Journal of Financial Stability 58 (2022) 100967

Contents lists available at ScienceDirect

Journal of Financial Stability

journal homepage: www.elsevier.com/locate/jfstabil

Macroprudential policies and bank competition: International bank-level evidence☆

Francisco González *

University of Oviedo, Spain

ARTICLE INFO

JEL classification:
G01
G31
G32
O40

Keywords:
Banks
Competition
Macroprudential
Regulation
Risk

ABSTRACT

The paper analyzes the effect of changes in eight types of bank-oriented macroprudential policies on bank competition and stability. Using a bank-level database of a maximum of 2511 listed banks from 52 countries, I find that a tightening in bank-oriented macroprudential policies on average increases both bank competition and stability. However, there are differences across policies and countries. Loan supply and liquidity-based policies increase bank competition whereas capital and tax-based policies reduce bank competition. Tighter legal restrictions on entry and activity in a country reduce the positive (increase the negative) effect of macroprudential policies on bank competition. In terms of policy implications, I identify a sub-set of especially useful macroprudential policies that increase not only financial stability but also bank competition.

1. Introduction

Banking literature has devoted great efforts to analyzing the effect of macroprudential policies on financial stability (Cerutti et al., 2017; Beck and Gambacorta, 2020). However, few studies analyze the impact of macroprudential policies on bank competition. This paper aims to provide new empirical evidence on the effect of macroprudential policies not only on financial stability but also on bank competition. Joint analysis on both market competition and financial stability is important because the traditional positive effects associated with competition in other industries are counteracted in banking by negative effects on financial stability. Like other industries, competition in banking can improve the efficiency of the production of financial services, the quality of financial products, and financial innovation (Claessens, 2009). However, competition can damage financial stability by reducing margins and banks' charter values, which increases banks' risk-taking incentives (Keeley, 1990; Claessens, 2009). These contrasting effects create a trade-off for bank competition between increasing efficiency and reducing stability. In this context, it is useful to analyze whether there are any policies that could increase both bank competition and stability. Such policies would combine the benefits of greater efficiency, quality, and innovation in financial services with the benefits of increased financial stability. However, macroprudential policies that increase bank competition but reduce bank stability or that increase bank stability but reduce competition would be less desirable because they would have to balance costs and benefits in terms of bank efficiency and stability.

The effect of macroprudential policies on bank competition is not clear from a theoretical perspective. I argue that they can affect bank competition through alternative and non-mutually exclusive channels such as charter value, credit supply, and barriers of entry into banking markets. Changes in some of these variables may change the competitive behavior of existing banks. Moreover, the impact on bank competition may vary across macroprudential policies and countries. Differences across macroprudential policies in their impact on charter value, credit supply, and entry barriers may cause differences in their effect on competition. Claessens and Laeven (2004) show that legal restrictions on bank entry and activities are the main drivers of market contestability and competition in bank markets because they affect the threat new competitors represent. These two regulatory characteristics may also lead to differences across countries when changes in macroprudential policies alter how attractive the banking sector is for new entrants.

☆ I would like to thank two anonymous referees for their helpful comments. I gratefully acknowledge financial support from the Spanish Ministry of Science and Innovation under the project PID2019–108503RB-I00.

* Correspondence to: Facultad de Economía y Empresa, Avenida del Cristo S/N, 33071 Oviedo, Asturias, Spain.
E-mail address: fgonzale@uniovi.es.

https://doi.org/10.1016/j.jfs.2021.100967
Received 24 April 2021; Received in revised form 18 November 2021; Accepted 6 December 2021
Available online 9 December 2021

Hence, in this paper I empirically analyze the effect of macroprudential policies on bank competition, considering potential differences across policies and countries but without identifying the specific channel/s through which macroprudential policies are transmitted to bank competition. I use international data from the Global Macroprudential Policy Instruments (GMPI) survey carried out by the IMF for the 2000–2013 period and focus on time-series changes in macroprudential policies to identify the causal effect of macroprudential policies on both bank competition and stability. More specifically, I apply a difference-in-differences (DID) analysis to better control for the traditional problems of omitted variables and endogeneity in cross-sectional studies using international data. I focus on bank-oriented macroprudential policies because the limited number of changes in borrower-oriented polices impedes analysis of their specific effect. The treatment group includes banks from 22 countries which experienced a total of 38 tightening episodes in 8 bank-oriented macroprudential policies. Banks from 30 countries without changes in macroprudential policies act as the control group. Bank-oriented macroprudential policies include capital-based (dynamic loan-loss provisions, higher capital requirements in systemic banks, and limits on leverage ratios), loan supply-based (concentration limits and limits on foreign currency loans), liquidity-based (limits on interbank exposures and reserve requirements adjusted countercyclically or imposing a specific wedge on currency deposits), and tax-based macroprudential tools.

I measure bank competition and stability at bank level in an international sample of a maximum of 2511 banks from 52 countries over the 2000–2013 period. I use the Lerner index at bank level as the main proxy for bank market power, inversely related to bank competition. This measure captures competition in broad bank activities because it includes interest and non-interest activities. Additionally, I check that the results are robust using the net interest margin as a complementary proxy capturing competition in traditional loan and deposit markets. I use several proxies for financial stability because macroprudential policies are designed to increase both the resilience of the financial system and to smooth financial cycles (Altunbas et al., 2018). Moreover, the effectiveness of macroprudential policies for achieving each of these two objectives varies (Claessens et al., 2013; Basten and Koch, 2020), so it is advisable to use different proxies for each one. Based on recent empirical literature, I use the bank's Z-score and its ratio of non-performing loans as proxies for bank risk and the resilience of the banking system (Altunbas et al., 2018). Also following the literature, I use bank credit growth as the proxy for analyzing the effectiveness of macroprudential policies to reduce financial cycles (Cerutti et al., 2017).

The results are new in the literature. To my knowledge, only Mirzaei and Moore (2020) and Scalco et al. (2021) have recently analyzed the effect of macroprudential policies on bank competition. However, they do not jointly analyze the effect of macroprudential policies on both bank competition and stability, nor do they analyze their effect on bank competition using a bank-level data base in an international sample or by exploiting changes in such policies to apply a DID analysis. Nor do any previous papers analyze how regulatory characteristics linked to bank entry and activity restrictions shape the effect of macroprudential policies on competition across countries.

I find that, on average, a tightening in bank-oriented policies increases bank competition. In particular, banks reduce their Lerner index by an average of about 0.71% points after a tightening in bank-oriented macroprudential policies compared to banks in the control group in the full sample. The above average positive effect is the result of differences across macroprudential policies and countries. I find that the positive effect on competition is basically caused by loan supply and liquidity-based policies such as limits on foreign currency loans, loan concentration, interbank exposure, and reserve requirements. However, capital-based policies such as requirements for dynamic loan-loss provisions, higher capital requirements for systematically important financial institutions, and increased taxes on financial institutions all reduce bank competition. Moreover, tighter entry and activity restrictions in a country reduce the positive effect of loan supply and liquidity-based policies on bank competition and increase the negative effect of capital and tax-based macroprudential policies on bank competition. The results are robust when I use an alternative control group based on a propensity score matching technique to reduce potential differences across the treatment and control banks. They are also robust to the inclusion or exclusion of banks in countries suffering systemic and borderline banking crises over the analysis period, to the inclusion of additional country-level control variables, and to the type of clustering applied to the standard errors. Moreover, all the regressions include bank- and year-fixed effects.

Regarding the impact on financial stability, the results indicate that a tightening in bank-oriented macroprudential policies is associated with a reduction in credit growth and bank risk. The positive effect on financial stability is associated with all types of macroprudential policies, both those which increase and those which reduce bank competition. These results for financial stability are consistent with extensive previous evidence finding that macroprudential policies are useful for smoothing financial cycles and with the more recent evidence suggesting that they are also useful for reducing bank risk.

The above results lead us to conclude that loan supply and liquidity-based macroprudential policies, such as limits on loan concentration, limits on foreign currency loans, limits on interbank exposures, and limits on reserve requirements, are associated with increases in both bank competition and stability. Therefore, such macroprudential policies are appealing because they not only provide the traditional benefits associated with bank competition in other industries in terms of efficiency, quality, and innovation but also increase financial stability. However, some capital-based policies, such as dynamic loan-loss provisions and capital requirements for systemic banks and taxes on financial institutions, have a positive effect on financial stability but reduce bank competition. Therefore, these policies are more affected by the trade-off between the benefits in terms of bank stability and the costs in terms of less efficiency, quality, and innovation in the financial system.

The rest of the paper is organized as follows. Section 2 discusses the hypotheses and the related literature. Section 3 describes the data, sample, and variables, and Section 4 explains the identification strategy in the empirical analysis. Section 5 presents the results and robustness checks. Finally, Section 6 concludes.

2. Hypotheses and related literature

2.1. Hypotheses

Banking literature does not suggest an unambiguous effect for macroprudential policies on bank competition because they may impact in alternative and non-mutually exclusive ways. These are basically related to their impact on bank charter value, credit supply, and entry barriers into banking markets.[1] Changes in some of these variables may change the competitive behavior of existing banks and their significance may also vary across macroprudential tools and countries, which I discuss below.

First, macroprudential policies may increase bank costs and consequently reduce banks' charter value. This reduction in charter value may have contrasting effects on banks' competitive behavior. On the one hand, it may lead banks to compete more aggressively in credit and deposit markets aiming to increase their market share to offset the drop in margins. On the other hand, the existence of tighter restrictions on bank entry and activities, reducing the threat of new competitors, may

[1] Claessens (2009)) and Bikker and Spierdijk (2009) provide a detailed review of the determinants of bank competition from the traditional structure-conduct-performance paradigm to the most recent theory of contestable markets.

lead existing banks to reduce competition so that they can pass on the higher cost to debtors and depositors through a higher margin (Claessens and Laeven, 2004). Capital-based tools obliging banks to increase capital ratios and higher taxes on financial institutions are examples of macroprudential policies that increase banks' costs and reduce banks' charter value.

Second, macroprudential policies may affect bank competition by reducing credit supply, again with different effects. On the one hand, a reduction in credit supply would allow banks to set higher spreads compared to a situation in which banks could increase the credit granted. On the other hand, limitations on credit activity for existing banks increase opportunities for new entrants, increasing market competition. This positive effect on bank competition would be greater the fewer the entry and activity restrictions in the bank market. The reduction in credit supply also relates to bank costs because it may reduce economies of scale and increase average bank costs, leading to the aforementioned ambiguous potential effect on bank competition. Loan-based macroprudential policies, such as concentration limits and limits on foreign currency loans, are specifically designed to reduce credit supply and may therefore have the opposite impact on bank competition. Concentration limits may also limit lending relationships because they lead debtors to borrow from more lenders. This reduces the market power of the relationship bank and may be an additional way of increasing bank market competition (Petersen and Rajan, 1995). Liquidity and capital-based policies are aimed more towards increasing the resilience of the banking system but may also reduce credit supply, albeit to a lesser extent than loan supply-based tools (Altunbas et al., 2018). Limits on interbank exposures and reserve requirements are liquidity-based measures that not only limit liquidity but also limit credit supply.

Capital-based macroprudential policies may affect credit supply but are less directly associated with reductions in credit supply than loan supply-based policies. For instance, higher capital requirements on systemically important banks allow banks to choose, to some extent, between increasing the level of capital and reducing the risk or the amount of credit. The adoption of dynamic loan-loss provisions is a capital-based macroprudential policy with a countercyclical impact on credit supply. It reduces credit supply in upturns and increases credit supply in downturns. As it only reduces credit supply temporarily, it is less clear that it increases attractiveness for entrants although it limits bank behavior and imposes costs for existing banks. For these reasons, dynamic loan-loss provisions may have a less positive (or more negative) impact on bank competition compared to macroprudential tools aimed at reducing loan growth in any time period, such as concentration limits or limits on foreign loans.

Third, some macroprudential policies may increase barriers to bank entry and reduce bank competition (Agoraki et al., 2011). Capital-related macroprudential policies are one example. For instance, higher capital requirements to SIFIs may impose a barrier for smaller banks' growth and may reinforce the market power of currently large banks.

These points indicate that there are contrasting theoretical arguments for how changes in bank costs, credit supply, and entry barriers, associated with changes in macroprudential policies, affect bank competition. Moreover, as different macroprudential policies have varying impacts on charter values, credit supply, and barriers to entry, their impact on bank competition may also differ. Finally, the varying significance of the contrasting arguments, depending on regulatory characteristics, may cause differences across countries. In particular, tighter restrictions on bank entry and activities would reduce the potential positive (increase the potential negative) impact of tightening macroprudential policies on bank competition. This is because tighter entry and activity restrictions allow existing banks to pass on higher costs created by a new macroprudential policy to debtors and depositors through a higher margin. Tighter entry and activity restrictions also reduce potential increases in competition associated with greater attractiveness of the banking sector for new entrants when a tightening in a macroprudential policy reduces credit supply for existing banks. The existence of theoretically contrasting effects for each macroprudential policy leads me to analyze the effect of macroprudential policies on bank competition as an empirical question, distinguishing effects across policies and countries.

2.2. Related literature

Most of the literature on macroprudential regulation focuses on its effect on financial stability. Theoretical studies provide a rationale for macroprudential policies in terms of greater financial stability (Kogler, 2020; Jeanne and Korinek, 2020), and empirical studies have defined two main objectives to test their effectiveness: the intermediate objective of reducing credit growth and financial cycles; and the ultimate objective of reducing bank risk (Altunbas et al., 2018; Meuleman and Vennet, 2020).

Focusing on the intermediate objective of reducing credit growth, studies show the effectiveness of a wide array of macroprudential policies in reducing credit growth and financial cycles using both country-level (Lim et al., 2011; Akinci and Olmstead-Rumsey, 2018; Bruno et al., 2017; Cerutti et al., 2017) and bank-level data (Claessens et al., 2013). More recent empirical studies using loan-level data from credit registry databases also confirm that the introduction of dynamic loan-loss provisions in Spain and Colombia (Jimenez et al., 2017; Gómez et al., 2020), the introduction of limits to the loan-to-value ratio in Canada (Allen et al., 2020), the introduction of the stress test in the US (Calem et al., 2020), and the introduction of a set of eight macroprudential policies in five Latin American countries (Gambacorta and Murcia, 2020) were effective in reducing credit growth. Some of these studies also show that macroprudential policies are more effective in reducing credit growth during upturns (Cerutti et al., 2017; Claessens et al., 2013), and that macroprudential policies and a tight monetary policy complement each other in reducing credit growth (Bruno et al., 2017; Gambacorta and Murcia, 2020).

Empirical studies analyzing the effectiveness of macroprudential policies in ultimately reducing bank risk are more scarce. Recent studies use international data at bank level to show that macroprudential policies are effective in reducing individual bank risk, especially in small and poorly capitalized banks, in banks with a larger share of wholesale funding (Altunbas et al., 2018), and in banks with worse governance (Gaganis et al., 2020). Liquidity tools and measures aimed at increasing the resilience of banks are especially effective for reducing systemic risk (Meuleman and Vennet, 2020). Using credit registry data in Brazil, Araujo et al. (2020) show that the introduction of limits to loan-to-value ratio reduces the risk of housing loans.

In contrast to those positive effects regarding financial stability, the literature also highlights macroprudential policies' negative effects. Ayyagari et al. (2018) use firm-level data from 48 countries to show that macroprudential policies have negative real effects in terms of lower corporate investment growth. This cost especially affects small firms with limited non-bank financing sources. Using a quarterly database for 56 countries, Richter et al. (2019) show that a particular macroprudential policy, stricter limits on loan-to-value ratio, reduces output. Gaganis et al. (2021) show a negative effect in terms of diminishing bank profit efficiency in a bank-level database from 130 countries.

However, to my knowledge, only two papers have recently analyzed the influence of some macroprudential policies on bank competition. The most closely related paper to mine is Mirzaei and Moore (2020). They analyze the influence of nine bank and borrower-oriented macroprudential policies on bank competition in 58 countries. They find that, on average, macroprudential policies reduce bank competition, especially in countries with poor institutional quality and low bank supervisory powers. Unlike this paper, they basically use country-level data, they do not apply a DID analysis to better control for endogeneity and omitted variables, they do not analyze the specific effect of each individual macroprudential policy, and they do not analyze

Table 1
Summary statistics for the full sample. This table shows summary statistics for the main variables in the regression models. Columns (1)-(6) report summary statistics for the full sample. Columns (7)-(8) present univariate results comparing the mean values of variables for treatment (banks in countries with changes in bank-oriented macroprudential policies) and control banks (banks in countries without changes in any type of macroprudential policy). Standard deviations of each variable are reported in parentheses below the corresponding mean value in columns (7)-(8). ***, **, and * in column (7) indicate significance at the 1%, 5%, and 10% levels, respectively, for a *t*-test of whether the treatment and control groups in the full sample have equal means. Table A2 in the Appendix provides variable definitions.

	Obs. (1)	Mean (2)	Std. Dev. (3)	P10 (4)	Median (5)	P90 (6)	Treatment sample (7)	Control sample (8)
Macroprudential policy, bank competition, and risk variables								
MPPBank	22,772	0.3782	0.7403	0	0	5	0.8181***(0.9087)	0(0.0000)
Lerner	22,772	0.2140	0.1079	0.0632	0.2235	0.4876	0.2219***(0.0939)	0.2072(0.1182)
Net interest margin	22,772	0.0445	0.1052	0.0125	0.036	0.0889	0.0322***(0.1420)	0.0554(0.0529)
Z-score	15,767	2.7441	1.3495	1.0846	2.8083	4.3133	2.8100*** (1.3755)	2.6819 (1.3217)
Non-performing loans	15,012	0.0506	0.0950	0.0016	0.0252	0.4604	4.8381**(10.0259)	5.2175(9.0857)
Credit growth	20,046	0.0390	0.1713	-0.1034	0.0256	1.3599	0.0294***(0.1534)	0.0473(0.1850)
Bank-level control variables								
Size	22,772	13.7066	2.5188	10.5092	13.6455	16.9221	14.1533***(2.1227)	13.3225(2.7580)
Liquidity	22,772	0.2867	0.2295	0.0445	0.2345	0.6133	0.2478***(0.2338)	0.3201(0.2204)
Interest income	22,772	0.7491	1.0569	0.3130	0.8034	0.9216	0.7782***(1.2020)	0.7240(0.9132)
Overhead	22,772	0.0710	0.1707	0.0110	0.0313	0.1445	0.0442***(0.1584)	0.0941(0.1773)
Country-level control variables								
Concentration	22,772	0.5384	0.2601	0.1899	0.4871	0.9445	52.9986*** (20.5010)	54.5612 (29.9287)
Entry	22,772	7.6132	0.8074	0	8	8	7.4181***(0.9064)	7.7809(0.6671)
Restrict	22,772	6.4861	1.6601	3	6	9	6.8268*** (1.8634)	6.1931 (1.3980)
KKZ	22,772	0.4997	0.9427	-0.7389	0.7917	1.6002	0.9910***(0.7836)	0.0773(0.8596)
Financial freedom	22,772	58.2066	20.4724	30	50	90	66.6385***(18.8668)	50.9564***(18.9672)
Government spending	22,772	0.5738	0.1944	0.2710	0.6110	0.7970	52.8605***(22.5996)	61.2721(15.2012)
Bank development	22,772	0.6934	0.4684	0.2254	0.5099	1.4317	76.7234***(44.2892)	62.9972(48.0343)
Stock development	22,772	0.7897	0.5348	0.2031	0.6277	1.4848	96.2658***(64.0951)	64.1062(36.1824)
GDP growth	22,772	0.0318	0.0366	-0.0029	0.0322	0.0815	2.6738***(3.2630)	3.6251(3.9216)
LnGDPpc	22,772	9.4655	1.2433	7.9090	9.8776	10.6997	9.8778***(1.3454)	9.1110(1.0230)
Inflation	22,772	84.6323	16.7938	60.8542	89.1534	100.7000	87.5815***(13.8128)	82.0964(18.6171)

potential differences across countries depending on entry and activity restrictions. Nor do they analyze the effect on bank competition and risk to identify particular macroprudential policies that can increase both bank competition and stability. Also recently, Scalco et al. (2021) find that tightening episodes in six macroprudential measures have a negative impact on bank competition in Brazilian banks. Unlike this paper, they do not apply a DID, do not analyze the effect on bank stability, and do not consider differences across countries. Moreover, focusing on one country reduces the number of changes in macroprudential policies and the ability to separate specific effects across macroprudential policies when changes in macroprudential policies affect more than one instrument.

This paper adds to the literature on the determinants of bank market competition showing the importance of macroprudential policies. Previous papers basically show that regulatory and institutional country characteristics affect bank competition (Claessens, 2009; Bikker and Spierdijk, 2009). Barth et al. (2004) use country-level data from 107 countries and report that tighter entry requirements lead to higher interest rate margins (consistent with the view that tighter entry restrictions reduce bank competition). Demirgüç-Kunt et al. (2004) use a bank-level database for 72 countries and report that not only tighter entry requirements but also tighter restrictions on bank activities and lower institutional development are associated with higher net interest margins. Claessens and Laeven (2004) confirm previous findings because tighter restrictions on bank entry and bank activities, together with institutions, reduce bank competition. There is also evidence suggesting that policies changing capital requirements may impact bank competition, although findings are mixed. Chevalier (1995), for non-financial firms, and Berger and Bouwman (2013), for banks, show that greater capital reduces market competition. However, Lyandres (2006) finds the opposite for a sample of non-financial firms. More recently, Calderon and Schaeck (2016) document that government interventions in 40 countries (liquidity support, recapitalizations, and nationalizations) trigger large increases in competition.

However, none of the studies above analyze the influence of macroprudential policies on bank competition and stability together. The joint analysis is important for identifying potential macroprudential policies able to both increase bank stability and competition. Such policies will help make the banking system not only more stable but also increase efficiency, quality, and innovation in the financial system.

3. Data and variables

3.1. Data

I use several main data sources. The macroprudential data come from the IMF Global Macroprudential Policy Instruments (GMPI) survey, carried out by the IMF's Monetary and Capital Department during 2013–2014. Responses were collected directly from country authorities and information on macroprudential policies covers the 2000–2013 period.[2] Annual bank-level information comes from the BankScope Bureau van Dijk Database. I use consolidated bank balance-sheet and income-statement data. All bank data is expressed in US dollars and in real prices whenever they are available. Country variables for regulation, institutional quality, financial development, bank market structure, government spending and macroeconomic characteristics come from several databases created by the World Bank, Heritage Foundation, and the IMF. Information on countries suffering systemic and borderline banking crises comes from Laeven and Valencia (2018).

I initially considered the 119 countries for which the IMF survey provides information on the 12 macroprudential instruments analyzed in Cerutti et al. (2017). I eliminated countries for which I had insufficient data to compute the Lerner index or to compute all the variables included in the regressions over the 2000–2013 period. The lack of data

[2] Cerutti et al. (2017) provide detailed information on this database. Ayyagari et al. (2018) and Mirzaei and Moore (2020) have also recently used this database to analyze the effect of macroprudential policies on credit growth at corporate level and bank competition, respectively. The period covered in this database also facilitates comparison of the results of this paper with those of two previous papers analyzing the effect of macroprudential policies on bank risk using international databases (Altunbas et al., 2018; Ezer, 2019).

Table 2
Macroprudential policies: definitions and changes. This table shows the ten bank-oriented macroprudential policies and changes in the particular policies analyzed in the paper.

Macroprudential policy	Abbreviation	Definition	Tightening in the particular instrument. Only countries changing a bank-oriented macroprudential policy	Tightening in the particular instrument in countries that also change their borrower-oriented macroprudential policies
Capital-based policies				
Time-varying/dynamic loan-loss provisioning	DP	Requires banks to hold more loan-loss provisions during upturns.	Colombia (2007); Kyrgyz Republic (2004); Peru (2008)	Bulgaria (2005); China (2003); Thailand (2011)
General countercyclical capital buffer/ requirement	CTC	Requires banks to hold more capital during upturns.		Pakistan (2008)
Leverage ratio	LEV	Limits banks from exceeding a fixed minimum leverage ratio.	Ecuador (2001); Jordan (2003); Kyrgyz Republic (2001); Switzerland (2008); Trinidad and Tobago (2008); Ukraine (2009)	
Capital surcharges on SIFIs	SIFI	Requires Systemically Important Financial Institutions to hold a higher capital level than other financial institutions.	Peru (2012)	Israel (2012)
Loan supply-based policies				
Concentration limits	CONC	Limits the fraction of assets held by a limited number of borrowers.	Croatia (2010); Ecuador (2001); Jordan (2001); Singapore (2002); Switzerland (2007); Trinidad and Tobago (2008); Ukraine (2001); USA (2001)	Romania (2003)
Limits on foreign currency loans	FC	Reduces vulnerability to foreign currency risks.	Argentina (2003); Austria (2010); Uganda (2010); Ukraine (2004)	Romania (2009); Turkey (2009)
Limits on domestic currency loans	CG	Limits credit growth directly.		
Liquidity-based policies				
Limits on interbank exposures	INTER	Limits the fraction of liabilities held by the banking sector or by individual banks.	Germany (2010); India (2007); Kyrgyz Republic (2003); Montenegro (2011); Portugal (2009); Switzerland (2007); Uganda (2004); Ukraine (2001)	Indonesia (2005); Israel (2001); Lebanon (2012); Romania (2003)
FX and/or countercyclical reserve requirements	RR_REV	Reserve requirements measures that impose a specific wedge on foreign currency deposits or are adjusted countercyclically.	Argentina (2001)	Bulgaria (2005); Turkey (2010)
Tax-based policy				
Levy/tax on financial institutions	TAX	Taxation on financial institutions.	Austria (2011); France (2011); Germany (2010); Netherlands (2012); Philippines (2002); Portugal (2012); Slovakia (2011)	China (2008)

reduced the sample to 69 countries. Following Cerutti et al. (2017), I initially distinguish between bank and borrower-oriented macroprudential policies. I identify 22 countries only experiencing changes in bank-oriented policies, seven countries only experiencing changes in borrower-oriented policies, ten countries experiencing changes in both borrower and bank-oriented policies, and 30 countries without any changes in macroprudential policies over the analysis period.[3] I focus on changes in bank-oriented policies because the small number of countries only experiencing changes in borrower-oriented policies makes it difficult to draw specific conclusions for this type of macroprudential instrument. I therefore exclude from the treatment and control groups the seven countries with changes in borrower-oriented policies (Canada, Costa Rica, Cyprus, Kuwait, Latvia, Saudi Arabia, and Serbia), and the ten countries with changes in both bank and borrower-oriented policies (Bangladesh, Bulgaria, China, Indonesia, Israel, Lebanon, Pakistan, Romania, Thailand, and Turkey). These exclusions aim to avoid potential confounding effects caused by different impacts of bank and borrower-oriented macroprudential policies on bank competition. Therefore, the main treatment group includes 1061 banks from the 22 countries only experiencing changes in bank-oriented macroprudential policies. The control group in the full sample includes 1450 banks from 30 countries without changes in macroprudential policies over the 2000–2013 period.

3.2. Variables

I now describe in more detail the proxies for the main variables: macroprudential policies, bank competition, and bank stability. Table A2 in the Appendix gives a detailed description of all of the variables used in the empirical analysis and their sources. Table 1 reports the summary statistics for the main variables and the comparison of means for treatment and control banks in the full sample.

3.2.1. Macroprudential policies

I consider the ten bank-oriented macroprudential policies documented in Cerutti et al. (2017): (1) Dynamic loan-loss provisioning (*DP*); (2) General countercyclical capital requirement (*CTC*); (3) Limits on leverage ratios (*LEV*); (4) Capital surcharges on SIFIs (*SIFI*); (5) Concentration limits (*CONC*); (6) Limits on foreign currency loans (*FC*); (7) Limits on domestic currency loans (*CG*); (8) Limits on interbank exposures (*INTER*); (9) Reserve requirement ratios linked to foreign depositor or adjusted countercyclically (*RR_REV*); and (10) Tax on financial institutions (*TAX*). Following Lim et al. (2011) and Altunbas et al. (2018), I classify them into four categories: capital-based instruments (*DP*, *CTC*, *LEV*, and *SIFI*), loan-supply-based instruments (*CONC, FC*, and *CG*), liquidity-based instruments (*INTER* and *RR_REV*), and tax-based instruments (*TAX*).

[3] Berger et al. (2009), Laeven and Levine (2009), Houston et al. (2010), Beck et al. (2013), and Biswas (2019), among others, use the Z-score as the main proxy for bank insolvency risk in cross-country studies.

[4] Table A1 in the Appendix reports all the changes in bank-oriented macroprudential policies initially considered in the analysis, using the same database as Cerutti et al. (2017).

The empirical analysis focuses on changes in any of the above bank-oriented macroprudential policies over the 2000–2013 period. Table 2 shows that there are 38 tightening episodes but no easing episodes of those policies over the analysis period in the 22 countries with changes only in their bank-oriented macroprudential policies. Three countries required dynamic loan-loss provisions (*DP*), six countries imposed limits on leverage ratios (*LEV)*, one country imposed higher capital requirements on SIFIs (*SIFI*), eight countries adopted more stringent limits on interbank exposures (*INTER*), nine countries imposed higher concentration limits on banks (*CONC*), four countries imposed more severe limits on foreign currency loans (*FC*), one country adopted stronger reserve requirements to limit total or foreign-currency credit growth (*RR_REV*), and seven countries increased taxes on financial institutions (*TAX*). There are no changes in general countercyclical capital buffer requirements (*CTC*) or in the limits on domestic currency loans (*CG*). For this reason, the analysis focuses on the eight macroprudential policies which were subject to changes. I use binary variables for each macroprudential tool taking the value of 1 if the tool is in place in a country in a particular year and zero otherwise. I additionally define an index (*MPPBank*) as the sum of the eight individual macroprudential variables.

3.2.2. Bank competition

I use the annual Lerner index (*Lerner*) as a proxy for market competition at bank level. The Lerner index has been widely and recently used as an indicator of the degree of market power at bank level.[5] It defines the difference between price (interest rate) and marginal cost expressed as a percentage of price. It assumes that divergence between product price and marginal cost of production is the essence of monopoly power. The Lerner index takes 0 in the case of perfect competition and 1 under perfect monopoly. Therefore, it is positively related to bank market power and inversely related to competition. I estimate an annual Lerner index for each bank following Maudos and Fernández De Guevara (2004) as explained in Table A2 in the Appendix. Table 1 shows that the mean value of *Lerner* in the treatment sample is 0.2219 and in the control group is 0.2072. The difference of means is statistically significant at conventional levels.

Following Calderon and Schaeck (2016) and as a robustness check, I also use the net interest margin (*Net interest margin*), calculated as the difference between banks' interest income and interest expenses and expressed as a percentage of earning assets, to measure bank competition at bank level. The Lerner index is a broader measure of competition because it includes not only interest income and expenses but also non-interest income and expenses. The net interest margin is also widely used in the literature on banking competition and complements the Lerner index in robustness checks (Claessens, 2009). Table 1 shows that the mean value of the net interest margin is statistically different between treatment and control banks.

3.2.3. Bank risk and credit growth

Bank risk and credit growth are, respectively, the traditional ultimate and intermediate targets of macroprudential policies (Altunbas et al., 2018). I use proxies for these two objectives. I use the Z-score (*Z-Score*) as a proxy for bank insolvency risk following most of the literature analyzing bank risk.[3] This is the return on assets plus the capital-asset ratio divided by the standard deviation of asset returns. To calculate the standard deviation of ROA, I use a five-year moving window including the five previous years. A higher *Z-score* indicates that the bank is more stable because it is inversely related to the probability of bank insolvency. Because the *Z-score* is highly skewed, I use its natural logarithm, which is normally distributed. I also use the annual ratio of non-performing loans to total gross loans (*Non-performing loans)* as a traditional proxy for bank credit risk (Berger et al., 2009; Goetz, 2018). Table 1 shows that the mean values of *Z-score and Non-performing loans* are statistically different at conventional levels between treatment and control banks.

Following the extensive literature analyzing the effect of macroprudential policies on credit growth as an intermediate target, I use the annual real growth in total loans of bank i in year t (*Credit growth*) as the proxy for financial stability (Cerutti et al., 2017). Table 1 shows that the mean value of *Credit growth* in the treatment group over the 2000–2013 period (0.0294) is statistically different from the mean value in the control group (0.0473).

3.2.4. Control variables

Regressions include control variables at both bank and country-level. I include the following four bank-level control variables: the natural logarithm of bank assets (*Size*), the percentage of liquidity assets over total assets (*Liquidity*), the percentage of interest income over total bank income (*Interest income*), and the percentage of overhead costs over total bank assets (*Overhead*). I also include bank concentration (*Concentration*), legal restrictions on bank entry (*Entry*), and legal restrictions on non-traditional bank activities (*Restrict*) as country-level variables explaining bank competition. I include the Kaufman et al. (2009) KKZ index as a proxy for a country's institutional quality (*KKZ*); the Financial Freedom Index published by the Heritage Foundation as a measure of the influence of government on financial services and institutions (*Financial freedom*); central government expenditure divided by GDP as a proxy for the country's current fiscal capacity (*Government spending*); the ratio of private credit by deposit money banks to GDP as the proxy for bank market development (*Bank development);* stock market capitalization divided by GDP as a proxy for a country's equity market development (*Stock development*). Finally, all the regressions include three macroeconomic variables: real gross domestic product growth (*GDP growth*), the natural logarithm of gross domestic product per capita (*LnGDPpc*), and the inflation rate (*Inflation*) of country *j* in year *t*. Table 1 shows that the mean values of all these variables are statistically different between the treatment and control banks using data for the whole analysis period. I check the robustness of the results when I include additional country-level control variables in sub-Section 5.5.

4. Identification strategy

I exploit time-series changes in macroprudential policies within a country to provide causal evidence of the impact of macroprudential policies on bank market competition applying a DID test.[6] I use the following specification:

$$\text{Lerner}_{it} = \alpha_0 + \alpha_1 \text{ MPPBank}_{ct} + \alpha_2 X_{it-1} + \alpha_3 Y_{ct-1} + \alpha_i + \alpha_t + \varepsilon_{ict} \quad [1]$$

where i, c, and t refer to bank, country and year, respectively. $Lerner_{it}$ is the Lerner index measuring bank market power for bank i in year t. *MPPBank* represents the change in a bank-oriented macroprudential policy. For a country c with a tightening in macroprudential policy in

[5] Berger et al. (2009), Turk-Ariss (2010), Agoraki et al. (2011), Beck et al. (2013), Forssbaeck and Shehzad (2015), Calderon and Schaeck (2016), and Biswas (2019), among others, use the Lerner index as an indicator of market competition at bank level in cross-country studies. Other alternative measures for bank competition, such as the Boone indicator and the Panzar and Rose H statistic, can only be computed at industry level.

[6] The use of a DID analysis to analyze the effectiveness of macroprudential tools to increase financial stability is now common in studies on tightening and easing episodes of specific macroprudential tools in individual countries (Jimenez et al., 2017; Araujo et al., 2020; Calem et al., 2020; Gómez et al., 2020). However, the use of a DID approach is less frequent in studies using international data, either at country or bank level. To my knowledge, only Claessens et al. (2013) and Gambacorta and Murcia (2020) apply a DID analysis to analyze how changes in macroprudential tools affect bank leverage and credit growth, and how they interact with monetary policy to limit credit growth, respectively.

Table 3
Propensity score matching. Comparison of means across the matched sample. This table shows the results of the propensity score matching model in column (1). I estimate the probit model by retaining all observations for the treatment and control banks in year t-1 relative to the change in macroprudential policy. The dependent variable in the probit model takes the value of 1 for banks in the treatment group. Independent variables are the bank- and country-level control variables included in model (1). Columns 2) and (3) present the means of the bank-level variables in the treatment and control groups in year t-1. The bank-level variables are not statistically different across the treatment and control groups at the 10% significance level. ***, **, * indicate significance at 1%, 5%, and 10% respectively.

	Probability of changing macroprudential policies (Change=1)	Matched sample		
		Comparison of means in year t-1		
	(1)		Treatment group (2)	Control group (3)
Size	-0.1017***(−3.58)	Bank-level dependent variables		
Liquidity	-1.2002***(−4.16)	Lerner	0.2653	0.2647
Interest income	-0.00464 (−1.11)	Net interest margin	0.0309	0.0318
Overhead	-1.6877** (−2.34)	Z-score	2.7893	2.7573
Concentration	-0.0523***(−15.13)	Non-performing loans	0.0309	0.0318
Entry	-0.5391***(−8.26)	Credit growth	0.2244	0.5471
Restrict	0.2220***(5.92)	Bank-level control variables		
KKZ	4.1000***(18.42)	Size	15.0913	15.1172
Financial freedom	-0.0027 (0.45)	Liquidity	0.1377	0.1352
Government spending	-0.0562***(−10.53)	Interest income	0.8485	0.8404
Bank development	-0.0172***(−8.13)	Overhead	0.0338	0.0323
Stock development	0.0001 (0.38)			
GDP growth	-0.1573***(−8.30)			
LnGDPpc	-1.6758***(−13.27)			
Inflation	-0.0348***(−5.95)			
Intercept	26.3198***(17.53)			
Bank-fixed effects	No			
Year-fixed effects	Yes			
Pseudo R^2	0.4794			
# observations	8861			

year m, *MPPBank* equals zero for the years before the tightening, i.e., for $t \leq m$, and one for the years after a tightening, i.e., for $t \geq m+1$. I consider changes in any of the eight bank-oriented macroprudential policies analyzed in the paper and *MPPBank* is also the sum of the eight dummy variables defined to capture a change in each particular macroprudential policy. In fact, I also use the eight dummy variables, instead of *MPPBank*, to analyze potential differences across macroprudential policies.[7] *MPPBank* always takes the value zero for countries that did not experience any change in macroprudential policies, which act as a control group. Since *MPPBank* is defined as one, one year after the tightening for countries that adopted a new bank-oriented macroprudential policy, α_1 measures the DID effect a year after the tightening. A positive (negative) value for α_1 would indicate a positive (negative) impact of the macroprudential policy on bank market power and, therefore, a negative (positive) impact on bank competition.

I include control variables to capture observable differences across banks and countries. X denotes the set of bank-level control variables (*Size*, *Liquidity, Interest income,* and *Overhead*). Y refers to the set of country-specific control variables (*Concentration, Restrict, Entry, KKZ, Financial freedom, Government spending, Bank development, Stock development, GDP growth, LnGDPpc*, and *Inflation*). All control variables are lagged one year to reduce simultaneity concerns. I additionally include bank (α_i) and year (α_t) fixed effects to reduce concerns regarding omitted variables. Bank-fixed effects capture any unobserved differences across banks when they are time-invariant. The year-fixed effects control for potential global trends in bank competition, for the potential confounding impact of the global financial crisis, and for any global change in the macroeconomic environment that may affect bank competition in all countries in a particular year. Therefore, this approach controls for time-invariant bank characteristics as well as the time-varying effects that are common to all banks in the sample. Moreover, given that the change in macroprudential policy happens at the country level, I cluster standard errors at the country level. This clustering allows me to account for potential time-varying correlations in unobserved variables that affect different banks within a given country and to control for within-bank error term correlations over time (Bertrand et al., 2004; Petersen, 2009). I check that the results are robust when I cluster standard errors at the bank level.

4.1. The propensity score matched sample

The DID approach requires the treatment and the control groups to be similar before the treatment. As a robustness check I then use a matched control group of banks by applying a propensity score-based matching technique following Serfling (2016). In the first step, I estimate a probit model with all observations for treatment and control banks in year t-1 relative to the change in the macroprudential policy. I use a binary dependent variable taking the value of 1 in the first group of banks. Explanatory variables are the remaining bank and country-level explanatory variables included in model [1]. The objective is to select banks in the matched control group that are ex-ante as likely to be affected by changes in macroprudential policies as the banks in the treatment group, and then to reduce endogeneity concerns in the changes in macroprudential policies. In the second step, I obtain the propensity score. Then, for every treated bank, I match each treatment bank in year t-1 to a control bank (with replacement), matching on year and closest propensity score. Finally, I retain all observations in the 4 years before and after the change in the macroprudential policy.

Table 3 reports the estimation results of the probit model and the means of the bank-level variables for the treatment and control groups in year t-1 in the matched sample. The sample means of bank-level variables for matched treated and control banks are not statistically different at the 10% level. This lack of significant differences indicates the usefulness of the matching procedure to identify a control group similar to the treated group before the treatment. In addition, I control for

[7] I account for a tightening of several points in macroprudential policies. For instance, Argentina underwent an increase in *MPPBank* in 2001 and 2003. I code *MPPBank* to be zero before 2001, one for 2002–2003, and two thereafter. Table A1 in the Appendix shows that Austria, Jordan, the Kyrgyz Republic, Peru, Portugal, Switzerland, and Uganda are the other countries in the sample experiencing two treatment events. Ukraine is the only country experiencing three treatment events. The remaining treatment countries only experience one change in bank-oriented macroprudential policies over the 2000–2013 period.

Table 4
Changes in macroprudential policies and bank market power. This table reports results for model [1]. The dependent variable is the annual bank Lerner index (*Lerner*). *MPPBank* takes the value zero for years before a tightening in bank-oriented macroprudential policies and one for years after the tightening. It always takes the value zero for countries that do not experience any change in macroprudential policies. Bank and country-level control variables are defined in the Appendix (Table A2). The DID analysis compares different groups of banks: columns (1)-(3) compare banks in reforming countries with banks in all non-reforming countries; columns (4)-(6) compare banks in reforming countries with the propensity score-based control group; columns (3) and (6) exclude banks in countries suffering systemic and borderline crises over the sample period. All regressions include bank and year-fixed effects. Columns (2) and (5) additionally include interactions of the bank-level control variables with the treatment dummy (*MPPBank*). t-statistics are in parenthesis. ***, **, * indicate significance at 1%, 5%, and 10% respectively.

	Full sample			Matched sample		
	(1)	(2)	Excluding countries with systemic and borderline banking crises (3)	(4)	(5)	Excluding countries with systemic and borderline banking crises (6)
MPPBank	-0.0071 * ** (−2.68)	-0.0848 * ** (−7.94)	-0.0197 * ** (−5.54)	-0.0136 * ** (−3.51)	-0.0663 * ** (−5.58)	-0.0312 * ** (−5.15)
Size	-0.0017 (−1.33)	-0.0040 * ** (−3.04)	-0.0032 * *(−2.13)	0.0042 * (1.70)	0.0017(0.64)	0.0048(1.58)
Liquidity	-0.0198 * ** (−2.61)	-0.0259 * ** (−4.91)	-0.0257 * ** (−3.21)	-0.0386 * ** (−4.33)	-0.0485 * ** (−4.90)	-0.0424 * ** (−3.95)
Interest income	0.0004(1.06)	-0.0007(−1.33)	-0.0003(−0.69)	-0.0005 (−1.48)	-0.0015 * ** (−2.71)	-0.0009 * ** (−2.53)
Overhead	-0.0464 * ** (−3.72)	-0.0757 * ** (−6.30)	-0.0304 * ** (−3.05)	-0.0008 (−0.07)	-0.0938 * ** (−3.76)	0.0036(0.30)
Concentration	0.0259 * * (1.79)	0.0195(1.35)	0.0374 * *(1.98)	0.0418 * * (2.30)	0.0399 * * (2.21)	0.0123(0.78)
Entry	0.0072 * ** (4.04)	0.0063 * ** (3.69)	0.0041 * (1.82)	-0.0002 (−0.12)	-0.0003 (−0.13)	-0.0001(−0.04)
Restrict	0.0024 * (1.74)	0.0028 * * (2.08)	-0.0002(−0.11)	-0.0035 (−1.42)	-0.0032 (−1.29)	-0.0037(−1.46)
KKZ	0.0674 * ** (4.03)	0.0063 * ** (3.69)	0.0092(0.47)	0.0802 * ** (3.49)	0.0776 * ** (3.40)	0.0900 * ** (3.24)
Financial freedom	-0.0018 * ** (−10.84)	-0.0019 * ** (−11.22)	-0.0023 * ** (−11.26)	-0.0013 * ** (−3.44)	-0.0013 * ** (−3.50)	-0.0023 * ** (−5.43)
Government spending	-0.0415 * * (−2.03)	-0.0261(−1.30)	-0.0392 * (−1.92)	0.0649 * ** (2.49)	0.0735 * ** (2.81)	0.1192 * ** (3.68)
Bank development	0.0665 * * (5.62)	0.0632 * ** (5.34)	0.0518 * ** (4.55)	0.0436 * (1.73)	0.0412(1.63)	0.0297(1.14)
Stock development	-0.0363 * ** (−3.75)	-0.0372 * ** (−3.94)	-0.0176 * (−1.74)	-0.0342 * ** (−2.77)	-0.0351 * ** (−2.83)	0.0066(0.59)
GDP growth	0.5772 * * (11.27)	0.5684 * ** (11.40)	0.6418 * ** (12.06)	0.3531 * ** (5.16)	0.3432 * ** (5.03)	0.4438 * ** (6.58)
LnGDPpc	-0.1988 * ** (−6.68)	-0.02070 * ** (−7.27)	-0.1583 * ** (−5.23)	-0.0440 (−0.93)	-0.0486 (−1.04)	-0.0495(−1.10)
Inflation	-0.0014 * ** (−5.68)	-0.0013 * ** (−5.33)	-0.0022 * ** (−7.93)	-0.0012 * ** (−3.46)	-0.0011 * ** (−3.48)	-0.0021 * ** (−5.17)
Intercept	2.1438 * ** (7.97)	2.2534 * ** (8.78)	2.0046 * ** (7.52)	0.5880(1.47)	0.6738 * (1.70)	0.7075 * (1.93)
Bank-fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Year-fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
SE clustered by country	Yes	No	Yes	Yes	No	Yes
Bank-level controls * MPPBank	No	Yes	No	No	Yes	No
R^2	0.3898	0.3990	0.4648	0.4020	0.4090	0.4831
# observations	22,772	22,772	15,808	16,702	16,702	12,421
# banks	2511	2511	1823	2122	2122	1489

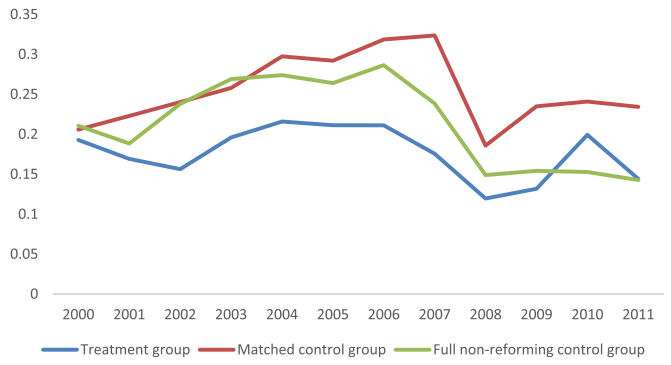
differences among banks in the treatment and control groups by including the bank-level variables as explanatory variables in all the DID regressions and by checking that the results do not change when I include interaction of each bank-level control variable with the treatment dummy to allow the effect of the bank control variables to be different for the treatment and control banks.

5. Empirical results

5.1. Macroprudential policies and bank competition

Table 4 reports the results for model [1] analyzing the effect of macroprudential tightenings on bank market power. Columns (1) - (3) report the results using the full sample of banks in countries without changes in macroprudential policies as the control group. Columns (4) - (6) report the results using the propensity-score matched group as the control group.

The coefficients of *MPPBank* are negative and statistically significant at the one percent level in columns (1) and (4) for, respectively, the full and the matched samples. The coefficients of *MPPBank* remain negative and significant in columns (2) and (5) when I include interactions of the treatment variable (*MPPBank*) with each of the bank-level control variables to allow the effect of these control variables to be different for the treatment and control banks. The negative coefficients of *MPPBank* are even more significant in these regressions, both economically and statistically. Finally, the coefficients of *MPPBank* remain negative and significant in columns (3) and (6) when I exclude banks from countries suffering systemic and borderline banking crises over the analysis period. I check the robustness of the results to this exclusion because these countries suffered more bank failures and authorities adopted intervention measures that might affect bank competition and confound the results. In particular, Calderon and Schaeck (2016) document increases in competition in these countries following government interventions in response to crises. Therefore, banks from Austria, France,



Graph 1. Lerner index in treatment and control groups.

Germany, the Netherlands, Portugal, Switzerland, Ukraine, and the US are not included in the treatment group. Banks from Belgium, Ireland, Kazakhstan, Slovenia, Spain, and the UK are not included in the control group in these two estimations. Moreover, the results of the propensity score matching DID estimation suggest that the results obtained using the full sample of banks are not driven by differences in observable bank and country characteristics between the treatment group of banks and the full sample of banks in non-reforming countries.

The negative coefficients of *MPPBank* in all the estimations indicate that, on average, tightening episodes in bank-oriented macroprudential policies are associated with subsequent reductions in bank market power or increases in competition. The economic impact is also significant. For instance, using the coefficients in column (1) for the full sample, banks reduce their Lerner index by an average of 0.71% points after a tightening in bank-oriented macroprudential policies relative to banks in the control group. Relative to the sample mean of *Lerner* of 0.2140, this finding represents a reduction in the Lerner index of 3.31% (=0.0071/0.2140). These values increase to a reduction of 1.36% points compared to the control group and a reduction of 6.35% (=0.0136/0.2140) relative to the sample mean of *Lerner* using estimates in column (4) for the matched sample.

Most of the control variables have significant coefficients at conventional levels. The negative and mostly significant coefficients of *Liquidity*, *Interest Income,* and *Overhead* indicate that higher bank liquidity, greater importance of income from credit markets, and higher overhead costs are associated with lower bank market power. The significant coefficients of country control variables indicate that stronger bank market power is associated with higher bank concentration, more stringent restrictions on bank entry, better institutional quality, less financial freedom, more bank development, less stock market development, more GDP growth, less GDP per capita, and less inflation. However, the signs of the coefficients for *Restrict* and *Government spending* are not homogenous across the alternative bank samples.

5.2. Parallel trends and exogeneity conditions

I now check that the analysis meets the two conditions required to apply DID tests: parallel trends and erogeneity.[8] First, the "parallel trends" condition implies that, in the absence of changes in macroprudential policies, bank competition should be similar for the treatment and control groups. This condition requires similar trends for both the treatment and control groups before tightenings in macroprudential policies, but not similar levels of bank competition. Graph 1 shows the evolution over time of bank competition for the treatment group and the two control groups (the full control group and the propensity-score matched group). I only consider the period before the change in the macroprudential policy. Hence, banks in the treatment groups are dropped from the analysis once the country experiences a change in any macroprudential instrument. As the latest tightening in bank-oriented macroprudential policy took place in 2012, I compare the Lerner index between the control group and both treatment groups up to 2011.

Graph 1 shows a similar trend for bank market power in the three groups of banks. All groups of banks experience a small increase in the Lerner index between 2001 and 2006, and there is a reduction in the Lerner index in all groups of banks in 2008, coinciding with the onset of the global financial crisis. The matched control group has a more similar trend to the treatment group than the control group including all non-reforming countries. The latter group of countries has a lower increase in bank market power after 2008 compared to the treatment and matched control groups.

In addition, I need to verify that the tightening episodes in macroprudential policies are exogenous to bank market competition, i.e., changes in macroprudential policies should be for reasons other than differences in bank competition. This condition is not guaranteed ex ante and reverse causality could create endogeneity biases in estimations. For instance, high bank competition, or low bank market power, may be seen by authorities as mechanisms increasing bank risk-taking incentives following the arguments of the competition-fragility view (Keeley, 1990). In this scenario, after increases in bank competition, authorities might find it appropriate to establish new macroprudential policies to limit bank risk and increase financial stability. In this case, there would also be a negative relationship between a tightening in bank-oriented macroprudential policies and bank market power, but the causality would run from bank market power to macroprudential policies.

I now apply two analyses to examine the exogeneity of the tightenings in macroprudential policies with respect to bank competition. First, I follow Acharya et al. (2014), Calderon and Schaeck (2016), and Serfling (2016) by applying Cox proportional hazard models. These models estimate the conditional probability of a change in the macroprudential policy. I use data at country level and the key explanatory variable is bank competition before the change in macroprudential policy. I include the same control variables as in model [1]. I focus on the time from the start of the sample to the occurrence of the change in the macroprudential policy. A country is dropped from the analysis once it experiences the change in the macroprudential policy. The hazard rate represents the likelihood that a change in a macroprudential policy is observed at year t in country i, given that there was no change until t. A positive (negative) coefficient for bank competition increases (decreases) the hazard of changes in macroprudential policies. Panel A of Table 5 reports the results. The non-significant coefficients of *Lerner* in all the estimations indicate that the changes in macroprudential policies are unrelated to the countries' pre-existing bank competition. The lack of significance of *Lerner* remains in estimations reported in columns (4)-(6), when I include bank-level control variables. In these estimations, I use the mean country value of *Size*, *Liquidity*, *Interest Income*, and *Overhead* in each particular year as explanatory variables.

Second, I follow Bertrand and Mullainathan (2003), Acharya and Subramanian (2009) and Serfling (2016) to test the exogeneity of changes in macroprudential policies by examining their dynamic effects. If a macroprudential tightening was introduced in response to a change in bank competition, then we might see an effect of the tightening even prior to the change itself. For this reason, I break down the macroprudential change variable into different separate time periods. I distinguish three periods using the following variables: (i) *MPPBank (−2,−1)*, which captures any effects from two years before to a year before the tightening; (ii) *MPPBank (0,1)*, which captures the effect in

[8] The use of a matched sample group selected by a propensity score-based technique helps meet both conditions because it gives greater similarity to the treatment and control groups before the change in macroprudential policy. The inclusion of bank and country-level control variables and of bank and year-fixed effects in all the regressions also allows us to reduce concerns caused, respectively, by observable and unobservable differences across treatment and control banks.

Table 5
Exogeneity of legal changes. Panel A reports results from a Cox proportional hazard model. This model estimates the conditional probability of a country changing a bank-oriented macroprudential policy. I use data at the country level and the key explanatory variable is bank competition before the change in macroprudential policy. I include the same control variables as in model [1]. I focus on the time from the start of the sample to occurrence of the change in the macroprudential policy. A country is dropped from the analysis once it experiences the change in the macroprudential policy. Panel B reports results for model [1] after breaking down the change in the bank-oriented macroprudential policy into several variables that capture dynamic effects. *MPPBank (−2,−1)* captures any effects from two years before to a year before the tightening; *MPPBank (0,1)* captures the effect in the year of the change and the year after the tightening; and *MPPBank (>=2)* captures the effect two years after the tightening and beyond. These variables always take the value zero for countries that do not experience any change in macroprudential policies. The dependent variable is the annual bank Lerner index (*Lerner*). Regressions include bank-level and/or country-level control variables although they are not reported to save space. The bank-level control variables are *Size*, *Liquidity, Interest income,* and *Overhead*. The country-level control variables are *Concentration, Entry, Restrict, KKZ, Financial freedom, Government spending, Bank development, Stock development, GDP growth, LnGDPpc*, and *Inflation.* All control variables are defined in the Appendix (Table A2). Regressions include bank and year-fixed effects. Columns (2) and (5) of Panel B additionally include interactions of the bank-level control variables with the three treatment dummies capturing the dynamic effect. t-statistics are in parenthesis. ***, **, * indicate significance at 1%, 5%, and 10% respectively.

	Panel A: Cox proportional hazard model					
	(1)	(2)	(3)	(4)	(5)	(6)
Lerner	0.3232(0.12)	2.4379(0.37)	1.6475(0.30)	-0.8953 (−0.30)	0.08798(0.11)	0.7120(0.17)
Bank-level control variables	No	No	No	Yes	Yes	Yes
Country-level control variables	Yes	Yes	Yes	Yes	Yes	Yes
Year-fixed effects	Yes	No	Yes	Yes	No	Yes
Country-fixed effects	No	Yes	Yes	No	Yes	Yes
LR Chi2	32.14***	64.14***	65.88***	33.89***	72.33***	64.39***
# observations	518	518	518	518	518	518
# countries	52	52	52	52	52	52
	Panel B: Dynamic analysis					
	Full sample			Matched sample		
			Excluding countries with systemic and borderline banking crises			Excluding countries with systemic and borderline banking crises
	(1)	(2)	(3)	(4)	(5)	(6)
MPPBank (−2,−1)	0.00002(0.01)	-0.0046 (−0.45)	0.0048(1.26)	0.0033(1.13)	-0.0128 (−0.84)	0.0018(0.41)
MPPBank (0,1)	-0.0070*** (−2.86)	-0.0703*** (−5.05)	-0.0193***(−5.61)	-0.0084*** (−2.80)	-0.0383*** (−2.56)	-0.0162***(−3.01)
MPPBank (>=2)	-0.0002 (−0.06)	-0.0140 (−0.95)	-0.0059**(−2.01)	-0.0123*** (−3.05)	-0.0296* (−1.95)	-0.0301***(−5.57)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes
Bank-fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Year-fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
SE clustered by country	Yes	No	Yes	Yes	Yes	Yes
Bank-level controls * Treatment dummies	No	Yes	No	No	No	No
R^2	0.3898	0.3998	0.4657	0.4066	0.4146	0.5021
# observations	22,772	22,772	15,808	16,702	16,702	12,421
# banks	2511	2511	1823	2122	2122	1489

the year of the change and the year after the tightening; and (iii) *MPPBank (>=2)*, which captures the effect two years after the tightening and beyond. With this design, the coefficients of *MPPBank (−2, −1)* should be insignificant for verifying the exogeneity assumption.

Panel B of Table 5 reports the results. The coefficients of *MPPBank (−2,−1)* are non-significant at conventional levels in all of the estimations, i.e., when I use the full sample of banks in non-reforming countries as the control group in columns (1)-(3), when I use the propensity-score based group as the control group in column (4)-(6), and also when I include interactions of the bank-level control variables with the three treatment dummies capturing the dynamic effect of the change in macroprudential policies, or when I exclude banks in countries suffering systemic and borderline banking crises. In line with the results reported in Table 4, the coefficients of *MPPBank (0,1)* are negative and statistically significant at the one percent level in all the estimations. Moreover, the significant, negative coefficients of *MPPBank (>=2)* in columns (3)-(6) suggest that the reduction in bank market power after tightening episodes in bank macroprudential policies is persistent over time. These results suggest that causality runs from the macroprudential tightening to bank market power and not vice versa.

5.3. Differences across individual macroprudential policies

The results reported in the above tables show an average negative impact for bank-oriented macroprudential policies on bank market power. I now analyze if there are differences across bank-oriented macroprudential policies, separating the impact of each individual macroprudential policy on bank market power. *DP*, *LEV*, *SIFI*, *CONC*, *FC*, *INTER*, *RR_REV*, and *TAX* are dummy variables identifying a tightening in the particular macroprudential policy because they take the value zero for years before a tightening and one for years after the tightening in the particular bank-oriented macroprudential policy. These variables always take the value zero for countries that do not experience any change in macroprudential policies. Table 6 reports the results for the eight bank-oriented macroprudential policies with changes over the 2000–2013 period in the sample. Although not reported to save space, the regressions include all the bank and country control variables.

I find differences across bank-oriented macroprudential policies. In particular, the statistically significant coefficients of loan supply-based (*CONC* and *FC*) and liquidity-based (*INTER* and *RR_REV*) macroprudential policies are always negative, consistent with the average negative impact found for macroprudential policies. *FC* has significant negative coefficients in three of the four estimations and *CONC* has significant negative coefficients in two estimations. *INTER* has significant negative coefficients in one estimation whereas *RR_REV* has significant negative coefficients in all the estimations. There are no positive significant coefficients for these variables in any estimation. These results suggest that tightening episodes to limits on the fraction of assets

Table 6

Changes in individual macroprudential policies and bank market power. This table results for model [1] separately for each bank-oriented macroprudential policy. The dependent variable is the annual bank Lerner index (*Lerner*). *DP*, *LEV*, *SIFI*, *FC*, *INTER, RR_REV*, and *TAX* are dummy variables identifying a tightening in the particular macroprudential policy because they take the value zero for years before a tightening and one for years after the tightening in the particular bank-oriented macroprudential policy. *Capital_TaxMPP* is the sum of *DP*, *SIFI*, and *TAX*, and *Loan_LiquidityMPP* is the sum of *CONC*, *FC*, *INTER,* and *RR_REV*. These variables always take the value zero for countries that do not experience any change in macroprudential policies. Banks from countries experiencing changes in macroprudential policies different to the type specifically analyzed are excluded from both the treatment and the control groups. Columns (1)-(6) report the results using the full sample of banks in non-reforming countries as the control group. Columns (7)-(12) report the results using the propensity score-based control group. All regressions include control variables although they are not reported to save space. The control variables are *Size*, *Liquidity, Interest income, Overhead, Concentration, Entry, Restrict, KKZ, Financial freedom, Government spending, Bank development, Stock development, GDP growth, LnGDPpc*, and *Inflation.* All regressions include bank and year-fixed effects. Bank and country-level control variables are defined in the Appendix (Table A2). Standard errors are clustered at the country level. t-statistics are in parenthesis. ***, **, * indicate significance at 1%, 5%, and 10% respectively.

	Full sample						Matched sample					
				Excluding countries with systemic and borderline banking crises						Excluding countries with systemic and borderline banking crises		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
DP	0.0754 * **			0.0637 * **			0.0381 * *			0.0247(0.89)		
	(6.19)			(4.61)			(2.46)					
LEV	-0.0038			0.0045(0.60)			0.0031(0.27)			0.0346(1.43)		
	(−0.49)											
SIFI	0.0300 * **			0.0179(1.48)			-0.0060			-0.0271		
	(2.60)						(−0.52)			(−1.37)		
CONC	-0.0070			-0.0678 * **			-0.0002			-0.0868 * **		
	(−0.89)			(−5.90)			(−0.02)			(−2.66)		
FC	-0.0501 * **			-0.0828 * **			-0.0188 * *			-0.0001		
	(−4.80)			(−4.95)			(−2.10)			(−0.01)		
INTER	-0.0163			0.0026(0.25)			-0.0716 * **			-0.0471		
	(−1.57)						(−4.25)			(−1.39)		
RR_REV	-0.1563 * **			-0.1643 * **			-0.1063 * **			-0.1180 * **		
	(−10.36)			(−9.61)			(−5.74)			(−2.62)		
TAX	0.0273 * *			0.0483 ***			0.0252 * **			0.0459 *		
	(2.32			(2.63)			(2.84)			(1.66)		
Capital_TaxMPP		0.0614 * **			0.0633 * **			0.0413 * **			0.0349 * **	
		(3.84)			(4.16)			(4.77)			(3.22)	
Loan_LiquidityMPP			-0.0184 * **			-0.0231 * **			-0.0230 * **			-0.0383 * **
			(−5.77)			(−6.51)			(−4.06)			(−3.02)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bank-fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year-fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
SE clustered by country	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.4079	0.4831	0.45632	0.4927	0.5645	0.5282	0.4274	0.5320	0.4446	0.5156	0.6148	0.5311
# observations	22,772	14,172	17,223	15,808	12,194	12,212	16,702	10,818	13,039	12,421	9280	9863
# banks	2511	1621	1903	1823	1412	1448	2122	1247	1540	1489	1085	1131

Table 7
Macroprudential policies and bank competition: differences across countries. This table reports the results of analyzing how restrictions on entry into bank markets (*Entry*) and restrictions on bank activities (*Restrict*) shape the effect of macroprudential policy on bank competition. Regressions follow model [1] adding an interaction term of the dummy treatment with each of the above-mentioned country variables. Panel A reports the results using the full sample of banks and Panel B reports the results using the propensity score-based control group. The dependent variable is the annual bank Lerner index (*Lerner*). *MPPBank* takes the value zero for years before a tightening in bank-oriented macroprudential policies and one for years after the tightening. *Capital_TaxMPP* is the sum of *DP*, *SIFI*, and *TAX*, and *Loan_LiquidityMPP* is the sum of *CONC*, *FC*, *INTER,* and *RR_REV*. Macroprudential variables always take the value zero for countries that do not experience any changes in macroprudential policies. All regressions include control variables although they are not reported to save space. The control variables are *Size*, *Liquidity, Interest income, Overhead, Concentration, Entry, Restrict, KKZ, Financial freedom, Government spending, Bank development, Stock development, GDP growth, LnGDPpc*, and *Inflation.* Bank and country-level control variables are defined in the Appendix (Table A2). All regressions include bank and year-fixed effects. Standard errors are clustered at the country level. t-statistics are in parenthesis. ***, **, * indicate significance at 1%, 5%, and 10% respectively.

Panel A. Full sample						
	Entry			Restrict		
	(1)	(2)	(3)	(4)	(5)	(6)
MPPBank	-0.1621 * ** (−5.33)			-0.0919 * ** (−11.67)		
MPPBank * Entry (Restrict)	0.0197 * ** (5.17)			0.0147 * ** (10.19)		
Capital_TaxMPP		0.1265(1.30)			-0.0547(−1.51)	
Capital_TaxMPP * Entry (Restrict)		-0.0083(−0.60)			0.0183 * ** (4.10)	
Loan_LiquidityMPP			-0.2252 * ** (−4.83)			-0.1415 * ** (−5.50)
Loan_LiquidityMPP * Entry (Restrict)			0.0330 * ** (5.09)			0.0189 * ** (5.96)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes
Bank-fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Year-fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
SE clustered by country	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.3962	0.4831	0.4777	0.4125	0.4863	0.4791
# observations	22,772	14,172	17,223	22,772	14,172	17,223
# banks	2511	1621	1903	2511	1621	1903
Panel B. Matched sample						
	Entry			Restrict		
	(1)	(2)	(3)	(4)	(5)	(6)
MPPBank	-0.0698 * *(−2.17)			-0.0843 * ** (−7.93)		
MPPBank * Entry (Restrict)	0.0073 * (1.75)			0.0121 * ** (6.99)		
Capital_TaxMPP		-0.0553(−0.93)			0.0349(1.45)	
Capital_TaxMPP * Entry (Restrict)		0.0123 * (1.64)			0.0009(0.28)	
Loan_LiquidityMPP			-0.1926 * ** (−3.60)			-0.0847 * ** (−6.20)
Loan_LiquidityMPP * Entry (Restrict)			0.0277 * ** (3.75)			0.0111 * ** (4.60)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes
Bank-fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Year-fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
SE clustered by country	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.4048	0.5321	0.4720	0.4176	0.5321	0.4550
# observations	16,702	10,818	13,039	16,702	10,818	13,039
# banks	2122	1247	1540	2122	1247	1540

held by a limited number of borrowers, on foreign currency loans, on interbank exposures, and on reserve requirements linked to foreign currency deposits or adjusted countercyclically are associated with a reduction in bank market power. Greater competition after a tightening in loan supply and liquidity-based policies is consistent with greater attractiveness for new entrants when these policies oblige existing banks to reduce their credit supply.

Conversely, capital-based instruments, such as *DP* and *SIFI*, and tax-based instruments (*TAX)* only have significant positive coefficients, whereas the coefficients of *LEV* are non-significant at conventional levels. *DP* has significant positive coefficients in three of the four estimations, *SIFI* has a significant positive coefficient in one estimation, and *TAX* has significant positive coefficients in all the estimations. There are no significant positive coefficients for these three variables in any estimation. The significant positive coefficients of *DP*, *SIFI*, and *TAX* suggest, respectively, that tightening episodes in dynamic loan loss provisions, in capital requirements for systemically important financial institutions, and in taxes on financial institutions are associated with increases in bank market power. Lower competition after a tightening in capital and tax-based policies is consistent with higher bank costs either reducing charter values and attractiveness for new entrants or creating barriers to entry.

I estimate the average effect of the two groups of bank-oriented macroprudential policies depending on the type of impact on bank market power. First, I capture the average effect of the three capital and tax-based policies with an individual positive effect on bank market power (*DP*, *SIFI*, and *TAX*) in columns (2), (5), (8), and (11). I exclude banks in countries with changes in any other type of macroprudential policy (*LEV*, *CONC*, FC, *INTER* and *RR_REV*) from these estimations and the significant positive coefficients of *Capital_TaxMPP* confirm the average increase in bank market power after tightening episodes in these macroprudential policies. Similarly, the coefficients of *Loan_LiquidityMPP* capture the average effect of the four loan supply and liquidity-based policies with an individual negative effect on bank market power (*CONC*, FC, *INTER* and *RR_REV*). I exclude banks in countries with changes in *DP*, *LEV*, *SIFI*, and *TAX* from these estimations. The significant negative coefficients of *Loan_LiquidityMPP* in columns (3), (6), (9), and (12) confirm the average reduction in bank market power after a tightening in the above-mentioned loan supply and liquidity-based policies (*CONC*, *FC*, *INTER,* and *RR_REV*).

5.4. Differences across countries: entry and activity restrictions

In this section, I analyze whether the effect of macroprudential policies on bank competition varies across countries depending on bank entry and activity restrictions. These two regulatory characteristics may shape the effect of macroprudential policies because they are determinants of the threat of entry by new competitors, and therefore affect market contestability (Claessens and Laeven, 2004). I now include an additional interaction term of the treatment dummy variables with the one year lagged value of *Entry* and *Restrict*, respectively.

The results in Table 7 show that the coefficients of *MPPBank* remain

Table 8
Additional robustness tests. Panel A reports results for model [1] but including additional country-level control variables. The dependent variable is the annual bank Lerner index (*Lerner*). *Pan*el B reports results using the *Net interest margin* as the dependent variable to proxy bank competition. *MPPBank* takes the value zero for years before a tightening in bank-oriented macroprudential policies and one for years after the tightening. *MPPBank (−2,−1)* captures any effects from two years before to a year before the tightening; *MPPBank (0,1)* captures the effect in the year of the change and the year after the tightening; and *MPPBank (>=2)* captures the effect two years after the tightening and beyond. *Capital_TaxMPP* is the sum of *DP*, *SIFI*, and *TAX*, and *Loan_LiquidityMPP* is the sum of *CONC*, *FC*, *INTER*, and *RR_REV*. Macroprudential variables always take the value zero for countries that do not experience any change in macroprudential policies. All regressions include control variables although they are not reported to save space. The control variables are *Size*, *Liquidity, Interest income, Overhead, Concentration, Entry, Restrict, KKZ, Financial freedom, Government spending, Bank development, Stock development, GDP growth, LnGDPpc*, and *Inflation.* The additional country-level variables included as controls in regressions reported in Panel A are *Government-owned*, *Foreign-owned*, *Official supervision* and *Capital requirement*. Bank and country-level control variables are defined in the Appendix (Table A2). All regressions include bank and year-fixed effects. Standard errors are clustered at the country level. t-statistics are in parenthesis. ***, **, * indicate significance at 1%, 5%, and 10% respectively.

	Panel A. Including additional country-level control variables Dependent variable: Lerner							
	Full sample				Matched sample			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
MPPBank	-0.0092 * ** (−3.55)				-0.0106 * ** (−2.70)			
MPPBank (−2,−1)		0.0029 (1.34)				0.0060 (0.83)		
MPPBank (0,1)		-0.0861 * ** (−7.81)		-0.0088 (−1.24)				
MPPBank (>=2)		-0.0002 (−0.05)				-0.0556 * ** (−3.84)		
Capital_TaxMPP			0.0686 * ** (3.87)				0.0344 * ** (3.18)	
Loan_LiquidityMPP				-0.0203 * ** (−6.07)				-0.0177 * ** (−3.46)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Additional country-level control variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bank-fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year-fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
SE clustered by country	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.4347	0.4441	0.5909	0.5274	0.4422	0.4519	0.6060	0.5011
# observations	19,666	19,666	12,042	14,901	15,480	15,480	9619	11,877
# banks	2474	2474	1590	1877	2112	2112	1243	1530
	Panel B. Dependent variable: Net interest margin							
	Full sample	Matched sample						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
MPPBank	-0.0019 * ** (−2.62)				-0.0018 * ** (−2.12)			
MPPBank (−2,−1)		-0.0002 (−0.39)				0.0004 (0.55)		
MPPBank (0,1)		0.0021 (0.94)				0.0012 (0.58)		
MPPBank (>=2)		-0.0079 * (−1.80)				-0.0072 * (−1.76)		
Capital_TaxMPP			0.0071 * ** (2.70)				0.0106 * ** (3.94)	
Loan_LiquidityMPP				-0.0045 * ** (−2.55)				-0.0050 * * (−2.36)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bank-fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year-fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
SE clustered by country	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.1010	0.1120	0.6220	0.1580	0.1040	0.1120	0.1511	0.1175
# observations	22,772	22,772	14,172	17,223	16,702	16,702	10,818	13,039
# banks	2511	2511	1621	1903	2122	2122	1247	1540

negative and significant whereas the coefficients of the interaction terms of *MPPBank* with both *Entry* and *Restrict* are positive and statistically significant in all the estimations. The positive coefficients of the interaction terms indicate that tighter entry and activity restrictions diminish the average reduction in bank market power after a tightening in macroprudential policies. The economic effects are also significant. For instance, the coefficients in column (1) imply that one standard deviation increase in bank entry restrictions (0.8074) diminishes the average negative impact of a tightening in macroprudential policies on bank market power by 7.43% of its mean value (=0.8074 *0.0197/0.2140). The reduction is 11.40% when I analyze the impact of restrictions on bank activities using coefficients in column (4) (=1.6601 *0.0147/0.2140).

The results for the two groups of macroprudential policies depending on their average effect on competition, although less statistically significant, are in the same line. The non-significant coefficients of *Capital_TaxMPP* and the positive significant coefficients of the interaction of this variable with *Entry* and *Restrict* in, respectively, column (2) of Panel B and column (5) of Panel A indicate that tighter entry and activity restrictions increase the reduction in competition (the increase in bank market power) associated with a tightening in capital-based and tax-based macroprudential policies. The significant negative coefficients of *Loan_liquidityMPP* and the significant positive coefficients of its interaction with both *Entry* and *Restrict* indicate that tighter entry and

Table 9

Macroprudential policies and financial stability. This table reports results for model [1] but using proxies for financial stability as the dependent variable. Panel A reports results using the banks' annual Z-score (*ZSCORE*) as the dependent variable. Panel B reports results using the ratio of non-performing loans to total bank loans (*Non-performing-loans*) as the dependent variable. Panel C reports the results using annual growth in total bank loans (*Credit growth*) as the dependent variable. *MPPBank* takes the value zero for years before a tightening in bank-oriented macroprudential policies and one for years after the tightening. *MPPBank (−2,−1)* captures any effects from two years before to a year before the tightening; *MPPBank (0,1)* captures the effect in the year of the change and the year after the tightening; and *MPPBank (>=2)* captures the effect two years after the tightening and beyond. *Capital_TaxMPP* is the sum of *DP*, *SIFI*, and *TAX*, and *Loan_LiquidityMPP* is the sum of *CONC*, *FC*, *INTER,* and *RR_REV*. Macroprudential variables always take the value zero for countries that do not experience any change in macroprudential policies. All regressions include control variables although they are not reported to save space. The control variables are *Size*, *Liquidity, Interest income, Overhead, Concentration, Entry, Restrict, KKZ, Financial freedom, Government spending, Bank development, Stock development, GDP growth, LnGDPpc*, and *Inflation.* Bank and country-level control variables are defined in the Appendix (Table A2). All regressions include bank and year-fixed effects. Standard errors are clustered at the country level. t-statistics are in parenthesis. ***, **, * indicate significance at 1%, 5%, and 10% respectively.

	Panel A: Dependent variable: Z-Score							
	Full sample				Matched sample			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
MPPBank	0.0994 * **				0.2718 * **			
	(3.59)				(3.58)			
MPPBank (−2,−1)		0.0294(1.07)				-0.0680(−1.03)		
MPPBank (0,1)		0.0998 * **				0.2282 * **		
		(3.45)				(3.81)		
MPPBank (>=2)		-0.0490				0.1336 * *		
		(−1.38)				(2.18)		
Capital_TaxMPP			0.4036 * **				0.8647 * **	
			(3.15)				(3.71)	
Loan_LiquidityMPP				0.1226 * **				0.3236 * **
				(3.75)				(3.98)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bank-fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year-fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
SE clustered by country	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.0799	0.0802	0.0717	0.0829	0.1508	0.1537	0.2233	0.1722
# observations	15,767	15,767	9416	12,781	13,695	13,695	9086	12,267
# banks	2436	2436	1591	1986	2059	2058	1224	1645
	Panel B: Non-performing loans							
	(1)	(2)	(3)		(7)	(8)	(9)	
MPPBank	-0.0008				-0.0032			
	(−0.38)				(−0.53)			
MPPBank (−2,−1)		0.0034(1.40)				-0.0037(−0.56)		
MPPBank (0,1)		0.0025(1.16)				0.0047(1.05)		
MPPBank (>=2)		-0.0087 *				-0.0102 *		
		(−3.69)				(−1.99)		
Capital_TaxMPP			-0.0243 * **				-0.0361 * **	
			(−3.64)				(−2.77)	
Loan_LiquidityMPP				-0.0083 * **				-0.0105 * **
				(−4.88)				(−2.82)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bank-fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year-fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
SE clustered by country	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.0714	0.0730	0.0691	0.0727	0.1805	0.1835	0.2198	0.2074
# observations	15,012	15,012	9717	13,342	14,122	14,122	8827	12,452
# banks	2141	2141	1455	1858	1780	1780	1094	1497
	Panel C: Dependent variable: Credit growth							
	(1)	(2)	(3)		(7)	(8)	(9)	
MPPBank	-0.0022				-0.0067 *			
	(−0.66)				(−1.86)			
MPPBank (−2,−1)		-0.0022				0.0030(0.63)		
		(−0.56)						
MPPBank (0,1)		0.016(0.35)				-0.0013(−0.32)		
MPPBank (>=2)		-0.0051				-0.0121 * **		
		(−1.11)				(−3.37)		
Capital_TaxMPP			0.0145(1.23)				0.0021(0.17)	
Loan_LiquidityMPP				-0.0002(−0.06)				-0.0100 * *
								(−2.54)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bank-fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year-fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
SE clustered by country	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.1753	0.1754	0.2134	0.1934	0.4210	0.4218	0.5736	0.4613
# observations	20,046	20,046	12,405	16,330	15,451	15,451	10,151	13,479
# banks	2457	2457	1594	1990	2087	2086	1234	1650

activity restrictions reduce the increase in competition after a tightening in loan supply-based and liquidity-based instruments.

These results are consistent with the threat of entry being relevant for shaping banks' competitive behavior after tightening episodes in macroprudential policies. In particular, they are consistent with tighter restrictions reducing increases in competition by allowing existing banks to transfer increases in bank costs caused by macroprudential policies to prices. They are also consistent with tighter restrictions reducing the increase in competition associated with greater attractiveness for new entrants after the tightening in policies reducing credit supply for existing banks.

5.5. Additional robustness checks

I now apply two additional tests. First, I check that the results do not change when I include additional country-level control variables. Although bank-fixed effects in regressions control for any unobserved time-invariant country variable, I also include the fraction of a country's banking system's assets that are 50% or more government-owned (*Government owned*), the fraction of a country's banking system's assets that are 50% or more foreign-owned (*Foreign owned*), an index of the official supervisory power (*Official supervision*), and a measure of the stringency of capital requirements (*Capital requirement*). These variables come from the World Bank's Bank regulation and Supervision Database and are explained in detail in Table A2 in the Appendix. The lack of data reduces the number of banks and observations in these regressions. Panel A of Table 8 shows that the main results do not change.

Second, I check that the results are robust when I use the net interest margin as the proxy for bank market power. This analysis complements previous results because the net interest margin focuses on traditional loan and deposit activities whereas the Lerner index additionally includes non-interest income and costs. Panel B of Table 8 shows that the main results remain unchanged when using the net interest margin as a dependent variable.

5.6. Macroprudential policies and financial stability

In this section, I apply the DID analysis specified in model [1] to test the impact of tightenings in bank-oriented macroprudential policies on financial stability. I test the impact for the aggregate index of macroprudential policies (*MPPBank*) and for the two groups of policies with a different impact on bank competition (*Capital-TaxMPP* and *Loan_LiquidityMPP*). Joint analysis of the effect of macroprudential policies on both bank competition and stability allows us to identify potential macroprudential policies that increase both. Such policies would not be affected by the traditional trade-off between the costs and benefits associated with increases in bank competition because they would be able to improve both bank efficiency and stability.

Table 9 reports the results of model [1] using the bank's Z-score, the ratio of non-performing loans, and growth in bank loans as proxies for bank stability. Panel A shows that both *MPPBank, Capital_TaxMPP,* and *Loan_LiquidityMPP* have positive significant coefficients in all the regressions using the bank's Z-score as the dependent variable. This indicates that tightening episodes have a positive effect on bank stability not only in the group of policies that reduce competition (*Capital_TaxMPP*) but also in the group of macroprudential policies that increase competition (*Loan_LiquidityMPP*). The results in Panels B and C confirm the positive effect of both groups of macroprudential policies on bank stability. The negative significant coefficients of *Capital_TaxMPP* and *Loan_LiquidityMPP* in three of the four estimations in Panel B indicate that tightenings in both types of macroprudential policies are associated with reductions in the ratio of non-performing-loans. Although negative, only the coefficient of *Capital_TaxMPP* in column (3) is not statistically significant at conventional levels. The results in Panel C using annual credit growth as the dependent variable are less significant because only the coefficients for the matched sample are statistically significant at conventional levels. The negative and significant coefficient of *MPPBank* in column (5) is again consistent with the effectiveness of macroprudential policies in increasing bank stability through a reduction in credit growth. The non-significant coefficient of *Capital_TaxMPP* in column (7) and the negative significant coefficient of *Loan_LiquidityMPP* in column (8) suggest that the effectiveness of macroprudential policies in reducing credit growth is associated with the loan supply-based and liquidity-based instruments. This result is consistent with the fact that loan supply-based policies are specifically designed to reduce credit growth as an intermediate objective for achieving financial stability (Altunbas et al., 2018). Moreover, the non-significant coefficients of *MPPBank (−2,−1)* in all the estimations and the significant coefficients of *MPPBank (0,1)* and/or *MPPBank (>=2)* indicate that causality runs from macroprudential policy to bank stability.

These results indicate that loan supply-based and liquidity-based policies (*CONC, FC*, *INTER*, and *RR_REV*) on average increase both bank competition and stability. Therefore, they are especially appropriate because not only do they have the traditional positive effects associated with bank competition in terms of greater bank efficiency, quality and innovation, but they also provide benefits in terms of more bank stability. However, capital and tax-based policies (*DP*, *SIFI*, and *TAX)* have positive effects on bank stability but may have negative effects associated with the reduction in bank competition in terms of lower efficiency, quality, and innovation in the banking sector.

6. Conclusions

This paper applies a difference-in-differences analysis to identify causality from macroprudential policies to bank competition and stability in an international sample of a maximum of 2511 listed banks from 52 countries. The results indicate that, on average, a tightening in bank-oriented macroprudential policies increases bank competition. However, this effect is not homogeneous across policies and countries. A tightening in loan supply-based and liquidity-based policies, such as limits on loan concentration, foreign currency loans, interbank exposure, and reserve requirements, increases bank competition. Conversely, a tightening in capital-based and tax-based policies, such as dynamic loan-loss provisions, capital requirements for systemic banks, and taxes on financial institutions, reduces bank competition. Moreover, there are differences across countries because tighter bank entry and activity restrictions reduce the average positive impact of macroprudential policies on bank competition. In particular, tighter restrictions are associated with a lower positive impact on competition for loan supply-based and liquidity-based policies and with a higher negative impact on competition for capital and tax-based macroprudential policies. Unlike the heterogeneous effect on bank competition across types of macroprudential policies, the DID analysis in this paper corroborates the positive effect on financial stability documented in previous studies for different types of instruments. My findings indicate that policies that increase or reduce competition are both effective for reducing credit growth and bank risk.

The results have important policy implications because they identify macroprudential policies that increase both bank competition and stability. In particular, a tightening in the limits on loan concentration, foreign currency loans, interbank exposure, and reserve requirements linked to foreign deposits or adjusted countercyclically increases both bank competition and stability. These policies are more attractive because they make the traditional benefits associated with bank competition in terms of greater efficiency, quality, and innovation compatible with the benefit of also increasing stability in the financial sector. However, a tightening in dynamic loan-loss provisions, additional capital requirements for SIFIs, and a greater tax burden on financial institutions are less appealing because they generate costs in terms of efficiency, quality, and innovation as they reduce bank competition.

Appendix

See here: Table A1, Table A2.

Table A1
Changes in macroprudential policies: the treatment and control groups. This table gives information about the countries with changes in bank-oriented macroprudential policies and the countries without changes in macroprudential policies included in the control group. Columns (1)-(3) show countries that only experience changes (tightenings) in bank-oriented macroprudential policies. Columns (4)-(6) show countries experiencing a tightening in both bank and borrower-oriented macroprudential policies, and columns (7)-(8) show countries without changes in macroprudential policies.

Countries with changes in bank-oriented macroprudential policies only			Countries with changes in both bank and borrower-oriented macroprudential policies			Countries without changes in macroprudential policies	
Country	Year and type of change in MPPBank	Systemic and borderline banking crises (start of crisis)	Country	Year and type of change in MPPBank	Year and type of change in MPPBorrower	Country	Systemic and borderline banking crises (start of crisis)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Argentina	2001 (+1); 2003 (+1)		Bangladesh	2004 (+1)	2004 (+1)	Armenia	
Austria	2010 (+1); 2011 (+1)	Systemic (2008)	Bulgaria	2005 (+2)	2006 (+1)	Australia	
Colombia	2007 (+1)		China	2003(+1); 2008 (+1)	2004 (+2)	Bahrain	
Croatia	2010 (+1)		Indonesia	2005 (+1)	2012 (+1)	Belgium	Systemic (2008)
Ecuador	2001 (+2)		Israel	2011 (+1); 2012 (+1)	2010 (+1)	Botswana	
France	2011 (+1)	Borderline (2008)	Lebanon	2012 (+1)	2008 (+1)	Brazil	
Germany	2010 (+2)	Systemic (2008)	Pakistan	2008 (+1)	2005 (+1)	Chile	
India	2007 (+1)		Romania	2003 (+2); 2009 (+1)	2004 (+2); 2008 (+1); 2011 (+1)	Czech Republic	
Jordan	2001 (+1); 2003 (+1)		Thailand	2011 (+1)	2003 (+1)	El Salvador	
Kyrgyz Republic	2001 (+1); 2003 (+1); 2004 (+1)		Turkey	2009 (+1); 2010 (+1)	2007 (+1); 2011 (+1)	Estonia	
Montenegro	2011 (+1)					Finland	
Netherlands	2012 (+1)	Systemic (2008)				Ireland	Systemic (2008)
Peru	2008 (+1); 2012 (+1)					Italy	Borderline (2008)
Philippines	2002 (+1)					Japan	
Portugal	2009 (+1); 2012 (+1)	Borderline (2008)				Kazakhstan	Systemic (2008)
Singapore	2002 (+1)					Kenya	
Slovakia	2011 (+1)					Macedonia, FYR	
Switzerland	2007 (+2); 2008 (+1)	Borderline (2008)				Malaysia	
Trinidad and Tobago	2008 (+2)					Mauritius	
Uganda	2004 (+1); 2010 (+1)					Morocco	
Ukraine	2001 (+2); 2004 (+1); 2009 (+1)	Systemic (2008)				New Zealand	
USA	2001 (+1)	Systemic (2007)				Paraguay	
						Russian Federation	Borderline (2008)
						Slovenia	Borderline (2008)
						South Africa	
						Spain	Systemic (2008)
						Sri Lanka	
						Tunisia	
						UK	Systemic (2007)
						Zambia	

Table A2
Variable definitions and data sources. The table gives the definitions of the variables used in the paper and their sources.

Name	Definition	Source
Macroprudential policies		
MPPBank	This takes the value zero for years before a tightening in bank-oriented macroprudential policies and one for years after the tightening. It always takes the value zero for countries that do not experience any change in macroprudential policies	Global Macroprudential Policy Instruments (GMPI), IMF
Capital_TaxMPP	This is the sum of *DP*, *SIFI*, and *TAX*. Therefore, it takes the value zero before any change in these three macroprudential policies. It always take the value zero for countries that do not experience any change in macroprudential policies.	
Loan_liquidityMPP	This is the sum of *CONC*, *FC, INTER* and *RR_REV*. Therefore, it takes the value zero before any change in these five macroprudential policies. It always take the value zero for countries that do not experience any change in macroprudential policies.	
Bank competition		
Lerner	This is the difference between the interest rate and marginal cost expressed as a percentage of price. It takes the value of 0 in perfect competition and 1 under perfect monopoly. Therefore, it is positively related to bank market power and is inversely related to bank competition. I estimate the marginal cost on the basis of the following translogarithmic cost function: $\ln C_{it} = \alpha_0 + \ln TA_{it} + \frac{1}{2}\alpha_k(\ln TA_{it})^2 + \sum_{z=1}^{3}\beta_z \ln w_{zit} + \frac{1}{2}\sum_{z=1}^{3}\sum_{k=1}^{3}\beta_{zk} \ln w_{zit} \ln w_{kit} + \frac{1}{2}\sum_{z=1}^{3}\gamma_z \ln TA_{it} \ln w_{zit} + \mu_1 Trend + \mu_2\frac{1}{2}Trend^2 + \mu_3 Trend \ln TA_{it} + \sum_{z=1}^{3}\lambda_z Trend \ln w_{zit} + \ln u_i$ [A.1] where C_{it} is total financial and operating costs (interest expense + commission expense + fee expense + trading expense + total operating expense) of bank i at time t, TA_{it} total assets and w_z the price of the different factors of production (z). I consider the price of three inputs: labor (w_1), fixed assets (w_2), and borrowed funds (w_3). They are calculated as follows: w_1 = personnel expense / total assets; w_2 = (total operating expense - personnel expense) / fixed assets, and w_3 = interest expense / deposits and short-term funding.I estimate the cost function (and hence marginal costs) separately for each country over the sample period. I allow the parameters of the cost function to vary from one country to another to reflect different technologies. To capture the influence of variables specific to each bank, I estimate the function by introducing fixed individual effects. I capture the influence of technical change on the cost function over time by including Trend.	BankScope Bureau van Dijk Database
Net interest margin	The difference between bank interest income and interest expenses divided by total earning assets.	
Bank risk and credit growth		
Z-score	This variable provides a measure inversely related to a bank's insolvency probability. Z-score compares the buffer of a bank (capitalization and returns) with the volatility of those returns. It is estimated as (ROA+(equity/assets))/sd(ROA); sd(ROA) is the standard deviation of ROA. I use a five-year moving window, including the two previous years and the two subsequent years, to calculate the standard deviation of ROA. I use the natural logarithm of the Z-score.	BankScope Bureau van Dijk Database
Non-performing loans	Ratio of non-performing loans to total bank loans.	
Credit growth	Real annual growth in total bank loans	
Bank-level control variables		
Size	The natural logarithm of total bank assets	BankScope Bureau van Dijk Database
Liquidity	The ratio of liquid assets to total assets	
Interest income	Interest income over total bank income	
Overhead	Personnel expenses and other non-interest expenses over total bank assets	
Country-level control variables		
Concentration	Assets of the three largest commercial banks as a share of total commercial banking assets. Total assets include total earning assets, cash and due from banks, foreclosed real estate, fixed assets, goodwill, other intangibles, current tax assets, deferred tax assets, discontinued operations and other assets.	Global Financial Development Database (GFDD). World Bank.
Entry	Legal restrictions on entry into the banking industry. ENTRY is based on whether or not the following information is required: (1) draft by-laws; (2) intended organizational chart; (3) financial projections for first 3 years; (4) financial information on main potential shareholders; (5) background/experience of future directors; (6) background/experience of future managers; (7) sources of funds to be used to capitalize the new bank; and (8) market differentiation intended for the new bank. Each type of information is assigned a value of 1 if it is required and 0 otherwise. Thus, Entry ranges from a minimum value of 0 to a maximum value of 8, and higher values for this variable indicate stronger barriers on entry into the banking industry. Data varies over time but not annually because the data was collected in the years 2000, 2003, 2007 and 2012.	World Bank' s Bank Regulation and Supervision Database
Restrict	This variable indicates whether bank activities in the securities, insurance, and real estate markets are: (1) unrestricted, (2) permitted, (3) restricted, or (4) prohibited. *Restrict* can range from 1 to 12, where higher values indicate more restrictions on banks. Data varies over time but not annually because the data was collected in the years 2000, 2003, 2007 and 2012.	
KKZ	The Kaufman et al. (2009) KKZ index. This is annually calculated as the average of six indicators: voice and accountability in the political system; political stability; government effectiveness; regulatory quality; rule of law; and control of corruption. Higher values indicate better institutional quality. I use annual values over our analysis period. See Kaufman et al. (2009) for a more detailed explanation.	The Worldwide Governance Indicators (WGI). World Bank
Financial freedom	Composite index of the extent of government regulation of financial services; the extent of state intervention in banks and other financial services; the difficulty of opening and operating financial services firms (for both domestic and foreign individuals); and government influence on the allocation of credit. This index ranges from 0 to 100.	Heritage Foundation
Government spending	The annual ratio of government spending to GDP.	IMF Financial statistics
Other country-level control variables		
Bank development	The annual ratio of private credit of deposit money banks to GDP.	Global Financial Development Database (GFDD). World Bank.
Stock development	The annual ratio of stock market capitalization to GDP.	
GDPgrowth	Annual growth in GDP.	
LnGDPpc	The annual natural logarithm of GDP per capita.	
Inflation	December Consumer Price Index (2010 = 100)	International Financial Statistics. IMF

(*continued on next page*)

Table A2 (*continued*)

Name	Definition	Source
Additional country-level control variables		
Government owned	Fraction of banking system's assets that are 50% or more government-owned in a country. Data varies over time but not annually because the data was collected in the years 2000, 2003, 2007 and 2012.	World Bank' s Bank Regulation and Supervision Database
Foreign owned	Fraction of banking system's assets that are 50% or more foreign-owned in a country. Data varies over time but not annually because the data was collected in the years 2000, 2003, 2007 and 2012.	
Official supervision	Official supervisory power, ranging from 0 to 14, captures the power of supervisors to take prompt corrective action, to restructure and reorganize troubled banks, and to declare a troubled bank insolvent. Higher values indicate greater power of supervisors. Data varies over time but not annually because the data was collected in the years 2000, 2003, 2007 and 2012.	
Capital regulation	A Capital regulatory index defined as the sum of two measures of capital stringency: *Overall Capital Stringency,* which indicates whether there are explicit regulatory requirements regarding the amount of capital that a bank must have relative to various guidelines; and *Initial Capital Stringency,* which indicates whether the source of funds counted as regulatory capital can include assets other than cash or government securities and borrowed funds, as well as whether the sources are verified by the regulatory or supervisory authorities. Capital regulation may range in value from 0 to 9, with a higher value indicating greater stringency. Data varies over time but not annually because the data was collected in the years 2000, 2003, 2007 and 2012.	

References

Acharya, V.V., Baghai, R.P., Subramanian, K.V., 2014. Wrongful discharge laws and innovation and innovation. Rev. Financ. Stud. 27, 301–346.

Acharya, V.V., Subramanian, K.V., 2009. Bankruptcy codes and innovation. Rev. Financ. Stud. 22, 4949–4988.

Agoraki, M.-E., Delis, M., Pasiouras, F., 2011. Regulations, competition and bank risk-taking in transition countries. J. Financ. Stab. 7, 38–48.

Akinci, O., Olmstead-Rumsey, J., 2018. How effective are macroprudential policies? An empirical investigation. J. Financ. Inter. 33, 33–57.

Allen, J., Grieder, T., Peterson, B., Roberts, T., 2020. The impact of macroprudential housing finance tools in Canada. J. Financ. Inter. 42, 100761.

Altunbas, Y., Binici, M., Gambacorta, L., 2018. Macroprudential policies and bank risk. J. Int. Money Financ. 81, 203–220.

Araujo, D., Barroso, J., Gonzalez, R., 2020. Loan-to-value policy and housing finance: Effects on constrained borrowers. J. Financ. Inter. 42, 100830.

Ayyagari, M., Beck, T., Martinez Peria M.S., 2018, The micro impact of macroprudential policies: Firm-Level Evidence. International Monetary Fund working paper, WP/18/267.

Barth, J., Caprio, G., Levine, R., 2004. Bank regulation and supervision: what works best? J. Financ. Inter. 13, 205–248.

Basten, C., Koch, C., 2020. Higher bank capital requirements and mortgage pricing: Evidence from the countercyclical capital buffer. Rev. Financ. 24, 453–495.

Beck, T., De Jonghe, O., Schepens, G., 2013. Bank competition and stability: cross-country heterogeneity. J. Financ. Inter. 22, 218–244.

Beck, T., Gambacorta, L., 2020. New evidence on the effectiveness of macroprudential policies. J. Financ. Inter. 42, 100834-372.

Berger, A.N., Bouwman, C.H.S., 2013. How does capital affect bank performance during financial crises? J. Financ. Econ. 109, 146–176.

Berger, A.N., Klapper, L., Turk-Ariss, R., 2009. Bank competition and financial stability. J. Financ. Serv. Res. 35, 99–118.

Bertrand, M., Duflo, E., Mullainathan, S., 2004. How much should we trust differences-in-differences estimates? Q. J. Econ. 119, 249–275.

Bertrand, M., Mullainathan, S., 2003. Enjoying the quiet life? Corporate governance and managerial preferences. J. Political Econ. 111, 1043–1075.

Bikker, J.A., Spierdijk, L., 2009, Measuring and explaining competition in the financial sector. Tjalling C. Koopmans Research Institute, Discussion Paper Series nº 09–01.

Biswas, A., 2019. Creditor rights and the market power-stability relationship in banking. J. Financ. Stab. 40, 53–63.

Bruno, V., Shim, I., Shin, H.S., 2017. Comparative assessment of macroprudential policies. J. Financ. Stab. 28, 183–202.

Calderon, C., Schaeck, K., 2016. The effects of government interventions in the financial sector on banking competition and the evolution of Zombie Banks. J. Financ. Quant. Anal. 51, 1391–1436.

Calem, P., Correa, R., Lee, S., 2020. Prudential policies and their impact on credit in the United States. J. Financ. Inter. 42, 100826.

Cerutti, E., Claessens, S., Laeven, L., 2017. The use and effectiveness of macroprudential policies: new evidence. J. Financ. Stab. 28, 203–224.

Chevalier, J.A., 1995. Capital structure and product-market competition: Empirical evidence from the supermarket industry. Am. Econ. Rev. 85, 415–435.

Claessens, S., 2009, Competition in the financial sector: Overview of competition policies. IMF working paper WP/09/45.

Claessens, S., Ghosh, S., Mihet, R., 2013. Macro-prudential policies to mitigate financial system vulnerabilities. J. Int. Money Financ. 39, 153–185.

Claessens, S., Laeven, L., 2004. What drives bank competition? Some international evidence. J. Money, Credit, Bank. 36, 585–592.

Demirgüç-Kunt, A., Laeven, L., Levine, R., 2004. Regulations, market structure, institutions, and the cost of financial intermediation. J. Money, Credit, Bank. 36, 593–622.

Ezer M., 2019, The Effectiveness of Macroprudential Policy on Bank Risk, Mimeo.

Forssbaeck, J., Shehzad, C.T., 2015. The conditional effects of market power on bank risk-cross-country evidence. Rev. Financ. 19, 1997–2038.

Gaganis, C., Galariotis, E., Pasiouras, F., Staikouras, C., 2021. Macroprudential regulations and bank profit efficiency: international evidence. J. Regul. Econ. 59, 136–160.

Gaganis, C., Lozano-Vivas, A., Papadimitri, P., Pasiouras, F., 2020. Macroprudential policies, corporate governance and bank risk: Cross-country evidence. J. Econ. Behav. Organ. 169, 126–142.

Gambacorta, L., Murcia, A., 2020. The impact of macroprudential policies in Latin America: An empirical analysis using credit registry data. J. Financ. Inter. 42, 100828.

Goetz, M.R., 2018. Competition and bank stability. J. Financ. Inter. 35, 57–69.

Gómez, E., Murcia, A., Lizarazo, A., Mendoza, J., 2020. Evaluating the impact of macroprudential policies on credit growth in Colombia. J. Financ. Inter. 42, 100843.

Houston, J.F., Chen, L., Ping, L., Yue, M., 2010. Creditor rights, information sharing, and bank risk taking. J. Financ. Econ. 96, 485–512.

Jeanne, O., Korinek, A., 2020. Macroprudential regulation versus mopping up after the crash. Rev. Econ. Stud. 87 (3), 1470–1497.

Jimenez, G., Ongena, S., Peydro, J.-L., Saurina, J., 2017. Macroprudential policy, countercyclical bank capital buffers and credit supply: evidence from the Spanish dynamic provisioning experiments. J. Political Econ. 125 (6), 2126–2177.

Kaufman, D., Kraay, A., Mastruzzi, M., 2009, Governance Matters VIII: Aggregate and Individual Governance Indicators 1996–2008, World Bank Policy Research Working Paper No. 4978.

Keeley, M.C., 1990. Deposit insurance, risk, and market power. Am. Econ. Rev. 80, 1183–1200.

Kogler, M., 2020. Risk shifting and the allocation of capital: A Rationale for macroprudential regulation. J. Bank. Financ. 118, 105890.

Laeven, L., Levine, R., 2009. Bank governance, regulation and risk taking. J. Financ. Econ. 93, 259–275.

Laeven, L., Valencia, F., 2018. Systemic Banking Crises Revisited. IMF Work. Pap., no 18/2 18, 06..

Lim, C.H., Columba, F., Costa, A., Kongsamut, P., Otani, A., Saiyid, M., Wezel, T., Wu, X., 2011, Macroprudential policy: what instruments and how are they used? Lessons from countries experiences. IMF Working Paper, nº 11/238.

Lyandres, E., 2006. Capital structure and interaction among firms in output markets: Theory and evidence. J. Bus. 79, 2381–2421.

Maudos, J., Fernández De Guevara, J., 2004. Factors explaining the interest margin in the banking sectors of the European Union. J. Bank. Financ. 28, 2259–2281.

Meuleman, E., Vennet, R, Vander, 2020. Macroprudential policy and bank systemic risk. J. Financ. Stab. 47, 100724.

Mirzaei, A., Moore, T., 2020, Do macro-prudential policies jeopardize banking competition? International Review of Finance. forthcoming. https://doi.org/10.1111/irfi.12330.

Petersen, M.A., 2009. Estimating standard errors in finance panel data sets: comparing approaches. Rev. Financ. Stud. 22, 435–480.

Petersen, M., Rajan, R., 1995. The effect of credit market competition on lending relationships. Q. J. Econ. (May) 110, 407–443.

Richter, B., Schularick, M., Shim, I., 2019. The costs of macroprudential policy. J. Int. Econ. 118, 263–282.

Scalco, P.R., Tabak, B.M., Teixeira, A.M., 2021. Prudential measures and their adverse effects on bank competition: the case of brazil. Econ. Model. 100, 105495.

Serfling, M., 2016. Firing costs and capital structure decisions. J. Financ. 71, 2239–2285.

Turk-Ariss, R., 2010. On the implications of market power in banking: Evidence from developing countries. J. Bank. Financ. 34, 765–775.