Credit Supply Responses to Reserve Requirement: Evidence from credit registry and policy shocks

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Motivation

- How innovations in Reserve Requirements – RR affect credit supply?
  - Banks react to changes in funding composition (Kashyap and Stein, 2000)
  - Reactions may depend on the state of the macroeconomy and on bank characteristics (Kashyap and Stein, 2000, Holmstrom and Tirole, 1997)
  - Composition of credit may change depending on the riskiness of borrowers (Borio and Zhu, 2008)
  - The question is important for emerging markets that traditionally use RR policy to smooth the credit cycle (Cordella et al., 2014)
  - There is little loan level evidence of the impact of RR policies in emerging markets (with the exception of Camors and Peydró (2013))

Contribution

- We build on Camors and Peydró (2013), but we:
  - Explore a larger and longer dataset
  - With policy shocks from tightening and loosening cycles
  - Providing a long-term analysis to capture macroeconomic and monetary policy interactions
  - Where the central piece in the identification strategy is the measurement of RR innovation:
    - We build an index by adding or subtracting one unit to the index upon the tightening or easing of the RR policy
    - We define a treatment variable, as the difference between quarterly changes in current RR and quarterly changes in a counterfactual RR

Literature

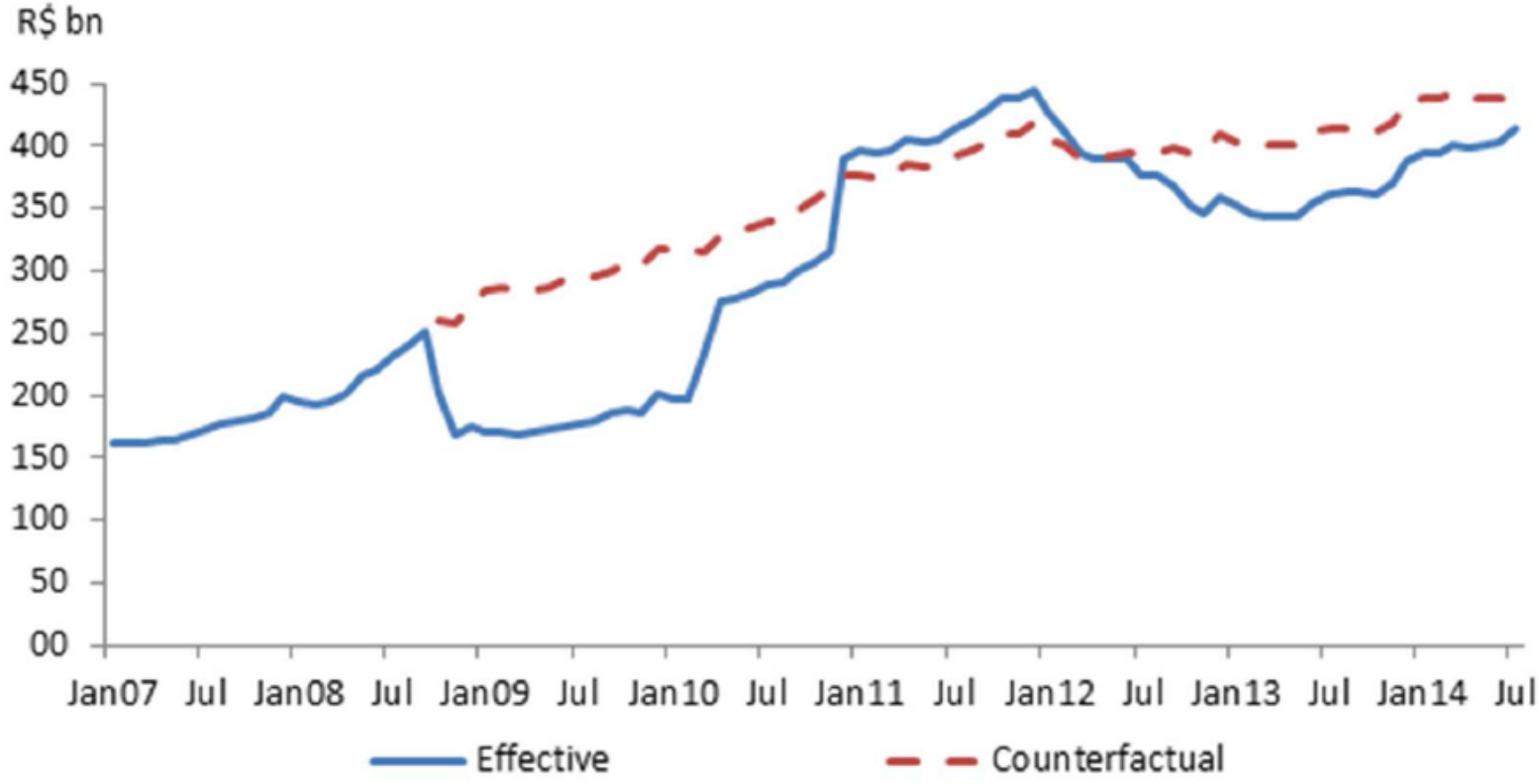
- The rationale for RR effects on credit supply follows Stein (1998) and Kashyap and Stein (2000)
- The risk-taking channel on monetary policy follows mostly Adrian and Shin (2009), Dell'Ariccia et al. (2009) and Jiménez et al (2014)
- The interaction with banks' liquidity and capital follows Kashyap and Stein (2000) and Holmstrom and Tirole (1997)
- The use of RR to foster financial stability is highlighted by Tovar and Mora et al. (2012)
- The financial stability and the business cycle-driven uses of RR cannot be separated from each other Cordella et al. (2014) and Cerutti et al. (2015)
- An increase of the requirements for short-term funding imply a reduction of credit supply Camors and Peydro (2013) and Glocker and Towbin (2012)

Background

- RR components are managed through:
  - Demand deposits (unremunerated)
  - Savings (remunerated according to savings accounts)
  - Time and Term deposits (remunerated at the daily prime rate)
  - Additional component comprised of three subcomponents, one for each of the previous components, (all remunerated at the daily prime rate)
  - It also manages deductibles, conditional deductibles, exemption thresholds, eligible liabilities and remuneration
- *Counterfactual* RR is used to monitor policy implementation:
  - The liabilities subject to RR (TLRR) are the same, but RR ratios, deductibles, conditional deductions and exemptions are calculated for every bank based on the pre-changes rule

Background

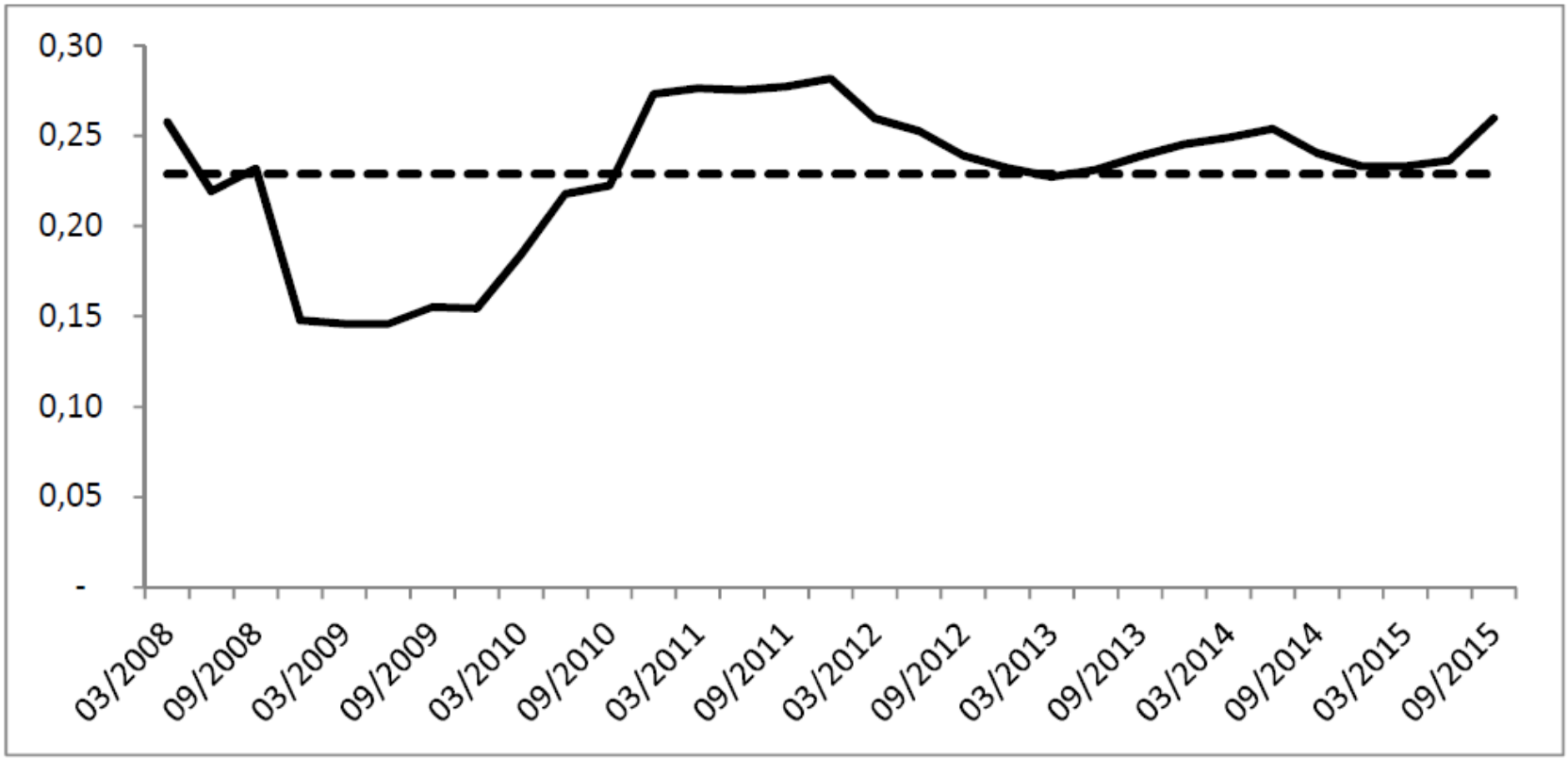
Figure 1. Total Reserve Requirements in Brazil (BRL in billions)



Notes: (i) Total includes all public, private domestic and private foreign banks operating in Brazil. (ii) Counterfactual reserve requirements are calculated based on regulation in place before September 2008.

Background

Figure 2. Reserve requirement ratios, i.e. total RR to total liabilities subjected to Reserve Requirements (TLRR)



Notes: (i) Total includes all public, private domestic and private foreign banks operating in Brazil.
(ii) Dashed line is the long-term average, 23% .

Data

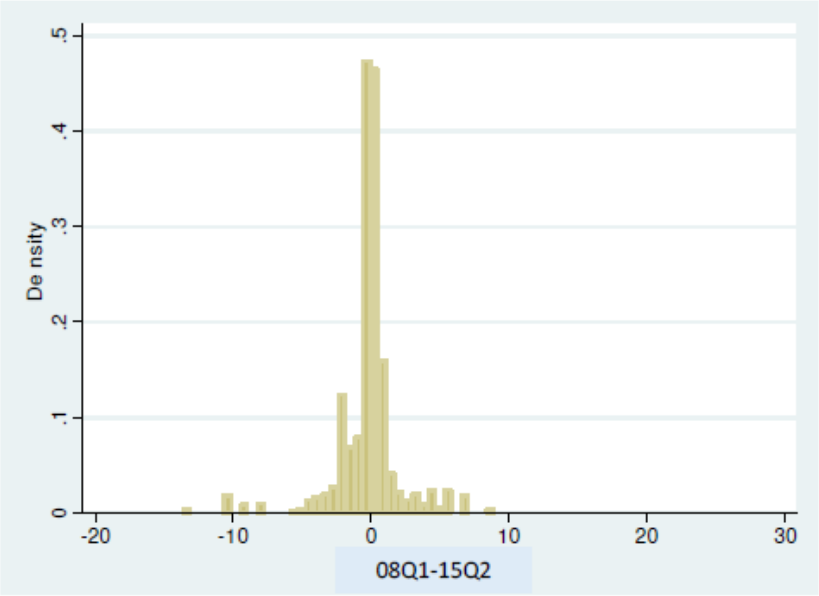
- We use the Brazilian Credit Register (SCR), which encompasses virtually all corporate loans in the domestic financial system
  - Data is quarterly from 2008Q1 to 2015Q2
  - We restrict our sample to firms with loans from more than one bank
  - This sample has over 36 million data points (27 periods, 132 banks and 478 thousand firms).
  - The dependent variable is the log change in the credit granted to a firm (f), by a bank (b) in a quarter (t), winsorized at the 2/98th percentile
  - The firm risk indicator of the firm at the bank or at the financial system
  - Bank balance sheet variables: total assets (size), liquidity ratio (liquidity), return over assets (ROA), Banks nonperforming loans to total credit (NPL); and public, foreign or small bank dummy variables

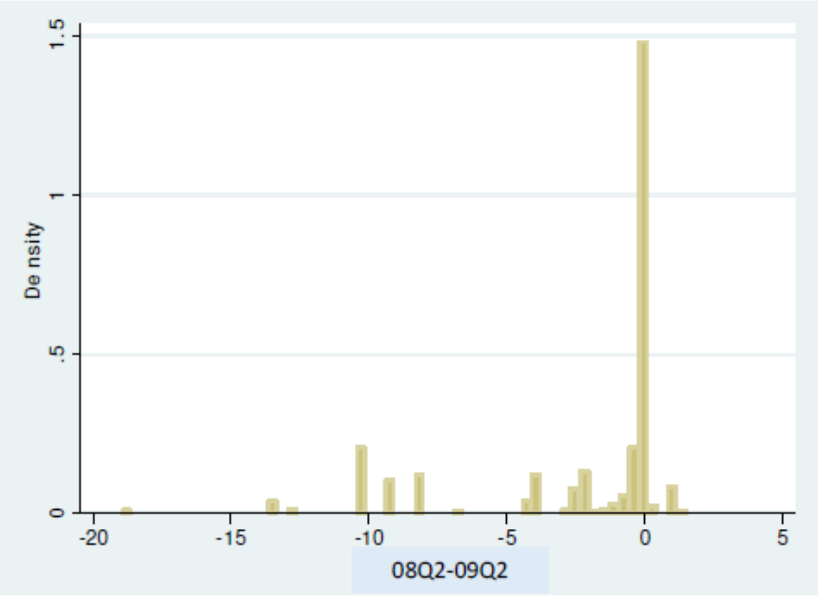
RR measurement

- We measure reserve requirements innovation with two alternative definitions:

1. We build a simple index, adding or subtracting a unit on a tightening or easing policy event in a quarter. The change in the index is the policy innovation

Figure 3. Innovation in reserve requirements





Data

2. We use a treatment variable defined as the quarterly change in effective reserve minus the quarterly change in counterfactual reserves, both measured as a ratio to liabilities subjected to RR (TLRR)

$$\Delta ReservReq_t^b = 100 * \left[\Delta\left(\frac{\text{Effective}_t^b}{\text{Liabilities}_t^b}\right) - \Delta\left(\frac{\text{Counterfactual}_t^b}{\text{Liabilities}_{b,t}}\right)\right]$$

where *b* refers to a bank and *t* to a quarter.

- The variation in counterfactual reserves filter out the determinants of reserve requirements other than regulatory change.

Methodology

- We present our results in two sessions:

1. Long panel estimates both using the RR index and the treatment variable

$$\Delta ln\left(\text{Credit}_{f,t}^{b}\right) * 100 = \sum_{i} \Delta ReservReq_{t-i}^{b} + \sum_{i} \Delta ReservReq_{t-i}^{b} * X_{f.t-i}^{b} + \sum_{i} X_{f.t-i}^{b} + \alpha_{f.t}^{b}$$

- The dependent variable is the log change in credit to a firm f in a specific bank b and period t
- The main independent variable is the innovation in reserve requirement
- Interaction terms of the policy innovation and a vector of variables of interest denoted by X in the equation
- We gradually introduce firm fixed, firm*time, bank and bank*time fixed across our model settings

Methodology

- We present our results in two sessions:

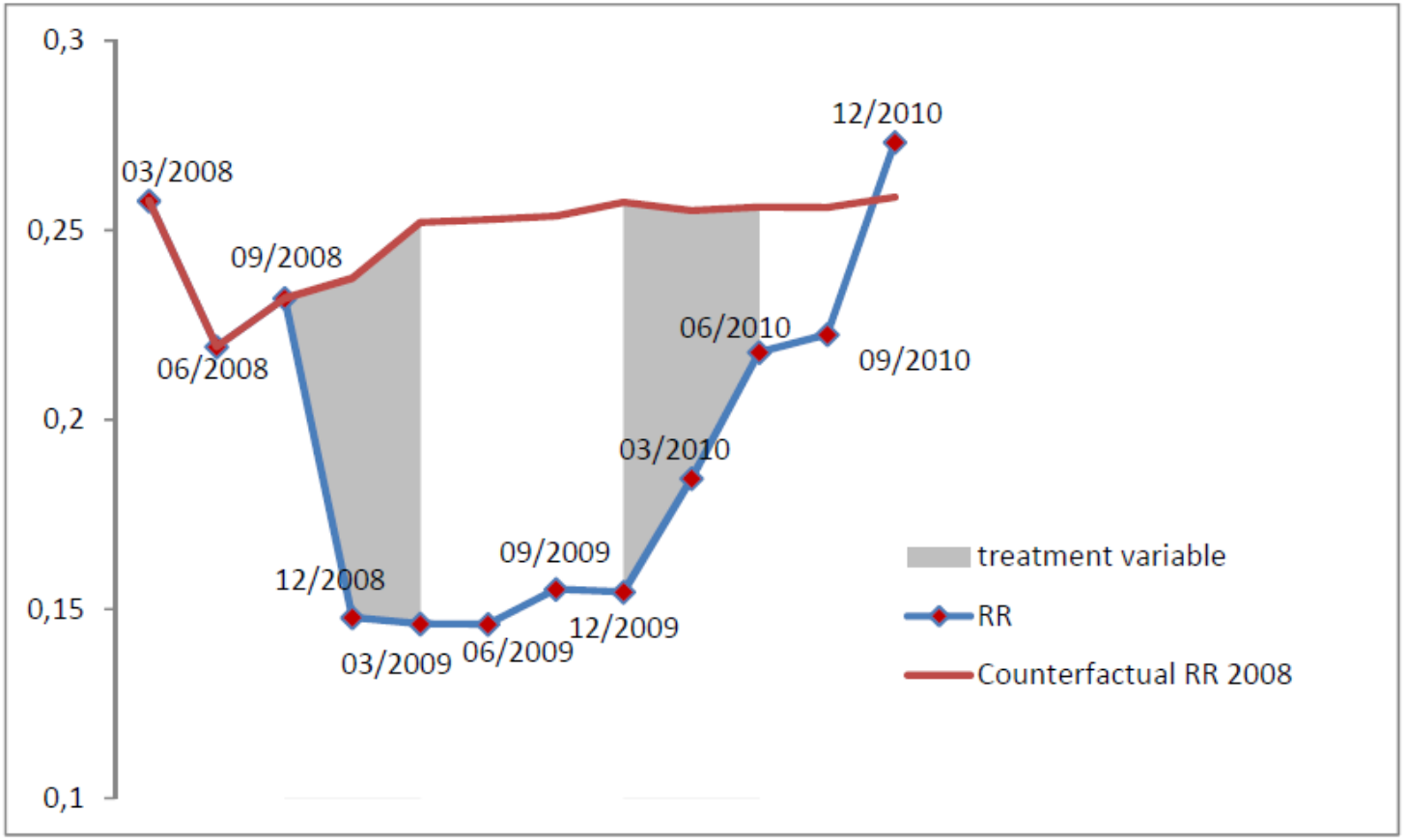
2. Cross-sectional estimates around the four main policy shocks in the sample

$$\Delta ln\left(\text{Credit}^{b}_{f,t+1,t}\right) = \Delta ReservReq^{b}_{t,t-1} + \Delta ReservReq^{b}_{t,t-1} * X^{b}_{f.t-1} + X^{b}_{f.t-1} + \alpha^{b}_{f.}$$

- The methodology replicates Camors and Peydro (2013), but the dependent variable in this diff-in-diff is one semester after the end of the policy shocks
- Interaction terms of the policy innovation and a vector of variables of interest denoted by X in the equation
- We gradually introduce firm fixed, firm*time, bank and bank*time fixed across our model settings

Methodology

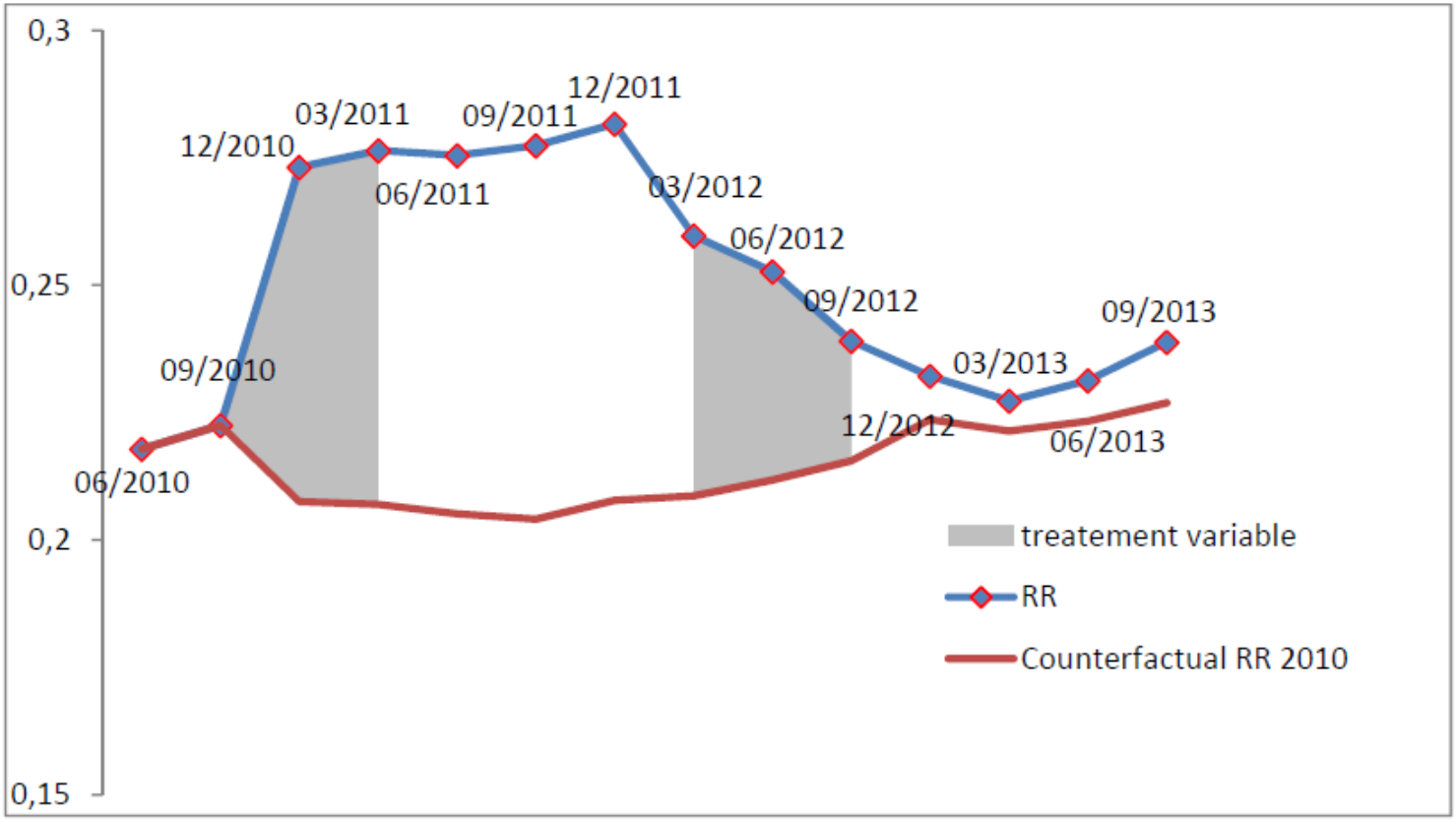
Figure 4: RR and Counterfactual RR of 2008 during the easing cyle.



Note: The change between RR and Counterfactual RR is the treatment variable illustrated in the shaded areas. The shock dates are (1) March-09 and (2) June-10. $\Delta ln\left(\text{Credit}^{b}_{f,t+1,t}\right)$ is the dependent variable calculated in the following semester, i.e. changes in total credit at the firm bank level between September relatively to March(2009) and December relatively to June (2010), respectively

Methodology

Figure 5: RR and Counterfactual RR of 2010 during the easing cyle



Note: The change between RR and Counterfactual RR is the treatment variable illustrated in the shaded areas. The shock dates are (1) Mar-11 and (2) Sep-09. $\Delta ln\left(\text{Credit}^{b}_{f,t+1,t}\right)$ is the dependent variable calculated in the following semester, i.e. changes in total credit at the firm bank level between September, 2011 relatively to March, 2011 and from June, 2013 relatively to December, 2012, respective

Results

- Long panel – full sample – short run elasticity

Dependent variable: $\Delta \ln(credit_{b,f,t})$

Model	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
$\Delta ResReq_{t-1}$	-1.02 ***	-2.34 ***	-3.40 ***	2.97 **	-0.42	-1.2 ***	-2.6 ***	-0.74 **	-1.63	-1.6	
	(0.37)	(0.67)	(1.20)	(1.15)	(0.32)	(0.4)	(0.81)	(0.38)	(1.28)	(1.89)	
$\Delta ResReq_{t-1}$:											
* Capital Ratio $_{t-1}$		12.58 ***							1.85	4.09 ***	
		(3.74)							(5.2)	(1.41)	
* Liquidity Ratio $_{t-1}$			11.53 **						8.86 ***	3.08 **	
			(4.68)						(3.25)	(1.83)	
* Size $_{t-1}$				-4.56 ***					-1.89 **	0.03	
				(1.52)					(0.77)	(0.06)	
* Public Bank					-1.71 ***				-1.52 ***	-0.72 ***	
					(0.42)				(0.31)	(0.09)	
* ΔPolicy Rate $_{t-1}$						-0.02			0.00	0.00	
						(0.02)			(0.02)	(0.01)	
* ΔGDP $_{t-1}$							0.30 ***		0.19 **	0.01	
							(0.11)		(0.11)	(0.04)	
* Firm Risk $_{t-1}$								-1.30 ***	-1.32 **	-0.98 ***	-1.05 ***
								(0.77)	(0.75)	(0.26)	(0.24)

Results

- Long panel – full sample – long run elasticity

Dependent variable: $\Delta \ln(\text{credit}_{b,f,t})$											
Model	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
$\Sigma_{i=0..4}\Delta$ResReq $_{t-i}$	-1.18	-3.01 ***	-2.93 **	-0.99	-0.43	-45.9 **	-14.9 ***	-0.24	-9.92 *	-10.2 *	
	(1.06)	(1.20)	(1.31)	(4.87)	(0.73)	(19.9)	(3.70)	(0.81)	(5.09)	(6.19)	
$\Sigma_{i=0..4}\Delta$ResReq $_{t-i}$											
* Capital Ratio $_{t-i}$		19.09 ***							13.52	8.21 **	
		(6.63)							(10.3)	(3.82)	
* Liquidity Ratio $_{t-i}$			11.40 *						13.33 **	10.48 ***	
			(6.33)						(5.76)	(3.92)	
* Size $_{t-i}$				0.03					0.27 *	0.30	
				(0.17)					(0.16)	(0.22)	
* Public Bank					-2.22 ***				-1.07	-0.48	
					(0.40)				(0.70)	(0.32)	
* ΔPolicy Rate $_{t-i}$						-0.54				-0.03 **	
						(0.66)				(0.02)	
* ΔGDP $_{t-i}$							1.83 ***			-0.10	
							(0.43)			(0.12)	
* Firm Risk $_{t-i}$								-1.37	-1.63	-2.92 ***	-2.64 ***
								(1.56)	(1.66)	(0.91)	(0.93)

Results

- Cross section using DiD: 4 shocks

Dependent variable: $\Delta \ln(credit_{b,f,t+1})$

	Loosening cyle				Tightening cyle			
	Easing		*Tightening*		*Tightening*		*Easing*	
	set/08 - mar/09		dez/09 - jun/10		set/10 - mar/11		Mar-12 -	
Model	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$\Delta ResReq_t$	-0.671**	0.350	0.455	-0.746***	-0.023	-0.847*	-0.653	-2.299**
	(0.294)	(0.311)	(0.344)	(0.237)	(0.337)	(0.437)	(0.925)	(1.013)
Observations	554,088	554,088	754,839	754,837	829,596	829,596	876,181	876,181
R-squared	0.005	0.540	0.001	0.461	0.000	0.454	0.000	0.458
Firm Controls	NO	<>	NO	<>	NO	<>	NO	<>
Bank Controls	NO	YES	NO	YES	NO	YES	NO	YES
Firm FE	NO	YES	NO	YES	NO	YES	NO	YES
Bank FE	<>	<>	<>	<>	<>	<>	<>	<>
$\Delta ResReq$	Counterf. 08	Counterf. 08	Counterf. 08	Counterf. 08	Counterf. 10	Counterf. 10	Counterf. 10	Counterf. 10

Results

- Risk Channel using DiD: 4 shocks (bank-fixed effects)

Dependent variable: $\Delta \ln(\text{credit}_{b,f,t+1})$

	Loosening cyle				Tightening cyle			
	Easing		*Tightening*		*Tightening*		*Easing*	
	set/08 - mar/09		dez/09 - jun/10		set/10 - mar/11		jun/12 - Sep/12	
Model	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
ΔResReq $_t$	0.300		-0.675***		-0.805*		-2.313**	
	(0.322)		(0.249)		(0.443)		(1.003)	
ΔResReq $_t$ * Firm Risk $_{t-1}$	1.800***	2.056***	-1.994***	-1.814***	-1.368**	-1.224**	0.397	-0.563
	(0.400)	(0.374)	(0.604)	(0.561)	(0.543)	(0.557)	(1.794)	(1.545)
Observations	554,088	554,088	754,837	754,839	829,596	829,596	876,181	876,181
R-squared	0.540	0.546	0.461	0.464	0.454	0.457	0.458	0.464
Firm Controls	<>	<>	<>	<>	<>	<>	<>	<>
Bank Controls	YES	NO	YES	NO	YES	NO	YES	NO
Firm FE	YES	YES	YES	YES	YES	YES	YES	YES
Bank FE	NO	YES	NO	YES	NO	YES	NO	YES
ΔResReq	Counterf. 08	Counterf. 08	Counterf. 08	Counterf. 08	Counterf. 10	Counterf. 10	Counterf. 10	Counterf. 10

Results

- Risk Channel channel: NPL (bank-fixed effects)

Dependent variable: $\Delta \ln(credit_{b,f,t+1})$

	Loosening cyle				Tightening cyle			
	Easing		*Tightening*		*Tightening*		*Easing*	
	set/08 - mar/09		dez/09 - jun/10		set/10 - mar/11		jun/12 - dez/12	
Model	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$\Delta ResReq_t$	0.322		-0.688***		-0.807*		-2.338**	
	(0.312)		(0.239)		(0.433)		(1.002)	
$\Delta ResReq_t$								
* Firm NPL_{t-1}	4.150***	3.984***	-4.703***	-4.705***	-4.277***	-4.025***	3.195**	2.873*
	(0.455)	(0.429)	(0.693)	(0.678)	(0.646)	(0.634)	(1.609)	(1.610)
Observations	554,088	554,088	754,837	754,839	829,596	829,596	876,181	876,181
R-squared	0.540	0.546	0.461	0.464	0.454	0.457	0.458	0.464
Firm Controls	<>	<>	<>	<>	<>	<>	<>	<>
Bank Controls	YES	NO	YES	NO	YES	NO	YES	NO
Firm FE	YES	YES	YES	YES	YES	YES	YES	YES
Bank FE	NO	YES	NO	YES	NO	YES	NO	YES
$\Delta ResReq$	Counterf. 08	Counterf. 08	Counterf. 08	Counterf. 08	Counterf. 10	Counterf. 10	Counterf. 10	Counterf. 10

Results

- All-in-all models DiD: 4 shocks

Dependent variable: $\Delta \ln(\text{credit}_{b,f,t+1})$

	Loosening cyle				Tightening cyle			
	Easing		*Tightening*		*Tightening*		*Easing*	
	set/08 - mar/09		dez/09 - jun/10		set/10 - mar/11		jun/12 - dez/12	
Model	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
ΔResReq $_t$	-1.987	-1.927	-2.837	-2.239	0.169	0.807	-17.173	-17.501
	(6.917)	(6.890)	(3.039)	(3.113)	(8.365)	(8.351)	(18.983)	(19.091)
ΔResReq $_t$								
* size $_{t-1}$	0.075	0.070	0.052	0.030	-0.138	-0.158	0.140	0.150
	(0.258)	(0.257)	(0.123)	(0.126)	(0.275)	(0.275)	(0.693)	(0.696)
* Liquidity $_{t-1}$	6.439*	6.635*	-0.344	-0.293	11.447	11.140	42.315***	42.395***
	(3.552)	(3.551)	(3.958)	(4.004)	(6.964)	(6.953)	(11.385)	(11.424)
* CAR $_{t-1}$	-10.120**	-10.026**	9.324	9.281	4.663	4.507	43.632***	43.800***
	(4.520)	(4.521)	(5.949)	(6.023)	(6.126)	(6.120)	(15.642)	(15.715)
* Firm Risk $_{t-1}$	0.732***		-2.216***		-1.094***		1.770*	
	(0.236)		(0.267)		(0.157)		(0.967)	
* Firm NPL $_{t-1}$		4.184***		-4.811***		-4.159***		3.195*
		(0.451)		(0.701)		(0.646)		(1.639)
Observations	554,088	554,088	754,837	754,837	829,596	829,596	876,181	876,181
R-squared	0.540	0.541	0.462	0.461	0.455	0.455	0.461	0.461
Firm Controls	<>	<>	<>	<>	<>	<>	<>	<>
Bank-Firm Controls	YES	YES	YES	YES	YES	YES	YES	YES
Firm FE	YES	YES	YES	YES	YES	YES	YES	YES
Bank FE	<>	<>	<>	<>	<>	<>	<>	<>
ΔResReq	Counterf. 08	Counterf. 08	Counterf. 08	Counterf. 08	Counterf. 10	Counterf. 10	Counterf. 10	Counterf. 10

Results

- Robustness: Placebo

	Placebo				No counterfactual			
	June-09 Dec-09	Dec-10 June-11	Dec-10 June-11	June-13 Dec-13	Sep-08 Mar-09	Dec-09 Jun-10	Sep-10 Mar-11	Jun-12 Dec-12
Model	(1)	(2)	(3)	(4)	(5)	(6)	(7)	-(8)
$\Delta ResReq_t$	-0.218	-0.036	-0.491	0.477	0.322	-1.399***	-3.153***	-4.553
	(0.378)	(0.300)	(0.510)	(0.504)	(0.602)	(0.281)	(1.181)	(3.898)
Observations	73,008	85,228	85,228	91,242	55,397	75,114	82,877	88,358
R-squared	0.464	0.455	0.455	0.462	0.541	0.458	0.456	0.459
Firm Controls	<>	<>	<>	<>	<>	<>	<>	<>
Bank Controls	YES	YES	YES	YES	YES	YES	YES	YES
Firm FE	YES	YES	YES	YES	YES	YES	YES	YES
Bank FE	<>	<>	<>	<>	<>	<>	<>	<>
$\Delta ResReq$	Counterf. 08	Counterf. 08	Counterf. 10	Counterf. 10	w/o Counterf.	w/o Counterf.	w/o Counterf.	w/o Counterf.

Conclusion

- We find that RR policy impact credit in the expected direction
- The quantitative impact is more sensible in the medium and long run
- We show that results are robust to using a simple index of reserve requirement policy *vis-a-vis* a more precise treatment variable based on bank level counterfactual reserve requirements
- There is suggestive evidence that higher liquidity and capital ratios appear to reduce the impact of RR policy
- Monetary policy is possibly a complement to RR policy in the sense that tightening one policy increases the effect of the other on credit
- We find that banks avoid riskier firms in the aftermath of policy changes. During tightening phases, when there is credit contraction, riskier firms receive less credit

Obrigado!

Bernardus Van Doornik