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The impact of macroprudential policies and their interaction with monetary policy: An empirical analysis using credit registry data

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Main characteristics of the study

- Most of the studies use aggregate data or bank-level data. A very limited use has been done of credit registry data (exceptions Jimenez et al, 2012; Dassatti and Peydro, 2014)
- Joint project under the auspices of the Consultative Council for the Americas (CCA):
  - Credit register data for five countries Latin America countries: AR, BR, CO, MX, PE (good laboratory)
  - Not possible to pool the data (data highly confidential)
  - Research protocol (same modelling strategy and similar data definition)
  - Focus on domestic credit. Project wants to complement the analysis of the IBRN (cross-border spillover of macroprudential tools)
  - Meta analysis (different macroprudential tools)

Macroprudential policies analysed: Sum up

Type of instrument	Measures	Tightening episodes	Loosening episodes
	(1)	(2)	(3)
a. Enhancing Resilience			
Capital requirement/Risk weights (RW)	0	0	0
Provisioning requirement (Prov)	5	5	0
Limits on dividend distribution	2	2	0
Liquidity ratios	0	0	0
b. Dampening the cycle			
Changes in reserve requirement (RR)	3	3	3
Changes in limits on net open position (NOP)	1	1	0
Changes in LTV, DTI limits	0	0	0
Limits on credit growth or lending to specific sectors	0	0	0
Requirement on external borrowing operations	2	1	1
c. Dispelling the gestation of cycle			
Levy/tax on specific assets/liabilities	0	0	0
Introduction of limits on Net open position (NOP)	1	1	0
Official warnings on specific vulnerabilities	0	0	0
Adjustments to lending standards	0	0	0
Total	***14***	***13***	***4***

Note: The distinction is based on Claessens et al (2013)

Macroprudential policies analysed: Argentina (1)

Instrument	Description	Policy objective (Claessens et al, 2013)
1. Capital buffer and profit distribution	In order to increase the level of capital of banks, the authorities established that any financial institution could redistribute profits through dividends as long as its regulatory capital after dividends are paid is at least x% above the regulatory minimum capital requirement. This measure was introduced in 2010, with 30% threshold of regulatory capital requirement over which profits may be distributed; it was further increased to 75% in 2012.	Enhancing resilience (introduction) and dampening the cycle (tightening)
2. Foreign currency net global position	This rule was established as a mechanism to limit currency mismatches of banking institutions. It was defined as the difference of assets and liabilities denominated in foreign currency. The limit was introduced in 2014, with a 30% threshold of regulatory capital and then lowered (tightened) to 20% in September that year.	Dispelling the gestation of cycle (introduction) Dampening the cycle (tightening)

Macroprudential policies analysed: Brazil (2)

Instrument	Description	Policy objective (Claessens et al, 2013)
3.Reserve requirements	Brazil has been active in the use of reserve requirement as a tool of dampen credit cycles. The episodes we analyse are the following: (i) the release of reserves in 2008-2009 in response to the liquidity squeeze following the global financial crisis; (ii) the reversal of the policies in 2010-2011 in the context of high capital inflows and associated credit growth; and (iii) the renewal of stimulus during 2012-2014 in response to perceived weakness of economic activity and credit growth.	Dampening the cycle

Macroprudential policies analysed: Colombia (3)

Instrument	Description	Policy objective (Claessens et al, 2013)
4.Dynamic Provisioning regime	New provisioning regime with countercyclical considerations for commercial loans (July 2007).	Enhancing resilience
5.Deposit requirement on external loans	The Central Bank adopted a requirement on short term external loans of 40% with a holding period of six months. This measure had the purpose of containing a potential substitution from local to external borrowing.	Dampening the cycle
6.Marginal reserve requirement on banking deposits	In response to an episode of excessive credit growth, in May 2007 the Central Bank established a marginal reserve requirement of 27% on current accounts, 12.5% for saving accounts and 5% for term deposits with a maturity lower than 18 months. The requirement was lately unified for the first two types of deposits at 27%.	Dampening the cycle

Macroprudential policies analysed: Mexico (4)

Instrument	Description	Policy objective (Claessens et al, 2013)
7. Changes in provisioning	From a backward-looking scheme of provisions, the authorities introduced a new provisioning methodology designed to increase the accuracy of provisions including expected losses considerations. It was introduced in 2009, 2011 and 2014 for different kinds of loan.	Enhancing resilience

Macroprudential policies analysed: Peru (5)

Instrument	Description	Policy objective (Claessens et al, 2013)
8.Dynamic Provisioning	To reduce the procyclical behaviour of credit, this scheme was introduced in 2008. The definition of accumulation and de-accumulation of provisions is defined based on the dynamics of aggregate economy (GDP growth).	Enhancing resilience

Main Questions

1. Are macroprudential tools effective on lending (controlling for bank-specific characteristics)?
2. Are macroprudential policies substitute or complements to monetary policy?
3. Are macroprudential policies counter-cyclical?
4. Are macroprudential policies effective to limit bank risk?

Literature review (1)

- DTI ratios and, probably to a lesser extent, LTV ratios are relatively more effective than capital req as tools for containing asset growth
  Claessens et al (2013); Kuttner and Shim (2012)
- MPP tightening is associated with lower bank credit growth and house price inflation
  Bruno, Shim and Shin (2016), Cerutti, et al. (2015); Akinci and Olmstead-Rumsey (2015), Lim et al (2011), Arregui et al (2012)
- Lower effects in financially more developed and open economies
  Cerutti, et al. (2015)
- Evidence of leakages to the shadow banking sector and cross-border
  Cizel et al (2016), Reinhart and Sowerbutts (2015), Buch and Goldberg (2016), Aiyar et al (2014)
- Introduction of CCB had little impact on credit extension although it had some effect on mortgage pricing
  Basten and Koch (2015); Gambacorta and Drehmann (2012)

Literature review (2)

- Reserve requirements can affect broader credit conditions and played a complementary role to monetary policy
  Tovar et al (2012); Lim et al (2011)
- Risk taking channel of monetary policy: Monetary policy conditions may affect financial stability
  Borio and Zhu (2012), Adrian and Shin (2014), Altunbas et al (2014); Jimenez et al (2012)
- *Complements or substitutes?* DSGE and empirical findings support that MPP and MP are more complements than substitutes but it depends on the type of shock
  Agenor and Pereira da Silva (2012); IMF (2013)
- Recent empirical evidence for Asian economies suggests that macroprudential policies tend to be more successful when they complement monetary policy by reinforcing monetary tightening rather than when they act in the opposite direction
  Bruno, Shim and Shin (2016)

1. Are macroprudential tools effective on lending?

$$\Delta Log\ Credit_{bft} = \delta_f + \beta \Delta \text{Macro tool}_{t-1} + \gamma \Delta \text{Macro tool}_{t-1} * X_{bt-1} + \mu\ controls_{bft} + \theta_t + \varepsilon_{bft}$$

where:

$\Delta Log\ Credit_{bft}$ is the change in the logarithm of actual value of loans by bank b to debtor f

$\Delta \text{Macro tool}_{t-1}$: tightening +1; 0 invariant; easing -1.

$X_{bt-1}$is a vector of bank specific characteristics (capital, liquidity, deposit ratio and size)

$controls_{bft}$ include macro variables and other bank and bank-debtor relationship characteristics

δ_f are bank fixed effects

θ_t are quarterly seasonal dummies

2. Are macroprudential policies substitute or complements to monetary policy?

$$\Delta Log\ Credit_{bft} = \delta_f + \beta \Delta \text{Macro tool}_{t-1} + \gamma \Delta \text{Macro tool}_{t-1} * \Delta r_t + \\ + \delta \Delta r_t + \mu\ controls_{bft} + \theta_t + \varepsilon_{bft}$$

- **The main test is on the significance of γ**
  - Since β, δ are expected to be negative (both monetary and macroprudential policies tightening reduce bank lending), the effect of a change of one policy on the other will depend on the sign of the coefficient γ
  - Each policy will reinforce the other (ie the two policies are complements) if $\gamma < 0$
  - By contrast, if a macroprudential policy tightening reduces the effectiveness of a monetary policy tightening (ie the two policies are substitutes) and we should observe $\gamma > 0$

3. Are macroprudential policies counter-cyclical?

$$\Delta Log\ Credit_{bft} = \delta_f + \beta \Delta \text{Macro tool}_{t-1} + \lambda \Delta LogGDP_t + \eta \Delta Macro\ tool_{t-1} * \Delta LogGDP_t + \mu\ controls_{bft} + \theta_t + \varepsilon_{bft_t}$$

- **The main test is on the significance of η**
  - Given the positive correlation between credit and the level of economic activity $\lambda > 0$
  - If macroprudential tools tends to smooth the cycle than the credit pro-cyclicality should be attenuated
  - If $\eta < 0$ a macroprudential tool tightening would help to reduce credit pro-cyclicality

4. Are macroprudential policies effective to limit bank risk?

- Ideally we should evaluate how macroprudential policies influence a bank's contribution to system-wide risk
- Such measure is not available for all countries (work in progress for Colombia and Mexico). In the analysis we have therefore considered a proxy for bank risk based on the quality of bank credit portfolio:

$$\Delta Log\ NPL_{bft} = \delta_f + \beta \Delta \text{Macro tool}_{t-1} + \mu\ controls_{bft} + \theta_t + \varepsilon_{bft}$$

where:

$\Delta Log\ NPL_{bft}$ is the change in the logarithm of actual value of non-performing loans by bank *b* to debtor *f*

- Results are complemented with evidence obtained using more refined analysis by country teams

Meta-analysis techniques

- Results at the country level are not perfectly comparable because they refer to different macroprudential tools
- **Meta-analysis techniques** to summarize the results. This approach is very helpful when studies are not perfectly comparable but evaluate the same or a closely related question (Buch and Goldberg (2014; 2016) and Arnold et al (2014))
  - Each observation is related to the evaluation of a macroprudential policy on a specific dimension (ie credit growth, bank risk indicator)
  - **Random effects methodology** in which the objective is to try to model the unexplained heterogeneity of effects
  - **Meta-regressions** to identify some variables that help to explain the differences among the coefficients reported by country groups

Data issues

- Lending to firms. Colombia also analysis for households
- Definition of $\Delta Macro\ tool_{t-1}$ as in Cerutti et al (2015), Altunbas, Binici and Gambacorta (2016); Akinci and Olmstead-Rumsey (2015); Buch and Goldberg (2016))
  - +1 if the MPP tool has been tightened in a given quarter
  - –1 if it has been eased
  - 0 if no change occurs

  Pros and cons: Not weight for the intensity/simplify comparison
- The macroprudential policies are different but can be grouped in two categories (Claessens, 2013):
  1. *Capital based* are intended to increase the financial sector's resilience
  2. *Cyclical* if they are more focused on dampening the cycle
- Analysis in the short term (up to year in the pipeline)

1. Effects of macroprudential policies on lending

- The range of the calculated mean effect among estimations is significantly **negative** for policies that were used for countercyclical purposes (*cyclical*)
- We find that a tightening in countercyclical macroprudential policy is associated with a reduction in credit growth of 3-12% (need to be complemented with elasticities)
- We do find that prudential policies aimed at raising additional buffers through capital requirements or provisioning (*capital base*) have less effect on credit growth (to be checked)
- We confirmed the results with meta-regressions
- The results are in line with findings in country papers

Meta-analysis of estimated coefficient of MPP on credit growth

	Eq.1	Eq.1 cyclical	Eq1 Capital	Eq.2	Eq.2 cyclical	Eq.2 Capital	Eq.3	Eq.3 cyclical	Eq.3 Capital	ALL	ALL cyclical	ALL Capital
Q	97***	6.85***	3.75	7080***	4317***	911***	5081***	1500***	511***	14475***	7703***	1563***
DF	13	6	6	13	6	6	12	6	6	40	20	19
I^2 (%)	86.6	12.3	0.3	99.8	99.9	99.3	99.8	99.6	99.1	99.7	99.7	98.8
τ^2	0.0101	0.0002	0.000	0.0031	0.0067	0.0009	0.0064	0.0030	0.0030	0.0042	0.0049	0.0011
Random -effects mean	-0.002	**-0.031*** **	-0.01	-0.004	**-0.096*** **	-0.007	-0.029	**-0.115*** **	-0.003	-0.012	**-0.088*** **	-0.009

Heterogeneity in effects of macroprudential policies on credit

Explanatory variables:	Dependent variable: Estimated effect of macroprudential policy on credit growth							
	Eq 1	Eq 1	Eq 2	Eq 2	Eq3	Eq3	ALL	ALL
Cyclical MP	**-0.1421* (0.074)**	**-0.139* (0.0652)**	**-0.40*** (0.1009)**	**-0.416** (0.1210)**	**-0.29*** (0.072)**	**-0.32*** (0.0694)**	**-0.28*** (0.0485)**	**-0.299*** (0.04928)**
Capital MP	-0.1045 (0.074)	-0.1039 (0.0652)	**-0.291** (0.1060)**	**-0.280* (0.1210)**	**-0.134* (0.0720)**	-0.116 (0.0694)	**-0.17*** (0.0486)**	**-0.164*** (0.04928)**
Country effects	No	Yes	No	Yes	No	Yes	No	Yes
Adjusted R^2 (percent)	18.8	23.3	52.7	36.9	59	62.9	47.6	50.2
Joint test for significance of all variables	1.89	1.24	8.01***	2.22	8.78***	5.92**	17.19***	6.96***
Number of observations	14	14	14	14	13	13	41	41

Bank-specific characteristics

- Parallel with bank lending channel literature: size, liquidity, bank capital and funding composition
- Size and liquidity are in general not statistically significant
- There is evidence that lending reacts differently for banks with a different level of risk and capitalisation (Brazil and Colombia)
- The relatively low importance on this characteristics can be explained by the fact that capital and liquidity ratios tend to be high in Latin American countries (difference with respect to target? Possibility to explore).
- Funding composition turned out to be highly relevant
- Why?

Why is bank funding composition important?

- Analysis of MPPs during the global financial crisis
- Banks that have a large deposit base will adjust their deposit rates to a lesser degree (and less quickly) than do banks whose liabilities mainly comprise variable-rate bonds that are directly affected by market movements (Berlin and Mester (1999)).
- Our result accords with the fact that a key transmission channel of the crisis was the dislocation in bank funding markets (Amiti, Mc Guire and Weinstein et al (2016), Gambacorta and Marques (2011))
- IBRN results: spillovers of interbank exposure limits through foreign bank affiliates differ in degree across banks not only in relation to banks' illiquid asset shares but also with respect to deposit shares, and internal capital market positions with their parent banks (Buch and Goldberg, 2016)

2. Interaction of monetary and macroprudential policies

- We find that macroprudential policies that are used as complements of monetary policy have larger negative effects on credit growth than other types of measure
- The level of complementarity between monetary and macroprudential policies is conditioned to the types of policy that are implemented
  - Policies with countercyclical objectives (*cyclical*) tend to be positively associated with the probability of exhibiting complementarity with monetary policy.
  - In contrast, policies that affect capital levels (*structural*) do not exhibit such an effect

Effects on credit growth of the MPPs that are used in conjunction with monetary policy

Explanatory variables:	**Dependent variable: Estimated effect of macroprudential policy on credit growth**							
	Eq 1	Eq 1	Eq 2	Eq 2	Eq3	Eq3	ALL	ALL
Cyclical MPs	**-0.1421* (0.074)**	**-0.1393* (0.0652)**	**-0.3485** (0.1223)**	**-0.2574* (0.1187)**	**-0.2412** (0.0768)**	**-0.272** (0.0847)**	**-0.26*** (0.064)**	**-0.236*** (0.058)**
Capital MPs	-0.1045 (0.074)	-0.1039 (0.0652)	**-0.2723** (0.1050)**	**-0.2061* (0.1012)**	-0.1133 (0.0704)	-0.1017 (0.07041)	**-0.124*** (0.049)**	**-0.104** (0.0439)**
Complementarity with monetary policy			-0.0746 (0.0960)	**-0.2330* (0.1034)**			**-0.1235* (0.0705)**	**-0.255*** (0.06647)**
Business cycle relationship					-0.07314 (0.0575)	-0.0548 (0.0600)	0.0713 (0.0684)	**-0.1387* (0.0724)**
Country effects	No	Yes	No	Yes	No	Yes	No	Yes
Adjusted R^2 (percent)	18.8	23.3	51.4	60.7	61.1	62.0	53.4	67.5
Joint test for significance of all variables	1.89	1.24	5.42**	3.75*	7.09***	4.8**	8.84***	9.63***
Number of observations	14	14	14	14	13	13	39	39

3. Interaction of macroprudential policies with the business cycle

- We find a positive relationship between the policies that are used in a countercyclical way with respect to the business cycle and the probability that the policy is used as a complement of monetary policy.
- In other words, policies that help to reduce the pro-cyclicality of credit tend to be complements of monetary policy.
- The results are also in line with findings in country papers (Brazil and Colombia).

Probit model on the complementarity between monetary and macroprudential policies

Explanatory variables	Dependent variable: Probability of complementarity between macroprudential and monetary policy					
	I	II	III	IV	V	VI
Cyclical MPs	**0.75** **(0.3398)**	**0.6818*** **(0.3265)**			0.5060 (0.3987)	0.2142 (0.3804)
Capital MPs	0.25 (0.3398)	0.3181 (0.3265)			0.1445 (0.3645)	0.2142 (0.2994)
Business cycle relationship			**0.55**** **(0.2006)**	**0.647**** **(0.199)**	0.3493 (0.2969)	**0.5714*** **(0.292)**
Country effects	No	Yes	No	Yes	No	Yes
Adjusted R^2(percent)	24.9	36.5	22.34	58.4	23.43	49.2
Joint test for all covariates	3.16*	2.49	4.45*	5.20**	2.3	2.93*
Number of observations	14	14	13	13	13	13

4. The effects of macroprudential policies on bank risk

- 3 countries (Argentina, Colombia and Mexico) estimated the coefficients for the proposed equation 4 that evaluate the impact of MPP on a proxy for bank risk given by the growth of non performing loans

- Prudential policies have significant effects on bank risk
  - this result is driven mainly by policies aimed at increasing the banking sector's resilience: the ranges of expected effects using random meta-analysis are clearly negative only for this type of policy
  - By contrast, we find no evidence that policies with a countercyclical aim (*cyclical*)

Meta-analysis of estimated coefficient of the effect of macroprudential policies on bank risk

	All equations	Cyclical MPs	Capital MPs
Q (1)	2705***	1895***	389***
Degrees of freedom	11	5	5
I^2	99.6%	99.7%	98.7%
τ^2	0.0010	0.0010	0.0006
Random-effect mean	**-0.020****	-0.010	**-0.039*****
95% confidence interval	-0.038 to -0.002	-0.035 to 0.015	-0.060 to -0.017

Meta regression of the effects of macroprudential policies on bank risk

Explanatory variables:	**Dependent variable: The estimated effect of macroprudential policy on bank risk**							
	I	II	III	IV	V	VI	VII	VIII
Cyclical MPs	-0.0038 (0.01978)	-0.0037 (0.0129)					0.01844 (0.02563)	0.00643 (0.0172)
Capital MPs	**-0.038*** **(0.0197)**	**-0.04***** **(0.0129)**					-0.0304 (0.02084)	**-0.0404**** **(0.0132)**
Complementarity with monetary policy			-0.012 (0.018)	0.0024 (0.0182)			-0.0215 (0.0280)	0.02500 (0.0193)
Business cycle relationship					-0.009 (0.018)	-0.0023 (0.0164)	-0.03304 (0.02046)	-0.03304 (0.02046)
Country effects	No	Yes	No	Yes	No	Yes	No	Yes
Adjusted R^2 (percent)	24.6	74.6	3.81	23.4	9.7	23.4	23.2	71.5
Joint test for significance of all variables	2.8	6.65**	NA	1.82	NA	1.82	1.87**	5.12**
Number of observations	12	12	12	12	12	12	12	12

The effects of macroprudential policies on bank risk

- The above results are also in line with the findings of country papers that adopt a more refined approach.
  - Aguirre and Repetto (2016) find that the use of MPP are associated with a subsequent reduction of the growth of NPL in Argentina
  - Gomez et al (2016) find that a tightening of MPPs in Colombia is associated with a reduction in NPL growth, an increase in the cost of lending and a larger decrease in credit for riskier borrowers
  - Barroso et al (2016) find that Brazil's use of reserve requirements affected access to credit in particular for riskier borrowers. During tightening phases, when there is credit contraction, riskier firms tend to receive less credit

Conclusions

1. Are macroprudential tools effective on lending?
   - Yes, but more the cyclical ones
   - Heterogeneity in bank behavior for funding composition
2. Are macroprudential policies substitute or complements to monetary policy?
   - Complements. These MPPs are particularly effective in taming the credit cycle
3. Are macroprudential policies counter-cyclical?
   - Yes, less structural policies on bank capital (need to investigate more)
4. Are macroprudential policies effective to limit bank risk?
   - Yes (capital requirements and dynamic provisions)

Next steps

- Longer horizon (important to check effect on capital based MPs)
- More on interaction between MPs, bank and firm specific characteristics
- Diff-in-diff (when possible, to complement analysis)
- Compute and compare elasticities

Annex 2. Macroprudential policies in CCA countries 2005-2014

Type of instrument	Measures	Frequency of use (percent)	Tightening measures	Loosening measures
	(1)	(2)	(3)	(4)
a. Enhancing Resilience (1)	29	49	22	9
Capital requirement/Risk weights (RW)	14	24	9	4
Provisioning requirement (Prov)	3	5	3	0
Limits on dividend distribution	7	12	6	4
Liquidity ratios	5	8	4	1
b. Dampening the cycle (2)	23	39	20	8
Changes in reserve requirement (RR)	8	14	7	4
Net open position (NOP)	6	10	6	0
Changes in LTV, DTI limits	8	14	6	3
Limits on credit growth or lending to specific sectors	0	0	0	0
Requirement on external borrowing operations	1	7	1	1
c. Dispelling gestation of cycle (3)	7	12	7	0
Levy or tax on specific assets and/or liabilities	4	7	4	0
Official warnings on specific vulnerabilities	2	3	2	0
Adjustments to lending standards	1	2	1	0
Total	***59***	***100***	***45***	***16***