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Capital and Currency-based Macroprudential Policies: an Evaluation Using Credit Registry Data

Aguirre, Horacio
Repetto, Gastón

Capital and Currency-based Macroprudential Policies: an Evaluation Using Credit Registry Data*

Horacio Aguirre† Gastón Repetto‡

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Abstract

We aim to assess the impact of capital- and currency-based macroprudential policy measures on credit growth at the bank-firm level, using credit registry data from Argentina. We examine the impact of the introduction and tightening of a capital buffer and a limit on the foreign currency position of financial institutions on credit growth of firms, estimating fixed effects and difference-in-difference models for the period 2009-2014; we control for macroeconomic, financial institutions and firms' variables, both observable and unobservable. We find that: the capital buffer and the limits on foreign currency positions generally contribute to moderating the credit cycle, both when introduced and when tightened; the currency-based measure appears to have a quantitatively more important impact; both measures operate on the extensive and the intensive margins, and have an impact on credit supply. Macroprudential policies also have an effect on ex post credit quality: growth of non-performing loans is reduced after their implementation. In general, credit granted by banks with more capital and assets evidences a higher impact of the introduction of the capital buffer, while this measure also acts more strongly during economic activity expansions.

JEL classification codes: E58, G28, C33
Keywords: Macroprudential policy, credit registry data, panel data models

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†Economic Research, BCRA. E-mail: haguirre@bcra.gob.ar

‡General Manager's office, BCRA. E-mail: grepetto@bcra.gob.ar

1 Introduction

In recent years, macroprudential tools have come to the forefront of the discussion on financial stability policy. They pose challenges to both analysts and policy-makers, including the proper definition of macroprudential policy (MPP), its implementation and the relevant evaluation of its impact. As MPP, by definition, is concerned with system-wide repercussions of the behaviour of financial institutions, beyond purely individual risk-taking, impact evaluation has both macroeconomic and microeconomic dimensions. While there is a relatively established body of work for the former, the latter is actually very scant. This contrasts with impact evaluation literature in other policy areas, which has profitted substantially from the growing availability of microdata. In this paper, we aim to assess the impact of capital- and currency-based macroprudential policy measures taken in Argentina from 2010 to 2014, through microeconometric analysis using credit registry data.

Emerging market economies (EMEs) have long put in place the kind of measures that only more recently have become widely known (and applied) as "macroprudential". Measures that exceed the safeguarding of individual financial institutions' risk to cover their system-wide impact, as well as their possible spillovers on the economy at large (and from the economy to the financial system) have become widespread since the breakout of the international financial crisis, following a period of steady discussion and development (Borio, 2003); it is perhaps unsurprising that EMEs, with a track record of financial crises since at least the mid-1970s, have been pioneers of macroprudential policy. This makes EMEs a natural starting place for studies on MPP effectiveness, as there is a wider variety of measures that have been taken, which have been in place for a longer period of time than in advanced economies.

Argentina is a relevant case study in MPP: the demise of the currency board regime, which pegged the Argentine peso to the US dollar in context of free capital mobility from 1991 to 2001, provided dramatic evidence on the close link between financial system and macroeconomic performance. This experience illustrates with utmost clarity the "risk taking channel" of monetary policy (Borio and Zhu, 2008), in that an implicit guarantee provided by monetary policy (perfect exchange rate stability) led to behaviour that assumed that a complete tail of the exchange rate risk distribution (foreign exchange depreciation) had virtually vanished. It was only natural that, from 2003 onwards, Argentine financial system regulation incorporated aspects such as explicit and implicit currency mismatches, and, in general, features that acknowledge the macro-financial link. This is makes the study of the Argentine experience worthwhile for policy design in EMEs at a more general level.

While EMEs' experience with macroprudential regulation make them an excellent showcase for studying the design and impact evaluation of such measures, studies have tended to survey and classify national and regional experiences, and use macroeconometric models (see, for instance, Lim et al, 2011); or, more incipiently, models have been developed that introduce "financial frictions" into conventional representations of macroeconomic and monetary policies[1]. There is ample scope for impact evaluation that goes beyond case studies and macroeconometric or theoretical models. In this sense, a microeconometric approach that profits from available credit data at a more granular level can shed light on the actual effect of policies; this is already widely applied in other policy fields, and the fact that many central banks collect credit registry data periodically in many Latin American countries represents an excellent opportunity for policy-relevant microeconometric research.

[1] For Latin America, substantial work has been carried out the BIS CCA research network on "Incorporating financial stability consideration into central bank policy models"; see http://www.bis.org/am_office/rsn/ifscicbpm.htm.

In this paper, we use data from Argentina's *Central de Deudores*, a database of borrowers from financial institutions supervised by the Central Bank of Argentina. We take a subset of the registry (law persons) to focus on credit to companies (as opposed to households, or physical persons); and look at how growth at the individual financial institution-firm level was affected by the introduction and tightening of two different macroprudential policy instruments: a capital conservation buffer and a limit on the foreign exchange position of financial institutions. Our evaluation is performed during the 2009-2014 period, estimating both fixed-effects and difference-in-difference models.

A fundamental empirical decision has to do with what we ultimately aim to assess: the effectiveness of macroprudential policy . Is this linked to policy curbing credit growth, or with it contributing to banks' resilience in the face of shocks? We think the latter is more akin to a proper definition of MPP's final objective, while the former may be considered an intermediate target in some cases. Credit growth over some threshold is conventionally considered a robust early warning indicator of financial crises; but there are reasons to think that in underdeveloped financial systems this may not always be the case. Structurally low credit-to-GDP may mean that more or less prolonged periods of credit growth are actually part of a financial development process and not necessarily an indicator of the build up of pressures in the credit market. Actually, in such countries, authorities may be pursuing financial development policies while at the same time implementing some type of MPP in order to strengthen the financial system and/or decrease risks that exceed individual financial institutions' performance. All things considered, macroprudential policy evaluation should be carried out over several dimensions; and credit growth is only one of them. With this caveat in mind, we proceed to measure the impact of MPP on credit growth at the bank-firm level as a first step in a comprehensive assessment.

The rest of the papers is organized as follows. Section 2 puts our work in the context of empirical assessments of macroprudential policy. Section 3 describes credit registry data in Argentina, and the subset of it we will employ; section 4 reviews the main features of the Argentine macroprudential policy framework, and the two particular measures we analyze. Section 5 looks at the interplay between MPP measures and our credit registry data sample, providing descriptive statistics; and then presents the econometric models and their main results. Section 6 concludes.

2 Related literature

Empirical evidence on the effectiveness of macroprudential policies is still in a developing stage. More work is needed in order to identify which are the most suitable policies to mitigate financial system vulnerabilities. The literature about the subject can be divided into macro- and microeconometric studies. The first group includes cross-country studies that use macroeconomic data to analyze the link between macroprudential policies, credit growth and other financial indicators. An important part of this work is based on the dataset presented by Lim et al (2011). These authors show that policies such as loant-to-value (LTV) and debt-to-income (DTI) limits, ceilings on credit growth, reserve requirements, and dynamic provisioning rules are associated with reductions in the procyclicality of credit and leverage. IMF (2012) explores the interaction between monetary and macroprudential policies. Focusing on capital requirements, reserve requirements, and LTV and DTI caps, the work finds that capital and reserve requirements constrain growth but that the effects differ in credit busts versus credit booms for capital requirements.

More recent papers have updated the existing databases or have created new ones in order to test the robustness of previous results. Kuttner and Shin (2013) use a BIS dataset of macroprudential measures covering as far back as 1980 for some countries. Using three different

econometric techniques, they find evidence for the economic and statistical significance of DTI and housing taxes on house price inflation. Bruno et al (2014) also use the BIS macroprudential policy and a dataset of capital flow management policies to study the effects of these policies on credit, banking flows and bond flows in twelve Asian countries. They find that monetary and macroprudential policies were used as complements in Asia from 2004 to 2013. Akinci and Olmstead-Rumsey (2015) cover 57 advanced and emerging economies from 2000 to 2013, and construct an index of domestic macroprudential policies. Their main findings suggest that macroprudential tightening is associated with lower bank credit growth, housing credit growth and house price inflation and that LTV,DTI and capital requirements measures emerges as the more effective policies. Additionally, the paper finds that macroprudential policies taken in emerging and advanced economies are different; while the former have adopted measures to moderate credit growth, the latter have used policies to control the evolution of the housing sector.

Focusing specifically on Latin America, Tovar et al. (2012) look at the impact on credit growth of reserve requirements and other MPP tools, including limits on foreign exchange positions; they find that they actually contribute to curbing credit procyclicality in a transitory fashion. In turn, Tobal (2014) presents a survey of foreign exchange MPP tools in Latin America, requesting central banks to provide information on the goals they pursued: controlling credit growth; achieving exchange rate stability; reducing currency mismatches; reducing maturity mismatches in foreign currency positions; correcting current account imbalances. Results show that reducing currency mismatches is the main purpose, followed by achieving exchange rate stability; and that the bulk of such measures were taken as countries were moving to more flexible exchange rate regimes -including inflation targeting ones.

The second group of studies is incipient -though growing in number- and largely charaterized by those that use micro-level evidence. This includes bank-level and credit registry data. Drehmann and Gambacorta (2011) aim to determine if the countercyclical capital buffer designed in the Basel III package could impact on bank lending, using quarterly balance sheet information of 772 individuals from the EU countries and United States, extending from 1998 to 2009. They simulate the increase in capital requirements if the countercyclical capital buffer had been operating since 1986; and.embed the additional capital in a lending equation to assess how the introduction of the buffer would have changed the supply of lending. They find that the buffer could help to reduce credit growth during booms and attenuate the contraction once it is released. Claessens et al (2014) use Bankscope's data to construct a panel of 2820 banks (1650 in 23 advanced countries and 1170 in emerging economies) over the period 2000-2010. They group macroprudential policies according to whether they are aimed at borrowers, bank's assets or liabilities, policies that encourage counter cyclical buffers and a final group of miscellaneous policies. They find that both caps on borrower's and financial institutions' assets and liabilities based measures are effective in reducing the growth in assets. Buffer-based policies seem to have little impact.

More recent papers exploit the granularity of credit registry data, as found in certain European and Latin American countries. The most widely cited is that of Jiménez et al. (2016), who examine the impact of countercyclical MPP -dynamic provisioning- on credit supply using Spanish credit registry data They employ a difference-in-difference approach and examine how credit evolved over the business cycle as dynamic provisions change, being able to assess performance during upswings and downturns of the cycle, as well compositional effects on credit; their findings reveal the ability of MPP to smooth the credit cycle. Dassati and Peydró (2014) look at how liquidity requirements in Uruguay affected credit supply, estimating a difference-in-difference model on loan-level data; they find that higher requirements decrease supply. In turn, López et al. (2014) examine loan risk, credit growth and countercyclical provisions in Colombia: they

find that while episodes of high credit growth lead to riskier loans, provisioning helps curb the amplitude of credit cycles. In Brazil, using credit registry data, Martins and Schechtman (2013) find that the increase of risk weights on highly leveraged automobile loans lead to the significant reduction of such type of credit.

The most recent studies on the experience of Latin American countries (Brazil, Colombia, Mexico, Perú) with macroprudential policies using credit registry data are the result of a BIS CCA research network of which our project is part; Gambacorta and Murcia Pabón (2017) employ meta-regression techniques to synthesize findings obtained across different models and samples employed in the network. Their main messages are that macroprudential policies have been quite effective in stabilising credit cycles, with faster propagation effects on credit growth for policies aimed at curbing the cycle than for policies aimed at fostering resilience; and that macroprudential tools have a greater effect on credit growth when reinforced by the use of monetary policy to push in the same direction.

All in all, most of the evidence on the relationship between macroprudential policies and financial institutions' performance produced so far has been obtained using aggregate data at country level or bank-level data. And limited use has been made of credit registry data -when it has, capital or lending-related measures have typically been assessed. Our paper is a contribution to this second literature strand, with a salient feature compared to previous studies: we analyze both capital-based and currency-based MPP measures, using a single framework and during the same sampling period. While currency-based measures are common in emerging market jurisdictions, they have not received attention in the evaluation literature commesurate with their widespread use.

3 Credit registry data in Argentina

Financial institutions under regulation and supervision of the Central Bank of Argentina (BCRA) inform monthly outstanding credit balances of their debtors since 1996; information is compiled and published by BCRA as *Central de deudores* (*Debtors' central*). The database is available on CD-ROM for use of financial and other institutions that comply with legal requirements concerning protection of personal data. Individual debtor's information can be accessed on BCRA's website using the individual tax identification number. Informing institutions include: banks (public, private –domestic, foreign and branches-), non-banking financial institutions (domestic and foreign), and credit companies (*cajas de crédito*).

Information provided by financial institutions to *Central de Deudores* comprises both debtor identification and credit characteristics. The former include whether it is physical or law person, its residency, whether it belongs to the private or public sector, its main economic activity, if it is a small or medium-sized enterprise (according to the financial institution that granted the loan), and whether it is a commercial or consumption debtor. Information on credit includes: amount in national currency (AR$); type of loan (overdraft, promisory note, pledge, mortgage, personal, credit card, others); situation as classified by the lending institution, i.e. if it is performing or non-performing, ranked from 1 (normal) to 6 (write-off); guarantees; provisions; interest rate; maturity. It should be noted, however, that not all information is available for the whole database since its inception, as informational requirements have changed over time, and not all institutions inform the complete required set continuously. Finally, institutions have to provide invididual debtor information for balances over AR$500 (around USD 36 as of the closing of this version).

An overview of the credit registry shows that, as of April 2015, there were 1.8 million debtors of the financial system, 150.000 of which were law persons. In what follows, we refer to law

persons as "companies", and physical persons as "individuals"; still, there is not always a one-to-one correspondence between both pair of terms, as, for example, owners of small-sized companies may borrow for their companies, but this would show up as debt of an individual and not of a business. Total debt of individuals and companies with the financial system stands at AR$800 billion (USD 57bn). Over 60% of such debt is held by companies (Figure 1).

Most debt is of small amount, and relatively concentrated in a reduced numbers of debtors (Figure 2). Almost 95% of debtors have credit for an amount that does not exceed AR$100.000 (USD 7000); and of those, some 99% hold debt of amounts of up to AR$ 50.000. At the same time, 2% of debtors hold around 60% of total debt. While both individuals and companies show concentrated distributions, this is more noticeable in the latter (Figure 3).

Differences between individuals and companies also show up in access to financial institutions. More than 60% of individual debtors have received loans from only one financial institution, and over 70% of credit has been granted to them by one or two financial institutions. It is also the case that the majority of corporate debtors (almost 70%) receive loans from one financial institutions; but the bulk of of debt granted to companies is to those that work with five or more institutions (Figure 4, a) and b)).

While corporate debtors (in number of individual firms) belong to the trade (23%), manufacturing (14%) and agricultural sectors (12%), most corporate debt (in amount of debt) corresponds to the manufacturing sector (42%, followed by trade, on average over the whole sample. Firms are geographically concentrated in the city and the province of Buenos Aires (over 60%).

Figure 1

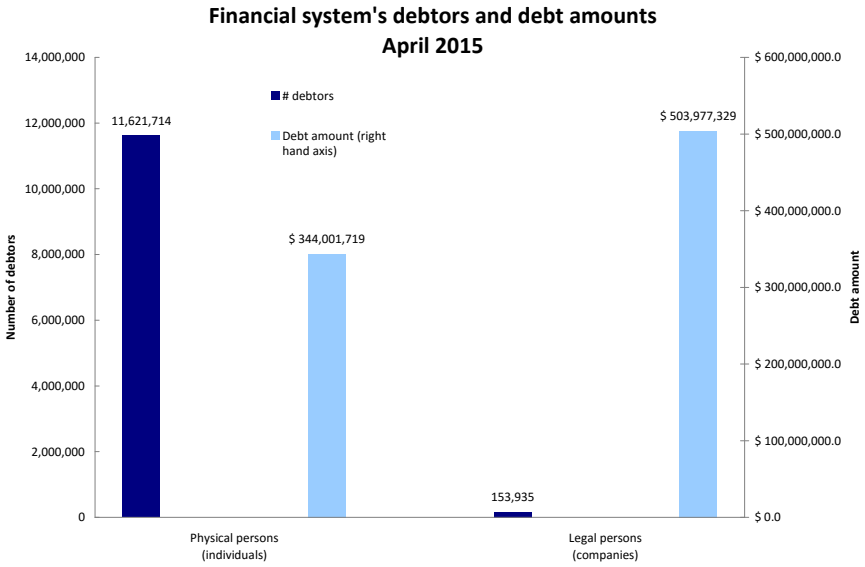


Figure 2

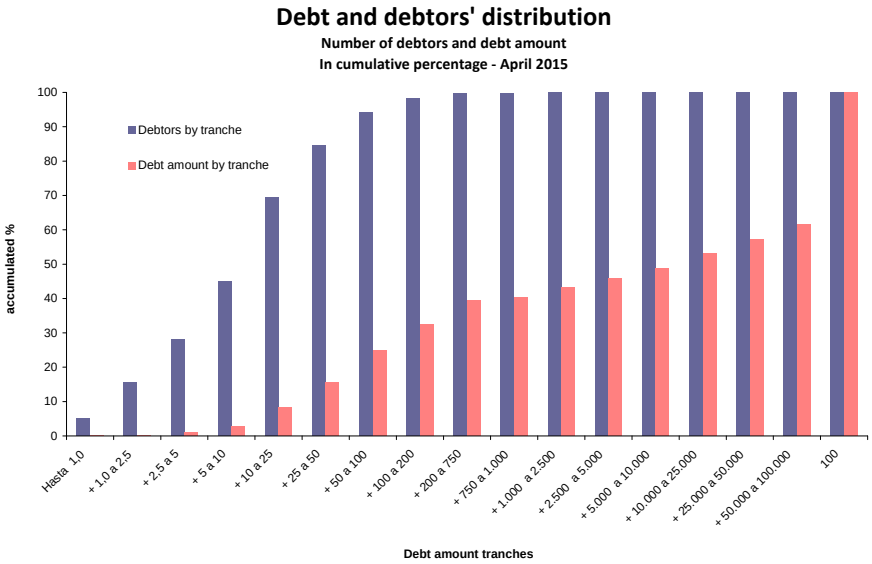


Figure 3

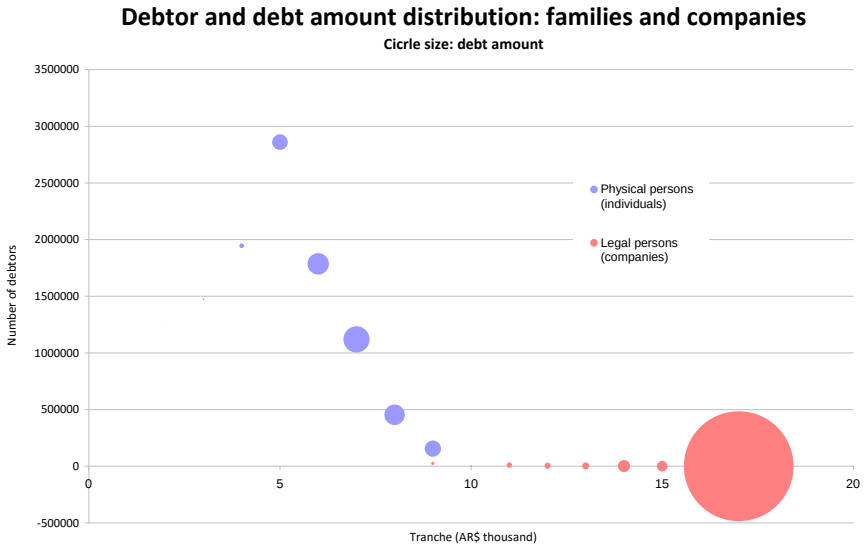


Figure 4 (a)

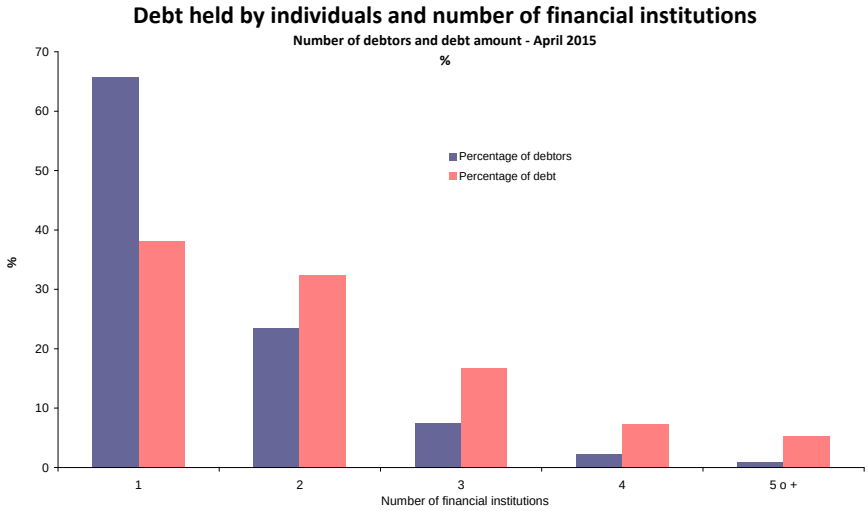
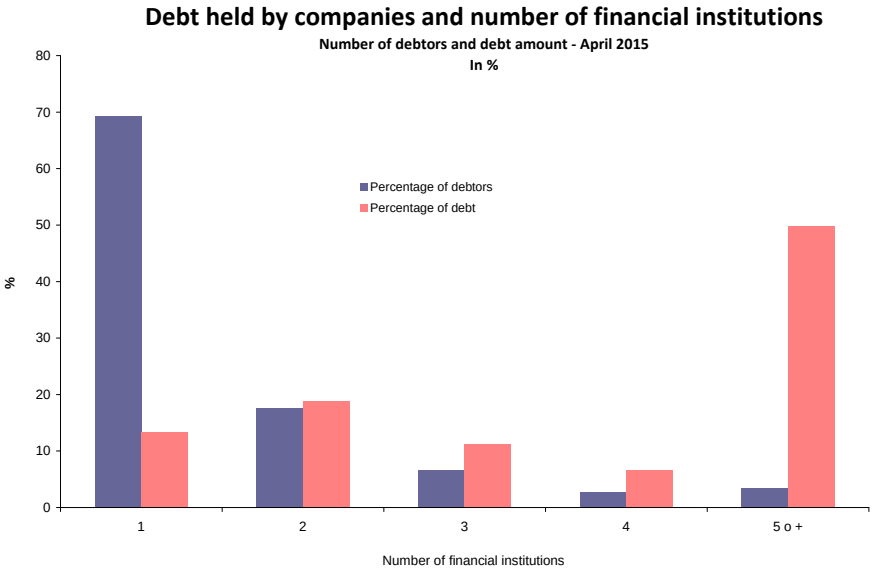


Figure 4 (b)



4 Macroprudential policy in Argentina: overview and assessment approach

In Argentina, a history of crises has made all too evident the link between financial system soundness and macroeconomic performance. Among recent episodes, the demise of the currency board, in place from 1991 to 2001, defined to a significant extent the shape taken by subsequent financial system regulation. The main features of such experience lie well beyond the scope of this paper; suffice it to say that the "convertibility" regime showed how implementing microprudential policy, even by state-of-the-art standards, may be insufficient to isolate the financial system from both negative shocks and the presence of "hidden" mismatches in a financially dollarized economy. As the peg to the US dollar was kept throughout the years, households and companies increased their debt in foreign currency, even while their revenues were mostly denominated in

pesos -considering the private sector as a whole. The government also issued a growing share of debt in foreign currency. To put it simply, both private and public agents appeared to behave as if the favourable external financial conditions registered in the first half of the 1990s would last indefinitely. As a series of EMEs' crises hit the country's ability to finance itself abroad, and deteriorated its competitiveness, a recession ensued; this ultimately led to a multiple crisis, on the fiscal, foreign exchange and banking fronts.

Since 2003, direct and indirect measures limiting foreign currency exposure of financial institutions have been a hallmark of the Argentine macroprudential framework. This also includes capital buffers (from 2010 to 2016, built through a profit reinvestment mechanism); loan-to-value ratios for certain types of credit; limits on credit to the government, and valuation of public sector securities in financial institutions' balance sheets; liquidity requirements and deposit insurance. Reserve accumulation and foreign exchange intervention could also be thought of as part of the macroprudential "toolkit" in a broader sense; the former provides a buffer of foreign exchange liquidity to be used under external stress; the latter limits the variability of a certain class of assets that weigh on financial stability. A similar reasoning applies to capital flows regulation. We provide an overview of the macroprudential framework in what follows (see BCRA, 2014a for a compilation of the whole regulatory framework).

Ruling out currency mismatches. There are three main measures in this respect. 1) Part of the market risk capital requirement is based on foreign exchange volatility, i.e. financial institutions have to comply with more or less regulatory capital depending on the volatility of their foreign currency exposure. 2) Foreign currency lending capacity: only firms whose revenues are denominated in foreign currency (or denominated in local currency but closely linked to the evolution of the exchange rate) such as those that export their production or substitute imports can obtain financing in foreign currency. This measure has been in place since 2002/03. 3) Foreign currency net global position: there is a limit on financial institutions' net position in foreign currency; the latter comprises assets and liabilities from financial intermediation, bonds in foreign currency and forwards. The limit was introduced in 2003 (30% of Tier 1 capital), suspended in 2005, and re-introduced in 2014: first as 30% of Tier 1 capital (February[2]), then lowered to 20% in September of that year[3]. We consider the latter change to be a tightening of the measure, as it sets a more stringent limit on banks' portfolio choice in terms of foreign currency: in a context of closed financial markets, decreasing the limit on net assets implies actually decreasing gross assets, as banks cannot increase their liabilities (ie cannot obtain funding in foreign currency). This limit was subsequently lowered to 15% in 2015[4], but this falls outside of our sampling period.

Capital buffer and profit reinvestment. From 2010 to 2016, any financial institution having profits to be distributed – after applying regulatory and supervisory filters – was able to allocate them through dividends as long as its regulatory capital – after dividends are paid – was at least 75% above the regulatory minimum capital requirement (a percentage that was changed since its introduction). This mechanism generated a capital buffer; its design was not necessarily countercyclical -even if it may have had cyclical properties, as profits change with the cycle. Thus, this macroprudential measure can be thought of as the joint implementation of limits on dividend distribution and a capital conservation buffer. This measure was introduced in 2010, with 30% threshold of regulatory capital requirement over which profits may be distributed[5];

[2] See Comunicación "A" 5536. "Comunicación" refers to the publicacion of BCRA regulation; all of BCRA communications are available on the BCRA website.

[3] See Comunicación "A" 5627.

[4] See Com. "A" 5834, November 2015.

[5] See Comunicación "A" 5072.

it was further increased to 75% in 2012[6]. In 2016, the measure was eliminated from BCRA regulation and substituted by a countercyclical buffer in line with Basel III standards[7]. This change falls outside of our sampling period -still, the analysis of the measure in place from 2010 to 2016 may shed some light on the general effects of capital buffers.

Reserve (liquidity) requirements. While this measure is not explicitly countercyclical, it nonetheless has macroprudential properties. Requirement ratios vary according to the currency and pending maturity of the liability, taking into account historical experiences. Liquidity requirements have changed over time, but not always with cyclical aims: changes in recent years tend to foster credit to SMEs and in relative underdeveloped regions, by reducing requirements to banks who grant such credits.

Loan to value / Debt to income ratios. There are loan-to-value ratios for mortgages (previously, for pledges) that affect credit to companies.There is a debt-to-income ratio on retail credit to physical persons.

Liquidity coverage ratio. Its gradual enforcement started in January 2015 for the twenty largest banks, according to a phase-in timetable provided for in Basel III. In addition, a list of liquidity risk monitoring tools have been defined.

Of the measures we have mentioned, we aim to assess the effects on credit growth to companies of: a) the capital buffer and profit reinvestment as introduced in the second quarter of 2010, and tightened in 2012; b) the tightening of the net foreign currency net global position in the first and third quarters of 2014; in all cases using credit registry data.

It can be argued that other elements of the macroprudential policy package are equally important (or even more so) than the measures we have chosen; in particular, limits to foreign currency lending capacity, or, in the broader macroprudential sense, international reserves' accumulation and foreign exchange intervention -the latter up to late 2015. However, evaluating measures like foreign currency lending limits would imply: increasing sample size out of workable limits, as the measure was first implemented in 2003; and including performance of financial institutions during the financial crisis of 2001-2002 and its aftermath, which would bias results toward public and private sector behaviour in reaction to financial crises (see González Padilla et al., 2006, for an econometric analysis using credit registry data that includes that period). As for foreign exchange intervention, other papers have looked at its macroeconomic effects as part of the macroprudential policy package (Aguirre and Blanco, 2015).

Both measures we examine, the introduction and tightening of the capital buffer and the increase of the foreign currency net global position (in what follows, DBK1, DBK2, PGN1 and PGN2, respectively) were introduced for reasons directly unrelated to credit growth. As we want to evaluate the impact of DBK and PGN on credit growth, the condition of exogeneity of the intervention is satisfied at the macroeconomic level; at the microeconomic level, the use of granular rules out potential endogeneity between the evolution of individual credit and interventions. While rationalising the ultimate aims of these measures exceeds the scope of this note, we mention here that DBK was initially put in place in a context of external financial turbulence (2010, with the first round of repercussions on EMEs of the Greek debt crisis); its tightening in 2012 was explicitly attributed to the aim of reinforcing institutions's solvency, in line with the discussion of new international standards such as the capital conservation buffer (BCRA, 2012). As for PGN, the suspension of limits in 2005 was decided in the face of foreign inflows, and allowed financial institutions to buy currency more aggressively; its re-introduction in 2014 occured amid pressure on the local foreign exchange market, and one of its aims was to increase

[6] See Comunicación "A" 5273.

[7] See. Com. "A" 5985, June 2016.

supply in foreign currency, as financial institutions were long in US dollar assets, decreasing foreign exchange volatility (BCRA, 2014b). In both cases, there was a macroprudential concern behind the measures, but one cannot attribute them to a response to a boom in credit that they tried to curb; so we can rule out endogeneity in the sense that changes observed in policy are a function of changes in credit growth. We believe this a substantial strength of the empirical analysis we propose: as long as credit growth is one of the relevant and conventional metrics of macroprudential policy, finding two cases in which changes in such policy do not obey to the specific aim of preventing or curbing a "credit boom" leaves with a "quasi natural experiment" of the impact of macroprudential policy on this dimension.

Ideally, we would like to assess the impact of macroprudential policy across the business and financial cycle, ie in "good" and "bad" times, with MPP being tightened in the former and eased in the latter period (as done by Jimenez et al.,2016). However, both measures considered here were introduced (or re-introduced) and tightened during the period we study. So we admittedly have a one-sided evaluation of both the capital buffer cum profit reinvestment and the limit on the global net position in foreign currency. As the former was eliminated in 2016, replaced by the Basel III countercyclical capital requirement, and the latter was reduced in 2017, we leave for further work an evaluation of the easing of both measures -this happened under a completely different monetary policy regime, which gives further justification for treating differently both phases of the cycle.

Another concern related to evaluating credit growth as MPP measures were put in place has to do with the possibility of firms obtaining financing from sources different than banks; if this was the case, we would be only partially capturing changes of the credit cycle. We can safely rule out this concern: the financial system in Argentina is heavily bank-based, so the financial cycle can be assimilated, to a large extent, to the cycle of banking credit. In addition, Argentine corporations stayed out of international financial markets during the period under study, so external credit is out of the question. Finally, Argentine companies rely largely on self-financing, and credit is only a (distant) alternative to it, so the choice for them is largely between their own use of funds, commercial credit and credit granted by local banks.

Finally, one could wonder whether the change in credit associated to the implementation of MPP measures is the proper metric to assess their effectiveness, if their aim is to strengthen the financial system; this could specially be the case of measures limiting foreign currency exposure. While financial system busts are systematically associated to previous credit booms (Mendoza and Terrones, 2012), and this is the rationale for prudential policies that take into account a cyclical aspect like the "credit gap", one could consider that reducing credit growth during booms is an intermediate rather than a final target. It can be argued that both targets are consistent in advanced economies, but the point is somewhat weaker in financially underdeveloped economies, with high potential for credit growth in the medium to long term. This is to say that the aim of our exercise is literally to assess the impact of some macroprudential measures on credit growth at the individual bank-firm level, which are best viewed as only part of a comprehensive assessment of MPP effectiveness.

5 Empirical strategy

5.1 Data and sample

We analyze quarterly data of *Central de Deudores* from the first quarter of 2009 to the fourth quarter of 2014. We look at credit to law persons ("companies"); this keeps sample size in check,

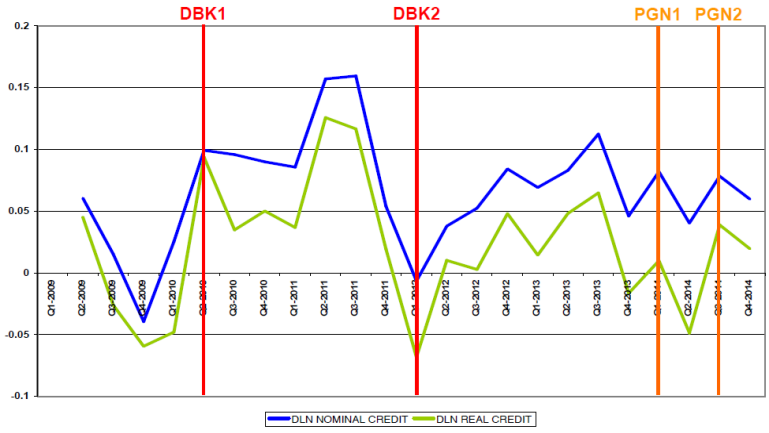
as there are around 150.000 companies each quarter, compared to over 10 million individuals, in a sample that spans twenty-four quarters. Focusing on credit to companies also helps depict the biggest market segment and the most representative debtors in terms of weight in that market, as described in section 3. Finally, the reaction of credit to companies and to households to different measures is expected to be different, so it makes sense to analyze them separately; we take this as a first step to analyzing the impact of MPP.

Each observation in the sample is the total stock of credit held by company i and granted by financial institution j, computing the quarterly average of three monthly observations. We make certain adjustments to the sample; we look at credit granted to private sector companies by financial instituions (FIs), so we leave out of the registry data set: a) credit granted from FIs to FIs; b) public sector institutions or companies as credit recipients; c) credit granted by non-financial institutions, i.e.not supervised or regulated by BCRA. This leaves us with roughly 5 million observations in our sample, each one of them a credit relationship between a firm and a company.

Our dependent variable is the change of the logarithm of real debt held by company i granted by FI j. Nominal debt is deflated using the GDP implicit price index (or GDP deflator). Using the rate of change of real debt means that we leave out of the sample all the cases in which debt is zero, where the rate of change is not defined. We are aware this introduces a potential bias in any estimate, as we omit the cases in which firms enter the market for the first time, or leave it after having been in for some time. We could address this by changing the dependent variable (for instance, the absolute change in real credit), but this would hinder comparability of results with the project of which our paper is part; and in that case it would be best to employ a two-step procedure (an equation to estimate the decision to enter or exit the credit market, another to estimate how much credit is granted).

Figure 5 shows the evolution of nominal and real credit growth in our sample, before and after each of the measures implemented. DBK1 and DBK2 denote, respectively, the introduction of the capital buffer in 2010 and its tightening in 2012; PGN1 and PGN2 denote, respetively, the reactivation of the limit on the foreign currency global position in 2014 and its tightening later that year.

Figure 5



5.2 Econometric model and results

5.2.1 Baseline model - fixed effects estimation

Our baseline model is defined in the following equation, estimated by fixed effects of bank-firm relationships:

$$\begin{aligned}\Delta Log\_credit_{ijt} &= \beta_0 + \beta_1 MPP\_tool_t + \beta_2 macro\_controls_t + \beta_3 FI\_controls_j + \\ &\quad \beta_4 firm\_controls_i + \beta_5 quarter_t + \varepsilon_{jit}\end{aligned}$$

The dependent variable is the change of the logarithm of real debt of company i granted by financial institution j, as explained previously. The independent variables comprise macroprudential tools, macroeconomic, financial institutions and firms' controls. Fixed effects correspond to bank-firm relationships (ie each pair ij has a fixed effect); we consider this the most appropriate choice for our baseline model, as credit depends not only on which bank grants it, but also to which firm it does so -as bank behaviour differs by firm, and firm behaviour to credit also differs by bank. Macroprudential tools are introduced as dummy variables for:

a) capital buffer (II-2010, I-2012) ;

b) foreign currency net global position (I-2014, III-2014).

We look at the impact of measures on the same quarter the measure was put implemented and the following one, using a dummy variable for impact and another one for lag; and, alternatively, using one dummy for impact and one lag ; and we also analyze the whole period when the measure was in place (one dummy for all quarters satisfying that condition).

Macroeconomic controls include:

- quarterly change in real GDP (not seasonally adjusted);
- change in money market rate (BADLAR, AR$, private sector);
- change in nominal exchange rate (AR$/USD)
- the balance of the foreign exchangemarket, defined as total operations of the financial system (including the Central Bank) with the non-financial private and public sectors, and the rest of the world[8].

Financial institutions' variables comprise:

-log of net total assets;

-liquidity ratio (liquid assets as % of total deposits);

-capital to assets ratio (equity to total assets);

-deposits to liabilities ratio;

-dummies for type of FI: public bank, private bank (domestic/foreign owned), non-banking FI[9].

And we chose the following control variables at the firm level:

-type of credit that the firm has taken;

-log of number of FIs that the firm is working with in each quarter.

There are also firm data on economic sector, geographic location and type of legal person, but as these features do not change over time, they do not show up in the fixed effect estimation. Finally, there are quarterly dummies to capture seasonal effects. Residuals are clustered by financial institution-firm relationships (and for robustness, we also analyze results from alternative residual clustering). Financial institutions' variables are lagged one period, and macroeconomic variables are contemporaneous or lagged one period (depending on model specification). When

[8] We consider this variable to be a better indicator of external conditions for the financial system than the current account or capital account of the balance of payments, as it shows directly whether the financial system as a whole is a net buyer or seller in the foreign exchange market.

[9] This variables do not appear in the fixed effect specification, but are included in alternative ones we employed, such as random effects.

running the regressions, we dropped outlying values of real credit growth in the top 1% percentile. Table 1 summarizes descriptive statistics of the dependent variable and the main control variables. Further description and sources of each variable are provided in the Annex.

Table 1: Baseline model

Descriptive stadistics

Variables	**Min**	**Max**	**Mean**	**Std. Dev.**
DLN_MONTO_R	-14.35	3.692949	-0.0576472	0.8950039
DLN_GDP	-0.09215	0.1270809	0.0132184	0.0632814
$DBADLAR\_pri$	-4.4819	6.44	0.2933992	2.356354
$\Delta exchange\_rate$	-0.01569	1.5503	0.2266692	0.3190883
$\Delta forex\_market\_balance$	-5037.02	5850.86	80.94156	3158.053
$Bank\_capital\_ratio$	2.9932	970.44	9.501752	24.31614
$Bank\_liquidity$	4.5	15199.7	26.62254	87184.25
$Ln(total\_assets)$	1.682275	12.7447	10.61474	1.176209
$Deposits\_to\_total\_liabilities\_ratio$	0.013339	98.13567	82.66676	4.940417

Table 2 shows the main results for the baseline model: both macroprudential measures have significant effects in all specifications. When we look at impact (model 1), the capital buffer initial implementation was positive for credit growth on the same quarter the measure was introduced, but negative one quarter later; while its tightening entailed lower credit growth both on the same quarter and the following one. The same signs of the coefficients are found for both reintroduction and tightening of the net foreign currency position. It is advisable to look at longer periods: including the average impact over two quarters (model 2), and the whole time the measure was in place (model 3), we find lower credit growth for all the measures considered here. Finally, if we include not only lags for the regressors but also lags for the controls (model 4), there is a negative average effect of the capital buffer on credit growth over two quarters when it was introduced and when it was tightened; and a positive effect of foreign currency limits when reintroduced, but a negative one when tightened.

Besides statistical signicance, estimated coefficients show economic significance. The introduction of the capital buffer reduces firms' credit growth by 1% to 2% quarterly (on average over two quarters), and by 3% quarterly during the whole period of implementation; there is higher impact of the tightening of this measure, that ranges from -8% to -11% quarterly. Limits to the global currency position also yield effects lower than -10% quarterly; but, as discussed in the previous paragraph, under one specification their introduction shows a positive sign.

Estimated signs on control variables also merit a mention. GDP growth is positive and significant for the impact and one quarter estimation (as one dummy) and for the whole period the policies were in place. Money market interest rates are associated to lower credit growth in the specifications that include contemporaneous impact and lag of the policy measures, either as two different dummies or a single one -but not in the case where there is a dummy for the whole period of policy implementation.

In turn, exchange rate depreciation (i.e. the local currency depreciating with respect to the US dollar) weighs negatively on credit growth, while a higher balance of the foreign exchange market is usually associated to higher credit growth. The latter two effects are consistent with anecdotal evidence of the disruptive impact on financial stability of foreign exchange depreciations and foreign exchange market turbulence.

As for financial institutions' controls, banks with more capital and liquidity, show higher credit growth granted to firms -something that applies under two specifications to banks with

a higher share of deposits to total assets. However, banks' size as measured by total assets appears to be negatively linked to credit growth. Finally, firms control show that those companies working with a larger quantity of financial institutions also hold credit at higher rates; and that the type of credit they hold is related to its growth.

Statistical significance of the coefficients on DBK1, DBK2, PGN1 and PGN2 is robust to alternative clustering of residuals, either by financial institutions, by firm, or by firm-bank relationship. The only change when different clusterings are considered occurs in the significance of some of the controls; see annex 2 for these results, in the specification of MPP measures as dummies during the complete period of implementation.

We then restrict the sample to firms that held debt in all quarters during the estimation period (table 3): they represent the relatively more important ones in terms of size and share in the credit market. In this case, the average effect over two quarters is negative for all the measures analyzed, and the same applies to the average effect during the whole time they were in place. When we also include lags of the control variables, we find that capital buffers weigh negatively on credit growth on average over two quarters, as does the tightening of the foreign currency position; but the opposit applies to the introduction of such limits. Estimated coefficients tend to be lower in this subsample, which we interpret as a difference between intensive and extensive margins: the latter would be somewhat lower than the former (by the order of 1,5 to 4 percentage points, depending on the measure considered), implying a higher impact on credit growth through the granting of credit to fewer companies than to less credit to the same firms. Our intepretation of extensive and intensive margins goes along the lines of Bolton et al. (2016), who find that banks that build long-term relationships with clients sustain credit supply across the cycle in a more stable fashion than merely "transactional" banks.

As the ultimate aim of macroprudential policy should be to strengthen the resilience of the financial system, we incorporate an indicator of solvency risk: the model is estimated for growth of non-performing loans, as classified by financial institutions (table 4). For the complete sample, capital buffer implementation and its tightening, as well as the the re-introduction of a ceiling on the foreign currency position and its tightening, carry a negative effect over the first two quarters of their implementations (either accumulated or average over them). The same applies to the effect during the whole time they were in place; this is robust to introducing lags in the control variables. Thus, we can say that both type of measures actually contributed to decreasing *ex post* riskier loans in banks' portfolios. There are two additional takeaways here: the introduction of the capital buffer shows a higher estimated impact on NPLs than on total credit, in any of the models employed; and the re-introduction of the global net currency position shows a negative on NPL growth effect over two quarters when controls are lagged, whereas for total credit such estimated impact was positive.

A caveat is here in order: we are using a measure of *ex post* or realized risk, whereas the ideal measure would be one of *ex ante* risk, so as to gauge to what extent MPP influences risk-taking by financial institutions. Ideally, we would like to measure to what extent MPP implementation makes the system less risky; we are instead looking at a proxy, whether such policy leads to a lower share of non-performing loans in banks' portfolios. Using this proxy is of course due to availability; our database provides us with non-performing loans as classified by financial institutions, so we may be capturing behaviour related to monitoring or classification rather than risk-taking per se. In other words, macroprudential measures could induce banks to change how they classify loans, or the pace at which they revise such classification. For instance, "good" loans become more expensive in terms of regulatory capital once requirements are tightened[10].

[10] Only going by this example, reclassification should work in the direction of increasing NPLs after MPP

While a measure of ex ante risk of debtors (such as credit ratings) would be certainly be preferred, this is not available for most of our dataset. What we are actually looking at is whether the implementation of MPP is in any way associated to changes in NPLs in banks' porfolios, as a way of approximating their overall resilience.

We also look at the impact of macroprudential policies on growth of non-performing loans of firms that are present during the whole sampling period (table 5): the introduction and tightening of the capital buffer decreases NPL growth both on average during the first two quarters after implementation, and during the whole period the measure was in place; the re-introduction of a limit on the global foreign currency position and its tightening work in the same direction. When control variables are lagged, all measures show a negative impact in the first two quarters of implementation. Here, once again we find that the introduction of the capital buffer entails a higher impact for NPLs than for total credit, in all models employed; and that the re-introduction of the global net foreign currency position goes from a positive to negative effect on growth when we look at NPL instead of total credit, and lags for controls.

We enrich model specification by allowing for interaction terms between policy and control variables (table 6). For expositional ease, we will focus on policy dummies active during the whole period of each measure's implementation. The interaction between the capital buffer's introduction and financial institutions' controls shows that banks with higher capital and higher total assets felt a marginally higher impact of the measure (i.e., credit growth was lower for those banks); while the opposite applies to banks with a higher share of deposits to total liabilities and higher liquidity. The tightening of the buffer offers comparable readings in terms of sign, except that banks with more assets can actually offset part of the measure's impact. As for the re-introduction of the global foreign currency position limit, there is no significant association of its impact with capital or liquidity, but bigger institutions in terms of assets evidence a higher impact of the measure, while those with a higher share of deposits in their liability structure show a lower effect. The tightening of this limit involves a bigger effect on credit growth for bigger banks in terms of capital and assets, but a lower one for those with a higher deposit-to-liabilities ratio; there is no discernible association with liquidity. Generally, at least one measure of bank size interacts negatively with the measure, denoting a more important impact of macroprudential policy on bigger banks, while there is no association with institutions' liquidity.

Macroprudential policy variables are also interacted with macroeconomic controls: the interaction of GDP growth with the capital buffer is negative and significant (both for introduction and tightening), suggesting that this measure contributes additionally to curbing credit growth during upswings of economic activity; this can be seen as reinforcing its macroprudential nature. Instead, such interaction is positive with the limit on global foreign currency position. In turn, the capital buffer interacted with money market interest rates delivers a positive and significant coefficient; but there is a negative and significant interaction between limits on the global foreign currency position and interest rates. Thus, the currency-based measure reinforces the negative effect of higher rates -in so far as market rates reflect monetary policy stance, this can be seen as a kind of synergy with macroprudential policy. In these models, evidence on interaction suggests a clear countercyclical role for the capital buffer, but not necessarily for the limit on the net foreign currency position of banks. In turn, the currency-based measure apparently works in the same direction as monetary policy -reinforcing the negative effects of interest rates on credit growth.

We also run the models using a random effects specification (not reported here but available

implementation, but we find the opposite, which reinforces the interpretation of our results as decreasing solvency risk. In addition, reclassification from "good" to "bad" loans generates negative effects on borrowers that banks may want to avoid in a long term relationship with clients.

on request from the authors), as this allows for both variations between and within individual firm credit relationships; and performed the Hausman test between random and fixed effect models. The null hypothesis of equality of estimated coefficients was rejected: based on the consistency of fixed effects estimation, this suggest the lack of exogeneity of regressors with respect to the unobservable random component in the random effects model. The result thus leads us to favour the fixed effects specification[11].

[11] Results using the fixed effects models represent the effect on the average firm-bank relationship; to gain an insight on the likely systemic repercussions, we run weighted fixed effect models weighted by the amount of each credit granted by a certain bank to a certain firm in terms of the whole sample. In this case, we found that DBK2 and PGN1 have negative and significant coefficients.

Table 2: Baseline model.

All firms, total credit

	1	2	3	4
Dependent variable: DLN_MONTO_R	Impact effect and lags	Impact efect and lags as an only dummmy	Effect during complete period of implementation	Impact effect and lags as an only dumy (with lag controls)
DBK1_I	0.02024***			
	(0.003207)			
DBK2_I	-0.08365***			
	(0.003407)			
PGN1_I	0.3223***			
	(0.009074)			
PGN2_I	-0.2066***			
	(0.003170)			
DBK1_I_L1	-0.06836***			
	(0.003125)			
DBK2_I_L1	-0.1571***			
	(0.003258)			
PGN1_I_L1	-0.09263***			
	(0.003256)			
PGN2_I_L1	-0.1693***			
	(0.002345)			
DBK1_C1		-0.01215***		-0.02395***
		(0.001887)		(0.002338)
DBK2_C1		-0.08847***		-0.08414***
		(0.002456)		(0.003857)
PGN1_C1		-0.1607***		0.1419***
		(0.002961)		(0.006593)
PGN2_C1		-0.1660***		-0.1446***
		(0.002062)		(0.002819)
DBK1_E			-0.03408***	
			(0.001703)	
DBK2_E			-0.1086***	
			(0.001811)	
PGN1_E			-0.1296***	
			(0.002736)	
PGN2_E			-0.1244***	
			(0.001936)	
DLN_GDP_R	-0.8167***	-0.07818***	0.2117***	0.3451***
	(0.03608)	(0.02474)	(0.02213)	(0.04566)
DBADLAR_PRI	-0.001774***	9.947e-04***	0.001746***	-0.005308***
	(3.717e-04)	(3.437e-04)	(3.399e-04)	(5.096e-04)
Δ exchange rate	-0.3492***	-0.04228***	-0.003762	-0.1568***
	(0.006112)	(0.002799)	(0.003073)	(0.004025)
Δ foreign_XR_balance	1.641e-06***	6.738e-06***	2.466e-06***	5.285e-06***
	(2.882e-07)	(2.583e-07)	(2.227e-07)	(2.840e-07)
DLN_GDP_R_L1				-0.08436**
				(0.03279)
DBADLAR_PRI_L1				0.002571***
				(3.278e-04)
Δ exchange rate_L1				-0.2071***
				(0.004907)
Δ foreign_XR_balance_L1				-3.616e-07
				(3.806e-07)

(continued)

Table 2 (continued): Baseline model.

All firms, total credit

Bank _capital_ratio_L1	0.004473***	1.809e-04	0.003268***	0.001046**
	(3.912e-04)	(3.827e-04)	(3.815e-04)	(4.847e-04)
Bank_Liquidity_L1	2.769e-06**	8.822e-07	4.472e-06***	2.593e-06***
	(1.079e-06)	(9.829e-07)	(1.103e-06)	(7.288e-07)
Ln(total_assets)_L1	-0.05925***	-0.1686***	-0.01265*	-0.01706
	(0.007421)	(0.007077)	(0.007520)	(0.01220)
Deposits_to_totliabilities_L1	-1.416e-04	-0.001773***	0.001627***	0.003012***
	(1.779e-04)	(1.739e-04)	(1.878e-04)	(2.558e-04)
Bank _capital_ratio_L2				0.005571***
				(4.912e-04)
Bank_Liquidity_L2				3.425e-07
				(7.543e-07)
Ln(total_assets)_L2				0.009923
				(0.01186)
Deposits_to_totliabilities_L2				-0.002565***
				(2.484e-04)
LNNBCRASUP	0.01240***	0.009594***	0.01384***	0.01577***
	(0.002040)	(0.002040)	(0.002042)	(0.002102)
grlin2	0.09105***	0.08911***	0.08948***	0.09204***
	(0.002600)	(0.002586)	(0.002605)	(0.002680)
grlin3	-0.08528***	-0.08277***	-0.09836***	-0.08418***
	(0.01312)	(0.01311)	(0.01313)	(0.01336)
grlin4	0.09225***	0.08580***	0.09478***	0.09076***
	(0.002443)	(0.002441)	(0.002448)	(0.002515)
grlin6	0.1900***	0.1922***	0.1903***	0.1902***
	(0.003157)	(0.003157)	(0.003157)	(0.003214)
grlin7	0.2240***	0.2051***	0.2264***	0.2308***
	(0.007789)	(0.007796)	(0.007770)	(0.007876)
Q2	0.1489***	-0.01520***	-0.04716***	-0.06154***
	(0.006188)	(0.004146)	(0.003801)	(0.007391)
Q3	-0.04548***	-0.05201***	-0.03869***	0.01852***
	(0.002022)	(0.001964)	(0.001905)	(0.004232)
Q4	0.02697***	-0.03504***	-0.02226***	-0.007287***
	(0.002202)	(0.001724)	(0.001740)	(0.002456)
Constant	0.4286***	1.5819***	-0.07164	-0.07057
	(0.06663)	(0.06244)	(0.06825)	(0.07785)
Debtor-Bank FE	Yes	Yes	Yes	Yes
Seasonal Dummies	Yes	Yes	Yes	Yes
Observations	4,455,316	4,455,316	4,455,316	4,277,174
R-squared	0.007	0.008	0.009	0.008
Number of RELA_id	457675	457,675	457,675	448,786

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 3: Baseline model, modified sample

Firms with debt in all periods, total credit

	1	2	3	4
Dependent variable: DLN_MONTO_R	Impact effect and lags	Impact efect and lags as an only dummmy (with no lag controls)	Effect during complete period of implementation	Impact effect and lags as an only dumy (with lag controls)
DBK1_I	0.03235***			
	(0.003769)			
DBK2_I	-0.07799***			
	(0.003934)			
PGN1_I	0.2617***			
	(0.01049)			
PGN2_I	-0.1502***			
	(0.003733)			
DBK1_I_L1	-0.06492***			
	(0.003608)			
DBK2_I_L1	-0.1288***			
	(0.003824)			
PGN1_I_L1	-0.07417***			
	(0.003877)			
PGN2_I_L1	-0.1197***			
	(0.002836)			
DBK1_C1		-0.006816***		-0.02297***
		(0.002224)		(0.002742)
DBK2_C1		-0.07484***		-0.07505***
		(0.002896)		(0.004542)
PGN1_C1		-0.1318***		0.1157***
		(0.003539)		(0.007620)
PGN2_C1		-0.1172***		-0.1014***
		(0.002459)		(0.003337)
DBK1_E			-0.02021***	
			(0.001973)	
DBK2_E			-0.08167***	
			(0.002059)	
PGN1_E			-0.1075***	
			(0.003272)	
PGN2_E			-0.08216***	
			(0.002304)	
Debtor-Bank FE	Yes	Yes	Yes	Yes
Seasonal Dummies	Yes	Yes	Yes	Yes
Observations	2,583,819	2,583,819	2,583,819	2,480,755
R-squared	0.008	0.008	0.008	0.009
Number of RELA_id	182,691	182,691	182,691	180,471

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Note: all models include macroeconomic, financial institutions and firm controls (not shown here, available on request)

Table 4: Credit quality model

All firms, non-performing loans only

	1	2	3	4
Dependent variable: DLN_MONTO_R	Impact effect and lags	Impact efect and lags as an only dummmy (with no lag controls)	Effect during complete period of implementation	Impact effect and lags as an only dumy (with lag controls)
DBK1_I	0.01750***			
	(0.002544)			
DBK2_I	-0.09753***			
	(0.002958)			
PGN1_I	0.009430			
	(0.008190)			
PGN2_I	-0.08729***			
	(0.002768)			
DBK1_I_L1	-0.09493***			
	(0.002554)			
DBK2_I_L1	-0.1209***			
	(0.003800)			
PGN1_I_L1	-0.02463***			
	(0.003329)			
PGN2_I_L1	-0.08024***			
	(0.002301)			
DBK1_C1		-0.04184***		-0.03855***
		(0.001504)		(0.001886)
DBK2_C1		-0.09589***		-0.02278***
		(0.002776)		(0.003731)
PGN1_C1		-0.05237***		-0.06522***
		(0.003230)		(0.005971)
PGN2_C1		-0.07126***		-0.05207***
		(0.001980)		(0.002562)
DBK1_E			-0.06028***	
			(0.001330)	
DBK2_E			-0.07473***	
			(0.001540)	
PGN1_E			-0.002192	
			(0.003151)	
PGN2_E			-0.02305***	
			(0.001922)	
Debtor-Bank FE	Yes	Yes	Yes	Yes
Seasonal Dummies	Yes	Yes	Yes	Yes
Observations	671,860	671,860	671,860	640,724
R-squared	0.029	0.028	0.029	0.029
Number of RELA_id	84.125	84,125	84,125	81,928

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Note: all models include macroeconomic, financial institutions and firm controls (not shown here, available on request)

Table 5: Credit quality model, modified sample

Firms with debt in all periods, non-performing loans only

	1	2	3	4
Dependent variable: DLN_MONTO_R	Impact effect and lags	Impact efect and lags as an only dummmy (with no lag controls)	Effect during complete period of implementation	Impact effect and lags as an only dumy (with lag controls)
DBK1_I	0.01144***			
	(0.002577)			
DBK2_I	-0.05866***			
	(0.002824)			
PGN1_I	0.008208			
	(0.007834)			
PGN2_I	-0.04621***			
	(0.002625)			
DBK1_I_L1	-0.07384***			
	(0.002629)			
DBK2_I_L1	-0.08364***			
	(0.004234)			
PGN1_I_L1	-0.04825***			
	(0.002963)			
PGN2_I_L1	-0.03697***			
	(0.002284)			
DBK1_C1		-0.03242***		-0.02894***
		(0.001587)		(0.001896)
DBK2_C1		-0.05951***		-0.01039***
		(0.002907)		(0.003658)
PGN1_C1		-0.07182***		-0.05874***
		(0.002804)		(0.005715)
PGN2_C1		-0.03162***		-0.01923***
		(0.001914)		(0.002446)
DBK1_E			-0.04126***	
			(0.001399)	
DBK2_E			-0.04378***	
			(0.001497)	
PGN1_E			-0.03707***	
			(0.002676)	
PGN2_E			-8.079e-04	
			(0.001885)	
Debtor-Bank FE	Yes	Yes	Yes	Yes
Seasonal Dummies	Yes	Yes	Yes	Yes
Observations	412.440	412.440	412.440	395.746
R-squared	0.013	0.028	0.028	0.028
Number of RELA_id	32,690	32,690	32,690	32070

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Note: all models include macroeconomic, financial institutions and firm controls (not shown here, available on request)

Table 6: Interactions

All firms, total credit

Dependent variable: DLNMONTO_R	Bank characteristics	Money market	GDP
DBK1_E	-0.09195***	-0.02696***	-0.01959***
	(0.01791)	(0.002223)	(0.002032)
DBK2_E	-0.2397***	-0.07717***	-0.07010***
	(0.01929)	(0.002368)	(0.002407)
PGN1_E	-0.2333***	0.2355***	0.2423***
	(0.01393)	(0.01862)	(0.01516)
PGN2_E	-0.3419***	-0.1345***	-0.1405***
	(0.01560)	(0.002723)	(0.002012)
DLN_GDP_R	0.2201***	0.7748***	0.8390***
	(0.02222)	(0.03330)	(0.02888)
DBADLAR_PRI	0.001843***	-6.316e-04	-6.977e-04*
	(3.411e-04)	(5.043e-04)	(3.733e-04)
D exchange rate	-0.007084**	-0.1714***	-0.1804***
	(0.003100)	(0.01019)	(0.007974)
D foreign_XR_balance	2.287e-06***	1.460e-06***	1.765e-06***
	(2.231e-07)	(3.020e-07)	(2.493e-07)
Bank _capital_ratio_L1	0.004115***	0.004549***	0.005056***
	(5.088e-04)	(3.994e-04)	(4.027e-04)
Bank_Liquidity_L1	-1.054e-04	5.615e-06***	5.726e-06***
	(6.917e-05)	(1.136e-06)	(1.120e-06)
Ln(total_assets)_L1	-0.03584***	0.03680***	0.04798***
	(0.008064)	(0.008049)	(0.008069)
Deposits_to_totliabilities_L1	6.287e-04***	0.003225***	0.003503***
	(2.087e-04)	(2.021e-04)	(2.018e-04)
LNNBCRASUP	0.01458***	0.01727***	0.01710***
	(0.002043)	(0.002101)	(0.002102)
grlin2	0.08931***	0.09125***	0.09128***
	(0.002605)	(0.002689)	(0.002690)
grlin3	-0.09094***	-0.09283***	-0.09182***
	(0.01312)	(0.01337)	(0.01337)
grlin4	0.09383***	0.09439***	0.09479***
	(0.002451)	(0.002519)	(0.002519)
grlin6	0.1901***	0.1899***	0.1899***
	(0.003158)	(0.003216)	(0.003217)
grlin7	0.2272***	0.2372***	0.2389***
	(0.007780)	(0.007864)	(0.007863)
Q2	-0.04577***	-0.1390***	-0.1657***
	(0.003823)	(0.006505)	(0.005289)
Q3	-0.03695***	0.003950*	0.01925***
	(0.001914)	(0.002326)	(0.002656)
Q4	-0.02136***	-0.01501***	-0.02624***
	(0.001747)	(0.002130)	(0.002048)
Bank capital ratio and DBK1_E	-0.001991***		
	(3.905e-04)		
Bank liquidity and DBK1_E	1.206e-04*		
	(7.037e-05)		
Ln(total_assets) and DBK1_E	-0.004715***		
	(0.001444)		
Deposits to total liabilities and DBK1_E	0.001410***		
	(1.390e-04)		

Table 6 (continued): Interactions

All firms, total credit

Bank capital ratio and DBK2_E	-0.003437***		
	(4.271e-04)		
Bank liquidity and DBK2_E	1.132e-04		
	(6.916e-05)		
Ln(total_assets) and DBK2_E	0.007843***		
	(0.001535)		
Deposits to total liabilities and DBK2_E	0.001114***		
	(1.505e-04)		
Bank capital ratio and PGN1_E	-2.201e-04		
	(3.600e-04)		
Bank liquidit and and PGN1_E	-4.845e-07		
	(9.464e-07)		
Ln(total_assets) and PGN1_E	-0.006824***		
	(0.001411)		
Deposits to total liabilities and PGN1_E	0.002029***		
	(1.010e-04)		
Bank capital ratio and PGN2_E	-0.001809***		
	(4.041e-04)		
Bank liquidit and and PGN2_E	-1.538e-06		
	(1.070e-06)		
Ln(total_assets) and PGN2_E	-0.007091***		
	(0.001509)		
Deposits to total liabilities and PGN2_E	0.003587***		
	(1.244e-04)		
BADLAR_R and DBK1_E		0.003882**	
		(0.001934)	
BADLAR_R and DBK2_E		0.001546***	
		(4.076e-04)	
BADLAR_R and PGN1_E		-0.06375***	
		(0.003355)	
BADLAR_R and PGN2_E		-3.927e-04	
		(9.594e-04)	
DLN_GDP_R and DBK1_E			-0.08137***
			(0.01561)
DLN_GDP_R and DBK2_E			-0.2336***
			(0.01849)
DLN_GDP_R and PGN1_E			5.7154***
			(0.2307)
DLN_GDP_R and PGN2_E			0.1635***
			(0.01743)
Constant	0.2090***	-0.6430***	-0.7684***
	(0.07429)	(0.07365)	(0.07389)
Debtor-Bank FE	Yes	Yes	Yes
Seasonal Dummies	Yes	Yes	Yes
Observations	4,455,316	4280904	4,280,904
R-squared	0,009	0,009	0,009
Number of RELA_id	457,675	448,941	448,941

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

5.2.2 Approximating supply-side effects' identification

One can rightly wonder to what extent the generally negative association between MPP measures and credit growth at the bank-firm level is due to demand or supply factors. This has been partially dealt with in the preceding analysis, as, following the bank-lending channel literature (Gambacorta, 2005), we controlled for cross-sectional differences between financial institutions: including interaction terms between MPP measures and banks' characteristics, we measure different responses that, say, smaller or larger banks show to policy shock. If we hypothesize that

banks differ in their ability to shield their portfolios from a policy shock (as they are more or less capitalized, liquid, dependent on deposits on their funding), we have identified a factor that determines loans' availability that is different from loan demand. Table 6 (model 1) shows that impact of MPP is negative and significant when controlling for specific bank characteristics interacted with macroprudential measures –suggesting that macroprudential policies have an effect on loan supply

We can take a step further in focusing on credit supply effects: in addition to firm-specific variables already employed (number of banks that firms work with, type of credit they take), we ran the models using firm fixed effects, thus being able to check whether macroprudential policy impact on supply is orthogonal to both observed and unobserved demand fundamentals -in other words, helping us identify supply-side effects. For ease of exposition, we show results only for the macroprudential dummy variables defined during all periods that measures were in place (table 7; results for the other definitions of MPP dummies are basically the same and available upon request).

For the whole sample of firms and taking total credit, all measures carry an estimated negative sign, and three of them -the tightening of the capital buffer, the introduction and tightening of foreign exchange limits- are significant. The size of estimated coefficients is lower than in the case of bank-firm fixed effects, which suggests that part of the estimated effect in the baseline model was associated to demand factors; one possible explanation is that, when confronted with tighter credit standards or rejection of a loan application, firms are available to switch to another bank[12] -so the estimated effect of the measure on credit is naturally lower. The tightening of the capital buffer is associated to a 4,5% average quarterly drop in credit supply; such drop is in the order of 8% and 7% in the case of the introduction and tightening of the limit to the net foreign currency position of financial institutions.

Restricting the sample to firms with bank debt in all periods (column 2 of table 7), we also find that the tightening of the capital buffer and the introduction and tightening of foreign currency limits are associated to lower credity supply growth at the bank-firm level. Estimated coefficients are lower than for the whole sample, once again suggesting a differential impact between extensive and intensive margins.

More interestingly, there appears to be a reduction of risk taking by banks as result of macroprudential policy: both the introduction and the tightening of capital buffers show higher estimated coefficients when we look at credit growth of non performing loans (column 3 of table 7) than in the complete sample. Credit supply to ex post riskier firms is reduced by 5 to 6% on average quarterly during the implementation period of the capital buffer; we find no discernible impact in this case for the currency-based measures. In other words, this suggests that capital-based measures operate more strongly to restrict credit supply of (ex post) riskier loans -in keeping with their macroprudential nature.

There are comparable supply-side results when we analyze non-performing credit growth of firms with debt in all periods: the capital buffer shows once again higher estimated coefficients (both when introduced and tightened) than in the case of total credit growth (column 4 of table 7). As stated, we have no measures of ex-ante risk, and non-performing loan growth only reveals realized risk, which may not necessarily be the best metric of risk taking.

We also run the models including both fixed effects by firms and interaction terms, for the whole sample (table 8, column 1). Results confirm what was previously discussed in this section: all measures reveal estimated negative signs, and three of them -the tightening of the capital

[12] This is indeed reinforced by the robustly positive estimated coefficient of the variable that counts the number of financial institutions that each debtor works with.

buffer, the introduction and tightening of foreign exchange limits- are significant.

For the most complete set of both observable and unobservable firm and bank variables, we include firm and financial institutions' fixed effects, together with the controls we have already employed (columns 2-4 of table 8). All four coefficients are negative and significant, when residuals are clustered by firms or by bank-firm relationships (when residuals are clustered by banks, only DBK1 is not statistically significant).

Finally, we run the models with bank and firm fixed effects, including only firms that deal with more than one bank. In a firm fixed effect specification, this is a standard way of identifying supply-side effects (Khwaja and Mian, 2008); in our case, it means diminishing sample size by almost half, and in doing so, changing what we can infer from the credit market in general. We are left with the firms that have, by definition, higher access to financial services, of which we can hypothesize are the biggest ones, with more permanent relations with banks, among other traits. This means improving supply-side identification at the cost of changing the sample in a way that is not necessarily exogenous to the effect we are trying to estimate. Nonetheless, the negative and significant coefficients remain for the tightening of the capital buffer, and the introduction and tightening of the limit on foreign currency positions (table 9, columns 1-3). When we include bank-firm relationship fixed effects (as in our baseline specification) in the model run for the subsample of firms that operate with multiple banks, all measures have negative and significant coefficients (table 9).

In general, then, our model suggests that MPP has a negative impact on credit supply at the bank-firm level, as shown by estimating the model with both observable and unobservable firm variables, as well as observable and unobservable bank variables (by themselves and interacted with monetary policy variables). In addition, capital buffers can be thought of as inducing lower ex post risk, as non-performing credit growth is lower when buffers are introduced and tightened.

Table 7 Firm fixed effects models

All firms, total credit

	1	2	3	4
Dependent variable: DLN_MONTO_R	**All firms, total credit**	**Firms with debt in all periods**	**All firms, non performing loans**	**Firms with debt in all periods, non performing loans**
DBK1_E	-0.00179898	0.01354551	-0.04562753***	-0.02447553***
	(0.01490994)	(0.01424719)	(0.00886882)	(0.00666619)
DBK2_E	-0.04544122***	-0.01779650*	-0.06088592***	-0.02673330***
	(0.01000026)	(0.00993405)	(0.01478986)	(0.00796386)
PGN1_E	-0.08205733***	-0.06374605***	0.00704014	-0.02737406
	(0.01208944)	(0.00877999)	(0.07798240)	(0.02230219)
PGN2_E	-0.07128664***	-0.03787655***	-0.02214340	-0.00146812
	(0.01316092)	(0.01191769)	(0.01587844)	(0.01185803)
Firm FE	Yes	Yes	Yes	Yes
Seasonal Dummies	Yes	Yes	Yes	Yes
Observations	4,455,316	2,583,819	671,860	412,440
R-squared	0.07368183	0.02764907	0.33878288	0.19484249
Number of RELA_id	457,675	182,691	84,125	32,690

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 8 Firm and bank fixed effects models

All firms, total credit

	1	2	3	4
Dependent variable: DLN_MONTO_R	All firms, total credit, interaction terms of bank variables with MPP measures	All firms, total credit, firm and banks fixed effecs		
DBK1_E	0.02283556	-0.00791132	-0.00791132***	-0.00791132***
	(0.13024987)	(0.01164269)	(0.00173716)	(0.00170819)
DBK2_E	-0.05202983	-0.05227089***	-0.05227089***	-0.05227089***
	(0.11958460)	(0.01017270)	(0.00180620)	(0.00176159)
PGN1_E	-0.07547362***	-0.08861532***	-0.08861532***	-0.08861532***
	(0.02173124)	(0.01156264)	(0.00281758)	(0.00279359)
PGN2_E	-0.09293621***	-0.07335649***	-0.07335649***	-0.07335649***
	(0.02455369)	(0.01388471)	(0.00197516)	(0.00194696)
Firm FE	Yes	Yes	Yes	Yes
Bank FE	No	Yes	Yes	Yes
Residual clustering	Bank	Bank	Firm	Bank-firm
Seasonal Dummies	Yes	Yes	Yes	Yes
Observations	4,455,316	4,429,039	4,429,039	4,429,039
R-squared	0.07393491	0.06395840	0.06395840	0.06395840
Number of RELA_id	457,675			

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 9 Firm and bank fixed effects models

Firms with multiple banks, total credit

	1	2	3	4	5	6
Dependent variable: DLN_MONTO_R	Firms with multiple banks, firm fixed effects			Firms with multiple banks, bank-firm fixed effects		
DBK1_E	0.02093375	0.02093375***	0.02093375***	-0.01954934*	-0.01954934***	-0.01954934***
	(0.01511340)	(0.00234420)	(0.00223754)	(0.01025809)	(0.00250363)	(0.00236362)
DBK2_E	-0.03122131***	-0.03122131***	-0.03122131***	-0.11038112***	-0.11038112***	-0.11038112***
	(0.01167496)	(0.00224971)	(0.00209845)	(0.01162077)	(0.00270170)	(0.00252789)
PGN1_E	-0.08921052***	-0.08921052***	-0.08921052***	-0.14544909***	-0.14544909***	-0.14544909***
	(0.01091394)	(0.00380373)	(0.00365384)	(0.01081037)	(0.00380198)	(0.00360910)
PGN2_E	-0.06413966***	-0.06413966***	-0.06413966***	-0.12878014***	-0.12878014***	-0.12878014***
	(0.01422088)	(0.00267020)	(0.00255663)	(0.01571548)	(0.00276625)	(0.00260373)
Debtor FE	Yes	Yes	Yes	No	No	No
Bank-firm FE	No	No	No	Yes	Yes	Yes
Residual clustering	Bank	Firm	Bank-firm	Bank	Firm	Bank-firm
Seasonal Dummies	Yes	Yes	Yes	Yes	Yes	Yes
Observations	2,544,711	2,544,711	2,544,711	2,559,679	2,559,679	2,559,679
R-squared	0.04958852	0.04958852	0.04958852	0.00994477	0.00994477	0.00994477
Number of RELA_id				292,524	292,524	292,524

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

5.2.3 Difference-in-difference estimation

The baseline model, acceptable as a first approximation to the question, faces nonetheless certain limitations. Regarding the identification strategy it can be argued that the baseline model implies that in the absence of the regulatory changes analyzed, credit growth at the firm-bank level would have been the same as in periods when policies were not in place. This is not necessarily an inadequate null hypothesis when dealing with macroprudential measures -their ultimate scope should be systemic, so if they have no impact this could in principle show across all financial institutions. Still, as the granularity of our database gives us the opportunity, we employ an alternative strategy, so that we can assess credit growth before and after the introduction of MP measures, and considering financial institutions affected and not affected by them -ie using control group to provide a counterfactual. We therefore propose the following difference-in-difference model:

$$\begin{aligned} \Delta Log\_credit_{ij}(impact\_period) &= \beta_0 + \beta_1 MPP\_tool_b + \beta_2 FI\_controls_j + \\ &\quad \beta_3 firm\_controls_i + \varepsilon_{ji} \end{aligned}$$

where we measure the change in real credit granted by bank i to firm j in the six months before and after MPP was implemented, and regress it against a variable that is defined as follows: it takes the value zero for banks that were not affected by macroprudential policy; and positive values for banks affected, measured by it impact in terms of their assets. Thus, we have defined a control group (banks not affected by MPP during the whole sampling period) against whose performance we measure that of banks that were affected by MPP (to the extent that they were)[13]. We use basically the same control variables as in the baseline model, for financial institutions and firms -macroeconomic controls are by definition done without in this setting, as they are subsumed in the constant term. All controls are included both for the six months before and after the measure was taken. We add the ratio of non performing loans , measured in two ways: by individual firm (i.e. delinquency measured at the firm, not the bank, level) and by financial institution. The inclusion of these controls was revealed relevant by results of the baseline model.

Results show that both the introduction of the countercyclical buffer and the reintroduction of the limit on the foreign currency position have significant and negative impacts on credit growth; the tightening of the countercyclical buffer, however, is positively and significantly associated to credit at the bank-firm level (tables 10, 11 and 12); we did not run the model for the tightening of the foreign currency limit as our sample covers only a quarter after its implementation. Estimated coefficients' size is not directly indicative of the quantitative impact, as the variable of interest is the change in total assets associated to policy; considering that the average impact on assets (for banks estimated to be impacted) was 0,036 in the case of DBK1, there is an average decrease in credit of 3,4%, a magnitude comparable to that found in baseline model estimations. A similar exercise yields a 4,8% impact of PGN1 on credit growth. Thus, the difference-in-difference also shows, for the introduction of the capital buffer and the limit on foreign currency holdings, both economic and statistical significance, and an impact in the same direction of that found in the baseline model.

The previous results remain in terms of signifcance when residuals are clustered by firms; when they are clustered by financial institutions, the limit on banks' net foreign currency position

[13] The variable is defined as the estimated impact of the regulation in terms of each financial institutions' assets, based on an internal assessment of BCRA staff.

carries a negative and significant effect on credit growth, while the negative coefficient on the introduction of the capital buffer and the positive coefficient on its tightening become not signicant.

Table 10: Diff-in-diff model: DBK1

Total credit, all firms

Dependent variable:	DLNMONTO_R_SPOS_SPRE_DBK1
DBK1_DIFACTNET	-0.94081100***
	(0.22132392)
KRAT_SPRE_DBK1	0.01861808***
	(0.00357240)
LIQUI_SPRE_DBK1	0.00182349***
	(0.00028266)
LNTOTASSET_R_SPRE_DBK1	0.48121519***
	(0.05938150)
DEPTOLIA_SPRE_DBK1	-0.00788514***
	(0.00154143)
grlin1_SPRE_DBK1	-0.39546045***
	(0.01308899)
grlin2_SPRE_DBK1	-1.44140044***
	(0.02060945)
grlin3_SPRE_DBK1	0.31999977***
	(0.03988166)
grlin4_SPRE_DBK1	-0.78302240***
	(0.01631163)
grlin6_SPRE_DBK1	-1.08319113***
	(0.02021146)
o.grlin7_SPRE_DBK1	-
LNNBCRASUP_SPRE_DBK1	-1.53526357***
	(0.00996843)
KRAT_SPOS_DBK1	-0.01159118***
	(0.00424735)
LIQUI_SPOS_DBK1	-0.00321468***
	(0.00043298)
LNTOTASSET_R_SPOS_DBK1	-0.43192908***
	(0.06032874)
DEPTOLIA_SPOS_DBK1	0.00777584***
	(0.00166808)
grlin1_SPOS_DBK1	0.57239268***
	(0.01348850)
grlin2_SPOS_DBK1	1.02701498***
	(0.02058375)
grlin3_SPOS_DBK1	-0.56501292***
	(0.07545833)
grlin4_SPOS_DBK1	0.61647047***
	(0.01615076)
grlin6_SPOS_DBK1	1.04302032***
	(0.01899907)
o.grlin7_SPOS_DBK1	-
LNNBCRASUP_SPOS_DBK1	1.42676217***
	(0.00981260)
NPLF_SPRE_DBK1	0.02074532
	(0.03049365)
NPLR_SPRE_DBK1	-0.61180714***
	(0.03672107)
NPLF_SPOS_DBK1	0.00488587
	(0.02954456)
NPLR_SPOS_DBK1	0.35328711***
	(0.03393197)
Constant	-0.25603872***
	(0.05281618)
Observations	175,166
R-squared	0.20384764

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 11: Diff-in-diff model: DBK2

Total credit, all firms

Dependent variable:	DLNMONTO_R_SPOS_SPRE_DBK2
DBK2_DIFACTNET	1.28648655***
	(0.24937334)
KRAT_SPRE_DBK2	-0.00284088
	(0.00395226)
LIQUI_SPRE_DBK2	0.00012114
	(0.00013200)
LNTOTASSET_R_SPRE_DBK2	1.27464362***
	(0.08582160)
DEPTOLIA_SPRE_DBK2	0.01173692***
	(0.00189631)
grlin1_SPRE_DBK2	-0.40967683***
	(0.01098296)
grlin2_SPRE_DBK2	-1.03671404***
	(0.02087910)
grlin3_SPRE_DBK2	-0.73891833***
	(0.15770775)
grlin4_SPRE_DBK2	-0.38960147***
	(0.01377802)
grlin6_SPRE_DBK2	-0.84843555***
	(0.01739832)
o.grlin7_SPRE_DBK2	-
LNNBCRASUP_SPRE_DBK2	-1.48870322***
	(0.00882225)
KRAT_SPOS_DBK2	0.01293389***
	(0.00405216)
LIQUI_SPOS_DBK2	-0.00003475
	(0.00002195)
LNTOTASSET_R_SPOS_DBK2	-1.21016096***
	(0.08555407)
DEPTOLIA_SPOS_DBK2	-0.01344363***
	(0.00187231)
grlin1_SPOS_DBK2	0.51442720***
	(0.01121982)
grlin2_SPOS_DBK2	0.97851588***
	(0.02084712)
grlin3_SPOS_DBK2	0.73518571***
	(0.12747899)
grlin4_SPOS_DBK2	0.46882683***
	(0.01360687)
grlin6_SPOS_DBK2	0.79688658***
	(0.01762802)
o.grlin7_SPOS_DBK2	-
LNNBCRASUP_SPOS_DBK2	1.45654991***
	(0.00895488)
NPLF_SPRE_DBK2	0.08178920***
	(0.02603660)
NPLR_SPRE_DBK2	-0.47912029***
	(0.03135830)
NPLF_SPOS_DBK2	0.00005726
	(0.02536353)
NPLR_SPOS_DBK2	0.54459454***
	(0.02815332)
Constant	-0.79491411***
	(0.04299044)
Observations	203,704
R-squared	0.17656033

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 12: Diff-in-diff model: PGN1

Total credit, all firms

Dependent variable:	DLNMONTO_R_SPOS_SPRE_PGN1
PGN1_DIFACTNET	-0.76439366***
	(0.07979851)
KRAT_SPRE_PGN1	0.00521491
	(0.00379828)
LIQUI_SPRE_PGN1	-0.00008546**
	(0.00003897)
LNTOTASSET_R_SPRE_PGN1	-0.28616889***
	(0.06430792)
DEPTOLIA_SPRE_PGN1	0.01670472***
	(0.00156641)
grlin1_SPRE_PGN1	-0.30188592***
	(0.00853584)
grlin2_SPRE_PGN1	-0.98777688***
	(0.01536021)
grlin3_SPRE_PGN1	-0.54837107***
	(0.09423030)
grlin4_SPRE_PGN1	-0.31655881***
	(0.01117806)
grlin6_SPRE_PGN1	-0.57801614***
	(0.01476203)
grlin7_SPRE_PGN1	-0.67616993***
	(0.03879155)
LNNBCRASUP_SPRE_PGN1	-1.51324766***
	(0.00750302)
KRAT_SPOS_PGN1	-0.00439135
	(0.00374120)
LIQUI_SPOS_PGN1	0.00005457**
	(0.00002378)
LNTOTASSET_R_SPOS_PGN1	0.29639502***
	(0.06469686)
DEPTOLIA_SPOS_PGN1	-0.01551830***
	(0.00156177)
grlin1_SPOS_PGN1	0.42478666***
	(0.00871498)
grlin2_SPOS_PGN1	0.89668919***
	(0.01535449)
grlin3_SPOS_PGN1	0.42722370***
	(0.08788470)
grlin4_SPOS_PGN1	0.40753527***
	(0.01122297)
grlin6_SPOS_PGN1	0.49736877***
	(0.01507395)
grlin7_SPOS_PGN1	0.85891453***
	(0.04049440)
LNNBCRASUP_SPOS_PGN1	1.49259761***
	(0.00761111)
NPLF_SPRE_PGN1	0.03341520
	(0.02220956)
NPLR_SPRE_PGN1	-0.33107997***
	(0.02683430)
NPLF_SPOS_PGN1	-0.02722661
	(0.02168551)
NPLR_SPOS_PGN1	0.53052676***
	(0.02400547)
Constant	-0.54447705***
	(0.03175478)
Observations	217,492
R-squared	0.21552404

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

6 Concluding remarks

Using credit registry data from the Central Bank of Argentina's *Central de Deudores*, we assess the impact on individual firms' credit growth of two types of macroprudential policies: a capital buffer based on limits to profit distribution, and a limit to the global foreign currency position of financial institutions. Assessing both capital-based and currency-based measures is a salient contribution of this paper: the latter kind of policies are of widespread use in emerging markets, but microeconometric evaluations have thus far focused on the former. We use quarterly data from 2009 to 2014, and estimate both fixed effects and difference-in-difference models. We examine the introduction and tightening of each measure; and include macroeconomic, financial institutions and firms' control variables. We propose different specifications, to capture for each measure its impact: initially and after one quarter, on average over two quarters and during the whole period it was in place. As all four instances of the measures' implementation were directly unrelated to credit growth, the exercise can be taken as quasi natural experiment to gauge the influence of macroprudential policy on what is conventionally considered its intermediate aim -curbing credit expansion.

Our main results for the fixed effects model show that:

- all measures have a significant effect on credit growth at the firm-bank level;
- there are differences between the initial impact and effects over time;
- the capital buffer is associated to lower credit growth, both when introduced and when tightened;
- limits on global foreign currency position are generally linked to lower credit growth when introduced and tightened;
- Currency-based measures appear to have a quantitatively more significant effect than capital-based ones
- macroprudential measures operate both on the extensive and the intensive margins: when the sample is adjusted to consider only firms that were always present in the credit market, all measures tend to reduce credit growth, and there is preliminary evidence to suggest that measures operate more through the granting of credit to fewer companies than to less credit to the same firms;
- macroprudential policies also have an effect on credit quality: growth of non-performing loans is reduced after the implementation of such measures; in particular, the capital buffer reduces NPL expansion more than total credit.
- interactions between macroprudential measures, macroeconomic conditions and financial institutions variables matter: in general, banks with higher capital and more assets evidence a higher impact of the introduction of the capital buffer, while this measure also acts more acutely during econonomic activity expansions..
- Results are robust to alternative clustering of residuals (firm, bank and firm-bank relationships).
- We run alternative specifications in order to approximate supply-side effects, including: interaction of bank variables with monetary policy variables, to identify the "bank lending

channel" (Gambacorta, 2005); firm fixed effects, for the whole sample and changing the sample to firms that operate with multiple banks (Kwaja and Mian, 2008); firm and bank fixed effects. Thus, we include observable and unobservable firm and bank variables, and find that coefficients on the MPP measures we study are negative and significant on what can be considered as a reasonable approximation to credit supply.

In turn, we employ difference-in-difference models with a six-month window before and after each macroprudential measure was taken, with bank and firm control variables in both periods. These yield a negative impact on credit growth at the firm-bank level for the introduction of the capital buffer and the limit on the foreign currency position; but the opposite effect for the tightening of the capital buffer. These results hold when residuals are unclustered and clustered by firms. When residuals are clustered by banks, only the coefficient on the currency-based measure remains negative and significant. In this sense, the estimated negative impact of the introduction of limits on banks' net foreign currency position appears to be more robust across specifications. This indeed highlights the relevance that currency-based macroprudential measures have in emerging market economies, in contrast with capital and lending related policies, more widespread across jurisdictions and part of the by now conventional macroprudential "toolkit."

We take our results as a first approximation toward a comprehensive assessment of macroprudential measures' impact. Ultimately, this type of policies should be aimed at increasing financial system's resilience against shocks, and also limiting negative spillovers from the system to the economy at large; this requires an evaluation on several fronts, and looking at credit growth is only one of them, which may be relevant insofar as credit booms typically precede crisis. But in economies financially underdeveloped, there may be a tradeoff between the financial development objective and macroprudential measures. Therefore, we leave for future work the incorporation of financial institutions and firms' risk measures; and to complete the evaluation of these measures along downsings of the business and financial cycles. The results presented here suggest that a granular level, macroprudential measures actually operate in the conventionally expected direction of taming credit booms, but more work is required to fully understand their effects.

References

[1] Aguirre, H., and E. Blanco (2015): "Credit and Macroprudential Policy in an Emerging Economy: a Structural Model Assessment," BIS Working Paper no. 504, July.

[2] Akinci, O. and Olmstead-Rumsey,J. (2015): "How effective are macroprudential policies: An empirical investigation". International Finance Discussions Papers 1136.

[3] Banco Central de la República Argentina (2012): *Boletín de Estabilidad Financiera, primer semestre*.

[4] ———————————- (2014a): *Marco normativo. Diciembre de 2014*, December.

[5] ———————————- (2014b): *Boletín de Estabilidad Financiera, segundo semestre*.

[6] Bolton, P., X. Freixas, L. Gambacorta and P. E. Mistrulli (2016): "Relationship and Transaction Lending in a Crisis," *Review of Financial Studie*s, vol. 29(10).

[7] Borio,C. and Zhu, H. (2008): "Capital regulation, risk-taking and monetary policy: a missing link in the transmission channel". BIS Working Paper n° 268

[8] Bruno, S., Shim, I. and Shin,H.S. (2014). "Comparative assessment of macroprudential policies" BIS.

[9] Cerutti,E., Claessens,S. and Laeven,L. (2015). "The use and effectiveness of macroprudential policies: New evidence". IMF Working Paper 15/61.

[10] Claessens,S., Ghosh,S.R. and Mihet,R.(2013). "Macro-Prudential policies to mitigate financial system vulnerabilities". IMF Working Paper 14/155.

[11] Dassatti Camors, C. and Peydró,J.L. (2014). "Macroprudential and monetary policy: Loan-level evidence from reserve requirements,". mimeo.

[12] Gambacorta, L. (2005): "Inside the bank lending channel," *European Economic Review*, Elsevier, vol. 49(7),

[13] Gambacorta and Murcia Pabón (2017): "The impact of macroprudential policies and their interaction with monetary policy: an empirical analysis using credit registry data," BIS Working Paper No. 636, May.

[14] González Padilla, G., L. Orué and G. Repetto (2006): "Argentina 1999-2005: Analizando el mercado de crédito bancario para empresas durante cambios de regímenes económicos". Documento de Trabajo 2006|9, BCRA, enero.

[15] IMF (2012):"The Interaction of Monetary and Macroprudential Policies." IMF Board Paper and Background Paper, January,Washington: International Monetary Fund.

[16] Jiménez, G., Ongena, S., Peydró,J.L. and Saurina, J. (2014): "Hazardous times for monetary policy: What do twenty-three millions bank loans say about the effect of monetary policy on credit risk-taking?." *Econometrica*, vol. 82(2), pages 463-505, 03.

[17] Jiménez, G. Ongena, S., Peydro, J.L. & Saurina, J.(2016). "Macroprudential Policy, Countercyclical Bank Capital Buffers and Credit Supply : Evidence from the Spanish Dynamic Provisioning Experiments," *Journal of Political Economy*, forthcoming.

[18] Khwaja, A. I., and A. Mian (2008): "Tracing the Impact of Bank Liquidity Shocks: Evidence from an Emerging Market," *American Economic Review*, 98(4).

[19] Kuttner,K.N. and Shim,I (2013). "Can non- interest rate policies stabilize housing markets? Evidence from a panel of 57 economies". NBER Working Papers 19723.

[20] Lim,C.H., Costa, A., Columbia,F., Kongsamut,P., Otani, A, Saiyid, M, Wezel,T, Wu,X, (2011) "Macroprudential policy: What instruments and how to use them? Lessons from country experiences" IMF Working Paper 11/238.

[21] López, M., Tenjo, F. and Zárate, H. (2014): "Credit cycles, credit risk and countercyclical loan provisions," *Ensayos sobre Política Económica* 32(74), 9 17.

[22] Martins, B. and Schechtman, R. (2013): "Loan pricing following a macro prudential within-sector capital measure", Working Papers Series 323, Central Bank of Brazil, Research Department.

[23] Mendoza, E. and M. Terrones (2012): "An anatomy of credit booms and their demise". Working Paper n° 18739, NBER.

[24] Tobal, M. (2014):"Prudential Regulation, Currency Mismatches, and Exchange Rate Regimes in Latin America and the Caribbean,"Research Papers n° 17, CEMLA.

[25] Tovar, C., M. Garcia-Escribano, and M. V. Martin (2012): "Credit Growth and the Effectiveness of Reserve Requirements and Other Macroprudential Instruments in Latin America," IMF Working Paper 12/142, June.

Annex. Description of variables and data sources

Table A.1

Variable	Description	Source
DLN_MONTO_R	Change of log of real debt held by company "i" granted by FI "j" in each quarter (average of monthly data), deflated by GDP implicit price index	Central de Deudores (CD), BCRA; INDEC (deflator)
DLN_GDP	Change of the log of GDP, quarter-over-quarter (q-o-q), not seasonally adjusted. Base year 2004, as published in 2016.	INDEC
$DBADLAR\_pri$	Change of Buenos Aires Deposits of Large Amount Rate (BADLAR), private sector, in Argentine pesos (q-o-q)	BCRA
$\Delta exchange\_rate$	Change of nominal exchange rate AR$/USD, official rate Number of FI that serve firms in the quarter (q-o-q)	BCRA
$\Delta forex\_market\_balance$	Change of total operations of the financial system (including the Central Bank) with the non-financial private and public sectors, and the rest of the world, in USD million (q-o-q)	BCRA
$Bank\_capital\_ratio$	Total equity to total assets ratio (quaterly average of monthly data)	Financial institutions balance sheets, BCRA
$Bank\_liquidity$	Ratio of: compulsory BCRA liquidity regulation item, plus holdings of BCRA bills and notes linked to repos, plus "Otras disponibilidades"; to total deposits (quarterly average of monthly data)	Financial institutions balance sheets, BCRA
$Ln(total\_assets)$	Log of total assets, net of double accounting associated to repo and forward operations (quarterly average of monthly data)	Financial institutions balance sheets, BCRA
$Deposits\_to\_total\_liabilities$	Total deposits to total liabilities ratio (quaterly average of monthly data)	Financial institutions balance sheets, BCRA
$ln\_NBCRASUP$	Number of FI that serve firm i in each quarter (quarterly average of monthly data)	CD, BCRA
$grlin2$	dummy variable for collateralized financing line (in all grlin cases, note that the omitted dummy is overdrafts and promisory notes financing lines)	CD, BCRA
$grlin3$	dummy variable for personal financing line	CD, BCRA
$grlin4$	dummy variable for credit card financing line	CD, BCRA
$grlin6$	dummy variable for other financing lines	CD, BCRA
$grlin7$	dummy variable for export financing line	CD, BCRA

Annex 2. Alternative clustering of residuals, baseline model

Total credit, all firms

	1	2	3	4
Dependent variable: DLNMONTO_R	No clustering	Banks	Firms	Bank-firm relationships
DBK1_E	-0.03407655***	-0.03407655***	-0.03407655***	-0.03407655***
	(0.00168966)	(0.01031341)	(0.00176277)	(0.00170262)
DBK2_E	-0.10857421***	-0.10857421***	-0.10857421***	-0.10857421***
	(0.00179815)	(0.01149459)	(0.00188378)	(0.00181068)
PGN1_E	-0.12958456***	-0.12958456***	-0.12958456***	-0.12958456***
	(0.00290389)	(0.01370639)	(0.00281889)	(0.00273597)
PGN2_E	-0.12437664***	-0.12437664***	-0.12437664***	-0.12437664***
	(0.00204193)	(0.01409986)	(0.00201039)	(0.00193606)
DLNGDP_R	0.21165664***	0.21165664	0.21165664***	0.21165664***
	(0.02089628)	(0.16712908)	(0.02255437)	(0.02212864)
DBADLAR_PRI	0.00174646***	0.00174646	0.00174646***	0.00174646***
	(0.00033705)	(0.00286463)	(0.00034681)	(0.00033992)
Δ exchange rate	-0.00376229	-0.00376229	-0.00376229	-0.00376229
	(0.00321230)	(0.01841141)	(0.00315250)	(0.00307349)
Δ foreign_XR_balance	0.00000247***	0.00000247**	0.00000247***	0.00000247***
	(0.00000022)	(0.00000105)	(0.00000023)	(0.00000022)
KRAT_L1	0.00326831***	0.00326831	0.00326831***	0.00326831***
	(0.00039018)	(0.00224747)	(0.00038224)	(0.00038148)
LIQUI_L1	0.00000447***	0.00000447	0.00000447***	0.00000447***
	(0.00000172)	(0.00000404)	(0.00000110)	(0.00000110)
LNTOTASSET_R_L1	-0.01264928*	-0.01264928	-0.01264928*	-0.01264928*
	(0.00759234)	(0.05575832)	(0.00747825)	(0.00752004)
DEPTOLIA_L1	0.00162675***	0.00162675	0.00162675***	0.00162675***
	(0.00018963)	(0.00139593)	(0.00018840)	(0.00018781)
LNNBCRASUP	0.01384023***	0.01384023**	0.01384023***	0.01384023***
	(0.00189272)	(0.00626399)	(0.00212275)	(0.00204152)
grlin2	0.08948264***	0.08948264***	0.08948264***	0.08948264***
	(0.00244408)	(0.02164533)	(0.00264663)	(0.00260520)
grlin3	-0.09836333***	-0.09836333**	-0.09836333***	-0.09836333***
	(0.01285398)	(0.03783823)	(0.01312901)	(0.01313200)
grlin4	0.09477554***	0.09477554***	0.09477554***	0.09477554***
	(0.00214147)	(0.02336475)	(0.00247263)	(0.00244771)
grlin6	0.19028562***	0.19028562***	0.19028562***	0.19028562***
	(0.00273941)	(0.02296271)	(0.00351084)	(0.00315737)
grlin7	0.22636564***	0.22636564***	0.22636564***	0.22636564***
	(0.00915153)	(0.02079593)	(0.00882621)	(0.00777028)
Q2	-0.04716464***	-0.04716464*	-0.04716464***	-0.04716464***
	(0.00358422)	(0.02598628)	(0.00388707)	(0.00380053)
Q3	-0.03868655***	-0.03868655***	-0.03868655***	-0.03868655***
	(0.00177531)	(0.01346262)	(0.00199751)	(0.00190546)
Q4	-0.02226024***	-0.02226024**	-0.02226024***	-0.02226024***
	(0.00170110)	(0.01098078)	(0.00179908)	(0.00174046)
Constant	-0.07163587	-0.07163587	-0.07163587	-0.07163587
	(0.06838691)	(0.50846430)	(0.06798677)	(0.06824554)
Debtor-Bank FE	Yes	Yes	Yes	Yes
Seasonal Dummies	Yes	Yes	Yes	Yes
Observations	4,455,316	4,455,316	4,455,316	4,455,316
Number of RELA_id	457,675	457,675	457,675	457,675
R-squared	0.00851507	0.00851507	0.00851507	0.00851507

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1