (9) time-varying or dynamic loan-loss provisioning (Dp), which requires banks to hold more loan-loss provisions during upturns; and (10) limits on domestic currency loans (Cg), which limits credit growth directly. Analysis of the data-set developed in Cerutti et al. (2015) shows that many of the instruments whose nature is macroprudential were applied in the years 2000–2015, which covers the economic and financial boom period of 2001–2006/7 and the crisis and its direct side-effects period (2008–2010). The number and diversity of these macroprudential policy instruments has evolved in recent years. Some of them were definitely in use in many countries before the crisis [see Table A2, and Cerutti's at al. (2017) database], whereas several others are relatively new tools implemented after the crisis, i.e., in 2011. As for the period of 2011–2015, the new instruments include regulations affecting risk-taking by significant financial institutions (Sifi) and countercyclical capital buffers or requirements (Ctc). As their period of application is rather short and rare across countries, we cannot make robust inferences about their role in the link between loans' growth and the business cycle and, thus, the procyclicality of credit. Therefore, we do not include them in our estimations.

In our study, we apply individual macroprudential policy instruments as well as two aggregated macroprudential policy indices in the baseline estimation, all of which come from Cerutti et al.'s (2017) database. These are, (1) *Borrower*, which takes values ranging between 0, 1, or 2, depending on the number of macroprudential policy instruments (covering Ltv_caps and DTI ratios) targeted on the capacity of non-financial borrowers to get a loan are applied in a country; and (2) *Financial*, which covers instruments directly affecting banks' balance-sheets and banks' resilience. We take original values of *Financial* from Cerutti et al.'s (2017) database; these range between 0 and 8, also depending on how many instruments targeted at the balance-sheet of banks are used in a country in a given year. *Financial* in our study covers six instruments (two of them — Ctc and Sifi — were excluded, due insufficient application in our country set, as mentioned earlier): credit growth limits (Cg), leverage ratio (Lev), limits on interbank exposures (Inter), concentration limits (Conc), limits on foreign currency loans (Fc), FX and/or countercyclical reserve requirements (Rr_rev), levy/tax on financial institutions (Tax), dynamic provisions (Dp), and credit growth limits (Cg). These instruments may also be divided into cyclical MPI (Dti, Ltv_cap, Cg, Rr_rev, Fc) and resilience enhancing MPI (Lev, Dp) (see Altunbas et al., 2018). As in Akici and Olmstead-Runsey (2018), in our study we use cumulative measures of MPI, because macroprudential measures can affect both credit growth and its procyclicality not just in the year of their implementation but also in subsequent years. Thus, in our study, the MPI is a dummy equal to1 in the period when the instrument was applied, and it is 0 otherwise. Such an approach has been applied by other researchers using large cross-country data sets (see, Lim et al., 2011; Cerutti et al., 2015; and Akici and Olmstead-Runsey, 2018). The potential drawback of the use of dummy variables which are constant over time of application of macroprudential policy tools is that we cannot identify how banking growth and sensitivity to business cycle react to easing or restricting of the policy (as is e.g. in Gambacorta and Murcia, 2020). However, in our empirical strategy we are interested in overall responses of lending to business cycle, in particular in longer periods, therefore of significance to our study is whether the instrument is in use, and how long it is applied. The use of conventional approach of testing the changes in the policy – denoted as -1, 0, +1 , respectively for easing, no change and restricting of the policy, (see e.g. Gambacorta and Murcia, 2020; Garcia Revelo et al., 2020), does not give us opportunity to test our hypotheses, in particular those related to the use of MPI and the duration of their application, and to the sensitivity of lending to business cycle. Additionally, most of the instruments work as automatic stabilizers (e.g. Ltv, Dti, Lev, Dp, Rr_rev, Fc) therefore they do not have to be modified to work in a countercyclical manner. In effect, their implementation and use will be automatically modifying levels of of newly extended loans. What's more, there is diversity of the values of particular instruments, e.g. Ltv_caps and Dti ratios across countries, with levels reflecting the regulatory needs in these economies. Independent of levels, macroprudential instruments applied at a single country perspective, are working to limit credit growth and, finally, to shape the sensitivity of lending to business cycle. Thus, of importance to us is whether a particular instrument is in use and what is the experience of its application, in terms of the number of years of its usage.

This objective can be resolved with the binary variables, denoting the use of instruments (dummy=1) or lack of its application (dummy=0).

Macroprudential tools are aimed at limiting credit fluctuations by taming loans' growth, and, thus, their final outcome should be reduction in the procyclicality of lending. In some countries, macroprudential policy instruments may be used on a regular basis due to the observed increased sensitivity of lending to the business cycle. Therefore, the association between GDPG and MPI may be positive in such economies. In these countries, reduction in systemic risk may by achieved through either the channel of limited loans' growth or the competition-channel. As can be seen from Table A2 (see the bottom panel of Table A2 in annex) macroprudential policy instruments have been used heterogeneously, in terms of duration of application as well as the number of instruments employed. Of cyclical instruments (see Altunbas et al., 2018 for the classification) in use for at least one year in our sample, Ltv_caps are most common (used in 47 countries), followed by Dti ratios (35 countries), Fc limits (26 countries), Rr_rev (25 countries), and Cg limits (12 countries). Of MPIs targeted at the asset side of banks' balance-sheets or those that are resilience-enhancing, Conc limits have been applied most frequently (96 countries), with Lev and Dp used relatively rarely (in 23 and 19 countries, respectively). To test the effect of MPI on the cyclicality of loans' growth, we also identify countries in which respective instruments were applied at least either four or nine years. Using this filter we find that almost all "cyclical" instruments have been used in approximately 20 countries (but, for Cg limits, applied in only 11 countries). Of the other categories of MPI, Conc limits are used on a regular basis in 86 countries and Inter limits, Lev, Tax, and Dp are used in in 27, 14, 12, and 12 countries, respectively.

In Table A3, we present the data on the propensity of use of individual macroprudential policy instruments across countries in 2004–2015 (measured as the number of countries applying the instruments). As can be inferred from the table, the usage of cyclical instruments was rather scarce in 2004, with Ltv_cap implemented in 16 countries, and Fc, Dti, Rr-Rev, and Cg applied in, 13, 10, 15, and 7 countries, respectively. The propensity of almost all of the cyclical instruments approximately doubled around 2012–2013, when the pace of the post-Global Financial Crisis regulations gained its momentum. The exceptions are Cg, which is scarcely applied for the whole period, and Rr_rev, which is used at almost fixed frequency. The capital-based instruments [i.e., Lev and Dp, see Altunbas et al. (2018)] exhibit a similar pattern of frequency of application as do cyclical instruments, with Lev and Dp, used, respectively, in 9 and 7 countries in 2004 (in 16 and 15 in 2012). Taxes on banking activities (Tax) present the same behavior as do cyclical and capital-based instruments. They were applied in 10 countries in 2004, and their propensity doubled in 2011. Of instruments affecting bank balance-sheets directly, Conc and Inter were used in 68 and 23 countries in 2004, respectively. Their propensity has increased (but at a slower pace than for cyclical and capital based instruments) in the years following the GFC, and they were implemented in 88 and 31 countries, respectively, around 2012.

3.6. Estimation approach

One possible limitation of the suggested empirical strategy is that, in principle, the condition of the banking sector may induce changes in macroprudential policy, the business cycle, and competition. In our study, we believe that the chances of any individual bank affecting macroprudential policy (i.e., the decision about its application or abandoning), the business cycle, and competition measured at the country level are very small. Following Leroy and Lucotte (2019), who analyze the role of competition in the procyclicality of bank credit in European banks, we expect that, in most cases, the weight of any random bank is small compared to that of the overall economy and also has little potential to influence competition and regulatory policy. Thus, we are relatively confident that the business cycle, macroprudential policy, and the Lerner index are exogenous. In effect, we believe that our regression results capture a causal link from the business cycle, macroprudential policy, the Lerner index, and their interaction terms to bank credit growth.

As for the bank-specific control variables (Cap, Nim, Dep, Llp, and Size) we control for potential endogeneity by including one year lagged values of each of these variables. In the estimation of Eqs. (1)–(3), the bank-level dependent variable, i.e., loans' growth, is regressed on real GDP growth, competition, and bank-(market-) level explanatory variables. Following suggestions by Bell and Jones (2015) and Bell et al. (2018) we apply a random effects (RE) estimator with robust bank clustered standard errors as a basic technique for our analysis. The choice of the RE is motivated by the fact that we need to consider the cross-country heterogeneity of competition and due to the use of binary variables in our analysis. Using any fixed effects modelling would

eliminate this heterogeneity (see Bell and Jones, 2015, p. 15). As for the binary variables, we apply dummy variable (equal to 1 or 0) to describe the actual use of macroprudential instruments (MPI) and to capture the duration of the use of these instruments (denoted as MPImin4, MPImin9). The use of FE estimator would eliminate the information about the direct effect of individual macroprudential policy instruments on loans growth rate. Thus, we would not be able to test our hypotheses about the role of MPI in cyclicality of credit, depending on the competitive environment.

We prefer bank-clustered, instead of country-clustered, standard errors due to the characteristics of our sample. When the cluster sizes are unbalanced (which is our case, due to huge diversity of the number of banks across countries and observations in our study) and their number is relatively small, inference using a cluster-robust estimator may be incorrect (Nichols and Shaffer, 2007; Cameron and Miller, 2015). Thus clustering by country is inappropriate in our study, and we employ clustering at the bank level.

3.7. Bank-level and macroeconomic data description

The data used in our analysis are a mix of bank-level and country-level data. We take bank balance-sheet and income statement information from the Bankscope database published by the Bureau Van Dijk, which provides comprehensive detailed information on banks across many countries. In this study, we apply data covering 109 countries over a period from 2004 to 2015. The data on banks are taken from unconsolidated financials [to avoid double counting of commercial and cooperative and to consider bank-specific aspects of lending, see, e.g., Claessens et al. (2014)]. We apply several filters to remove potential data errors and outliers. We exclude outliers by winsorizing all observations at 1%. Due to the fact that we are interested in the procyclicality of the loan growth rate, we focus on those banks for which we have at least 6 years' of observations on loans — to take into account the whole business cycle. To assure the quality of the dataset, we drop those banks for which we have missing information on total assets (which is included in several bank-specific variables applied in our model) in the 6 years' time-period. Our sample is hugely diversified in terms of the number of banks across countries (see Table A2 in the Annex) and some countries (e.g., Germany, Italy, the Russian Federation, and the United States) dominate the sample. We control for the potential estimation bias due to these large banking sectors by including the top 200 banks (in terms of balance-sheet size) and the other 100 are selected randomly from the rest of the country-level subsample. In effect, the number of observations used in our regressions is over 70,000, with the number of banks equal to 8,236. Some basic information about the sample is provided in Tables 1 and 2.

Looking at variables of interest to our study we find that the mean loans' growth equals 7.08 percent, with a standard deviation of 17.47 percentage points. The GDPG mean value is 2.28, with standardized variability of 2.83. As Table A1 shows (see the Appendix), there is a huge heterogeneity of the average Lerner index across countries, with a mean value of 0.238 and a standard deviation of 0.133 (see Table 1 Panel A). The correlations in Table 1 in Panel B indicate a statistically-significant association between loans' growth and all of the explanatory variables. In particular, the correlation coefficient for GDPG is positive (around 0.25) suggesting that individual bank lending is potentially procyclical.

[insert Tables 1 around here]

4. Estimation results

4.1. Baseline results

Table 2 presents the baseline regressions. In the first two regressions, we include only the business cycle measure (GDPG) and BSOC, including lagged capital ratio (Cap), net interest margin (Nim), deposits over total assets (Dep), loan loss provisions (Llp), logarithm of total assets (Size), and change in monetary policy (ΔMP). The next four estimations cover also competition intensity (Lerner lagged) and aggregated macroprudential policy instruments, i.e., Borrower and Financial. In models 7 and 8, we include both the Lerner index and Borrower and Financial, respectively. The last two regressions are run without bank-specific variables to test the robustness of sensitivity of individual bank lending to the aggregated macroeconomic environment, industry competition, and macroprudential regulations.

[insert Table 2 around here]

In line with previous research (Bertay et al., 2015; Leroy and Lucotte, 2019; Gambacorta and Gomez, 2020), we find that loans' growth is procyclical, because, in all specifications in Table 3, the coefficient on *GDPG* is positive and statistically significant at 1% and ranges between 0.623 (in the FE model) and 1.57 (in RE estimations). These results imply that a one percent increase in GDPG is related in 0.623 and 1.57 percent increase in loans' growth. In economic terms, a one standard deviation change in GDPG (which is 2.84 percentage points) results in a loans' growth change ranging between 1.41 and 3.58. Such results represent, respectively, an 8.25% (=0.623*2.84 /7.77) and 20.81% (=1.57 *2.84 /7.77) change from the mean value of loans' growth.

4.2. Competition intensity and the links between macroprudential policy and loans' growth

Table 3 documents the effects of individual macroprudential policy instruments on loans' growth (regression coefficients on MPI) and the impact of macroprudential policy conditioned on the levels of the competition intensity (i.e., Lerner index) elaborated in Eq. (1)— which is denoted by both the regression coefficient on MPI and the interaction term between MPI and $Lerner_{(t-1)}$. As was explained in section 3, due to the use of interaction terms between MPI and Lerner, the coefficient on MPI informs about loans growth in countries using macroprudential policies under the condition that Lerner is 0 – which denotes perfect competition. Our results suggest that under perfect competition, in countries applying MPIs, loans' growth is generally reduced through the use of (1) cyclical instruments (i.e. Ltv_cap, Dti, Rr_rev, Fc, Cg), (2) Tax, and (3) balance-sheet oriented tools (i.e., Conc and Inter), which is consistent with previous evidence – that however, did not cover the role of competition (see, e.g., Akinci and Olmstead-Rumsey, 2018; Bruno et al., 2017; Cerutti et al., 2015, 2017). Capital-based instruments (Lev and Dp) are related with increased loans' growth. Considering statistically significant estimations (all of them at p-values equal to either 1 or 5%) we find that the reduction in loan's growth ranges between -12.68 percentage points (see column 1 in Table 4) in the case of Ltv_caps, and -1.786 percentage points (see column 9 in Table 3). In an economic sense, these results imply, respectively, that countries using Ltv_caps (for at least one year) denote decreased loans' growth from the mean (which is 7.669 percentage points) by 163% (=100×(-12.68)/7.669. Looking at other cyclical instruments, we find that Cg is associated with a reduction in average loans' growth by 53%. Dti and Fc produce a comparable reduction in average credit growth rate, by approximately 85%. In countries using Lev for at least one year, we observe increased loans' growth, of 50% (=100×3.919/7.669) change from the mean value.

The regression coefficients on interaction terms between competition and individual macroprudential policy instruments inform about the diversified impact of competition on the effects of macroprudential policy instruments; however, they do so with a dominating view that increased competition strengthens the countercyclical effects of MPI in terms of reduced loans' growth, which is consistent with our hypothesis H2. From a point of view of general economic activity such an effect may be beneficial for the economy as a whole, if macroprudential policy excessively tames lending, thus producing fewer opportunities for financing innovative investments. Cyclical instruments and Tax tend to exhibit weakened impact (i.e., their potential to reduce lending is tamed) on loans' growth in countries with decreased competition, because the regression coefficients on the interaction terms of $MPI_t \times Lerner_{(t-1)}$ are positive and statistically significant (in most models at 1%) (see columns 1–5 and 10 in Table 3). In contrast, capital-based instruments (Lev) and balance-sheet oriented tools (Conc and Inter), tend to diminish loans' growth in less competitive banking industry, which is denoted by the negative coefficients on the interaction terms on $MPI_t \times Lerner_{(t-1)}$ (see columns 6, 8, and 9 in Table 3).

To find the general economic importance of the impact of individual MPIs at different levels of competition, (which is calculated using interactions), we evaluate the conditional effect of MPI at the mean value[2] of $Lerner_{(t-1)}$, which is approximately 0.2383. In particular, the evidently negative impact of cyclical instruments on loans' growth is definitely weakened in less competitive banking sectors, with Ltv_cap still exhibiting the strongest effect, equal, on average, to -4.29 (=12.68+0.352×0.2383×100), denoting that the average loans' growth is now reduced by 55.30% (=-4.29/7.669)

[2] Refer to Burks et al. (2019), who explain more about the interpretation of interaction models. In our study, we apply the mean values only to take into account the importance of measures of central tendency and to make the inferences clear.

in comparison to the average country not using Ltv_cap.[3] The impacts of Dti, Fc, and Cg on loans' growth are moderated dramatically for the mean Lerner and equal, respectively, -0.13, -1.47, and -0.41, showing that the reductions of loans' growth from the mean are -1.69%, -18.98%, and -5.35%, respectively As for the Tax, the decline in impact on credit growth is also large, and accounts for -3.44 (=-10.244+0.284×23.83), thus, the negative change from the mean credit growth is now -44.40%. The capital-based Lev ratio has potential to reduce loans' growth in countries exhibiting moderate competition intensity, because, for the mean value of Lerner, its effect on the growth of lending equals -4.06 (=3.919+(-0.335)×23.83), resulting in a reduction in loans' growth rate by -52.27%. The balance-sheet targeted instruments' negative impact on loans' growth is strengthened and equals -5.38 for Conc and -6.15 for Inter, implying a definitely larger decline in loans' growth in an average country and bank, by, respectively, -69.31% and -79.19%. Two instruments, Rr_rev and Dp, with an insignificant impact on loans' growth in perfectly competitive banking sectors, have a significant and positive effect on loans' growth at a mean level of Lerner, equal to 4.66 and 3.64, respectively. This implies that, in countries that have implemented these instruments, decreased competition intensity is related to a strong increase in lending growth.[4] To sum up, the results presented thus far give support to the view expressed in hypothesis H2, that increased competition strengthens the effect of macroprudential policy on credit growth. However, for instruments with relatively weak impact on loans' growth under perfectly competitive environment, we find that decreased competition is associated with strengthened countercyclical effect of macroprudential policy on credit growth. Such a result is in line with our hypothesis H1.

[insert Table 3 around here]

4.3. Effects of macroprudential policy on the sensitivity of lending to business cycle

Tables 4 and 5 document the effect of individual macroprudential policy instruments on the sensitivity of lending to the business cycle (Table 4) and on the procyclicality of lending (Table 5) of individual banks, at this point without consideration of the role of competition. These regressions are obtained with equation Eq. (3) included in Section 3.2. In contrast to previous evidence using aggregated data (Lim et al., 2011), but in line with Gambacorta and Murcia (2020) and expectations expressed by Danielsson et al. (2016), our results in Table 5 imply that individual bank lending is more sensitive to the business cycle in countries applying MPI. Such enhanced sensitivity is found for all cyclical instruments — Ltv_cap, Dti, Rr_rev, Cg, Fc — as well as for capital-based Dp and balance-sheet targeted Conc (see models 1–5, 7, and 9 in Table 5), where the coefficients on the interaction term of $MPI_t \times GDPG_t$ are positive and significant at 1% in almost all estimations (but for Cg and Conc). Thus, our results, in particular for cyclical instruments, are in line with the hypothesis that use of macroprudential policy is associated with increased procyclicality (Danielsson et al., 2016). Looking at cyclical instruments one-by-one, we find that, in countries applying Ltv_cap, Dti, Rr-rev, Cg, and Fc, the effect of GDPG on lending growth ranges between 1.533 and 2.377, and equals, respectively, 2.089, 2.377, 1.844, 1.533, and 2.077. In economic terms, our results imply that, in banking sectors applying cyclical instruments, a one standard deviation increase in GDPG brings about an increase of average loans' growth rate by 45–69% (respectively, for Cg and Dti), up to 11.26%–13.19%. Only two instruments are limiting the positive sensitivity of lending to the business cycle, i.e., capital-based Lev and balance-sheet oriented Inter, because the interaction term on $MPI_t \times GDPG_t$ is negative and significant at 1%. However, the general effect of the business cycle on lending is still positive and equals 0.879 and 1.083 for Lev and Inter, respectively. Tax exhibits a weak and insignificant impact on the sensitivity of lending to the business cycle, maybe because its major goals are not necessarily related with cyclicality in banking.

[insert Table 4 around here]

[3] We may also calculate the effect of a one standard devation increase in Lerner on the link between loans' growth and Ltv_cap. In such a case, the tamed effect of Ltv_cap on loans' growth will obviously be even weaker, and it equals approximately 0.3693, implying an increase in average loans' growth by 4.76%.

[4] The respective increase at the mean level of Lerner is by 60.09% (=-0.221+0.205×23.83, for the Rr_rev), and 46.94% (=0.1+0.132×23.83, for the Dp).

The results presented in Table 5 give further support to the hypothesis that use of cyclical instruments is associated with increased procyclicality of lending (Danielsson et al., 2016). Looking at the effects of the business cycle on lending growth in countries applying such cyclical instruments as Ltv-cap, Dti, and Rr_rev for at least four or nine years we find that positive regression coefficients shown in Table 5, are even higher, thus denoting increased procyclicality due to extended duration of the use MPIs. In particular, in the case of Dti and Rr_rev the significant coefficients equal, respectively, 1.407 and 2.706 in countries using Dti and Rr-rev for at least four years (see columns 2 and 3, Panel A in Table 5), and 3.366 and 2.622 (see Panel B in Table 5) in countries using respective instruments for at least nine years. The same observation is visible for Dp and Tax. In particular, extended duration of their application for at least four (nine) years is related with increased procyclicality of bank lending. Capital-based Lev and asset-structure affecting Inter and Conc are related with decreased procyclicality of credit growth. Interestingly, foreign currency limits (Fc) seem to work countercyclically in countries applying them at least nine years. Looking now at Cg, we find that their effect on procyclicality is insignificant, but they have some potential to reduce procyclicality of credit in countries applying them at least four years, as the regression coefficient on $MPI_t \times GDPG_t \times$MPImin4 is negative and equals -1.138 (see column 4, Panel A in Table 5). To sum up, the results presented thus far seem to be in line with our hypothesis H5 that extended duration of use of macroprudential instruments, is associated with increased procyclicality of lending. This effect is especially present in cyclical instruments, i.e. Ltv_cap, Dti and Rr_rev.

[insert Table 5 around here]

4.4. Impact of macroprudential policy on procyclicality of lending and the role of competition intensity

Table 6 documents that intensity of competition does essentially affect the direction of the link between MPI and the sensitivity of lending to the business cycle (refer to Panel A), as well as the procyclicality of lending (see Panel B). We shall start our analysis with Panel A of the table. In column 1 we present the model of Eq. (4) with interaction between business cycle and competition to find out how competitive environment affects procyclicality of lending, without consideration of macroprudential policy instruments. As we can see, bank lending is procyclical in perfectly competitive industry (Lerner =0) because the coefficient on GDPG is positive and statistically significant at 1 % and equals 0.647. What's more, any decrease in the intensity of competition is related with increased procyclicality of lending, because the regression coefficient on interaction of $GDPG_t \times Lerner_{(t-1)}$ is positive and statistically significant at 1%.

Turning to our question about the role of competition in the link between macroprudential policy and sensitivity of lending to business cycle with, we run regressions expressed with Eq. (5) described in Section 3.3.They are presented in Panel A of Table 6 in columns 2-11. In these models, regression coefficients on GPDG (β_2 presented in Eq. (5) in Section 3.2) are positive and statistically significant and range between 0.445 and 1.729. Such results imply that in countries not applying macroprudential instruments at all (MPI=0) with perfectly competitive banking industries (Lerner=0), lending is procyclical. Looking now at the link between business cycle and lending in countries applying MPI and in perfectly competitive banking industry (see regression coefficient on $MPI_t \times GDPG_t$) we find increased procyclicality of credit in countries using Ltv_cap, Dti, Rr_rev, Fc and Cg, and decreased procyclicality of credit in countries applying Lev, Dp, Conc, Inter and Tax. Looking further at countries using cyclical instruments (Ltv_cap, Dti, Rr_rev, Fc and Cg) under imperfectly competitive banking sector we find that decreased competition in the banking industry is associated with reduced procyclicality of lending. As the regression coefficients on triple interaction terms on $MPI_t \times GDPG_t \times Lerner_{(t-1)}$ are negative, any decrease in competition in the banking industry (as reflected in increased values of Lerner index) is associated with reduced procyclicality of lending. We therefore find support for our hypothesis H3 that increased competition is associated with increased procyclicality of lending in countries using macroprudential policy instruments. However, these results are binding only for cyclical instruments that are in fact related with increased procyclicality of credit.

To interpret these results in economic terms, we have to consider the continuous nature of Lerner. First, we shall look at the effect of business cycle on credit growth in countries using cyclical MPI, applying the mean level of Lerner. Next, we will investigate these effects at the mean Lerner plus one standard deviation. And,

finally, we will look at the role of market power increased by two standard deviations (i.e., mean Lerner plus two standard deviations of Lerner). As for the mean levels of Lerner, we find that the sensitivity of lending to the business cycle is reduced compared to the effect when we ignore competition intensity. In particular, the overall effect of GDPG on loans' growth in a country with average competition intensity depends on the type of MPI applied, and ranges between 0.736 (=0.595+0.811-0.028×23.83) and 1.307 (=0.698+1.168-0.023×23.33) (for Cg and Dti, respectively). Such a result implies an economically large reduction in the sensitivity of lending to the business cycle, with a change in the regression coefficients in the range between -29.98% (=-0.023×23.33/(0.698+1.168), for the Dti) and 60.91% (=-0.058×23.83/(0.445+1.828), for the Rr_rev). Obviously, if we take into account decreased competition, i.e., mean Lerner plus one standard deviation of Lerner, the overall effect of GDPG on lending is weaker — in between 0.118 (for Rr_rev) and 0.996 (for Dti), and, thus, the reduction of the sensitivity of lending to the business cycle is even deeper. And finally, if we consider a mean Lerner increased by two standard deviations, the overall effect of GDPG on credit growth ranges between -0.652 (for Rr_rev) and 0.684 (for Dti). To sum up, our results seem to support the view that decreased competition in banking sector helps to achieve reduced sensitivity of lending to the business cycle in countries applying cyclical MPI, which are in fact related with observed increased procyclicality of lending.

As for the rest of the instruments, i.e., capital-based Lev and Dp, balance-sheet targeted Conc and Inter, and Tax (see columns 7–11 in Panel A in Table 6), we find support for the view expressed in hypothesis H4 — that, more competitive environment reduces procyclicality of credit in countries using macroprudential policy instruments. In particular, looking at the regression coefficients on the interaction terms of $MPI_t \times GDPG_t \times Lerner_{(t-1)}$, we notice that they are positive and significant at 1% (but for the Tax which is significant at 10%). If we consider a scenario of perfect competition (i.e., Lerner equal to 0), the sensitivity of lending to GDPG ranges between -3.28 (=1.311+-4.597, for Lev) and 0.334 (=1.16-0.825, for Conc). Increases in the Lerner index, e.g., up to the mean value, are, therefore, related to increased (and positive) overall sensitivity of lending to the business cycle, ranging between 0.717 (=0.746-0.799+0.032×23.83) and 1.479 (=1.729-2.08+0.076×23.83) for Tax and Inter, respectively.

[insert Table 6 around here]

In panel B of Table 6, we show the role of competition in the effects of macroprudential policy on sensitivity of lending to business cycle, focusing also on countries using MPI for at least nine years. We do this because the duration of the use of these instruments matters for the sensitivity of lending to business cycle (as has been presented in Table 5). In these models, the regression coefficients on double interaction terms of $MPI_t \times GDPG_t$ inform about the link between lending and the business cycle in a perfectly competitive environment (Lerner=0) in countries using MPI shorter than 9 years. The results show that the use of Ltv_caps for less than 9 years is associated with increased procyclicality of credit because the coefficient is positive and statistically significant (at 1%) and equals 2.498. However, several instruments tend to work countercyclically in shorter periods. They include Dti, Fc and Inter. For these instruments the statistically significant regression coefficients on MPI×GDPG are negative and range between -4.79 and -3.2. Turning now to the sensitivity of lending to business cycle in countries using MPI for at least 9 years and operating in a perfectly competitive banking market (Lerner=0) and looking at statistically significant results, we find that Ltv_caps and Lev are associated with decreased procyclicality of credit, with the regression coefficient on $MPI_t \times GDPG_t \times MPImin9$ equal, respectively, -1.491 and -5.875. In contrast, Dti, Fc and Tax used at least 9 years are linked with increased procyclicality of lending in perfectly competitive banking industries. The statistically significant regression coefficients on $MPI_t \times GDPG_t \times MPImin9$ for Dti, Fc, Inter and Tax equal, respectively, 5.189, 5.507, 2.147 and 1.691.The summary of this analysis is included in Table 7.

Looking next at the role of imperfectly competitive environment we also find that time period of use of macroprudential instruments does essentially matter for the effects of business cycle on loans growth rate. As can be generally inferred from Tables 6 and 7, instruments used shorter than 9 years and associated with evident procyclicality of lending under perfect competition, may work countercyclically in less competitive banking industry. Such a result is found for Ltv_cap, with statistically significant regression coefficients. On the other hand, in longer periods, Ltv_cap is working countercyclically under perfectly competitive environment, thus any decrease in the intensity of competition is associated with more procyclicality of bank lending, because the

regression coefficient on $MPI_t \times GDPG_t \times Lerner_{(t-1)} \times MPImin9$ is positive and statistically significant at 1% and equals 0.081. Other instruments exhibiting similar pattern include Cg, and Dp – but the effects are not statistically significant.

Several instruments applied shorter than 9 years are associated with a reduced procyclicality of loans growth under perfectly competitive environment in the banking industry, and any decline in competition intensity (in terms of Lerner in between of 0 and 1) is related with increased sensitivity of lending to business cycle. These instruments include Dti, Fc and Inter, for which the regression coefficients are statistically significant. However, longer use of these instruments is associated with increased procyclicality of lending (the link between business cycle and loans growth is positive) under perfectly competitive environment. Looking now at the regression coefficient on $MPI_t \times GDPG_t \times Lerner_{(t-1)} \times MPImin9$ we find that it is negative and statistically significant for Dti, Fc and Inter, implying that any decrease in competition intensity is associated with reduced procyclicality of lending in countries using these macroprudential instruments.

To sum up, the results presented thus far give support to both our main hypotheses regarding the role of competitive environment for procyclicality of credit, but the verification of hypotheses depends on the instruments applied. Hypothesis H3 suggesting that more competitive environment is associated with increased procyclicality of lending in countries using macroprudential policy instruments is true of Ltv for periods shorter than 9 years and of Dti, Fc, Inter and Tax for the use of instruments at least 9 years. Hypothesis H4 according to which more competitive environment reduces procyclicality of credit is supported in countries using macroprudential policy instruments in shorter periods not exceeding 9 years for Dti, Fc and Conc and in countries applying Ltv in longer periods exceeding 8 years. Generally our results are in line with our hypothesis H5 that the cyclicality of credit to business cycle in countries applying macroprudential policy instruments depends on the duration of the use of this particular instrument. This length of application of macroprudential policy is also essentially affecting the association between competitive environment and sensitivity of lending to business cycle.

For RR_rev, Lev and Conc the duration of use of MPI does not alter the link between business cycle and loans growth, and does not change the role of competitive environment in this link. Rr_rev is associated with increased procyclicality of credit under perfectly competitive environment, in line with hypothesis H3, and with decline in sensitivity of lending to business cycle in less competitive banking industry. Lev and Conc are associated with reduced procyclicality under perfect competition and with an increase in procyclicality in an imperfectly competitive banking sector, which seems to conform hypothesis H4.

Table 7. The association between competitive environment and the links between business cycle and lending in countries using macroprudential instruments – the role of the duration of use of macroprudential instruments.

	Perfectly competitive environment (Lerner=0)		Imperfectly competitive environment (Lerner over 0 and up to 1)	
	MPI used below 9 years	MPI at least 9 years	MPI used below 9 years	MPI at least 9 years
Ltv	+***	-***	-***	+***
Dti	-***	+***	+	-*
RR_rev	+	+	-	-
Fc	-***	+***	+	-*
Cg	+	-	-	+
Lev	-	-***	+	+***
Dp	+	-	-	+
Conc	-	-	+*	+
Inter	-***	+***	+***	-***
Tax	-	+*	-	-

Notes: The direction of links between lending and business cycle in countries using MPI (sign before the regression coefficients) is taken from Table 6 Panel B. + (-) denotes a positive (negative) regression coefficient; „*", „***" denote an estimate significantly different from 0 at the 10% and 1% levels, respectively

4. Robustness checks

To build more confidence into our main findings, we employ several robustness checks to determine whether our results remain unchanged. First, we investigate the robustness of our results by employing an alternative measure for the business cycle. To this end, we include the real growth of GDP per capita instead of the real GDP growth. Estimations in Tables 8 and 9 give further support for the implications stemming from analysis covered in previous sections. In particular, regression results presented in Table 8 conform with those included in Table 3, in that decreased competition reduces the strength of MPI in diminishing loans' growth. We also find support to the view that in a perfectly competitive banking sector the of MPI is associated with reduced loans growth.

[insert Table 8 around here]

Additional models (expressed with Eq. (5)) run to test hypotheses H3 and H4 presented in Table 9 in Panel A and B are in line with the main results shown in Table 6. In these models, regression coefficients on GPDGpercapita (β_2 presented in Eq. (5) in Section 3.2) are significantly positive (but for the Rr_rev) and range between 0.105 (for Rr_rev) and 1.729 (for Inter) (see Panel A in Table 9). Such results further support the view that in countries not applying macroprudential instruments at all (MPI=0) with perfectly competitive banking industries (Lerner=0), lending is procyclical. Additionally, in countries using cyclical instruments (Ltv_cap, Dti, Rr_rev, Fc and Cg) under perfectly competitive banking sector, lending is also procyclical. This procyclicality is increased in comparison to countries not applying MPI. Our results further support the view that decreased competition in the banking industry is associated with reduced procyclicality of lending, in line with results included in Table 6, because the regression coefficients on triple interaction terms on $MPI_t \times GDPGper\ capita_t \times Lerner_{(t-1)}$ are negative and statistically significant. We therefore find support to our hypothesis H3 that increased competition is associated with increased procyclicality of lending in countries using macroprudential policy instruments. However, this hypothesis is binding only for cyclical instruments that are in fact related with increased procyclicality of credit in a perfectly competitive banking sector (as suggested by Danielsson et al., 2016). As for the other instruments, i.e., capital-based Lev and Dp, balance-sheet targeted Conc and Inter, and Tax (see columns 7–11 in Panel A in Table 6), we find support for the view expressed in hypothesis H4 — that, more competitive environment reduces procyclicality of credit in countries using macroprudential policy instruments. In particular, looking at the regression coefficients on the interaction terms of $MPI_t \times GDPGpercapita_t \times Lerner_{(t-1)}$, we notice that they are positive and significant at 1% (but for the Tax which is significant at 10%). If we consider a scenario of perfect competition (i.e., Lerner equal to 0), the sensitivity of lending to GDPG ranges between -3.124 (=1.1+-4.224, for Lev) and 0.307 (=0.355-0.048, for Conc). Increases in the Lerner index, which proxy decreased competition, are related with increased (and positive) overall sensitivity of lending to the business cycle.

The results presented in Panel B of Table 9 give further support to the hypothesis that the effect of macroprudential policy on procyclicality of lending as well as the association between competition and procyclicality of lending in countries using MPI depends on the length of use of macroprudential policy instruments (as stresses in our hypothesis H5).

[insert Table 9 around here]

Second, instead of using the Lerner index, which changes from year to year, we apply a country-level average value of Lerner (i.e., one value per country). Looking at the results in Table 10, we again infer that our conclusions stemming from the analysis presented in Tables 6 and 8 are valid. In particular, we find that the regression coefficients on the interaction term of MPI_t*$GDPG_t$*Lerner_avg are negative for cyclical MPI and positive for capital-based, balance-sheet oriented instruments and Tax.

[insert Table 10 around here]

Third, instead of using the competition intensity with values changing annually, we apply a high-competition dummy, which equals 1 in countries with relatively intense competition, with the average country-level Lerner index below the 30th percentile. As is found in Table 11, countries which do not apply individual macroprudential tools (as listed in the headings of columns) and in which banking industry is relatively

competitive exhibit decreased procyclicality of credit, because the regression coefficients on GDPG*High competition dummy are negative (see columns 2, 3, 5, 6,7 ,8 10) and is several cases statistically significant (see columns 2, 6, 7 and 10). In other cases, i.e. in countries that do not use Ltv_cap (regression 1), Fc (regression 4) and Inter (regression 9) the coefficients are positive denoting increased procyclicality of lending in more competitive banking sectors. Our additional results show also that in more competitive banking sectors and using macroprudential policy tools bank lending is more procyclical in comparison to countries not using such instruments as Ltv_cap, Dti, rr_rev, Cg, Lev, Dp, Conc and Tax, because the coefficients on the interaction terms between MPI*GDPG*High competition dummy are positive (and significant in most cases).

[insert Table 11 around here]

Fourth, we apply an alternate definition of high-competition countries as covering those in which both the Lerner index and Panzar–Rosse H-statistics are below the median value. As our dataset does not allow us to analyze the role of Cg and Dp, due to a limited number of observations on H-statistics, we do not include regressions with these instruments in this robustness check. This sensitivity analysis is presented in Table 11, and it gives further support to the results presented in Tables 6, because we find that, in countries experiencing high competition in the banking industry, and applying macroprudential policy tools, loans' growth is more positively sensitive to GDP growth and, therefore, more procyclical. Such an effect is also in accordance with effects obtained in Table 11.

[insert Table 12 around here]

5. Conclusions

This paper investigates the role of the degree of banking competition in the effectiveness of macroprudential policy in achieving reduced cyclicality of bank credit using a cross-country sample of banks from 109 countries over the period of 2004–2015. It focuses on two intermediate objectives of macroprudential policy in the time-dimension of financial stability; one of them is reduced lending growth and the other is tamed procyclicality of credit. Merging the literature on the effects of macroprudential policy on bank-level activity, as well as on the role of competition in risk-taking and in procyclicality of lending, we have put forward research questions. First, does competitive environment shape the link between macroprudential policy and loans growth? Second, is increased competition associated with decreased procyclicality of credit? Third, are macroprudential policy instruments associated with decreased (or increased) procyclicality of credit? Fourth, does the link between the macroprudential policy and procyclicality of lending depend on the duration of the use of instruments? Fifth, how competitive environment shapes the link between the loans growth and business cycle in countries using macroprudential policy instruments? Sixth, does the link between competitive environment and the sensitivity of lending to business cycle in countries using MPI depend on the duration of the use of macroprudential tools? Our findings are as follows.

With regards to the first question, competitive environment does essentially matter for the link between loans growth and macroprudential policy. More specifically, we find that increased competition strengthens the countercyclical effects of MPI in terms of reduced loans' growth.

Going now to the second question, bank lending is procyclical in perfectly competitive industry. However, any decrease in the intensity of competition in countries not applying macroprudential policy instruments is related with increased procyclicality of lending.

Referring to the third question, we find that the sensitivity of lending to business cycle in countries implementing macroprudential policy depends on the type of macroprudential policy instrument. We find increased procyclicality of credit to business cycle in countries using cyclical instruments — Ltv_cap, Dti, Rr_rev, Cg, Fc — as well as for capital-based Dp and balance-sheet targeted Inter. Thus, our results, in particular for cyclical instruments, are in line with the hypothesis that use of macroprudential policy is associated with increased procyclicality. Only two instruments are limiting the positive sensitivity of lending to the business cycle, i.e., capital-based Lev and balance-sheet oriented Inter.

As for the fourth question, the association between the macroprudential policy and procyclicality does depend on the duration of the use of instruments. Our general finding is in line hypothesis that extended duration

of use of macroprudential instruments, is associated with increased procyclicality of lending. This effect is especially present for such cyclical instruments as Ltv_cap, Dti and Rr_rev.

In response to the fifth question, asking how competitive environment shapes the link between the loans growth and business cycle in countries using macroprudential policy instruments, our results are following. Looking at the link between business cycle and lending in countries applying MPI in perfectly competitive banking industry we find increased procyclicality of credit in countries using cyclical instruments, i.e. Ltv_cap, Dti, Rr_rev, Fc and Cg, and decreased procyclicality of credit in countries applying balance-sheet oriented instruments, such as Lev, Dp, Conc, Inter and Tax. Looking further at countries using cyclical instruments under imperfectly competitive banking sector we find that decreased competition in the banking industry is associated with reduced procyclicality of lending. The opposite is found for countries using Lev, Dp, Conc, Inter and Tax.

We find confirmation to our sixth question, as we show that the link between competitive environment and the sensitivity of lending to business cycle in countries using MPI depend on the duration of the use of macroprudential tools. Instruments used shorter than 9 years and associated with evident procyclicality of lending under perfect competition, may work countercyclically in less competitive banking industry. Such a result is found for cyclical Ltv_cap (and also for Cg, and Dp). On the other hand, in longer periods, Ltv_cap is working countercyclically under perfectly competitive environment, thus any decrease in the intensity of competition is associated with more procyclicality of bank lending. Some of the instruments (e.g. Dti, Fc and Inter) are associated with a reduced procyclicality of loans growth in periods shorter than 9 years under perfectly competitive environment in the banking industry, and any decline in competition intensity is related with increased sensitivity of lending to business cycle. However, longer use of these instruments is associated with increased procyclicality of lending (the link between business cycle and loans growth is positive) under perfectly competitive environment.

References

1. Akinci O., & Olmstead-Rumsey J, 2018. How effective are macroprudential policies? An empirical investigation, Journal of Financial Intermediation, Volume 33, 2018, Pp. 33-57, https://doi.org/10.1016/j.jfi.2017.04.001.
2. Alam, N., Hamid, B. A., & Tan, D. T. 2018. Does competition make banks riskier in dual banking system. Borsa Istanbul Review. https://doi.org/10.1016/j.bir.2018.09.002
3. Albertazzi, U. & Gambacorta, L., 2009. Bank Profitability and the Business Cycle. Journal of Financial Stability, 5, 393-409. http://dx.doi.org/10.1016/j.jfs.2008.10.002
4. Almeida, H., M. Campello, & C. Liu, 2006. The Financial Accelerator: Evidence from International Housing Markets. Review of Finance, 10 (3), pp. 321-352.
5. Altunbas Y, Binici M., Gambacorta L., 2018. Macroprudential policy and bank risk, Journal of International Money and Finance, Volume 81, 2018, pp. 203-220, https://doi.org/10.1016/j.jimonfin.2017.11.012.
6. Anginer D., Demirguc-Kunt A., & Zhu M., 2014. How does competition affect bank systemic risk?, Journal of Financial Intermediation, Volume 23, Issue 1, 2014, pp. 1-26, https://doi.org/10.1016/j.jfi.2013.11.001.
7. Arce O. & Andres J., 2012. Banking Competition, Housing Prices and Macroeconomic Stability The Economic Journal, Vol. 122, Issue 565, pp. 1346-1372, 2012. http://dx.doi.org/10.1111/j.1468-0297.2012.02531.x
8. Athanasoglou, P.P. , Daniilidis, I., & Delis, M.D. , 2014. Bank procyclicality and output: issues and policies. J. Econ. Bus. 72, pp. 58–83. https://doi.org/10.1016/j.jeconbus.2013.10.003.
9. Beck, T., 2008. Bank Competition and Financial Stability: Friends or Foes? (June 1, 2008). World Bank Policy Research Working Paper No. 4656, Available at SSRN: https://ssrn.com/abstract=1152483
10. Beck, T., De Jonghe O., & Schepens G., 2013. Bank competition and stability: cross-country heterogeneity. Journal of Financial Intermediation Vol.22, pp. 218-244.
11. Bell, A., & Jones, K., 2015. Explaining Fixed Effects: Random Effects Modeling of Time-Series Cross-Sectional and Panel Data. Political Science Research and Methods, 3(01), pp. 133–153. https://doi.org/10.1017/psrm.2014.7
12. Bell, A., Fairbrother, M., & Jones, K., 2018. Fixed and random effects models: making an informed choice. Quality and Quantity. https://doi.org/10.1007/s11135-018-0802-x

13. Berberis N., Thaler R., 2003. A survey of behavioral finance. In: Handbook of the Economics of Finance, Edited by G.M. Constantinides, M. Harris & R. Stulz, 2003. Elsevier Science B.V.
14. Berger A. N., Klapper L. F. &Turk-Ariss R., 2009. Bank competition and financial stability. Journal of Financial Services Research 35, pp. 99–118.
15. Bernanke B.S., Leeper E. M., Sims Ch. A., Zha T., & Hall R.E., 1996. What Does Monetary Policy Do? *Brookings Papers on Economic Activity* Vol. 1996, No. 2 (1996), pp. 1-78
16. Bernanke B.S., M. G., Gilchrist S., 1999. The financial accelerator in a quantitative business cycle framework, in: Handbook of Macroeconomics, Elsevier, Volume 1, Part C, pp. 1341-1393
17. Bernanke, B. & Gertler, M., 1989. Agency Costs, Net Worth, and Business Fluctuations, American Economic Review, American Economic Association, vol. 79(1), pp. 14-31.
18. Bertay A. C., Demirgüç-Kunt A., Huizinga H., 2015. Bank ownership and credit over the business cycle: Is lending by state banks less procyclical?, Journal of Banking & Finance, Volume 50, 2015, pp. 326-339, https://doi.org/10.1016/j.jbankfin.2014.03.012.
19. Borio C., Furfine C., & Lowe P., 2001. Procyclicality of the financial system and financial stability: issues and policy options. BIS Papers No. 1, Basel: Bank for International Settlements, 2001.
20. Borio, C., (2014)The financial cycle and macroeconomics: What have we learnt?, Journal of Banking & Finance, Volume 45, 2014, 182-198, , https://doi.org/10.1016/j.jbankfin.2013.07.031.
21. Bouvatier V., López-Villavicencio A., & Mignon V., 2012. Does the banking sector structure matter for credit procyclicality?, Economic Modelling, Volume 29, Issue 4, pp. 1035-1044, https://doi.org/10.1016/j.econmod.2012.03.012.
22. Bruno, V., Shim, I., & Shin, H. S., 2017. Comparative assessment of macroprudential policies. Journal of Financial Stability, 28, pp. 183–202. https://doi.org/10.1016/j.jfs.2016.04.001
23. Burks J. J., Randolph D. W., & Seida J. A., 2019. Modeling and interpreting regressions with interactions, Journal of Accounting Literature, Volume 42, 2019, pp. 61-79, ISSN 0737-4607, https://doi.org/10.1016/j.acclit.2018.08.001.
24. Cameron C. A. & Miller D. L., 2015. A practitioner's guide to cluster-robust inference. Unpublished paper, University of California Davis. . Journal of Human Resources , 50 , pp. 317 – 372 .
25. Cerutti E, Claessens S, & Laeven L., 2015. The Use and Effectiveness of Macroprudential Policies: New Evidence. IMF Working Paper IMF /15/61.
26. Cerutti E, Claessens S, & Laeven L., 2017. The Use and Effectiveness of Macroprudential Policies: New Evidence. Journal of Financial Stability, vol. 28, pp. 203-224. DOI: 10.1016/j.jfs.2015.10.004
27. Cipollini A., & Fiordelisi F., 2012. Economic value, competition and financial distress in the European banking system, Journal of Banking & Finance 36, pp. 3101-3109.
28. Claessens S., & Laeven L., 2004. What drives bank competition? Some international Evidence. Journal of Money, Credit and Banking 36, 3, June part 2, 563-583.
29. Claessens S., Kose M. A., & Terrones M. E., 2012. How Do Business and Financial Cycles Interact? Journal of International Economics 87, 178-190.
30. Claessens, S., Ghosh, S. R., & Mihet, R. (2014.). Macro-Prudential Policies to Mitigate Financial System Vulnerabilities. IMF Working Paper WP/14/155
31. Committee on the Global Financial System CGFS., 2012. Operationalising the selection and application of macroprudential instruments. CGFS Papers No 48. Bank for International Settlements, 2012.
32. Craig B., & Dinger V., 2013. Deposit market competition, wholesale funding, and bank risk. Journal of Banking and Finance 37, 3605-3622.
33. Danielsson, J., Macrae R., Tsomocos, D., Zigrand J.-P., (2016) Why macropru can end up being procyclical. VOX EU/CEPR. 15 December 2016. https://voxeu.org/article/why-macropru-can-end-being-procyclical
34. David, J., Revelo, G., Lucotte, Y., & Pradines-jobet, F. (2020). Macroprudential and monetary policies : The need to dance the Tango in harmony, Journal of International Money and Finance 108. https://doi.org/10.1016/j.jimonfin.2020.102156"2020.102156
35. Demirgüç-Kunt, I. A., Soledad, M., & Peria, M., 2014. A Framework for Analyzing Competition in the Banking Sector : An Application to the Case of A Framework for Analyzing Competition in the Banking Sector An Application to the Case of Jordan, (December 2010).
36. Ely, R. A., Tabak, B. M., & Teixeira, A. M. (2020). The transmission mechanisms of macroprudential policies on bank risk. Economic Modelling, (August 2019). https://doi.org/10.1016/j.econmod.2020.02.005"2020.02.005
37. European Systemic Risk Board (ESRB), 2014a. The ESRB Handbook on Operationalising Macro-Prudential Policy in the Banking Sector.
38. European Systemic Risk Board (ESRB), 2014b. Flagship Report on Macro-Prudential Policy in the Banking Sector.

39. Fu, X. M., Lin, Y. R., & Molyneux, P., 2014. Bank competition and financial stability in Asia Pacific. Journal of Banking and Finance, 38(1), 64–77. https://doi.org/10.1016/j.jbankfin.2013.09.012
40. Fungáčová, Z. , Shamshur, A. , & Weill, L. , 2017. Does bank competition reduce cost of credit? Cross-country evidence from Europe. J. Bank. Finance 83, 104–120 . https://doi.org/10.1016/j.jbankfin.2017.06.014.
41. Gaganis, C., Lozano-vivas, A., Papadimitri, P., & Pasiouras, F. (2020). Macroprudential policies , corporate governance and bank risk : Cross-country evidence. Journal of Economic Behavior and Organization, 169, 126–142. https://doi.org/10.1016/j.jebo.2019.11.004"2019.11.004
42. Galati, G., Moessner, R., 2018. What do we know about the effects of macroprudential policy?. Economica 85 (340), 735–770.
43. Gambacorta, L., & Murcia, A. (2020). The impact of macroprudential policies in Latin America : An empirical analysis using credit registry data. Journal of Financial Intermediation, 42(April 2019), 100828. https://doi.org/10.1016/j.jfi.2019.04.004"2019.04.004
44. Goetz M. R., 2018. Competition and bank stability, Journal of Financial Intermediation, Volume 35, Part A, 2018, Pp. 57-69,https://doi.org/10.1016/j.jfi.2017.06.001.
45. Gómez, E., Murcia, A., Lizarazo, A., & Carlos, J. (2020). Evaluating the impact of macroprudential policies on credit growth in Colombia. Journal of Financial Intermediation, 42(August 2019), 100843. https://doi.org/10.1016/j.jfi.2019.100843"2019.100843
46. International Monetary Fund (IMF), 2013. Key aspects of Macroprudential Policy – Background paper. IMF Policy Paper. Washington: International Monetary Fund.
47. International Monetary Fund, Financial Stability Board, Bank for International Settlements (IMF-FSB-BIS), (2016) Elements of Effective Macroprudential Policies. Lessons from International Experience. August 2016. https://www.bis.org/publ/othp26.pdf
48. Jayakumar, M., Pradhan, R. P., Dash, S., Maradana, R. P., & Gaurav, K., 2018. Banking competition, banking stability, and economic growth: Are feedback effects at work? Journal of Economics and Business, 96, 15–41. https://doi.org/https://doi.org/10.1016/j.jeconbus.2017.12.004
49. Keeley M. C., 1990. Deposit insurance, risk and market power in banking. American Economic Review 80, 1183–1200.
50. Kim, D., & Sohn, W., 2017. The effect of bank capital on lending: Does liquidity matter? Journal of Banking and Finance. 77, 95–107.
51. Kiyotaki, N., & Moore, J., 1997. Credit cycles. Journal of Political Economy 105 (2) . 211–48
52. Lerner A.P., 1934. The Concept of Monopoly and the Measurement of Monopoly Power. The Review of Economic Studies. Vol. 1, No. 3, 157-175.
53. Leroy, A., & Lucotte, Y., 2017. Is there a competition-stability trade-off in European banking?, Journal of International Financial Markets, Institutions and Money, Volume 46, pp. 199-215, https://doi.org/10.1016/j.intfin.2016.08.009.
54. Leroy, A., & Lucotte, Y., 2019. Competition and credit procyclicality in European banking. Journal of Banking & Finance, 99, 237–251. https://doi.org/https://doi.org/10.1016/j.jbankfin.2018.12.004
55. Lim, C., Columba, F., Costa, A., Kongsamut, P., Otani, A., Saiyid, M., Wu, X. (n.d.). Macroprudential Policy : What Instruments and How to Use Them ? Lessons from Country Experiences.
56. Lim, C., Columba, F., Costa, A., Kongsamut, P., Otani, A., Saiyid, M., Wezel, T., Wu, X., 2011. Macroprudential Policy: What Instruments and How to Use Them? Lessons from Country Experiences. IMF Working Paper 11/238.
57. Luu, H. N., & Vo, X. V. (2020). Macroprudential policy and bank risk-taking behaviour: Implications from regulatory stress test. International Review of Financial Analysis, 101586. https://doi.org/10.1016/j.irfa.2020.101586"2020.101586
58. Martinez-Miera, D., Repullo, R., 2010. Does competition reduce the risk of bank failure? Rev. Finan. Stud. 23 (10), 3638–3664.
59. Mester, L. J. (2017). The nexus of macroprudential supervision , monetary policy , and financial stability, Journal of Financial Stability, 30, 177–180.
60. Minsky H., 1986. Stabilizing an unstable economy. Mc Graw Hill.
61. Mirzaei A., Moore T., & Liu G., 2013. Does market structure matter on banks' profitability and stability? Emerging vs. advanced economies, Journal of Banking & Finance, Volume 37, Issue 8, 2013, Pp. 2920-2937,https://doi.org/10.1016/j.jbankfin.2013.04.031.
62. Nichols A. & Schaffer M. E., 2007. Clustered standard errors in Stata, United Kingdom Stata Users' Group Meetings 2007 07, Stata Users Group.
63. Olivero, M. P., Li, Y., & Jeon, B. N., 2011. Competition in banking and the lending channel: Evidence from bank-level data in Asia and Latin America. Journal of Banking and Finance, 35(3), 560–571. https://doi.org/10.1016/j.jbankfin.2010.08.004

64. Olszak, M., Pipień, M., Kowalska, I., & Roszkowska, S., 2017. What Drives Heterogeneity of Cyclicality of Loan-Loss Provisions in the EU? Journal of Financial Services Research, 51(1). https://doi.org/10.1007/s10693-015-0238-6
65. Olszak, M., Roszkowska, S., & Kowalska, I., 2018. Macroprudential policy instruments and procyclicality of loan-loss provisions – Cross-country evidence. Journal of International Financial Markets, Institutions and Money, 54. https://doi.org/10.1016/j.intfin.2018.01.001
66. Poghosyan, T. (2020). How effective is macroprudential policy ? Evidence from lending restriction measures in EU countries. Journal of Housing Economics, 49(April), 101694. https://doi.org/10.1016/j.jhe.2020.101694"2020.101694
67. Ravn, H., 2016. Endogenous credit standards and aggregate fluctuations , Journal of Economic Dynamics & Control 69, 89–111. https://doi.org/10.1016/j.jedc.2016.05.011
68. Reinhart C. M., & Rogoff K. S., 2009. This Time Is Different: Eight Centuries of Financial Folly. Princeton University Press
69. Tabak, B. M., Fazio, D. M., & Cajueiro, D. O., 2012. The relationship between banking market competition and risk-taking: Do size and capitalization matter? Journal of Banking and Finance, 36(12), 3366–3381. https://doi.org/10.1016/j.jbankfin.2012.07.022
70. Turk-Ariss R., 2010. On the Implications of Market Power in Banking: Evidence from Developing Countries. Journal of Banking and Finance 34(4), pp. 765-775.
71. Ventouri A., 2018. Bank competition and regional integration: Evidence from ASEAN nations, Review of Development Finance, Volume 8, Issue 2, 2018, pp. 127-140, https://doi.org/10.1016/j.rdf.2018.08.002.
72. Weill, L., 2013. Bank competition in the EU: how has it evolved? Journal of International Financial Markets, Institutions and Money 26, pp. 100–112 .
73. Zhang, A., Pan, M., Liu, B., & Weng, Y. (2020). Systemic risk : The coordination of macroprudential and monetary policies in China. Economic Modelling, 93(August), 415–429. https://doi.org/10.1016/j.econmod.2020.08.017"2020.08.017
74. Zulkhibri, M. (2018). Macroprudential policy and tools in a dual banking system : Insights from the literature. Borsa _ Istanbul Review, 1-12. https://doi.org/10.1016/j.bir.2018.04.001"2018.04.001

Appendix

Table A1. Variables definitions and data sources

Variable (notation)	Definition and source
Loans growth (L)	Growth ratio of net loans deflated with CPI. Source: Bankscope
Capital ratio (Cap)	Equity capital to total assets. Source: Bankscope
Net interest margin (Nim)	Net interest margin over average assets. Source: Bankscope
Deposits (Dep)	Customer deposits plus interbank deposits over total assets. Source: Bankscope
Loan-loss provisions (Llp)	Net loan-loss provisions over average net loans. Source: Bankscope
Size (Size)	Logarithm of total assets. Source: Bankscope
Change in monetary policy (Δir)	A change in the monetary policy rate. Source: International Financial Statistics, International Monetary Fund
GDPG	Rate of real GDP growth in percentages. Source: International Financial Statistics, International Monetary Fund
GDPGpercapita	Rate of real per capita GDP growth in percentages. Source: International Financial Statistics, International Monetary Fund
Lerner	Measure of market power in the banking market that compares output pricing and marginal costs (i.e. markup). An increase in the Lerner index indicates a decrease in the degree of competition in the banking market. Source: Global Financial Development Database, World Bank.
H-statistic	Degree of competition in the banking market as measured by the elasticity of bank revenues relative to input prices. The H-statistic suggests market structure on a continuum with 0 indicating monopoly and 1 perfect competition. Source: Global Financial Development Database, World Bank.
Borrower	Index of borrower-targeted macroprudential policy instrumetns (i.e. loan-to-value caps and debt-to-income ratio). This index takes values 0,1 or 2, depending on the number of instruments applied in a country. Source: Global Macroprudential Policy Instruments database collected in the IMF

	surrvey, International Monetary Fund, Cerutti et al. (2017)
Financial	Index of financial institution-targeted macroprudential policy instrumetns. This index values range between 0-10, depending on the number of instruments applied in a country. Source: Global Macroprudential Policy Instruments database collected in the IMF surrvey, International Monetary Fund. Cerutti et al. (2017)
Ltv_cap	Restricts to loan-to-value used as a strictly enforced cap on new loans, as opposed to a supervisory guideline or merely a determinant of risk weights. Source: Global Macroprudential Policy Instruments database collected in the IMF surrvey, International Monetary Fund, Cerutti et al. (2017)
Dti	Constrains household indebtedness by enforcing or encouraging a limit. Source: Global Macroprudential Policy Instruments database collected in the IMF surrvey, International Monetary Fund, Cerutti et al. (2017)
Conc	Limits the fraction of assets held by a limited number of borrowers. Source: Global Macroprudential Policy Instruments database collected in the IMF surrvey, International Monetary Fund, Cerutti et al. (2017)
Inter	Limits the fraction of liabilities held by the banking sector or by individual banks. Source: Global Macroprudential Policy Instruments database collected in the IMF surrvey, International Monetary Fund, Cerutti et al. (2017)
Lev	Limits banks from exceeding a fixed minimum leverage ratio. Source: Global Macroprudential Policy Instruments database collected in the IMF surrvey, International Monetary Fund, Cerutti et al. (2017)
Fc	Limits banks' foreign currency loans, as a way to reduce vulnerability to foreign-currency risks. Source: Global Macroprudential Policy Instruments database collected in the IMF surrvey, International Monetary Fund, Cerutti et al. (2017)
Tax	Taxes revenues of financial institutions. Source: Global Macroprudential Policy Instruments database collected in the IMF surrvey, International Monetary Fund, Cerutti et al. (2017)
Rr_rev	Restricts to reserve requirements that: i) imposes a wedge of on foreign currency deposits , or ii) is adjusted countercyclically. Source: Global Macroprudential Policy Instruments database collected in the IMF surrvey, International Monetary Fund, Cerutti et al. (2017)
Cg	Limits credit growth directly. Source: Global Macroprudential Policy Instruments database collected in the IMF surrvey, International Monetary Fund, Cerutti et al. (2017).
Dp	Requires banks to hold more loan-loss provisions during upturns. Source: Global Macroprudential Policy Instruments database collected in the IMF surrvey, International Monetary Fund, Cerutti et al. (2017).

Table A2. Baseline descriptive statistics across countries.

Country	No. of banks	No. of observations	Competition intensity		Individual MPI and their use (number of years in the period of 2004-2015)										Values of aggregated MPI		Income group
			Lerner average	H-statistic average	Ltv_cap	Dti	Conc	Inter	Lev	Fc	Tax	Rr_rev	Dp	Cg	Borrower	Financial	
Albania	10	86	0.26	0.44	0	0	10	0	0	8	0	0	0	0	0	0-2	Developing
Algeria	16	145	0.41	0.50	7	8	12	0	0	0	0	0	0	0	0-2	1	Developing
Angola	11	104	0.27	0.60	0	0	9	0	0	5	0	0	0	0	0	0-2	Developing

Argentina	53	475	0.32	0.61	0	0	12	12	0	12	0	12	0	12	0	5	Developing
Armenia	13	125	0.30	0.64	0	0	12	12	0	0	0	12	0	0	0	3	Developing
Australia	21	204	0.12	0.29	0	0	12	12	0	0	0	0	9	2	0	2-3	High income
Austria	138	1257	0.53	0.77	12	0	2	0	0	6	5	0	0	0	1	2-4	High income
Azerbaijan	14	104	0.30	0.31	0	3	12	0	6	0	0	11	0	0	0-2	1-3	Developing
Bahamas	4	38	0.34	0.23	12	12	11	0	0	0	0	0	0	0	2	0-1	High income
Bahrain	5	43	0.28	0.08	0	12	12	0	12	0	0	0	0	0	1	2	High income
Bangladesh	26	271	0.21	0.38	12	0	12	0	1	0	10	0	0	12	1	3-4	Developing
Belarus	9	64	0.26	0.97	0	0	0	0	0	5	0	12	0	0	0	1-2	Developing
Belgium	25	238	0.14	0.74	0	0	12	0	0	0	12	0	0	0	0	2	High income
Belize	2	18	0.29	n.a.	0	0	12	0	0	0	0	0	0	0	0	1	Developing
Bolivia	10	100	0.30	0.74	0	6	0	0	0	0	12	12	5	0	0-1	2-3	Developing
Bosnia and Herzegovina	21	180	0.26	0.46	0	0	12	0	0	1	1	0	0	0	0	1-3	Developing
Botswana	8	75	0.21	0.61	0	0	12	0	0	0	0	0	0	0	0	1	Developing
Brazil	81	690	0.22	0.73	3	0	12	0	0	12	0	12	12	0	0-1	4	Developing
Brunei Darussalam	1	11	n.a.	n.a.	4	4	11	10	0	0	0	0	0	0	0-2	0-2	High income
Bulgaria	16	158	0.34	0.56	0	0	12	9	0	0	0	3	10	0	0	1-4	Developing
Burundi	4	28	0.32	0.66	0	0	12	0	0	0	0	12	12	0	0	3	Developing
Canada	14	125	-0.02	0.82	8	8	12	12	12	0	0	0	0	0	0-2	1-3	High income
Cape Verde	4	42	n.a.	n.a.	0	0	12	0	0	0	0	0	0	0	0	1	Developing
Chile	18	84	0.23	0.81	12	12	12	12	12	0	12	0	6	0	2	4-5	High income
China	114	964	0.35	0.58	12	12	12	2	4	3	0	1	12	1	2	2-8	Developing
Colombia	4	30	0.36	0.55	12	12	12	12	0	12	12	0	9	0	2	4-5	Developing
Congo. Dem. Rep.	9	66	0.14	0.58	0	0	12	12	0	0	0	0	0	0	0	2	Developing
Costa Rica	14	146	0.25	0.81	11	0	12	12	0	0	0	0	1	0	0-1	2-3	Developing
Croatia	29	290	0.28	0.30	0	0	6	12	0	0	1	0	5	0	0	1-3	High income
Cyprus	10	68	0.30	1.05	12	0	0	0	0	0	1	0	0	0	1	0-1	High income
Czech Republic	16	162	0.36	0.62	2	0	12	0	0	0	0	0	0	0	0-1	1-2	High income
Denmark	38	386	0.30	0.45	11	0	7	0	0	0	0	0	0	0	0-1	0-1	High income
Dominican Republic	36	304	0.12	0.54	0	0	12	0	0	12	0	0	7	0	0	2-3	Developing
Egypt	22	234	0.05	0.66	0	0	0	0	0	0	0	0	0	0	0	0	Developing
Estonia	4	31	0.24	0.58	1	1	2	0	0	0	0	0	0	0	0-2	0-1	High income
Ethiopia	9	89	0.54	0.64	0	0	4	0	0	0	0	0	0	0	0	0-1	Developing
Finland	8	72	0.09	0.83	0	0	12	0	0	0	3	0	0	0	0	1-2	High income
France	164	1577	0.20	0.69	0	0	12	12	0	0	5	0	0	0	0	2-3	High income
Gambia	2	20	0.24	n.a.	0	0	12	0	8	2	0	0	0	0	0	1-3	Developing
Georgia	4	23	0.31	0.10	0	0	12	0	0	0	0	12	0	0	0	2	Developing
Germany	1064	10746	-0.11	0.90	0	0	2	6	0	0	6	0	0	0	0	0-3	High income
Ghana	16	144	0.37	0.23	0	0	12	0	0	0	12	0	0	0	0	2	Developing
Greece	9	85	0.22	0.85	0	11	12	0	0	0	0	0	0	0	0-1	1	High income
Haiti	1	6	0.18	0.35	0	0	12	0	0	12	0	8	0	0	0	2-3	Developing
Honduras	18	180	0.26	0.92	0	0	11	0	0	0	4	0	0	0	0	0-2	Developing
Hong Kong	26	228	-1.06	0.42	12	12	12	0	0	0	0	0	0	0	2	1	High income
Hungary	13	115	0.22	0.62	6	6	0	0	0	5	6	0	0	0	0-2	0-3	High income
Iceland	2	11	0.21	0.52	0	0	12	12	0	12	0	0	0	0	0	3	High income
India	55	570	0.27	0.61	5	0	12	9	0	0	0	0	0	0	0-1	1-3	Developing
Indonesia	55	487	0.36	0.59	4	0	11	0	0	0	0	2	0	0	0-1	0-2	Developing
Ireland	7	67	0.25	0.07	1	0	2	0	0	0	1	0	0	0	0-1	1-2	High income
Israel	9	88	0.22	0.46	4	3	12	5	0	0	0	0	0	0	0-2	1-2	High income
Italy	454	4720	0.14	0.89	2	0	12	12	0	0	1	0	0	0	0-2	2-3	High income
Jamaica	5	44	0.34	0.97	0	0	0	1	12	0	10	0	0	0	0	1-2	Developing
Japan	127	1331	0.36	0.46	0	0	12	2	0	0	0	0	0	0	0	1-2	High income
Jordan	2	12	0.36	0.32	0	0	12	0	12	12	0	0	0	0	0	1-2	Developing
Kenya	27	264	0.37	0.42	0	9	0	0	0	0	0	0	0	0	0-1	0	Developing
Korea. Rep.	12	132	0.32	0.47	12	11	0	0	0	9	5	0	0	0	1-2	0-2	High income

Kosovo	4	31	n.a.	n.a.	1	1	4	0	4	0	0	0	0	0	0-1	0-2	Developing
Kuwait	3	20	0.56	0.36	3	12	12	0	2	12	0	0	9	12	1-2	3-6	High income
Kyrgyz Republic	3	32	0.44	0.40	0	6	0	12	12	0	0	1	12	12	0-1	4-5	Developing
Lao PDR	1	12	n.a.	n.a.	0	0	12	12	0	0	0	12	0	0	0	3	Developing
Latvia	17	143	0.31	0.45	9	0	2	0	0	0	5	0	0	0	0-1	0-3	High income
Lebanon	17	75	0.04	0.41	8	12	12	4	0	0	0	12	0	0	1-2	2-3	Developing
Lesotho	3	27	n.a.	n.a.	0	0	12	4	0	0	0	0	0	12	0	2-3	Developing
Lithuania	8	80	0.24	0.94	5	5	2	0	0	0	1	0	0	0	0-2	0-3	High income
Luxemburg	2	12	0.23	0.65	0	0	9	0	0	0	0	0	0	0	0	0-1	High income
Malawi	4	42	0.25	0.09	0	0	10	0	0	12	0	0	0	0	0	1-2	Developing
Malaysia	24	246	0.20	0.87	12	0	12	0	0	0	0	0	0	0	1	1	Developing
Malta	6	59	0.28	n.a.	0	0	10	2	0	3	1	0	0	0	0	0-4	High income
Mauritius	14	134	0.37	0.53	2	2	12	0	0	0	0	0	0	0	0-2	1	Developing
Mexico	26	108	0.62	0.81	0	0	12	12	0	0	0	0	3	0	0	2-4	Developing
Moldova	11	109	0.30	0.42	0	0	12	0	0	12	0	0	0	8	0	2-3	Developing
Mongolia	3	21	0.60	n.a.	3	3	12	0	0	0	0	12	0	0	0	2-3	Developing
Montenegro	7	56	0.01	n.a.	0	0	8	5	0	0	0	0	0	0	0	0-2	Developing
Morocco	6	50	0.26	0.57	0	0	12	12	0	12	0	0	0	0	0	3	Developing
Mozambique	10	97	0.25	0.22	0	0	12	0	0	0	0	12	0	12	0	3	Developing
Nepal	24	232	0.18	0.78	7	0	12	0	0	0	0	0	12	0	0-1	2	Developing
Netherlands	19	158	0.14	0.70	3	3	2	0	0	0	4	0	0	0	0-2	0-2	High income
New Zealand	10	85	0.18	0.10	3	0	0	0	0	0	0	0	0	0	0-1	0	High income
Nigeria	15	142	0.21	0.55	0	0	12	0	0	2	0	0	0	0	0	1-2	Developing
Norway	12	95	0.38	0.67	6	6	12	0	0	0	0	0	0	0	0-2	1-3	High income
Pakistan	21	211	0.17	0.81	12	11	12	12	0	12	12	12	0	8	1-2	5-7	Developing
Panama	35	212	0.35	0.68	0	0	12	0	0	0	0	0	2	0	0	1-2	Developing
Paraguay	13	134	0.19	0.66	0	0	12	12	10	0	0	0	0	12	0	3-4	Developing
Peru	14	138	0.30	0.75	0	0	12	12	0	0	0	12	8	0	0	3-6	Developing
Philippines	22	216	0.21	0.25	0	0	12	0	0	0	12	0	0	8	0	2-4	Developing
Poland	33	288	0.31	0.63	2	4	12	2	0	0	0	0	0	0	0-2	1-2	High income
Portugal	19	152	0.19	0.76	0	0	12	0	0	0	4	0	0	0	0	1-2	High income
Romania	19	151	0.25	0.85	9	12	12	12	0	2	0	0	0	0	1-2	1-2	Developing
Russian Federation	756	6533	0.21	0.73	0	0	12	0	0	0	0	0	0	0	0	2-3	Developing
Serbia	27	257	0.20	0.77	5	9	12	0	0	5	0	11	0	0	0-2	1-3	Developing
Singapore	9	84	0.77	0.86	12	3	12	3	1	0	0	0	0	0	1-2	1-4	High income
Slovak Republic	7	57	0.27	0.75	2	0	0	0	0	0	5	0	0	0	0-1	0-1	High income
Slovenia	15	144	0.21	0.72	0	0	10	0	0	0	5	0	0	0	0	0-2	High income
South Africa	12	128	0.16	0.81	0	0	8	0	3	0	0	0	0	0	0	0-2	Developing
Spain	89	743	0.33	0.42	12	0	12	2	0	0	1	0	12	0	1	2-4	High income
Sri Lanka	12	129	0.22	0.51	1	0	12	0	0	0	0	0	0	0	0-1	1	Developing
St. Kitts and Nevis	2	22	n.a.	n.a.	0	0	11	0	11	0	0	0	0	0	0	1-2	High income
Sweden	19	194	0.32	0.40	6	0	12	0	0	0	8	0	0	0	0-1	1-3	High income
Switzerland	101	1015	0.16	0.57	0	0	9	9	6	0	0	0	0	0	0	0-4	High income
Tajikistan	3	22	n.a.	n.a.	0	0	12	0	0	0	0	4	0	0	0	1-2	Developing
Thailand	20	205	0.39	0.48	12	0	8	0	0	0	0	0	5	0	1	0-2	Developing
Trinidad and Tobago	4	26	0.35	0.60	0	0	8	12	8	0	12	0	0	0	0	2-4	High income
Uganda	14	125	0.28	0.33	0	0	11	12	3	6	0	0	0	0	0	1-4	Developing
Ukraine	34	280	0.25	0.71	0	0	12	0	0	12	5	10	0	0	0	3-4	Developing
United Kingdom	93	801	0.31	0.59	0	0	2	0	0	0	0	0	0	0	0	0-1	High income
United States	5528	58693	0.27	0.46	0	0	12	12	12	0	0	0	0	0	0	3	High income
Uruguay	17	150	0.19	0.74	0	0	0	0	4	0	0	12	2	0	0	1-3	High income
Venezuela	21	180	0.32	0.75	0	0	0	0	0	0	0	0	0	0	0	0	Developing
					No of countries applying MPI at least 1/4/9 years												
					45	31	97	39	21	27	32	23	20	12			

28	21	87	30	13	21	20	18	16	10
18	14	81	27	9	14	10	16	10	7

„n.a." denotes not available; Developing (High income) denotes countries classified as developing (high income) according to the IMF standards [see Cerutti et al.'s (2015, 2017) database]. Variable definitions are provided in the Appendix in Table A1.

Table A3. Number of countries using individual macroprudential instruments in 2004-2015

MPI instrument	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Ltv_cap	16	17	17	19	20	21	24	28	30	35	39	43
Dti	10	13	13	14	16	16	21	22	22	26	26	28
Rr_rev	15	18	18	18	18	18	18	18	19	19	19	21
Cg	7	7	7	7	10	10	10	10	10	10	11	12
Fc	13	14	14	14	15	15	17	21	21	23	25	26
Lev	9	9	9	9	12	12	13	13	16	19	17	17
Dp	7	8	8	11	12	12	13	15	15	16	18	18
Conc	68	73	77	80	84	85	86	86	88	88	96	96
Inter	23	23	23	26	26	26	27	29	31	32	37	38
Tax	10	10	10	10	11	11	13	20	23	24	22	30

Source: Authors' analysis of the Cerutti et al. (2015, 2017) database.

Tables to be inserted in the main text

Table 1. Descriptive statistics and correlations .

Panel A: Descriptive statistics of bank-specific and country-level variables .

	$\Delta logLoans$	Cap	Nim	Dep	Llp	Size	Δir	GDPG	Lerner
# observ.	86784	89623	88595	89050	75356	88863	102229	103059	102876
Mean	7.472	11.843	4.026	0.818	0.737	12.591	-0.189	2.282	0.238
Std. Dev.	17.135	7.732	1.858	0.127	1.158	1.778	1.343	2.838	0.133
Min	-53.905	2.060	-0.228	0.087	-1.752	8.981	-35.262	-14.810	-1.949
Max	103.885	88.699	16.470	0.946	9.538	18.486	22.264	34.500	0.708

This table contains correlations between main bank-specific and country level variables: L- real loans growth; CAP – equity capital divided by total assets; Nim – net interest margin; Dep - deposits divided by total assets; LLP – loan loss provisions divided by average loans; Size – logarithm of total assets; Δir - change in monetary policy interest rate; GDPG– real GDP growth; # observ. – number of observations.

Panel B: Correlation matrix of bank-specific and country-level variables.

	L	Cap	Nim	Dep	Llp	Size	Δir	GDPG
L	1,00							
Cap	0.13***	1.00						
Nim	0.08***	0.24***	1.00					

Dep	-0.09***	-0.61***	-0.14***	1.00				
Llp	-0.04***	0.16***	0.22***	-0.2***	1.00			
Size	0.01***	-0.24***	-0.24***	-0.06***	0.07***	1.00		
Δir	-0.04***	-0.01***	0.00	-0.01***	-0.07***	-0.01**	1.00	
GDPG	0.25***	0.04***	0.14***	0.00	0.06***	0.07***	-0.07***	1.00
Lerner(-1)	-0.01**	0.00	-0.04***	0.03***	-0.02***	-0.04***	0.02***	0.12***

This table contains correlations between main bank-specific (lagged) and country level variables: L- real loans growth; CAP – equity capital divided by total assets; Nim – net interest margin; Dep - deposits divided by total assets; LLP – loan loss provisions divided by average loans; Size – logarithm of total assets; Δir - change in monetary policy interest rate; GDPG– real GDP growth; Lerner(t-1) – Lerner index lagged by one year;„***" denotes an estimate significantly different from 0 at the 1% level. „(t-1)" denotes that the variable is lagged by one year.

Table 2. Baseline results

Dependent variable	FE	RE	RE	RE	RE	RE	RE	RE	RE	RE
L	1	2	3	4	5	6	7	8	9	10
$CAP_{(t-1)}$	0.726*** (0.057)	0.57*** (0.041)	0.605*** (0.042)	0.584*** (0.042)	0.581*** (0.041)	0.586*** (0.042)	0.615*** (0.042)	0.617*** (0.042)		
$Nim_{(t-1)}$	-0.462*** (0.139)	0.113 (0.092)	0.173* (0.092)	0.099 (0.092)	0.093 (0.092)	0.179* (0.091)	0.153* (0.092)	0.234** (0.092)		
$Dep_{(t-1)}$	2.22 (2.264)	-10.32*** (1.372)	-6.306*** (1.454)	-9.713*** (1.384)	-10.05*** (1.369)	-7.131*** (1.39)	-6.052*** (1.447)	-3.671** (1.456)		
$Llp_{(t-1)}$	-2.688*** (0.099)	-2.288*** (0.097)	-2.302*** (0.097)	-2.325*** (0.097)	-2.273*** (0.097)	-2.362*** (0.096)	-2.287*** (0.097)	-2.365*** (0.096)		
$Size_{(t-1)}$	-13.19*** (0.358)	-0.847*** (0.071)	-0.794*** (0.072)	-0.784*** (0.072)	-0.732*** (0.074)	-1.082*** (0.074)	-0.682*** (0.075)	-1.013*** (0.075)		
Δir_t	-0.01 (0.076)	-0.27*** (0.076)	-0.09 (0.084)	-0.266*** (0.079)	-0.271*** (0.076)	-0.283*** (0.076)	-0.091 (0.084)	-0.126 (0.084)	-0.217*** (0.075)	-0.259*** (0.076)
$GDPG_t$	0.623*** (0.036)	1.243*** (0.033)	1.436*** (0.04)	1.283*** (0.036)	1.259*** (0.034)	1.192*** (0.033)	1.452*** (0.04)	1.377*** (0.04)	1.572*** (0.033)	1.512*** (0.033)
$Borrower_t$					-1.567*** (0.338)		-1.528*** (0.343)		-1.898*** (0.253)	
$Financial_t$						-2.49*** (0.133)		-2.269*** (0.133)		-1.393*** (0.099)
$Lerner_{(t-1)}$			-0.189*** (0.02)				-0.188*** (0.019)	-0.176*** (0.019)	-0.143*** (0.013)	-0.13*** (0.013)
$Lerner_{(t-1)}sq$				-0.001*** (0)						
F test p-value	0.00									
Wald test p-value		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
R-sq.	0.19	0.11	0.12	0.11	0.11	0.12	0.12	0.13	0.05	0.05
# observ.	70 825	70 825	70 150	70 150	70 825	70 825	70 150	70 150	85 225	85 225

# banks	8 236	8 236	8 193	8 193	8 236	8 236	8 193	8 193	8 521	8 521

This table contains information about baseline results. FE and RE denotes Fixed effects and Random Effects respectively. All regressions are estimated using bank-clustered standard errors. Robust standard errors are included in parentheses. All models include intercepts, which were not presented to save space.„*", „**", „***" denote an estimate significantly different from 0 at the 10%, 5% and 1% levels, respectively. „(t-1)" denotes that the variable is lagged by one year. „# observ.", „#banks" denote number of observations and banks, respectively. Variable definitions are provided in the Appendix in Table A1.

Table 3. Effect of macroprudential policy on loans growth and the role of competition intensity.

MPI instrument:	**Ltv_cap**	**Dti**	**Rr_rev**	**Fc**	**Cg**	**Lev**	**Dp**	**Conc**	**Inter**	**Tax**
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
$CAP_{(t-1)}$	0.631***	0.608***	0.602***	0.613***	0.609***	0.589***	0.603***	0.601***	0.589***	0.617***
	(0.042)	(0.042)	(0.043)	(0.042)	(0.042)	(0.042)	(0.042)	(0.043)	(0.042)	(0.042)
$Nim_{(t-1)}$	0.162*	0.194**	0.067	0.176*	0.161*	0.088	0.158*	0.186**	0.093	0.133
	(0.092)	(0.092)	(0.095)	(0.093)	(0.093)	(0.091)	(0.092)	(0.092)	(0.092)	(0.092)
$Dep_{(t-1)}$	-2.98**	-5.072***	-5.363***	-6.041***	-6.077***	-2.547*	-5.822***	-5.874***	-2.697*	-5.507***
	(1.438)	(1.433)	(1.475)	(1.477)	(1.467)	(1.49)	(1.462)	(1.464)	(1.516)	(1.461)
$Llp_{(t-1)}$	-2.223***	-2.295***	-2.333***	-2.285***	-2.296***	-2.381***	-2.308***	-2.312***	-2.426***	-2.301***
	(0.096)	(0.097)	(0.097)	(0.097)	(0.097)	(0.097)	(0.097)	(0.096)	(0.096)	(0.096)
$Size_{(t-1)}$	-0.692***	-0.855***	-0.867***	-0.792***	-0.799***	-1.338***	-0.913***	-0.877***	-1.35***	-0.685***
	(0.074)	(0.075)	(0.074)	(0.074)	(0.073)	(0.087)	(0.074)	(0.073)	(0.08)	(0.073)
Δir_t	-0.002	-0.026	-0.143*	-0.144*	-0.137	-0.088	-0.058	-0.105	-0.05	-0.106
	(0.084)	(0.084)	(0.083)	(0.082)	(0.084)	(0.088)	(0.085)	(0.084)	(0.087)	(0.084)
$GDPG_t$	1.547***	1.482***	1.433***	1.466***	1.45***	1.437***	1.422***	1.417***	1.371***	1.462***
	(0.038)	(0.037)	(0.042)	(0.043)	(0.042)	(0.06)	(0.041)	(0.041)	(0.045)	(0.041)
$Lerner_{(t-1)}$	-0.302***	-0.252***	-0.201***	-0.21***	-0.198***	0.003	-0.202***	-0.014	-0.062***	-0.206***
	(0.016)	(0.014)	(0.022)	(0.022)	(0.021)	(0.017)	(0.022)	(0.037)	(0.018)	(0.021)
MPI_t	-12.68***	-6.761***	-0.221	-6.987***	-4.147**	3.919***	0.51	-1.128	-1.786**	-10.20***
	(0.685)	(0.978)	(1.607)	(1.501)	(1.929)	(1.436)	(1.368)	(0.931)	(0.812)	(0.891)
$MPI_t \times Lerner_{(t-1)}$	0.352***	0.278***	0.205***	0.231***	0.157**	-0.335***	0.132***	-0.179***	-0.183***	0.284***
	(0.022)	(0.026)	(0.054)	(0.048)	(0.06)	(0.048)	(0.041)	(0.04)	(0.03)	(0.047)
Wald test p-value	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
R-sq	0,13	0,12	0,12	0,12	0,12	0,13	0,12	0,12	0,13	0,12
# observ.	70 150	70 150	70 150	70 150	70 150	70 150	70 150	70 150	70 150	70 150
# banks	8 193	8 193	8 193	8 193	8 193	8 193	8 193	8 193	8 193	8 193

This table contains information about the role of competition intensity in the link between macroprudential policy and loans growth. This is presentation of results obtained with equation Eq.(2). All regressions are obtained using random effects estimator with bank-clustered standard errors. Robust standard errors are included in parentheses. All models include intercepts, which were not presented to save space. „*", „**", „***" denote an estimate significantly different from 0 at the 10%, 5% and 1% levels,

respectively. „(t-1)" denotes that the variable is lagged by one year. $MPI_t \times Lerner_{t-1}$ denotes the interaction term between MPI and Lerner, and informs about the role of competition intensity in the effects of MPI on loans growth. „# observ.", „#banks" denote number of observations and banks, respectively. Variable definitions are provided in the Appendix in Table A1.

Table 4. Effects of individual tools of macroprudential policy on sensitivity of lending to GDPG

MPI instrument:	**Ltv_cap**	**Dti**	**Rr_rev**	**Fc**	**Cg**	**Lev**	**Dp**	**Conc**	**Inter**	**Tax**
	1	2	3	4	5	6	7	8	9	10
$CAP_{(t-1)}$	0.619***	0.6***	0.595***	0.605***	0.603***	0.596***	0.602***	0.603***	0.591***	0.617***
	(0.042)	(0.042)	(0.043)	(0.042)	(0.042)	(0.042)	(0.042)	(0.043)	(0.042)	(0.042)
$Nim_{(t-1)}$	0.118	0.192**	0.106	0.181*	0.196**	0.116	0.141	0.202**	0.057	0.147
	(0.093)	(0.092)	(0.095)	(0.093)	(0.093)	(0.092)	(0.093)	(0.092)	(0.092)	(0.093)
$Dep_{(t-1)}$	-5.907***	-6.783***	-5.867***	-6.328***	-6.595***	-2.46*	-6.184***	-6.235***	-3.305**	-5.765***
	(1.446)	(1.449)	(1.455)	(1.455)	(1.452)	(1.455)	(1.454)	(1.445)	(1.437)	(1.453)
$Llp_{(t-1)}$	-2.245***	-2.297***	-2.33***	-2.299***	-2.284***	-2.409***	-2.305***	-2.324***	-2.433***	-2.288***
	(0.097)	(0.097)	(0.097)	(0.097)	(0.097)	(0.096)	(0.097)	(0.096)	(0.096)	(0.097)
$Size_{(t-1)}$	-0.675***	-0.863***	-0.841***	-0.787***	-0.776***	-1.226***	-0.925***	-0.869***	-1.226***	-0.681***
	(0.074)	(0.075)	(0.074)	(0.073)	(0.074)	(0.086)	(0.074)	(0.073)	(0.077)	(0.073)
Δir_t	-0.09	-0.097	-0.057	-0.089	-0.056	0.008	-0.056	-0.112	-0.011	-0.102
	(0.084)	(0.084)	(0.083)	(0.084)	(0.084)	(0.084)	(0.083)	(0.084)	(0.084)	(0.084)
$GDPG_t$	**1.375*** **	**1.369*** **	**1.351*** **	**1.433*** **	**1.378*** **	**1.667*** **	**1.372*** **	**1.281*** **	**1.685*** **	**1.451*** **
	(0.042)	(0.041)	(0.042)	(0.042)	(0.042)	(0.053)	(0.042)	(0.098)	(0.065)	(0.041)
$Lerner_{(t-1)}$	-0.185***	-0.186***	-0.178***	-0.189***	-0.182***	-0.129***	-0.188***	-0.179***	-0.162***	-0.194***
	(0.019)	(0.02)	(0.019)	(0.02)	(0.019)	(0.017)	(0.02)	(0.019)	(0.018)	(0.02)
MPI_t	-5.82***	-2.958***	2.974***	-1.223	-3.245***	-2.787***	1.389*	-5.366***	-4.574***	-4.765***
	(0.514)	(0.852)	(0.968)	(1.757)	(0.726)	(0.367)	(0.719)	(0.48)	(0.363)	(0.558)
$MPI_t \times GDPG_t$	**0.714*** **	**1.008*** **	**0.492*** **	**0.1**	**0.649*** **	**-0.788*** **	**0.694*** **	**0.147**	**-0.602*** **	**-0.026**
	(0.097)	(0.128)	(0.139)	(0.178)	(0.116)	(0.065)	(0.124)	(0.104)	(0.076)	(0.202)
Wald test p-value	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
R-sq	0,12	0,12	0,12	0,12	0,12	0,13	0,12	0,12	0,13	0,12
# observ.	70 150	70 150	70 150	70 150	70 150	70 150	70 150	70 150	70 150	70 150
# banks	8 193	8 193	8 193	8 193	8 193	8 193	8 193	8 193	8 193	8 193

This table contains information about the impact of macroprudential policy on sensitivity of lending to GPDG. This is estimation of equation Eq.(4). All regressions are obtained using random effects estimator with bank-clustered standard errors. Robust standard errors are included in parentheses. All models include intercepts, which were

not presented to save space. „*", „**", „***" denote an estimate significantly different from 0 at the 10%, 5% and 1% levels, respectively. „(t-1)" denotes that the variable is lagged by one year . „# observ.", „#banks" denote number of observations and banks, respectively. $MPI_t \times GDPG_t$ denotes interaction term between macroprudential policy instruments and business cycle, and informs about impact of MPI on procyclicality of lending. Other variable definitions are provided in the Appendix in Table A1.

Table 5.Effects of individual tools of macroprudential policy on procyclicality of lending (the role of the duration of MPI usage)

MPI instrument:	**Ltv_cap**	**Dti**	**Rr_rev**	**Fc**	**Cg**	**Lev**	**Dp**	**Conc**	**Inter**	**Tax**
	1	2	3	4	5	6	7	8	9	10
Panel A: Sensitivity of lending to business cycle (procyclicality) in countries applying MPI at least 4 years										
$GDPG_t$	1.283***	1.325***	1.339***	1.421***	1.37***	1.708***	1.357***	1.287***	1.759***	1.418***
	(0.043)	(0.041)	(0.042)	(0.042)	(0.043)	(0.058)	(0.042)	(0.11)	(0.072)	(0.043)
$Lerner_{(t-1)}$	-0.182***	-0.181***	-0.18***	-0.188***	-0.179***	-0.122***	-0.186***	-0.185***	-0.156***	-0.175***
	(0.019)	(0.019)	(0.019)	(0.02)	(0.019)	(0.017)	(0.02)	(0.02)	(0.018)	(0.02)
$MPI_t \times GDPG_t$	0.105	-0.474*	-2.178***	1.194	0.809***	-0.803***	0.249	0.419*	0.013	-0.33
	(0.136)	(0.264)	(0.485)	(1.571)	(0.198)	(0.177)	(0.207)	(0.216)	(0.095)	(0.214)
$MPI_t \times MPImin4*GDPG_t$	0.553***	1.407***	2.706***	-1.138	-0.144	-0.051	0.44**	-0.273	-0.708***	0.179*
	(0.127)	(0.252)	(0.466)	(1.539)	(0.207)	(0.183)	(0.18)	(0.239)	(0.12)	(0.096)
R-sq	0.13	0.12	0.12	0.12	0.12	0.13	0.12	0.12	0.13	0.12
Panel B: Sensitivity of lending to business cycle (procyclicality) in countries applying MPI at least 9 years										
$GDPG_t$	1.353***	1.353***	1.339***	1.431***	1.376***	1.695***	1.367***	1.281***	1.696***	1.454***
	(0.042)	(0.041)	(0.042)	(0.042)	(0.042)	(0.054)	(0.042)	(0.099)	(0.066)	(0.041)
$Lerner_{(t-1)}$	-0.19***	-0.188***	-0.179***	-0.191***	-0.18***	-0.112***	-0.19***	-0.182***	-0.164***	-0.194***
	(0.019)	(0.019)	(0.019)	(0.02)	(0.019)	(0.016)	(0.02)	(0.019)	(0.019)	(0.02)
$MPI_t \times GDPG_t$	0.362**	-2.225***	-2.09***	-0.184	1.052***	0.194	-0.067	0.526**	-0.561***	-1.267***
	(0.169)	(0.363)	(0.48)	(0.573)	(0.226)	(0.225)	(0.348)	(0.241)	(0.149)	(0.275)
$MPI_t \times MPImin9 \times GDPG_t$	0.273	3.366***	2.622***	0.154	-0.542**	-1.124***	0.828**	-0.385*	-0.042	1.795***
	(0.175)	(0.379)	(0.462)	(0.599)	(0.263)	(0.227)	(0.366)	(0.227)	(0.159)	(0.444)
R-sq	0.13	0.12	0.12	0.12	0.12	0.13	0.12	0.12	0.13	0.12
Wald test p-value (in panel A, B & C)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
# observ. (in panel A & B)	70 150	70 150	70 150	70 150	70 150	70 150	70 150	70 150	70 150	70 150
# banks (in panel A & B)	8 193	8 193	8 193	8 193	8 193	8 193	8 193	8 193	8 193	8 193

This table contains information about impact of macroprudential policy on procyclicality of lending. This is a shortened presentation of results obtained with equation Eq.(4). Full results are available upon request. All regressions are obtained using random effects estimator with bank-clustered standard errors. Robust standard errors are included in parentheses. All models include intercepts, which were not presented to save space. „*", „**", „***" denote an estimate significantly different from 0 at the 10%, 5% and 1% levels, respectively. „(t-1)" denotes that the variable is lagged by one year. „# observ.", „#banks" denote number of observations and banks, respectively. MPI×GDPG denotes interaction term between macroprudential policy instruments and business cycle; $MPI_t \times GDPG_t \times$MPImin4– denotes the interaction between macroprudential policy instruments applied at least four years and the business cycle, and informs about impact of MPI on procyclicality of lending in countries that apply MPI at least 4 years; $MPI_t \times GDPG_t \times$MPImin9– denotes the interaction between macroprudential policy instruments applied at least nine years and the business cycle, and informs about impact of MPI on procyclicality of lending in countries that apply MPI at least 9 years. Other variable definitions are provided in the Appendix in Table A1.

Table 6. Effects of invidual tools of macroprudential policy on procyclicality of lending and competition intensity

MPI instrument:		Ltv_cap	Dti	Rr_rev	Fc	Cg	Lev	Dp	Conc	Inter	Tax
	1	2	3	4	5	6	7	8	9	10	11
Panel A: Competitive environment and the effects of macroprudential policy on sensitivity of lending to business cycle											
$CAP_{(t-1)}$	0.615***	0.645***	0.618***	0.606***	0.613***	0.614***	0.604***	0.612***	0.617***	0.624***	0.625***
	(0.042)	(0.042)	(0.042)	(0.043)	(0.042)	(0.042)	(0.042)	(0.042)	(0.042)	(0.042)	(0.042)
$Nim_{(t-1)}$	0.177*	0.152	0.205**	0.12	0.184**	0.198**	0.103	0.166*	0.152*	0.037	0.138
	(0.092)	(0.092)	(0.092)	(0.095)	(0.094)	(0.093)	(0.091)	(0.093)	(0.092)	(0.093)	(0.093)
$Dep_{(t-1)}$	-4.892***	-1.441	-3.949***	-4.086***	-4.858***	-4.991***	-0.014	-4.853***	-3.738**	0.328	-4.286***
	(1.465)	(1.455)	(1.451)	(1.469)	(1.468)	(1.472)	(1.462)	(1.477)	(1.48)	(1.495)	(1.467)
$Llp_{(t-1)}$	-2.291***	-2.203***	-2.279***	-2.326***	-2.291***	-2.282***	-2.29***	-2.298***	-2.277***	-2.37***	-2.288***
	(0.096)	(0.096)	(0.096)	(0.097)	(0.097)	(0.097)	(0.095)	(0.096)	(0.096)	(0.096)	(0.096)
$Size_{(t-1)}$	-0.846***	-0.725***	-0.894***	-0.916***	-0.844***	-0.836***	-1.32***	-0.962***	-0.933***	-1.322***	-0.735***
	(0.073)	(0.075)	(0.076)	(0.075)	(0.073)	(0.074)	(0.084)	(0.075)	(0.073)	(0.079)	(0.073)
Δir_t	-0.134	-0.047	-0.073	-0.109	-0.139	-0.112	-0.036	-0.106	-0.174**	-0.098	-0.149*
	(0.083)	(0.083)	(0.082)	(0.082)	(0.085)	(0.082)	(0.083)	(0.084)	(0.083)	(0.084)	(0.083)
$Lerner_{(t-1)}$	-0.25***	-0.356***	-0.303***	-0.259***	-0.25***	-0.255***	-0.035**	-0.247***	0.003	-0.069***	-0.26***
	(0.021)	(0.016)	(0.016)	(0.022)	(0.021)	(0.022)	(0.017)	(0.022)	(0.038)	(0.019)	(0.022)
MPI_t		-15.48***	-10.27***	-6.109**	-5.019	-13.45***	11.933***	5.146**	1.344	2.325***	-7.179***
		(0.778)	(1.457)	(2.367)	(3.552)	(2.789)	(0.941)	(2.474)	(0.921)	(0.747)	(1.468)
$MPI \times Lerner_{(t-1)}$		0.451***	0.324***	0.403***	0.199	0.434***	-0.69***	-0.098	-0.326***	-0.339***	0.155**
		(0.03)	(0.049)	(0.083)	(0.151)	(0.104)	(0.038)	(0.081)	(0.043)	(0.032)	(0.07)
$GDPG_t$	0.647***	0.668***	0.698***	0.445***	0.595***	0.539***	1.311***	0.715***	1.16***	1.729***	0.746***
	(0.08)	(0.084)	(0.079)	(0.086)	(0.088)	(0.088)	(0.084)	(0.081)	(0.142)	(0.118)	(0.08)
$GDPG_t \times Lerner_{(t-1)}$	0.035***	0.038***	0.033***	0.042***	0.037***	0.038***	0.014***	0.03***	0.002	-0.003	0.032***
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.006)	(0.004)	(0.004)
$MPI_t \times GDPG_t$		1.362***	1.168***	1.828***	0.811*	1.931***	-4.597***	-0.995**	-0.825***	-2.08***	-0.799*
		(0.222)	(0.439)	(0.303)	(0.417)	(0.358)	(0.285)	(0.501)	(0.17)	(0.181)	(0.46)
$MPI_t \times GDPG_t \times Lerner_{(t-1)}$		-0.044***	-0.023*	-0.058***	-0.028	-0.054***	0.183***	0.044***	0.046***	0.076***	0.032*
		(0.008)	(0.014)	(0.01)	(0.018)	(0.013)	(0.01)	(0.016)	(0.007)	(0.007)	(0.017)

R-sq: within	0.12	0.13	0.13	0.13	0.12	0.12	0.14	0.12	0.13	0.14	0.12
Panel B: Competitive environment and the effects of macroprudential policy on procyclicality of lending (role of mpi applied at least 9 years)											
$GDPG_t$		0.72***	0.69***	0.407***	0.588***	0.535***	1.29***	0.713***	1.12***	1.778***	0.732***
		(0.083)	(0.079)	(0.085)	(0.088)	(0.089)	(0.083)	(0.081)	(0.143)	(0.118)	(0.08)
$GDPG_t \times Lerner_{(t-1)}$		0.034***	0.033***	0.043***	0.037***	0.038***	0.015***	0.03***	0.003	-0.004	0.032***
		(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.003)	(0.004)	(0.006)	(0.004)	(0.004)
$MPI_t \times GDPG_t$		2.498***	-3.2***	1.256	-4.79*	2.353	-0.27	0.205	-0.36	-4.142***	-0.819
		(0.441)	(1.148)	(1.316)	(2.903)	(1.668)	(0.576)	(0.644)	(0.452)	(0.332)	(0.555)
$MPI_t \times GDPG_t \times Lerner_{(t-1)}$		-0.11***	0.025	-0.006	0.172	-0.072	0.031	-0.004	0.031*	0.146***	-0.011
		(0.018)	(0.038)	(0.069)	(0.118)	(0.052)	(0.02)	(0.02)	(0.017)	(0.012)	(0.023)
$MPI_t \times GDPG_t \times MPImin9$		-1.491***	5.189***	0.65	5.507*	-0.83	-5.875***	-0.538	-0.439	2.147***	1.691*
		(0.481)	(1.211)	(1.322)	(2.936)	(1.709)	(0.659)	(0.975)	(0.449)	(0.357)	(0.973)
$MPI_t \times GDPG_t \times Lerner_{(t-1)} \times MPImin9$		0.081***	-0.075*	-0.054	-0.2*	0.029	0.222***	0.029	0.016	-0.072***	-0.022
		(0.02)	(0.04)	(0.069)	(0.119)	(0.054)	(0.024)	(0.028)	(0.016)	(0.013)	(0.036)
R-sq: within		0.14	0.13	0.13	0.12	0.13	0.14	0.13	0.13	0.14	0.13
Wald test p-value (in panel A & B)		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
No of observation (in panel A & B)		70 150	70 150	70 150	70 150	70 150	70 150	70 150	70 150	70 150	70 150
No of banks (in panel A & B)		8 193	8 193	8 193	8 193	8 193	8 193	8 193	8 193	8 193	8 193

This table contains information about the impact of intensity of competition in countries applying individual macroprudential policy instruments on the sensitivity (Panel A) of lending to business cycle and the procyclicality of lending (Panel B). All estimations are run with equation (3). In Panel B only shortened view is included, because the results for the other control variables are stable and similar to those included in Panel A. Full results are available upon request. All regressions are obtained using random effects estimator with bank-clustered standard errors and applying Eq (5). To save space, only the results important from the point of view of hypotheses tested in the paper, are included in the table. Robust standard errors are included in parentheses. All models include intercepts, which were not presented to save space. „*", „**", „***" denote an estimate significantly different from 0 at the 10%, 5% and 1% levels, respectively. „(t-1)" denotes that the variable is lagged by one year. „# observ.", „#banks" denote number of observations and banks, respectively. $GDPG_t \times Lerner_{(t-1)}$ denotes the effect of competition on procyclicality of lending. $MPI_t \times GDPG_t$ denotes interaction term between macroprudential policy instruments and business cycle. $MPI_t \times GDPG_t \times Lerner_{(t-1)}$) – denotes the impact of competition on the interaction between MPI and business cycle. $MPI_t \times GDPG_t \times MPImin9$ – denotes the interaction between macroprudential policy instruments applied at least nine years and the business cycle. $MPI_t \times GDPG_t \times Lerner_{(t-1)} \times MPImin9$– denotes the role of competition in the interaction between macroprudential policy instruments applied at least nine years and the business cycle. Variable definitions are provided in the Appendix in Table A1.

Table 8. Sensitivity of the effects of invidual tools of macroprudential policy on loans growth and competition intensity – the role of GDP per capita growth

MPI instrument:	**Ltv_cap**	**Dti**	**Rr_rev**	**Fc**	**Cg**	**Lev**	**Dp**	**Conc**	**Inter**	**Tax**
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
$CAP_{(t-1)}$	0.625***	0.609***	0.63***	0.606***	0.601***	0.613***	0.608***	0.589***	0.603***	0.6***
	(0.043)	(0.043)	(0.042)	(0.043)	(0.043)	(0.042)	(0.043)	(0.042)	(0.042)	(0.043)
$Nim_{(t-1)}$	0.247***	0.288***	0.221**	0.247***	0.113	0.228**	0.211**	0.139	0.209**	0.234**
	(0.092)	(0.092)	(0.093)	(0.092)	(0.096)	(0.093)	(0.094)	(0.091)	(0.093)	(0.092)
$Dep_{(t-1)}$	-3.332**	-3.527**	-2.826*	-4.879***	-5.097***	-5.804***	-5.858***	-2.443	-5.597***	-5.571***
	(1.448)	(1.467)	(1.447)	(1.441)	(1.478)	(1.481)	(1.471)	(1.496)	(1.465)	(1.469)
$Llp_{(t-1)}$	-2.284***	-2.39***	-2.261***	-2.33***	-2.369***	-2.319***	-2.332***	-2.409***	-2.341***	-2.34***
	(0.097)	(0.096)	(0.097)	(0.097)	(0.097)	(0.097)	(0.097)	(0.097)	(0.097)	(0.097)
$Size_{(t-1)}$	-0.785***	-1.068***	-0.741***	-0.907***	-0.91***	-0.832***	-0.84***	-1.365***	-0.955***	-0.912***
	(0.077)	(0.077)	(0.075)	(0.076)	(0.075)	(0.075)	(0.073)	(0.088)	(0.075)	(0.073)
Δir_t	-0.007	-0.093	-0.018	-0.042	-0.155*	-0.158*	-0.15*	-0.1	-0.071	-0.118
	(0.084)	(0.086)	(0.084)	(0.084)	(0.083)	(0.082)	(0.085)	(0.088)	(0.085)	(0.084)
$GDPGpercapita_t$	1.492***	1.432***	1.384***	1.418***	1.399***	1.402***	1.372***	1.372***	1.322***	1.423***
	(0.038)	(0.038)	(0.042)	(0.043)	(0.042)	(0.063)	(0.041)	(0.042)	(0.046)	(0.042)
$Lerner_{(t-1)}$	-0.293***	-0.244***	-0.194***	-0.203***	-0.19***	0.016	-0.195***	0.032	-0.051***	-0.202***
	(0.015)	(0.014)	(0.021)	(0.022)	(0.021)	(0.017)	(0.021)	(0.037)	(0.018)	(0.021)
MPI_t	-12.26***	-6.191***	0.362	-6.912***	-3.129	4.413***	0.927	0.121	-1.608**	-11.07***
	(0.69)	(0.983)	(1.612)	(1.518)	(1.931)	(1.481)	(1.368)	(0.947)	(0.815)	(0.904)
$MPI_t \times Lerner_{(t-1)}$	0.344***	0.274***	0.199***	0.231***	0.15**	-0.349***	0.124***	-0.223***	-0.19***	0.322***
	(0.022)	(0.026)	(0.054)	(0.049)	(0.061)	(0.049)	(0.041)	(0.041)	(0.03)	(0.048)
Wald test p-value	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
R-sq.	0.13	0.12	0.12	0.12	0.12	0.13	0.12	0.12	0.13	0.12
# observ.	70 150	70 150	70 150	70 150	70 150	70 150	70 150	70 150	70 150	70 150
# banks	8 193	8 193	8 193	8 193	8 193	8 193	8 193	8 193	8 193	8 193

This table contains information about robustness checks. This is estimation of models presented with equation Eq.(2). Full results are available upon request. All regressions are obtained using random effects estimator with bank-clustered standard errors. Robust standard errors are included in parentheses. All models include intercepts, which were not presented to save space. „*", „**", „***" denote an estimate significantly different from 0 at the 10%, 5% and 1% levels, respectively. „(t-1)" denotes that the variable is lagged by one year. „# observ.", „#banks" denote number of observations and banks, respectively. $MPI_t \times Lerner_{(t-1)}$ denotes the interaction term between MPI and Lerner, and informs about the role of competition intensity for the link between MPI and loans growth. Variable definitions are provided in the Appendix in Table A1.

Table 9. Sensitivity of effects of macroprudential policy on procyclicality of lending and competition intensity – the role of GDP per capita growth

MPI instrument:		**Ltv_cap**	**Dti**	**Rr_rev**	**Fc**	**Cg**	**Lev**	**Dp**	**Conc**	**Inter**	**Tax**
	1	2	3	4	5	6	8	7	9	10	11
Panel A: Impact of competition on the effects of macroprudential policy on sensitivity of lending to business cycle											
$GDPGpercapita_t$	0.378***	0.343***	0.423***	0.105	0.261***	0.262***	1.1***	0.435***	0.355***	1.467***	0.539***
	(0.085)	(0.091)	(0.085)	(0.09)	(0.095)	(0.095)	(0.089)	(0.087)	(0.129)	(0.13)	(0.088)
$GDPGpercapita_t \times Lerner_{(t-1)}$	0.044***	0.05***	0.043***	0.055***	0.048***	0.047***	0.021***	0.041***	0.042***	0.007	0.039***
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.007)	(0.004)	(0.004)
$MPI_t \times GDPGpercapita_t$		1.437***	1.045**	1.989***	1.302***	1.966***	-4.224***	-0.687	-0.048	-1.837***	-0.802***
		(0.226)	(0.478)	(0.286)	(0.383)	(0.365)	(0.296)	(0.515)	(0.167)	(0.187)	(0.272)
$MPI_t \times GDPGpercapita_t \times Lerner_{(t-1)}$		-0.051***	-0.026*	-0.065***	-0.051***	-0.059***	0.165***	0.027*	0.005	0.065***	0.013
		(0.008)	(0.015)	(0.01)	(0.016)	(0.013)	(0.011)	(0.016)	(0.008)	(0.007)	(0.014)
R-sq.	0.12	0.13	0.13	0.13	0.12	0.12	0.14	0.12	0.13	0.14	0.12
Panel B: Impact of competition on the effects of macroprudential policy on procyclicality of lending (role of mpi applied at least 9 years)											
$GDPGpercapita_t$		0.354***	0.423***	0.117	0.268***	0.255***	1.107***	0.428***	0.298**	1.523***	0.535***
		(0.088)	(0.085)	(0.09)	(0.094)	(0.096)	(0.088)	(0.087)	(0.127)	(0.13)	(0.088)
$GDPGpercapita_t \times Lerner_{(t-1)}$		0.047***	0.043***	0.054***	0.048***	0.048***	0.021***	0.041***	0.044***	0.005	0.039***
		(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.007)	(0.004)	(0.004)
$MPI_t \times GDPGpercapita_t$		1.684***	-1.63	1.371	-2.444	2.705	0.029	0.385	0.178	-2.697***	-0.777***
		(0.435)	(1.009)	(1.871)	(2.396)	(1.688)	(0.562)	(0.657)	(0.462)	(0.428)	(0.274)
$MPI_t \times GDPGpercapita \times Lerner_{(t-1)}$		-0.091***	-0.032	-0.017	0.092	-0.089*	0.016	-0.012	-0.014	0.084***	-0.042**
		(0.016)	(0.035)	(0.076)	(0.099)	(0.051)	(0.018)	(0.021)	(0.018)	(0.021)	(0.016)
$MPI_t \times MPImin9 \times GDPGpercapita_t$		-0.282	3.34***	0.596	3.608	-1.126	-6.209***	-0.185	-0.167	0.965**	2.83***
		(0.458)	(1.06)	(1.893)	(2.43)	(1.728)	(0.662)	(1.101)	(0.454)	(0.433)	(0.856)
$MPI_t \times MPImin9 \times GDPGpercapita_t \times Lerner_{(t-1)}$		0.045**	-0.016	-0.048	-0.139	0.04	0.238***	0.013	0.018	-0.02	-0.039
		(0.017)	(0.037)	(0.077)	(0.101)	(0.053)	(0.023)	(0.035)	(0.017)	(0.021)	(0.034)
R-sq.		0.14	0.13	0.13	0.12	0.13	0.14	0.12	0.13	0.14	0.13
Wald test p-value (in panel A & B)		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

# observ. (in panel A & B)	70 150	70 150	70 150	70 150	70 150	70 150	70 150	70 150	70 150	70 150
# banks (in panel A & B)	8 193	8 193	8 193	8 193	8 193	8 193	8 193	8 193	8 193	8 193

This table contains information about robustness checks. This is a shortened presentation of results obtained with equation Eq.(5), because the coefficients for the other control variables are stable and similar to those included in Table 7. Full results are available upon request. All regressions are obtained using random effects estimator with bank-clustered standard errors. Robust standard errors are included in parentheses. All models include intercepts, which were not presented to save space. „*", „**", „***" denote an estimate significantly different from 0 at the 10%, 5% and 1% levels, respectively. „(t-1)" denotes that the variable is lagged by one year. „# observ.", „#banks" denote number of observations and banks, respectively. $GDPGpercapita_t \times Lerner_{(t-1)}$ denotes the effect of competition on procyclicality of lending. $MPI_t \times GDPGpercapita_t$ denotes interaction term between macroprudential policy instruments and business cycle. $MPI_t \times GDPGpercapita \times Lerner_{(t-1)}$– denotes the impact of competition on the interaction between MPI and business cycle. $MPI_t \times MPImin9 \times GDPGpercapita_t$ – denotes the interaction between macroprudential policy instruments applied at least nine years and the business cycle. $MPI_t \times MPImin9 \times GDPGpercapita_t \times Lerner_{(t-1)}$– denotes the impact of competition on interaction between macroprudential policy instruments applied at least nine years and the business cycle. Variable definitions are provided in the Appendix in Table A1.

Table 10. Sensitivity of effects of macroprudential policy on procyclicality of lending and competition intensity – the role of average industry competition

MPI instrument:		**Ltv_cap**	**Dti**	**Rr_rev**	**Fc**	**Cg**	**Lev**	**Dp**	**Conc**	**Inter**	**Tax**
	1	2	3	4	5	6	8	7	9	10	11
GDPG	1.224***	1.168***	1.165***	1.137***	1.159***	1.207***	1.556***	1.174***	1.235***	1.602***	1.247***
	(0.063)	(0.065)	(0.064)	(0.064)	(0.065)	(0.064)	(0.07)	(0.063)	(0.097)	(0.08)	(0.064)
Lerner_avg	-0.081***	-0.102***	-0.093***	-0.081***	-0.081***	-0.08***	-0.058***	-0.09***	-0.058***	-0.07***	-0.094***
	(0.015)	(0.016)	(0.016)	(0.016)	(0.016)	(0.016)	(0.017)	(0.015)	(0.018)	(0.016)	(0.016)
GDPG×Lerner_avg	0.001	0	0	0	0.001	0.001	0.002	0	0.001	0.001	0
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.003)	(0.002)	(0.002)
MPI		-16.15***	-7.391***	-6.84**	-6.296*	2.811	5.276**	2.501	-6.949***	-2.655***	-3.39***
		(2.002)	(2.186)	(3.171)	(3.411)	(5.42)	(2.548)	(3.484)	(0.882)	(0.605)	(0.704)
MPI×Lerner_avg		0.459***	0.165*	0.411***	0.116	-0.272	-0.315***	-0.054	0.08**	-0.06**	-0.047
		(0.082)	(0.085)	(0.14)	(0.14)	(0.305)	(0.098)	(0.133)	(0.036)	(0.026)	(0.044)
MPI×GDPG		1.292***	1.091**	1.682***	1.301***	0.516	-3.527***	-1.284*	0.074	-1.225***	-1.446***
		(0.288)	(0.423)	(0.387)	(0.429)	(0.527)	(0.553)	(0.664)	(0.176)	(0.197)	(0.28)
MPI×GDPG×Lerner_avg		-0.025**	-0.002	-0.04***	-0.021	-0.007	0.098***	0.071***	-0.004	0.018**	0.078***
		(0.01)	(0.015)	(0.016)	(0.018)	(0.025)	(0.021)	(0.023)	(0.006)	(0.008)	(0.014)
Wald test p-value	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
R-sq.	0.11	0.12	0.11	0.11	0.11	0.11	0.12	0.12	0.12	0.13	0.12
# observ.	70 682	70 682	70 682	70 682	70 682	70 682	70 682	70 682	70 682	70 682	70682
# banks	8 216	8 216	8 216	8 216	8 216	8 216	8 216	8 216	8 216	8 216	8216

This table contains information about robustness checks This is a shortened presentation of results obtained with equation Eq.(5), because the coefficients for the other control variables are stable and similar to those included in Table 6. Full results are available upon request. All regressions are obtained using random effects estimator with bank-clustered standard errors. Robust standard errors are included in parentheses. All models include intercepts, which were not presented to save space. „*", „**", „***" denote an estimate significantly different from 0 at the 10%, 5% and 1% levels, respectively. „# observ.", „#banks" denote number of observations and banks, respectively. Lerner_avg denotes average competition intensity calculated at the country-level. Variable definitions are provided in the Appendix in Table A1.

Table 11. Sensitivity of effects of macroprudential policy on procyclicality of lending and competition intensity – the role of high competition dummy

MPI instrument:	**Ltv_cap**	**Dti**	**Rr_rev**	**Fc**	**Cg**	**Lev**	**Dp**	**Conc**	**Inter**	**Tax**
	1	2	3	4	5	6	7	8	9	10
GDPG	1.132***	1.78***	1.195***	1.234***	1.624***	1.432***	1.178***	1.196***	1.163***	1.71***
	(0.042)	(0.123)	(0.037)	(0.037)	(0.073)	(0.12)	(0.036)	(0.04)	(0.038)	(0.07)
High competition dummy	4.789***	2.711***	3.422***	3.716***	0.799	0.829	3.164***	3.886***	3.258***	0.544
	(0.409)	(0.824)	(0.408)	(0.405)	(0.693)	(0.908)	(0.4)	(0.411)	(0.406)	(0.51)
GDPG×High competition dummy	0.014	-0.638***	-0.109	0.08	-0.192	-0.434**	-0.191**	-0.029	0.03	-0.468***
	(0.086)	(0.166)	(0.093)	(0.087)	(0.153)	(0.199)	(0.093)	(0.091)	(0.087)	(0.106)
MPI×GDPG	0.491***	-0.255***	0.716***	0.303	-0.81***	-0.223*	0.41**	0.434***	1.116***	-1.057***
	(0.076)	(0.044)	(0.146)	(0.272)	(0.083)	(0.126)	(0.168)	(0.097)	(0.131)	(0.079)
MPI×GDPG×High competition dummy	0.277	0.329***	0.273	-0.628	0.362**	0.52**	0.824***	1.376***	-0.442	0.577**
	(0.171)	(0.062)	(0.227)	(0.383)	(0.18)	(0.219)	(0.254)	(0.307)	(0.396)	(0.291)
R-sq.	0.12	0.12	0.11	0.12	0.13	0.12	0.12	0.12	0.12	0.12
Wald test p-value	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
# observ.	70 682	70 682	70 682	70 682	70 682	70 682	70 682	70 682	70 682	70 682
# banks	8 216	8 216	8 216	8 216	8 216	8 216	8 216	8 216	8 216	8 216

This table contains information about robustness checks. This is a shortened presentation of results obtained with equation Eq.(3), because the coefficients for the other control variables are stable and similar to those included in Table 7. Full results are available upon request. All regressions are obtained using random effects estimator with bank-clustered standard errors. Robust standard errors are included in parentheses. All models include intercepts, which were not presented to save space. „*", „**", „***" denote an estimate significantly different from 0 at the 10%, 5% and 1% levels, respectively. „# observ.", „#banks" denote number of observations and banks, respectively. Variable definitions are provided in the Appendix in Table A1.

Table 12. Sensitivity of effects of macroprudential policy on procyclicality of lending and competition intensity – the role of high competition dummy measured with Lerner and Panzar-Rosse H-statistics.

MPI instrument:	**Ltv_cap**	**Dti**	**Rr_rev**	**Fc**	**Lev**	**Conc**	**Inter**	**Tax**
	1	2	3	4	5	6	7	8
GDPG	1.18***	1.144***	1.178***	1.183***	1.777***	1.139***	1.686***	1.217***
	(0.041)	(0.04)	(0.038)	(0.038)	(0.072)	(0.169)	(0.076)	(0.038)
MPI	-1.014*	-2.425**	6.09***	-3.494***	-3.064***	-7.419***	-4.818***	-2.376**
	(0.578)	(0.99)	(1.397)	(0.847)	(0.474)	(0.776)	(0.468)	(1.075)
GDPG×L_H_high_competition	-0.021	0.091	-0.142*	-0.029	-0.496***	0.148	-0.284**	0.126
	(0.087)	(0.084)	(0.086)	(0.089)	(0.104)	(0.207)	(0.136)	(0.086)
MPI*GDPG	0.441***	1.104***	0.317*	0.827***	-1.12***	0.082	-0.874***	0.571**
	(0.106)	(0.137)	(0.173)	(0.153)	(0.08)	(0.173)	(0.085)	(0.268)
MPI×GDPG×L_H_high_competition	0.218	-0.395	0.913***	-0.053	0.6**	-0.154	0.473***	-1.362***
	(0.253)	(0.442)	(0.253)	(0.229)	(0.289)	(0.226)	(0.164)	(0.394)
Wald test p-value	0.00	0.00	0.00	0,00	0.00	0.00	0.00	0.00
R-sq.	0.12	0.12	0.12	0.11	0.12	0.12	0.13	0.12
# observ.	70 682	70 682	70 682	70 682	70 682	70 682	70 682	70 682
# banks	8 216	8 216	8 216	8 216	8 216	8 216	8 216	8 216

This table contains information about robustness checks. This is a shortened presentation of results obtained with equation Eq.(3). Full results are available upon request. All regressions are obtained using random effects estimator with bank-clustered standard errors. Robust standard errors are included in parentheses. All models include intercepts, which were not presented to save space. „*", „**", „***" denote an estimate significantly different from 0 at the 10%, 5% and 1% levels, respectively. „# observ.", „#banks" denote number of observations and banks, respectively. L_H_high_competition – is a dummy taking the value of 1 in countries in which both average Lerner and avargae Panzar-Rosse is below median value, and 0 otherwise. Variable definitions are provided in the Appendix in Table A1.