[How effective are capital-based macroprudential measures in taming the macro-financial cycles?]

[A structural enquiry into Spain]

Following the downturn of 2008, financial policymakers introduced a new set of rules, capital-based macroprudential measures, to contain systemic risks, regulate bank system-wide behavior, and hold bank incentives under check. We estimate the effectiveness of capital requirements in constraining credit supply and credit-driven booms in Spain over the period 1993-2015. The impact from an increase in capital requirements is considerable, in particular for firm credit, albeit further pass-through to the macroeconomy is only significant at 95% for the pre-Great Recession period and the sovereign debt crisis. In addition, our conditional projection exercises show that there are major economic benefits from holding higher ex-ante system-wide capital ratios and implement capital increases in a more gradual fashion, in line with the findings from the DSGE literature on optimal policy implementation.

Following the financial downturn in 2008, a strong international consensus emerged on the need to re-orientate the regulatory framework to place stronger emphasis on the mitigation of risks in the financial system as a whole. But rather than taking away powers from the micro bank-level oriented regulation, the new *macroprudential policy* is supposed to complement it and tackle issues beyond the reach of the *micropudential rulebook*.

One class of policies is the capital-oriented regulation of the Basel III Accord and the EU Regulation on Macroprudential Supervision,[1], which gave rise to the introduction of capital buffers on top of Pillar 1 requirements. The Countercyclical Capital Buffer (CCyB) stands out among these buffers due to its new features. Its primary aim is to prevent excessive build-up in credit (stock) in order to generate greater self-insurance for a system as a whole by increasing the buffer during a credit boom. Conversely, in busts, this buffer could be lowered in order to provide incentives for banks to increase their credit lines and reduce the likelihood of a collective credit contraction. Furthermore, the possibility to apply sector-specific capital requirement now allow the competent authority, in addition, to change buffers on exposures to specific sectors of the economy, thereby only mitigating the risks in those sectors where credit is growing quickly without dampening credit to the rest of the economy. Finally, buffers for global and domestic systemically importantly institutions have also been introduced.

In Spain, the CCyB is currently set at 0. However, as soon as the Spanish economy and credit start to pick up, the attention and temptation of both policy-makers to raise the buffer will also increase. As a result, there is also an increasing interest in understanding the way capital ratios are likely to affect the economy. Currently, there is a high degree of uncertainty as to how banks might respond to future increases in macroprudential capital ratio requirements (the so-called *expectations channel of capital requirements*), the effect of banks' responses on the real economy, and how this might vary depending on the state and point of the business cycle. In addition, there is an additional complication in obtaining accurate estimates of the effects from the fact that such a policy tool has never before been used. Furthermore, there are very few changes to aggregate regulatory capital requirements observable in the past data, making them very rare events. And even for those events, it is difficult to isolate how much of

[1] Developed in the EU through the CRD-IV and CRR

the change in bank lending was caused by a *genuine* regulatory change rather than the particular state of the business cycle, or other macroeconomic developments.

Briefly on the methodology

Our aim in this paper is to estimate the effect increases in capital requirements have on credit supply to firms and households over the business-cycle, on non-bank credit, and the wider economy. The model focuses on the time dimension (1993:I-2015:IV) and examines the joint dynamics of the aggregate capital ratio across all Spanish-resident banks and a set of macro-financial variables capturing their joint dynamics. The variables are summarised in table 1:

Table 1: Description and basic statistics of the variables that enter the model

Variable	Definition	Sample period	Sample moments
GDP	Annual growth rate of real GDP	1990:Q1 – 2015:Q3	Mean: 2.069 Std deviation: 2.34
Bank credit	Annual growth rate in real bank credit. We separate here between credit to non-financial firms and household and independently estimate these specifications.	1990:Q1 – 2015:Q3	**Firm credit:** Mean: 5.14 Std deviation: 8.31 **Hshld credit:** Mean: 6.40 Std deviation: 7.83
Bank excess return on the stock market	The difference between stock returns of banks relative to the overall market return. The variable is expressed in quarterly growth rate.	1990:Q1 – 2015:Q3	Mean: -0.72 Std deviation: 5.92
Non-bank credit	Annual growth rate of non-bank credit to non-financial firms.	1990:Q4 – 2015:Q3	Mean: -1.95 Std deviation: 12.27
Capital ratio	Aggregate capital ratio for the entire banking sector. We separate here between total capital and Tier 1 capital.	1993Q3 – 2015:Q3	**Total capital/Tier 1:** Mean: 11.28/9.27 Std deviation: 0.92/1.21

In order to isolate genuine capital ratio increases resulting from higher capital requirements by the authority from those resulting from underlying business cycle developments, we use sign restrictions to separate the two. The sign restrictions we use are summarised in table 2:

Table 2: Sign restrictions applied

Variable	Sign restriction	Rationale
Bank credit	Negative	Higher capital increases the cost of supplying credit and thus reduces overall bank lending
Non-bank credit to firms	Positive	The demand for credit by firms is unaffected and thus firms shift to capital markets to satisfy their demand
Excess return	Negative	Banks profitability decreases because Banks forego profitable lending opportunities

We estimate the Bayesian Structural VAR (or B-SVAR) model using a penalty criterion function that penalises draws with undesired sign restrictions. This method is computationally more demanding than the standard rejection method, but is preferred for two reasons. First, the impulse responses are empirically less biased since they are not a result of a binary choice mechanism, but are more representative of the *true* underlying data-generating process. Second, it is more information efficient since it uses information on the entire distribution of impulse responses, but penalises those who are not in line with the assumed sign-restriction scheme.

Impact assessment

From Tables 3-4, we find that a 1p.p. increase in bank capital ratio due to changes in regulatory requirements reduces credit to firms by 1,1 p.p, credit to households by 1 p.p, excess return of bank shares by 2 p.p, and GDP by 0,35 p.p. For big firms, there is some substitution away from bank financing to market financing amid capital increases since the issuance of bonds increases by 2,2 p.p. However, the overall impact on the macroeconomy (in the short-run) remains negative since only the big firms have access to bond markets. Shock to capital buffer is important for driving the model since it explains between 15 and 20 p.p. of the total variation in the other model variables, no matter what specification or time period we use.

Table 3: Impulse response (IRF) peak impacts of a capital shock for the firm credit specification. The columns report the (endogenous) impact on the various model variables, while the rows represents different model specifications. The numbers in bold are statistically significant at 95%.

Method	IRF – bank credit to firms	IRF- non-bank credit	IRF – excess return	IRF - GDP
Impact sign restrictions	**-1.1 p.p.**	**+2.2 p.p.**	**-2 p.p.**	-0.3 p.p.
One year sign-restrictions	**-1.4 p.p.**	**+1.8 p.p.**	not significant	**-0.3 p.p.**
Tier 1 capital	**-1 p.p.**	**+2.5 p.p.**	-2 p.p.	-0.2 p.p.
Excluding non-bank credit	**-1.1 p.p.**	-	**-2.5 p.p.**	-0.3 p.p.
Cholesky decomposition	not significant	**+1 p.p.**	not significant	not significant

Table 4: Impulse response (IRF) peak impacts of a capital shock for the household credit specification. The columns report the (endogenous) impact on the various model variables, while the rows represents different model specifications. The numbers in bold are statistically significant at 95%.

Method	IRF – bank credit to households	IRF – excess return	IRF - GDP
Impact sign restrictions	**-1 p.p.**	**-2 p.p.**	-0.3 p.p.
One year sign-restrictions	**-0.8 p.p.**	not significant	**-0.2 p.p.**
Tier 1 capital	**-1 p.p.**	**-2.1 p.p.**	-0.2 p.p.
Excluding non-bank credit	**-1.1 p.p.**	**-2.5 p.p.**	-0.25 p.p.
Cholesky decomposition	not significant	not significant	not significant

During crises periods, the estimated impact is even more profound (or negative). For instance, if we include the sovereign debt crisis period, the negative impact of the shock on firm credit intensifies to 1,5p.p, leading to a larger fall of the excess return (-2,1p.p.). The total impact on GDP is also larger (-0.4p.p.) and statistically significant at 95% level.

To put our results into a broader perspective, we compare our findings with those found so far in the literature. Compared to other SVAR studies in the literature, we find somewhat stronger impact for Spain compared to either the UK (Noss and Toffano 2016) or the Euro Area (Kanngiesser et al 2016). That is not surprising since in the case of Euro Area, stronger impacts in some countries cancel out the weaker impacts in others, and thus the overall area impact is smaller. Compared to the UK, we believe that the differences can be explained by multiple factors. First, in Spain only banks supply credit, and these banks are uniformally bound by the same capital regulation. In the UK, the picture is more diverse, since non-bank intermediaries also supply credit, and there is a big shadow banking sector which is not bound by the same capital regulation. Hence the impact of bank capital-regulation on credit supply and GDP should be *ceteris paribus* lower. Second, we use bank-level consolidated data while Noss and Toffano (2016) do not, which means that their estimates are very likely under-biased. Third, our samples differ considerably. While their model is almost entirely estimated during the Great Moderation period, our model includes the Great Recession, when banks underwent the historically largest deleveraging and balance sheet adjustment process. Thus, we should expect our estimates to be higher. Fourth and final, while we employ the same identification strategy, our estimation method is more robust and we save many more draws in our estimation so to ensure convergence. Thus, we expect our estimates also to be more robust and efficient.

Conditional projections:

Lastly, we conduct a series of conditional projections at various cut-off dates using the estimated model in order to understand the role that expectations play for the conduct of capital-based policy. The results are reported in Table 5. We find that there are major economic benefits from holding higher *ex ante* bank-system capital ratios and adopt a more gradual approach in implementing increases in capital requirements. At the same time, there is a solid role for expectations in the implementation of capital regulation. For the same level of

capital, an expectation of loose financial conditions results in less costly implementation of such regulation compared to a scenario with expectations of tight financial conditions and macroeconomic downturn. These results provide support for the principle of countercyclical capital regulation since the macroeconomic benefits of such regulation are the highest.

Table 5: We run projections for 3 key variables in the model: Capital ratio, firm credit, and GDP. Condition on projection is **ONLY** imposed on capital ratio, however. Numbers in the table represent the difference in (peak) impacts between conditional and unconditional projections. In the conditional projection, the level of capital is *ex ante* **1 p.p.** higher. Numbers in BLUE are those when the value of conditional is higher than unconditional. Numbers in GREEN are those when the value of conditional is lower. Sign in brackets shows whether the projections are within the negative or positive interval. For instance, during crises periods, credit growth is negative (albeit temporary), which we mark with (-). We run projections with different 7 cut-off dates. However, no matter, when our projections start, they ALL end in 2018:Q4.

Capital ratio	2004q3	2006q3	2009q3	2010q4	2011q3	2014q4	2015q4
2004q4	0.75	-	-	-	-	-	
2007q4	0	0.35	-	-	-	-	
2009q4	-0.15	-0.05	1.1	-	-	-	
2011q4	-0.1	-0.1	0	0.25	-	-	
2013q4	-0.5	-0.075	-0.1	0	0.1	-	
2015q4	-0.1	-0.05	-0.05	-0.05	0	0.2	1.6
2017q1	0	0	-0.05	-0.05	0	0	0.2
2018q4	0	0	0	-0.05	0	-0.05	0

Credit	2004q3	2006q3	2009q3	2010q4	2011q3	2014q4	2015q4
2005q4	0.1 (+)	-	-	-	-	-	-
2007q4	0.4 (+)	0.1 (+)	-	-	-	-	-
2009q4	0.7 (+)	0.5 (+)	0 (-)	-	-	-	-
2011q4	0.5 (+)	1.7 (+)	0.8 (-)	0.2 (-)	-	-	-
2013q4	0.2 (+)	0.75 (+)	0.75 (-)	0.3 (+)	0 (-)	-	-
2015q4	0 (+)	0 (+)	0.5 (+)	0.25 (+)	0.05 (-)	0.4 (-)	0.2 (-)
2017q1	0 (+)	0 (+)	0.2 (+)	0.2 (+)	0.05 (+)	1 (+)	1.5 (+)
2018q4	0 (+)	0 (+)	0 (+)	0 (+)	0 (+)	1.5 (+)	2 (+)

GDP	2004q3	2006q3	2009q3	2010q4	2011q3	2014q4	2015q4
2005q4	0.2 (+)	-	-	-	-	-	-
2007q4	0.2 (+)	0.3 (+)	-	-	-	-	-
2009q4	0.12 (+)	0.35 (+)	0 (-)	-	-	-	-
2011q4	0.1 (+)	0.25 (+)	0.3 (-)	0.3 (+)	-	-	-
2013q4	0 (+)	0.05 (+)	0.15 (+)	0.3 (+)	0.1 (-)	-	-
2015q4	0 (+)	0 (+)	0 (+)	0.15 (+)	0.1 (+)	0.5 (+)	0 (+)
2017q1	0 (+)	0 (+)	0 (+)	0 (+)	0 (+)	0.6 (+)	0.7 (+)
2018q4	0 (+)	0 (+)	0 (+)	0 (+)	0 (+)	0.3 (+)	1 (+)

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