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# Financial system and real economy : interactions and regulations

Cyril Couaillier

► **To cite this version:**

Cyril Couaillier. Financial system and real economy : interactions and regulations. Economics and Finance. Institut d'études politiques de paris - Sciences Po, 2022. English. NNT : 2022IEPP0046 . tel-04536574

**HAL Id: tel-04536574**

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Institut d'études politiques de Paris  
ÉCOLE DOCTORALE DE SCIENCES PO  
Programme doctoral en économie  
Département d'économie  
Doctorat en sciences économiques

Financial System and Real Economy:  
Interactions and Regulations

Cyril Couaillier

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# Acknowledgements

First of all, I thank Stéphane Guibaud, my supervisor. His support and suggestions were key in the success of this PhD. In particular, his insistence on the necessity to provide clear messages, to be able to explain all details of your settings and to work a lot on slides, down to the type of  $l$  characters to use in mathematical equations, will be remembered. I also strongly appreciated that, contrary to standard Phd student / supervisors relations, he actually visited me in my office at the Banque de France.

I thank H el ene Rey and Mirko Wiederholt for participating to the jury of my PhD and Steven Ongena and Guillaume Vuillemeys for the same reason and for reviewing my thesis. Their research strongly influenced mine and I am honored to have them all in my PhD thesis committee.

I thank Valerio Scalone and Dorian Henricot, who co-authored two chapters of this PhD. I was a pleasure to start my life as a researcher working with them. I remember passionate discussion about the literature on Occasionally Binding Constraints and the interpretation of Modigliani-Miller theorem. Without them, this PhD would not have been the same, of lower quality and definitely less entertaining.

I entered this PhD in SciencesPo while working at the Banque de France, which could have triggered legitimate concerns on both sides. As such, I thank Julien Idier and Aurore Schilte, leads of the Macroprudential Team of the Banque de France, who let me devote part of my time to this research, confident that it could benefit the team. Conversely, I also thank Eymeric Henry, then the Scientific Director of the PhD in Economics program at Sciences Po, who trusted me in producing a valuable PhD while working at the Banque de France.

I thank Carsten Detken, Marco Lo Duca, Evangelia Rentzou, managers of the Macroprudential division of the European Central Bank, and Stephan Fahr, Costanza Rodriguez d'Acri & Markus Behn, my successive team leads there. Their support and trust were particularly important for the third paper of this PhD. More generally, I owe them a lot regarding my integration in the ECB and how to feed my research into policy debates.

I thank the professors at SciencesPo, in particular Nicolas Coeudacier and Guillaume Plantin, who provided me with many precious suggestions regarding the design of my econo-

metric settings and the interpretation of the results.

I must also thank numerous friends and colleagues. An exhaustive list would be very long, but it definitely includes Thomas Ferriere, Silvia Gabrieli, Thomas Garcia, Jan Hajeck, Jemery L'hour, Jan Lang, Clement Mazet-Sonilhac, Cristian Perales, Thibaut Piquart & Alessio Reghezza. Their suggestions and support played an important role in this PhD.

Last but not least, I thank my wife, Aster, my parent Vincent and Laurence and my sisters Madeleine and Sabine. I am unsure whether bank capital regulation and fixed-effects thrill them. However, their support during this PhD and long before means that this thesis is also, in a way, theirs.

# Note to the Reader

The three chapters of this dissertation are self-contained research articles and can be read separately. They are preceded by an introduction which summarizes the research presented in this dissertation. The terms "paper" or "article" are used to refer to chapters. Chapters 1 and 2 are co-authored.

This thesis and the chapters it contains should not be reported as representing the views of the European Central Bank (ECB) or the Banque de France (BdF). The views expressed are those of the authors and do not necessarily reflect those of the ECB nor the BdF.



# Contents

|  |           |
|--|-----------|
| <b>Introduction</b>  | <b>15</b> |
| <b>1 How does Financial Vulnerability amplify Housing and Credit Shocks?</b> | <b>27</b> |
| 1 Introduction . . . . .   | 27        |
| 2 Empirical model . . . . .  | 31        |
| 2.1 Econometric model . . . . .  | 31        |
| 2.2 Shocks identification . . . . .  | 33        |
| 3 Data . . . . .   | 34        |
| 4 Results . . . . .  | 36        |
| 4.1 Housing and credit shocks . . . . .                                      | 36        |
| 4.2 Credit demand and credit supply . . . . .                                | 42        |
| 4.3 Alternative exercise: a unique financial shock . . . . .                 | 44        |
| 4.4 Sensitivity analysis . . . . .   | 46        |
| 5 Conclusion . . . . .   | 48        |
| <b>2 How do markets react to tighter bank capital requirements?</b>          | <b>67</b> |
| 1 Introduction . . . . .   | 67        |
| 2 The CCyB framework . . . . .   | 71        |
| 3 Empirical approach . . . . .   | 73        |
| 4 Data . . . . .   | 74        |
| 5 Results . . . . .  | 77        |
| 5.1 CCyB impact on country-level market variables . . . . .                  | 77        |
| 5.2 CCyB impact on bank CDS spreads . . . . .                                | 77        |
| 5.3 CCyB impact on stock prices . . . . .                                    | 82        |
| 6 Conclusion . . . . .   | 83        |
| A Identification of CCyB announcement dates . . . . .                        | 88        |
| B The CCyB framework in the EEA . . . . .                                    | 89        |
| C Additional tables . . . . .  | 92        |



|          |  |            |
|----------|--|------------|
| <b>3</b> | <b>What are banks' actual capital targets?</b> | <b>101</b> |
| 1        | Introduction . . . . .                         | 101        |
| 2        | Announced banks target CET1 ratios . . . . .   | 104        |
| 2.1      | The use of announced targets . . . . .         | 104        |
| 2.2      | A new dataset of announced targets . . . . .   | 105        |
| 3        | Econometric settings and data . . . . .        | 107        |
| 4        | Results . . . . .                              | 110        |
| 4.1      | Determinants of CET1 targets . . . . .         | 110        |
| 4.2      | Speed of adjustment . . . . .                  | 116        |
| 4.3      | Impact on balance-sheet adjustment . . . . .   | 117        |
| 5        | Conclusion . . . . .                           | 122        |
| A        | Appendix . . . . .                             | 125        |
|          | <b>Conclusion</b>                              | <b>131</b> |
|          | <b>Résumé en Français</b>                      | <b>3</b>   |

# List of Figures

- 1.1 Debt to Service Ratio (DSR) in 3 years difference. Note: the orange line with circles presents the DSR ratios computed by the BIS, in 3-year difference. The blue line with crosses is the transition function from high to low state regimes, obtained in our benchmark estimation with  $c = 0.5$  and  $\theta = 3$ . Grey bars indicate NBER recessions. . . . . 36
- 1.2 Impulse responses of a selection of the endogenous variables to a housing shock. Note. The responses of output growth and equity price growth are cumulated, while the responses for the ratio of investment/output are in levels. The red (green) lines are the impulses when leverage is high (low). Shaded areas represent the 67% confidence intervals. . . . . 38
- 1.3 Impulse responses of a of output growth to a credit shock. Note. The responses of output growth and equity price growth are cumulated, while the responses for the ratio of investment/output are in levels. The red (green) lines are the impulses when leverage is high (low). Shaded areas represent the 67% confidence intervals. . . . . 40
- 1.4 Impulse responses to a credit supply shock. Note: The responses of output growth and equity price growth are cumulated, while the responses for the ratio of investment/output are in levels. The red (green) lines are the impulses when leverage is high (low). Shaded areas represent the 67% confidence intervals. . . . . 43
- 1.5 Impulse responses to a credit demand shock. Note. The responses of output growth and equity price growth are cumulated, while the responses for the ratio of investment/output are in levels. The red (green) lines are the impulses when leverage is high (low). Shaded areas represent the 67% confidence intervals. . . . . 45

|      |  |    |
|------|--|----|
| 1.6  | Impulse responses of our endogenous variables to a financial shock. Note. The responses of output growth and equity price growth are cumulated, while the responses for the ratio of investment/output are in levels. The red (green) lines are the impulses when leverage is high (low). Shaded areas represent the 67% confidence intervals. . . . .   | 47 |
| 1.7  | Robustness with 2-year difference in DSR, for housing (left column) and credit (right column) shocks. Note. The responses of output growth and equity price growth are cumulated, while the responses for the ratio of investment/output are in levels. The red (green) lines are the impulses when leverage is high (low). Shaded areas represent the 67% confidence intervals. . . . .         | 55 |
| 1.8  | Robustness with 5-year difference in DSR, for housing (left column) and credit (right column) shocks. Note. The responses of output growth and equity price growth are cumulated, while the responses for the ratio of investment/output are in levels. The red (green) lines are the impulses when leverage is high (low). Shaded areas represent the 67% confidence intervals. . . . .         | 56 |
| 1.9  | Robustness with DSR in level, for housing (left column) and credit (right column) shocks. Note. The responses of output growth and equity price growth are cumulated, while the responses for the ratio of investment/output are in levels. The red (green) lines are the impulses when leverage is high (low). Shaded areas represent the 67% confidence intervals. . . . .                     | 57 |
| 1.10 | Robustness with DSR from the Fred of Saint Louis, for housing (left column) and credit (right column) shocks. Note. The responses of output growth and equity price growth are cumulated, while the responses for the ratio of investment/output are in levels. The red (green) lines are the impulses when leverage is high (low). Shaded areas represent the 67% confidence intervals. . . . . | 58 |
| 1.11 | Robustness with 3 lags, for housing (left column) and credit (right column) shocks. Note. The responses of output growth and equity price growth are cumulated, while the responses for the ratio of investment/output are in levels. The red (green) lines are the impulses when leverage is high (low). Shaded areas represent the 67% confidence intervals. . . . .                           | 59 |
| 1.12 | Robustness with $\theta = \infty$ , for housing (left column) and credit (right column) shocks. Note. The responses of output growth and equity price growth are cumulated, while the responses for the ratio of investment/output are in levels. The red (green) lines are the impulses when leverage is high (low). Shaded areas represent the 67% confidence intervals. . . . .               | 60 |

|      |  |    |
|------|--|----|
| 1.13 | Robustness with $\theta = 1.5$ , for housing (left column) and credit (right column) shocks. Note. The responses of output growth and equity price growth are cumulated, while the responses for the ratio of investment/output are in levels. The red (green) lines are the impulses when leverage is high (low). Shaded areas represent the 67% confidence intervals. . . . .                                | 61 |
| 1.14 | Robustness with the mortgage debt, for housing (left column) and credit (right column) shocks. Note. The responses of output growth and equity price growth are cumulated, while the responses for the ratio of investment/output are in levels. The red (green) lines are the impulses when leverage is high (low). Shaded areas represent the 67% confidence intervals. . . . .                              | 62 |
| 1.15 | Robustness with CPI core, for housing (left column) and credit (right column) shocks. Note. The responses of output growth and equity price growth are cumulated, while the responses for the ratio of investment/output are in levels. The red (green) lines are the impulses when leverage is high (low). Shaded areas represent the 67% confidence intervals. . . . .                                       | 63 |
| 1.16 | Robustness with CPI, for housing (left column) and credit (right column) shocks. Note. The responses of output growth and equity price growth are cumulated, while the responses for the ratio of investment/output are in levels. The red (green) lines are the impulses when leverage is high (low). Shaded areas represent the 67% confidence intervals. . . . .  | 64 |
| 1.17 | Robustness with the Shadow Short Term rate from Wu, Xia (2016), for housing (left column) and credit (right column) shocks. Note. The responses of output growth and equity price growth are cumulated, while the responses for the ratio of investment/output are in levels. The red (green) lines are the impulses when leverage is high (low). Shaded areas represent the 67% confidence intervals. . . . . | 65 |
| 1.18 | Robustness with the Federal Fund Rate, for housing (left column) and credit (right column) shocks. Note. The responses of output growth and equity price growth are cumulated, while the responses for the ratio of investment/output are in levels. The red (green) lines are the impulses when leverage is high (low). Shaded areas represent the 67% confidence intervals. . . . .                          | 66 |
| 2.1  | CCyB levels over time for the 15 countries having activated (in %) . . . . .   | 75 |

|     |  |     |
|-----|--|-----|
| 2.2 | Median cumulated abnormal changes in CDS spreads around CCyB hikes<br><i>Note:</i> Green (red) line indicates median the cumulated abnormal change in CDS spread for (un)affected banks, in basis points. (Un)affected banks are banks receiving a strictly positive (null) CCyB shock on announcement days. CCyB announcements with overlapping event windows are excluded. . . . . | 79  |
| 2.3 | Pooled distribution of bank CET1 ratios by level of residence country proactiveness in increasing the CCyB. . . . .  | 82  |
| 2.4 | Stacking order of capital requirements, and sanctions for breaching . . . . .  | 91  |
| 3.1 | Examples of announced target CET1 ratios . . . . .   | 107 |
| 3.2 | Banks' target CET1 ratios - % . . . . .  | 107 |
| 3.3 | Distance of banks CET1 ratios to targets . . . . .   | 108 |
| 3.4 | Comparison of long term elasticities - announced targets and partial adjustment models . . . . .   | 115 |
| 3.5 | Comparison of fit quality - announced targets and partial adjustment models  | 115 |

# List of Tables

|      |   |     |
|------|---|-----|
| 1.1  | The table presents the sign restrictions assumed on the reaction on impact of endogenous variables (column) to identify the structural shocks shocks (row). When the space is empty, the response is left unrestricted. . . . . | 54  |
| 1.2  | The table presents the sign restrictions assumed on the reaction on impact of endogenous variables (column) to identify the structural shocks shocks (row). When the space is empty, the response is left unrestricted. . . . . | 54  |
| 1.3  | The table presents the sign restrictions assumed on the reaction on impact of endogenous variables (column) to identify the structural shocks shocks (row). When the space is empty, the response is left unrestricted. . . . . | 54  |
| 2.1  | Impact of CCyB increases on domestic variables . . . . .  | 78  |
| 2.2  | Impact of CCyB increases on bank CDS spreads . . . . .  | 80  |
| 2.3  | Impact of CCyB increases on bank CDS spreads - bank characteristics . . .   | 81  |
| 2.4  | Impact of CCyB increases on bank stock returns . . . . .  | 84  |
| 2.5  | Summary statistics of country-level CCyB changes in the sample . . . . .  | 92  |
| 2.7  | Impact of CCyB increases on bank CDS spreads delta in pp . . . . .  | 93  |
| 2.6  | Bank summary statistics . . . . .   | 93  |
| 2.8  | Robustness to alternative specifications for normal CDS spread variations . .   | 94  |
| 2.9  | Robustness to alternative specifications for normal CDS spread variations . .   | 95  |
| 2.10 | Persistence of the impact of CCyB increases on bank CDS spreads . . . . .   | 95  |
| 2.11 | Robustness to using different samples of CDS depending on their liquidity .   | 96  |
| 2.12 | Impact of announcements of no CCyB change on bank CDS spreads . . . . .   | 97  |
| 2.13 | Robustness to removing one by one the dates of CCyB increases . . . . .   | 98  |
| 2.14 | Placebo test . . . . .  | 99  |
| 2.15 | Impact of CCyB increases on bank CDS spreads depending on country proac-<br>tiveness . . . . .  | 99  |
| 2.16 | Impact of CCyB increases on bank stock returns - bank characteristics . . .   | 100 |
| 3.1  | Determinants of target CET1 ratio . . . . .   | 111 |

|     |  |     |
|-----|--|-----|
| 3.2 | Speed of adjustment . . . . .  | 117 |
| 3.3 | Impact of distance to target . . . . .   | 119 |
| 3.4 | Impact of distance to target - Sign-dependent effect . . . . .                   | 120 |
| 3.5 | Impact of distance to target, robustness with distance to requirements . . . . . | 121 |
| A1  | Summary statistics . . . . .   | 125 |
| A2  | Correlation Matrix . . . . .   | 126 |
| A3  | Speed of adjustment . . . . .  | 127 |
| A4  | Impact of distance to target - preCovid . . . . .                                | 128 |
| A5  | Impact of distance to target - with time fixed effects . . . . .                 | 129 |
| A6  | Impact of distance to target - pooled regressions without intercept . . . . .    | 130 |

# Introduction

The Great Financial Crisis was a painful reminder of the damage an unstable financial system can cause to the real economy. Such an unstable financial system can favor the apparition of *systemic risk*, i.e. "*the risk that financial instability becomes so widespread that it impairs the functioning of a financial system to the point where economic growth and welfare suffer materially*" (ECB (2009)). In reaction, financial regulators have developed indicators to monitor the development of systemic risks and have designed regulatory tools to mitigate the increase of such risk and improve the resilience of the financial systemic against their materialisation. Simultaneously, such issues have raised renewed interest from economists, to support policymakers regarding the theoretical and empirical design of the new regulation.

This PhD thesis contributes to the three main components of financial regulation: first the estimation of systemic risk, second the calibration of adequate policy instruments and third the *ex post* evaluation of their impact. Chapter 1 contributes to the first step, chapters 2 and 3 to the second and third ones.

The contribution of Chapter 1 consists in investigating how the macroeconomic impact of credit supply, credit demand and housing shocks varies with the household indebtedness. Households' financial vulnerability substantially affects the propagation of financial shocks. Whether those shocks originate in the housing sector or from credit supply or credit demand is key to determine their state effect and the appropriate policy response (e.g. adjustment in housing production, change in bank capital requirements or in limits of borrowers indebtedness respectively). Through the lens of an empirical non-linear macroeconomic model applied to the US economy, we study how the impulse responses of housing and credit shocks vary according to the evolution households' debt burden. Under high vulnerability, only housing shocks are amplified and their state effect is in line with economic theory. Conversely, expansionary credit supply shocks have more effect when vulnerability is low, whereas their effect turns strongly recessionary when vulnerability is high, suggesting debt overhang.

In Chapter 2, we investigate how investors reacts to announced changed in bank capital requirements. We use hikes in the countercyclical capital buffer [CCyB] to measure how



markets react to tighter bank capital requirements. Our identification strategy relies on two unique features of the CCyB institutional framework in Europe. First, all national authorities make quarterly announcements of CCyB rates. Second, these hikes affect all European banks proportionally to their exposure to the country of activation. We show that CCyB hikes translate in lower CDS spreads for affected banks, in particular those with lower capital ratios. On the other hand, bank valuations do not react. Markets therefore consider that higher countercyclical capital requirements make banks more stable at no material cost for shareholders. We claim that these effects relate to the capital constraint itself, as opposed to the potential signal conveyed on the state of the financial cycle. Those results suggest that there is scope for further use of the CCyB to enhance banks' solvency at no significant cost for shareholders.

Chapter 3 investigates how banks set their target capital ratio and how they adjust to reach it. This paper answers these questions using an original dataset of capital ratio targets directly announced to investors by European banks, materially improving data quality compared to usual estimated implicit target. It provides the following key lessons. First, targets are affected by capital requirements and a procyclical behavior consistent with market pressure. Second, banks do not distinguish between the different types of capital requirements for setting their targets, suggesting weak usability of the regulatory buffers. Third, the distance between actual CET1 ratio and the target is a valuable predictor of future balance-sheet adjustment, suggesting that banks actively drive their capital ratios toward their announced targets, through capital accumulation and portfolio rebalancing. Fourth, this adjustment occurs both above and below targets, but banks below target adjust faster, suggesting stronger pressure. These results provide important lessons for policymakers regarding the design of the prudential framework and the effectiveness of countercyclical policies.

I now present in more details the chapters composing this PhD.

## **Chapter 1: How does Financial Vulnerability amplify Housing and Credit Shocks?**

Household indebtedness is a key driver of financial stability and a well-known amplifier of financial crises (Jordà et al. (2013); Mian et al. (2017))

In particular, their Debt Service Ratio (thereafter DSR), i.e. the share of their income that households use every period to pay back their debt, is a key indicator of their financial resilience. It is likely that the same credit shock does not have the same impact when households have low debt repayments and thus ample financial slack than when there are

already on the verge of over-indebtedness. By the same token, a housing shock, due for instance to a higher preference for housing, is likely to have a larger impact when households have large financial capacities to finance house purchase.

In this paper, we separate housing and credit shocks and investigate how their impact varies with households indebtedness cycle. For this purpose, we use a Smooth-Transition Local Projection, in which the impact of a shock depends on the 3-year change in households' Debt Service Ratio. We identify credit and housing shocks with sign restrictions, using the setting proposed by Furlanetto et al. (2017). We estimate the model on US data for the period 1983 to 2019. We uncover three main results.

First, high indebtedness amplifies the response of housing shocks, whereas it does not amplify credit demand shocks. This asymmetry in indebtedness state effects is consistent with the theoretical findings in Justiniano et al. (2015)). In their macroeconomic model, agents are subject to a borrowing constraint and can borrow only up to fraction of their collateral. If collateral value increases because of an housing shock, so does the debt limit: agents will be able to increase their leverage and spend more, activating a collateral channel that amplifies the initial fluctuation. Instead, when a credit demand shock hits the economy, borrowers will buy more houses, whereas savers will buy less, triggering a redistribution of housing from savers to borrowers, without generating a substantial increase in house prices and in the debt limit.

Our second key result states that expansionary credit supply shocks have positive impact under low vulnerability, but prove detrimental on the medium term when vulnerability is high. Under low vulnerability, the effects on output of a credit supply shock is positive and persistent, while the debt/house ratio remains overall constant throughout the projection, in line with the fact that house prices and debt positively co-move in response to the shock. Instead, high debt burden overturns the initial positive effects of expansionary credit shocks, producing negative cumulated effects on output, few quarters after the shock arrival. The fact that that an expansionary credit supply shock has more persistent effect under low vulnerability recalls the finding in Justiniano et al. (2019). In their model when indebtedness is low and lending constraints are binding, an increase in lending capacity expands credit and triggers a positive co-movement of lending and house prices. Instead, when indebtedness is high, lending constraints are not necessarily binding, reducing the expansionary effect of the credit supply shock. In our estimation we find that, if anything, under high debt burden, an expansionary credit supply shock ends up having a recessionary effect consistently with a story of debt overhang, which induces over-indebted agents to deleverage when their debt burden is too high.

In an alternative exercise, we repeat our estimation without disentangling housing and

credit shocks and we find that the undistinguished financial shock exhibits relevant state effects similar to the housing shock. This exercise highlights our contribution with respect to the empirical literature which detect non-linear effects for financial shocks (Carriero et al. (2018); Colombo and Paccagnini (2020); Cheng and Chiu (2020); Barnichon et al. (2016)). These works do not disentangle financial shocks into housing and credit shocks and find that exogenous variations in credit conditions are amplified in crisis time. To this extent, our paper contributes to this literature showing how state effects differ across the different types of financial shocks.

## **Chapter 2: How do markets react to tighter bank capital requirements?**

The Great Financial Crisis (GFC) highlighted the need for sufficient bank capital, as banking crises and their companion credit crunches are particularly damaging to the real economy. Consequently, the main regulatory response to the GFC consisted in a large increase in bank capital requirements. Their optimal level is however subject to an ongoing debate among academics and policymakers. While higher requirements are associated with more resilience, they can also induce an inefficient reduction in lending (see for instance Van den Heuvel (2008), Repullo and Suarez (2012), Clerc et al. (2015), Mendicino et al. (2018), Malherbe (2020)). As such, it is key for regulators to strike the appropriate balance between the benefits of more stable banks and the costs of more expensive capital. In this study, we use the institutional setup of the countercyclical capital buffer (CCyB) in the European Economic Area (EEA), in an event-study framework, to assess how financial markets perceive the costs and benefits of higher capital requirements.

The CCyB is a time-varying bank capital requirement introduced in Basel III and adapted in European regulation, that provides two attractive features for such study. To start with, CCyB levels are homogeneous decisions announced quarterly at the national level, and we can precisely identify announcement dates thanks to press releases. This allows for an event study approach. If announcements were partially anticipated, our estimates would simply be conservative. In contrast, changes to the regulatory framework typically result from years of negotiation, and are largely anticipated. These agreements typically consist in one-off regulatory changes, making it difficult to disentangle the effect of potentially numerous innovations, or to ensure external validity. Since then, the Basel III framework introduced other bank-specific capital requirements, but their computation is often mechanical (e.g. for Global and Other Systemic Banks) and thus easy to anticipate, and/or without a proper

communication framework to the markets.<sup>1</sup> Second, the CCyB rate in a given country applies to all banks of the EEA proportionally to the share of that country in their total (relevant) exposures. Consequently, each shock heterogeneously impacts all banks of the EEA, allowing for cross-sectional studies.

CCyB increases could trigger market reactions through two channels. First, they reveal private information that the national regulator may hold on the state of the economy when setting the rate. The interpretation of such signal is *a priori* ambiguous. Macroprudential authorities typically raise the CCyB when the economy is in good shape, but also when financial risks are building up. We label this the *signalling channel*. The second channel relates to the requirement itself, that tightens the capital constraint, potentially forcing banks to adjust their balance sheet. We label this the *capital channel*. Disentangling both channels is key to appropriately interpret results in terms of costs and benefits.

We proceed in three steps.

First, we investigate the impact of CCyB hikes on country-level variables, namely stock indices and sovereign CDS. We find no significant impact: country-level variables do not systematically react to country-level CCyB increases. This is inconsistent with the *signalling channel* and suggests that any impact is likely to transit through the *capital channel*.

Second, we show that the announcement of a national CCyB hike translates into lower CDS spreads for banks exposed to this country. Markets thus recognize that capital requirements improve bank solvency, consistent with studies highlighting their effect on capital ratios (Alfon et al. (2005)) and risk-taking (Behncke et al. (2020)). The effect is more pronounced for banks with lower capital ratios and higher risk. Indeed, we find a larger spread decrease of banks below the CET1 ratio distribution median, and symmetrically above the CDS spread distribution median. The interpretation is twofold. Markets anticipate more constrained banks to be more likely to adjust their balance sheet towards higher capital ratios, and higher capital ratios have larger effects on solvency for riskier and less capitalised banks.

Finally, we show that CCyB increases are not associated with any stock return regularity. This, in conjunction with the decline in CDS spreads, is again inconsistent with the *signalling channel*: good economic news lowering CDS spreads should also increase stock value. This confirms the activation of the *capital channel*, but in a way that has no significant impact on stock prices. Strong stock prices may be beneficial for a regulator, if they reflect the

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<sup>1</sup>In the European Banking Union, the bank-specific Pillar 2 Guidance is confidential, and the Single Supervisory Mechanism publishes bank-specific Pillar 2 Requirements applying to Significant Institutions only since 2020. See <https://www.bankingsupervision.europa.eu/banking/srep/html/p2r.en.html>. Finally, the UK had pre-GFC bank-specific, time-varying requirement, which has been the focus of Alfon et al. (2005) or Francis and Osborne (2012), but these requirements were confidential.

absence of an inefficient reduction in lending, or if they strengthen domestic banks' ability to raise equity or resist foreign takeovers. The absence of negative stock price reaction would also suggest that the CCyB announcement is well understood by the markets, an important attention point for prudential authorities. Therefore, we interpret the absence of stock price reaction as evidence that CCyB increases have only muted undesirable effects.

From a policy perspective, our results suggest that macroprudential authorities had room for a more active use of the CCyB to increase bank resilience, while not adversely affecting bank valuations.

To the best of our knowledge, our setup allows us to make the first direct empirical estimation of the impact of capital requirement announcements on financial markets.

### **Chapter 3: What are banks' actual capital targets?**

Setting the capital structure is a key step of business management, in particular for banks. Indeed, authorities impose a range of capital requirements banks must comply with, while maturity transformation and, more generally, asset-liability management are at the heart of their business models. As such, investigating banks' target capital ratios, their determinants and their impact on banks' future behavior is a key area of financial research.

Indeed, banks' capital ratios are key drivers of their lending policy and, more generally, of their strategic decisions (Berrospide et al. (2010)). Most of the capital requirements of the European and American banking regulations are expressed in terms of the CET1 ratio, i.e. the ratio of Common Equity Tier 1, the purest form of capital consisting mostly of issued equity and retained earnings, over Risk Weighted Assets (RWA), which corresponds to a bank's Total Original Exposures (TOE) weighted by their estimated risks. The CET1 ratio is also the main capital ratio used by investors to assess a bank's solvency. As such, the distance between a bank's actual CET1 ratio and its target can be an important predictor of its future balance-sheet adjustment. Indeed, a bank below (above) its target should act to increase (reduce) its CET1 ratio, through three main channels: its stock of CET1, its TOE and its Risk Weight density, the ratio between RWA and TOE. First, it can increase its stock of CET1 by improving its profitability, by issuing equity or by diminishing its capital payouts (dividends and share buybacks). Second, it can reduce the size of its total exposures at constant outstanding CET1. Finally, at constant asset size, it can rebalance its portfolio toward safer assets to reduce risk weight density and thus RWA. On the contrary, a bank above its target can return capital to investors through larger payouts, increase its balance-sheet or rebalance it toward riskier assets.

In turn, (target) capital structure has strong normative implications, affecting the effec-

tiveness of public measures, either directly, for prudential policies (Aiyar et al. (2016)), or indirectly, for the channelling of monetary policy (Gambacorta and Shin (2018)). In particular, regarding capital requirements, the Great Financial Crisis (GFC) has highlighted the need for banks being sufficiently capitalised to weather a systemic crisis, and hence the use of countercyclical prudential policies to mitigate procyclical bank reactions and credit rationing during crisis. Consequently, the Basel III reform of international financial regulation has introduced two new types of instruments. First, it creates *usable* buffers, i.e. requirements that banks must meet in normal times but which they can on which they can draw in case of trouble. Second, it has introduced a time-varying countercyclical capital requirement. Regulators can increase it during the expansionary phase of the financial cycle to create a "*prudential space*". They can then relax it during crisis to support credit supply without endangering banks solvency (see, among others, Jiménez et al. (2017) for empirical evidence of the effectiveness of countercyclical requirements and Dewatripont and Tirole (2012) for theoretical rational). Nevertheless, this strategy crucially depends on banks' reaction to capital requirements and the macroeconomic environment. Should banks not react to change in capital requirements, or treat usable buffers as hard requirements, this would impede the countercyclical objective of the regulatory framework. On the contrary, market pressure could force banks to procyclically target higher capital ratios during crisis, leading to credit rationing.

How do banks set their capital ratio targets? Do those targets inform us on banks' future behaviour? I answer those questions using an original dataset of targets that European banks publicly announce as part of their investor communication. Since the seminal paper of Flannery and Rangan (2008), the literature has relied on partial adjustment models to estimate unobserved banks' capital targets (based on the evolution of actual capital ratios) and, in turn, assess banks' adjustment toward their targets. Exploiting announced targets instead provides several key advantages. First, it allows for directly regressing an observed variable rather than estimating an unobserved one, typically producing much more accurate estimations. Second, it explicitly disentangles shocks affecting only the capital ratio from those affecting the target itself. Third, it breaks the link between the estimations of target determinants and adjustment toward targets, as the latter step does not rely on the estimations produced in the former. As such, estimation errors are not compounded. To the best of my knowledge, this is the first paper exploiting a dataset of *observed* bank capital targets.

I first investigate target determinants. Using partial adjustment models, Berger et al. (2008) show that American banks hold excess capital on top of regulatory requirements and adjust quickly when poorly capitalised. Using a sample of American and European banks, Gropp and Heider (2010) find that deposit insurance and capital requirements played

a secondary role in explaining capital ratios in 1991-2004, which rather converged toward bank-specific, time invariant levels. De Jonghe and Öztekin (2015) and Bakkar et al. (2019) find similar results, based on an international sample of banks. This paper contributes to this literature by removing the need for partial adjustment model, using instead observed targets, allowing for a more precise estimate of the drivers of the targets and the speed of adjustment. Moreover, this paper also investigates the differentiated impact of the distinct components of the capital requirements stack introduced by the Basel III reform. This informs in particular on the usability of the regulatory buffers, that are designed to be drawn on by troubled banks at the cost of restriction on capital payout, acting as a countercyclical cushion during crisis. A lower coefficient for those buffers than for stricter requirements would indicate that banks see lower cost in breaching the former, suggesting willingness to dip into them in case of need. To the best of my knowledge, this is the first paper to investigate this issue. I uncover two key target determinants . First, capital requirement have a material but lower than unity impact on target: banks do not adjust one for one to change in capital requirements, suggesting that they balance the risk of breaching requirements with their perceived costs of having a high capital ratio. Importantly, this impact is not significantly different for the diverse components of the capital requirements stack. This suggests that banks do not distinguish between hard and usable requirements, impeding the countercyclical objective of the regulatory framework. Second, targets are procyclical, as a fall in expected GDP growth tends to increase targets. This is consistent with banks being under pressure and trying to reassure investors regarding their solvency in adverse time.

Then, I show that capital targets contain important information on the future evolution of banks' balance-sheet, exploring the speed and channels of adjustment toward targets. At the macroeconomic level, a strand of the literature aggregates individual bank-level distances to (estimated) targets into a single representative time series fed into macroeconometric models. Mésonnier and Stevanovic (2017) find that large shocks to such macroeconomic distance to capital target explain a large part of the variance in credit to business and real activities. At the micro level, De Jonghe and Öztekin (2015) find that banks increase their capital ratios toward target through equity growth rather than balance-sheet reduction. Using monthly German data, Memmel and Raupach (2010) confirm that the most important contribution to adjustment comes from the liability side, despite faster adjustment on the asset side. Bakkar et al. (2019) find that Systemically Important Financial Institutions (SIFI) adjust differently than other banks and Maurin and Toivanen (2012) that banks adjust proportionally more their security holdings than their loans to reach their targets. Removing the need to estimate unobserved targets, I find that banks are serious about the targets they announce. This adjustment occurs whatever the initial sign of the distance to target, but it is substantially

faster for banks below their targets, in line with strong pressure from investors to protect the franchise value and avoid costly regulatory breach. Most of the adjustment occurs through their stock of capital, in line with De Jonghe and Öztekin (2015) and Memmel and Raupach (2010). Nevertheless, about one third of the adjustment occurs through asset side management via RWA reduction, mostly thanks to portfolio shift. In particular, banks adjust their Non-Financial Corporate (NFC) credit exposures, which typically carry high risk weights. Moreover, banks below their targets tend to reduce Non-Performing Exposure (NPE) recognition. Those results raise concerns regarding procyclical behaviour during crisis, when banks suffer losses and tend to announce higher targets, as this suggest that they delay loss recognition and procyclically cut on NFC credit supply to plug the gap when firms need credit the most. On the flip side, it suggests that reducing capital requirements in crisis time would have a strong expansionary effect by reducing capital targets.

Those results provide key lessons for policymakers regarding the impact of capital requirements on targets, and, in turn, the effectiveness of the regulatory framework. This paper suggests that banks do not consider regulatory buffers to be *usable*, contrary to the intention of the regulator, as the framework was designed for banks to draw on buffers during a crisis in order to absorb losses rather than cutting credit supply. However, *releasable* buffers could mitigate banks' procyclical behaviour, as a countercyclical reduction in requirements can lower CET1 ratio targets, offset banks tendency to increase targets in crisis time. By reducing targets, this would encourage banks to increase credit supply, in particular corporate credit. Finally, monitoring banks' announced targets and the distance between their targets and actual CET1 ratios would inform on banks' future behaviour, thus informing policymakers when setting monetary or prudential policies.



# References

- Aiyar, S., Calomiris, C. W., and Wieladek, T. (2016). How does credit supply respond to monetary policy and bank minimum capital requirements? *European Economic Review*, 82:142–165.
- Alfon, I., Argimón Maza, I., and Bascuñana-Ambrós, P. (2005). How individual capital requirements affect capital ratios in uk banks and building societies. *Documentos de trabajo/Banco de España*, 0515.
- Bakkar, Y., De Jonghe, O., and Tarazi, A. (2019). Does banks’ systemic importance affect their capital structure and balance sheet adjustment processes? *Journal of Banking & Finance*, page 105518.
- Barnichon, R., Matthes, C., and Ziegenbein, A. (2016). Assessing the non-linear effects of credit market shocks. *CEPR Discussion Paper No. DP11410*.
- Behncke, S. et al. (2020). Effects of macroprudential policies on bank lending and credit risks. Technical report, Swiss National Bank.
- Berger, A. N., DeYoung, R., Flannery, M. J., Lee, D., and Öztekin, Ö. (2008). How do large banking organizations manage their capital ratios? *Journal of Financial Services Research*, 34(2-3):123–149.
- Berrospeide, J. M., Edge, R. M., et al. (2010). The effects of bank capital on lending: What do we know, and what does it mean? *International Journal of Central Banking*, 6(34):1–50.
- Carriero, A., Galvao, A. B., and Marcellino, M. (2018). Credit conditions and the effects of economic shocks: Amplification and asymmetries. *Economic Modelling and Forecasting Group*.
- Cheng, C. H. J. and Chiu, C.-W. (2020). Nonlinear effects of mortgage spreads over the business cycle. *Journal of Money, Credit and Banking*, 52(6):1593–1611.

- Clerc, L., Derviz, A., Mendicino, C., Moyen, S., Nikolov, K., Stracca, L., Suarez, J., and Vardoulakis, A. P. (2015). Capital Regulation in a Macroeconomic Model with Three Layers of Default. *International Journal of Central Banking*, 11(3):9–63.
- Colombo, V. and Paccagnini, A. (2020). Does the credit supply shock have asymmetric effects on macroeconomic variables? *Economics Letters*, 188:108958.
- De Jonghe, O. and Öztekin, Ö. (2015). Bank capital management: International evidence. *Journal of Financial Intermediation*, 24(2):154–177.
- Dewatripont, M. and Tirole, J. (2012). Macroeconomic shocks and banking regulation. *Journal of Money, Credit and Banking*, 44:237–254.
- ECB (2009). The concept of systemic risk. *Financial Stability Review*, pages 134–142.
- Flannery, M. J. and Rangan, K. P. (2008). What caused the bank capital build-up of the 1990s? *Review of Finance*, 12(2):391–429.
- Francis, W. B. and Osborne, M. (2012). Capital requirements and bank behavior in the uk: Are there lessons for international capital standards? *Journal of Banking & Finance*, 36(3):803–816.
- Furlanetto, F., Ravazzolo, F., and Sarferaz, S. (2017). Identification of financial factors in economic fluctuations. *The Economic Journal*, 129(617):311–337.
- Gambacorta, L. and Shin, H. S. (2018). Why bank capital matters for monetary policy. *Journal of Financial Intermediation*, 35:17–29.
- Gropp, R. and Heider, F. (2010). The determinants of bank capital structure. *Review of finance*, 14(4):587–622.
- Jiménez, G., Ongena, S., Peydró, J.-L., and Saurina, J. (2017). Macroprudential policy, countercyclical bank capital buffers, and credit supply: Evidence from the spanish dynamic provisioning experiments. *Journal of Political Economy*, 125(6):2126–2177.
- Jordà, Ò., Schularick, M., and Taylor, A. M. (2013). When credit bites back. *Journal of Money, Credit and Banking*, 45(s2):3–28.
- Justiniano, A., Primiceri, G. E., and Tambalotti, A. (2015). Household leveraging and deleveraging. *Review of Economic Dynamics*, 18(1):3–20.
- Justiniano, A., Primiceri, G. E., and Tambalotti, A. (2019). Credit supply and the housing boom. *Journal of Political Economy*, 127(3):1317–1350.

- Malherbe, F. (2020). Optimal capital requirements over the business and financial cycles. *American Economic Journal: Macroeconomics*, 12(3):139–74.
- Maurin, L. and Toivanen, M. (2012). Risk, capital buffer and bank lending: a granular approach to the adjustment of euro area banks. *ECB working paper*.
- Memmel, C. and Raupach, P. (2010). How do banks adjust their capital ratios? *Journal of Financial Intermediation*, 19(4):509–528.
- Mendicino, C., Nikolov, K., Suarez, J., and Supera, D. (2018). Optimal dynamic capital requirements. *Journal of Money, Credit and Banking*, 50(6):1271–1297.
- Mésonnier, J.-S. and Stevanovic, D. (2017). The macroeconomic effects of shocks to large banks' capital. *Oxford Bulletin of Economics and Statistics*, 79(4):546–569.
- Mian, A., Sufi, A., and Verner, E. (2017). Household debt and business cycles worldwide. *The Quarterly Journal of Economics*, 132(4):1755–1817.
- Repullo, R. and Suarez, J. (2012). The Procyclical Effects of Bank Capital Regulation. *The Review of Financial Studies*, 26(2):452–490.
- Van den Heuvel, S. J. (2008). The welfare cost of bank capital requirements. *Journal of Monetary Economics*, 55(2):298–320.

# Chapter 1

## How does Financial Vulnerability amplify Housing and Credit Shocks?

*This chapter is based on a paper co-authored with Valerio Scalone (ECB)*

### Abstract

Households' financial vulnerability substantially affects the propagation of financial shocks. Whether those shocks originate in the housing sector or in the credit sector is key to determine their state effect. Through the lens of an empirical non-linear macroeconomic model, we study how the impulse responses of housing and credit shocks vary according to the evolution households' debt burden. Under high vulnerability, only housing shocks are amplified and their state effect is in line with economic theory. Conversely, expansionary credit supply shocks have more effect when vulnerability is low, whereas their effect turns strongly recessionary when vulnerability is high.

## 1. Introduction

Households' indebtedness is key to explain the large cost of financial crises (Jordà et al. (2013); Mian et al. (2017)). In macroeconomic models with financial frictions, debt plays the role of financial accelerator: a tightening in financial conditions modifies borrowing capacity of indebted agents, who are forced to reduce their spending, amplifying the initial fluctuation (Kiyotaki and Moore (1997); Guerrieri and Iacoviello (2017)). In line with these structural models, a set of empirical works finds evidence that the effect of a tightening in credit conditions is amplified during crisis time (Cheng and Chiu (2020); Barnichon et al. (2016); Carriero et al. (2018)). However, these empirical works generally detect these state effects only focusing on a unique type of financial shock, without considering whether the tightening in financial conditions originates from an exogenous variation in collateral valuation (i.e. housing shock), from changes in borrowing conditions (credit demand shock), or from changes in credit sector capacity to supply lending (credit supply shock).

Nevertheless, the seminal contributions of Justiniano et al. (2015, 2019)) show that taking

into account the different origin of the financial shocks is key to determine how they are amplified by current financial conditions. First, housing shocks are more likely to be amplified when indebtedness is high and borrowers decisions are directly related to the valuation of their collateral (i.e. when the borrowing constraint is binding). Second, credit supply shocks have more impact when lenders' supply of debt is constrained by regulatory and technological limits (i.e. when lenders constraint binds).

How does financial vulnerability amplify housing and credit shocks? Does distinguishing financial shocks according to their origin matters to determine their state effects, as suggested by Justiniano et al. (2015, 2019)? To the best of our knowledge, this paper is the first one to jointly assess state effects for housing, credit demand and credit supply shocks. The main message of this paper is that the distinction between those shocks is key in detecting state effects related to financial vulnerability.

The first relevant result is that high indebtedness amplifies the response of housing shocks, whereas it does not amplify credit demand shocks. This detected asymmetry concerning state effects across indebtedness is consistent with the theoretical findings in Justiniano et al. (2015)). In their macroeconomic model, agents are subject to a borrowing constraint and can borrow only up to fraction of their collateral. If collateral value increases because of an housing shock, so does the debt limit: agents will be able to increase their leverage and spend more, activating a collateral channel that amplifies the initial fluctuation. Instead, when a credit demand shock hits the economy, borrowers will buy more houses, whereas savers will buy less, triggering a redistribution of housing from savers to borrowers, without generating a substantial increase in house prices and in the debt limit.

Our second key result states that expansionary credit supply shocks have positive impact under low vulnerability, but prove detrimental on the medium term when vulnerability is high. Under low vulnerability, the effects on output of a credit supply shock is positive and persistent, while the debt/house ratio remains overall constant throughout the projection, in line with the fact that house prices and debt positively co-move in response to the shock. Instead, high debt burden overturns the initial positive effects of expansionary credit shocks, producing negative cumulated effects on output, few quarters after the shock arrival. The fact that that an expansionary credit supply shock has more persistent effect under low vulnerability recalls the finding in Justiniano et al. (2019). In their model when indebtedness is low and lending constraints are binding, an increase in lending capacity expands credit and triggers a positive co-movement of lending and house prices. Instead, when indebtedness is high, lending constraints are not necessarily binding, reducing the expansionary effect of the credit supply shock. In our estimation we find that, if anything, under high debt burden, an expansionary credit supply shock ends up having a recessionary effect consistently with

a story of debt overhang, which induces over-indebted agents to deleverage when their debt burden is too high.

In an alternative exercise, we repeat our estimation without disentangling housing and credit shocks and we find that the undistinguished financial shock exhibits relevant state effects similar to the housing shock. This exercise highlights our contribution with respect to the empirical literature which detect non-linear effects for financial shocks (Carriero et al. (2018); Colombo and Paccagnini (2020); Cheng and Chiu (2020); Barnichon et al. (2016)). These works do not disentangle financial shocks into housing and credit shocks and find that exogenous variations in credit conditions are amplified in crisis time. To this extent, our paper contributes to this literature showing how state effects differ across the different types of financial shocks.

Many theoretical models study the non-linear propagation of different types of financial shocks (He and Krishnamurthy (2013); Guerrieri and Iacoviello (2017); Maffezzoli and Monacelli (2015)), but few structural models jointly study non-linear propagation of housing and credit shocks. Jensen et al. (2020) find very similar amplification effects for both shocks when agents are constrained. Conversely, Justiniano et al. (2015, 2019) who, in more stylised frameworks, find opposite results. We contribute to this literature by providing empirical results in line with the modelling features by Justiniano et al. (2019), who consider both borrowing and lending constraints. This rich interaction between the origin of financial shocks and their amplification through indebtedness is instead overall missing in macroeconomic models featuring borrowing constraints as unique financial friction.

Our analysis is based on on a non-linear econometric model on US data by using Local Projections (LP, Jordà (2005)) with state effects. The empirical model is a multivariate version of the Smooth Transition Local Projection model (ST-LP, Auerbach and Gorodnichenko (2013)). The non-linear structure of the model allows to take into account the smooth transition of the economy from one state to another, in our case high debt burden and low debt burden. The multivariate structure allows us to use standard identification techniques originally introduced for the VAR approach. From a methodological point of view, to the best of our knowledge, we are the first ones to use: i) ST-LP in a multivariate framework and ii) to apply sign restrictions in a local projection setting, in order to recover structural shocks in line this theoretical literature. To this extent, the seminal work by Plagborg-Møller and Wolf (2021) theoretically backs the use of structural identification strategies initially conceived for SVAR into a Local projection framework.

Our model includes real, financial and monetary variables. Through sign restrictions, we jointly identify a wide set of structural shocks: financial shocks (housing, credit shocks), monetary shocks and real shocks (aggregate demand, aggregate supply, investment shocks).

In line with the sign restrictions strategy by Furlanetto et al. (2017), the ratio between debt stock and houses value is used to disentangle housing from credit shocks, in that an expansionary credit (housing) shock has a positive (negative) impact on this ratio.<sup>1</sup> The house/ratio credit provides also information on the co-movement between house and credit: if after a financial shock hitting one of the two elements, the ratio remains constant, this implies that housing and credit co-move, hinting to a financial accelerator phenomenon. If the ratio significantly move, housing and credit are decoupled signalling that the financial accelerator is somewhat less at play. In a second specification, we further disentangle credit demand shocks from credit supply shocks, by restricting the response on impact of the mortgage rate, in that an expansionary demand (supply) shock has a positive (negative) effect on the mortgage rate. Together with Furlanetto et al. (2017), other works propose several identification strategies, based on Cholesky ordering or sign restrictions, in order to study jointly the propagation of credit and housing shocks (Musso et al. (2011); Walentin (2014); Gambetti and Musso (2017)) Our paper contributes to this literature, by applying a structural identification strategy in a non-linear framework. Our state-dependent effects show that certain features of the housing and credit shocks propagation depend on financial vulnerability. In particular, Furlanetto et al. (2017) find that an expansionary credit supply shock has a recessionary impact in the medium term. Thanks to our non-linear specification, we find that this holds only when financial vulnerability is high. Besides, in this literature, the housing shock has a positive effect on output. To this extent, we find that taking into account the level of vulnerability is crucial to assess the impact of the shock.

To measure debt burden, we use Households' Debt Service Ratio (thereafter DSR), i.e. the fraction of income that is used to pay interest and amortize the principal. The choice of the DSR features different positive aspects. First, the DSR takes into account three key components of financial vulnerability: i) the cost of debt, related to the effective interest rate payed by households; ii) the aggregate stock of debt issued by households, iii) the evolution of households' income. For this reason, the DSR is one of the main indicators used in banking, to assess households' risk in the mortgage sector. Second, the DSR can inform *ex-ante* about the *build-up of financial risks* in households' sector, as opposed to variables which signal *ex-post* the *materialization of risk*, through distress indicators, either financial (e.g. financial stress indicators) or economic (e.g. NBER recessionary periods, industrial production evolution). Juselius and Drehmann (2020) show that an increase of the DSR above its steady state provokes a recession and a fall in asset prices. In this respect, the

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<sup>1</sup>In particular Furlanetto et al. (2017) provide a series of set-ups to jointly identify different types of financial shocks (housing, credit demand and credit supply shocks). We expand their analysis, by applying their type of identification strategy in a non-linear framework so to obtain impulse responses depending on the evolution of the DSR.

evolution of the DSR is widely used in macrofinancial risk analysis to detect the build-up of financial risk in the economy given its good signalling properties as an early warning indicator of financial crisis (for instance Lang et al. (2019)). Expressing the DSR in 3-year difference gets rid of the low-frequency structural changes and enhances on its signalling property. Importantly, our results are robust to using the DSR expressed in levels, as well as in longer or shorter differences.<sup>2</sup>

Those results have also two important policy implications for macroprudential measures aiming to prevent the excessive build-up of financial vulnerability. First, they suggest that in terms of benefits, macroprudential tools which are successful to contain large increases in the DSR over the medium term, could reduce the sensitivity of the economy to two types of shocks that can trigger serious and persistent output loss: incoming recessionary housing shocks, triggering a financial accelerator mechanism, and positive credit supply shock resulting in recessionary debt overhang effect on the medium run. A second take away concerns the cost of activating macroprudential measures and derives from the fact that borrowers' based measures and capital requirements generally are mapped with respectively credit demand and credit supply shocks (Furlanetto et al. (2017); Gerali et al. (2010); Jensen et al. (2018)). In terms of costs, the state effects found for credit demand and credit supply shocks highlight that when vulnerability is high, costs associated to activation of macroprudential measures are not amplified and, if anything, they are smaller than under low vulnerability.

The remainder of the paper is as follows. Section 2 presents the empirical model. In Section 3, data and the identification strategy are presented. Section 4 presents the results and sensitivity analysis. Section 5 concludes. Robustness exercises are housed in the Appendix.

## 2. Empirical model

In this section, first, we present our econometric non-linear model used to obtain state-dependent impulse responses. Second, we present our identification strategy to disentangle housing, credit demand and credit supply shocks.

### 2.1. *Econometric model*

Our empirical setting is a multivariate version of the Smooth Transition Local Projection model (thereafter STLP, Auerbach and Gorodnichenko (2013)). In this model, the interaction between a continuous state variable (in our case the 3-year change in the DSR) and the

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<sup>2</sup>Differently from Barnichon et al. (2016); Carriero et al. (2018), our state variable is a measure of debt burden (the DSR) which has good ex-ante signalling properties in risk assessment (Lang et al. (2019)), as opposed to state variables capturing materialized crisis time only ex-post.



explanatory variables delivers impulse responses that depend on the regime of the economy (e.g. high versus low financial vulnerability).

Impulse responses are extracted via Local Projections (thereafter LP, Jordà (2005)). The model is estimated at different forecast periods:  $h = 1, \dots, H$ . Impulse responses for the horizon  $h$  are directly recovered from the coefficients estimated for that particular horizon, without computing the Moving Average representation of the model. The use of LP with respect to other VAR-type approaches is motivated by three reasons. First, LP allow flexibility in the inclusion of regressors, which is very useful in our context since we incorporate different types of non-linearities. Second, when the model is misspecified with respect to the data generating process, LP avoids the accumulation of misspecification error over the projection horizon. Third, since LP directly provides the impact from  $t$  to  $t + h$ , we do not need to endogenize the state variable: LP implicitly take this evolution into account in the estimation of coefficients.<sup>3</sup> The multivariate structure allows identifying the structural shocks following the standard identification strategies originally introduced for VAR methods (e.g. in our case sign restrictions for the identification of housing and credit shocks). To this extent, Plagborg-Møller and Wolf (2021) show that the identification strategy valid in a VAR framework can be equivalently performed in a LP context.<sup>4</sup>

For each period  $t = 0, \dots, T$  and each horizon  $h = 0, \dots, H$ , with  $n$  the number of endogenous variables, and  $p$  the number of lags, our econometric setting is:

$$\begin{aligned}
 Y_{t+h} = & F(z_{t-1})(\alpha_h^{\mathcal{H}} + \beta_h^{\mathcal{H}}Y_{t-1} + \sum_{\ell=2}^p L_{h,\ell}^{\mathcal{H}} Y_{t-\ell}) \\
 & + (1 - F(z_{t-1}))(\alpha_h^{\mathcal{L}} + \beta_h^{\mathcal{L}}Y_{t-1} + \sum_{\ell=2}^p L_{h,\ell}^{\mathcal{L}} Y_{t-\ell}) \\
 & + u_{h,t},
 \end{aligned} \tag{1.1}$$

where  $Y_t$  is the  $(n, 1)$  vector of endogenous variables at time  $t$ ,  $z_{t-1}$  is the scalar state variable at time  $t - 1$  and  $u_{h,t}$  is the  $(n, 1)$  vector of errors at horizon  $h$  at time  $t$ . The scalar function  $F(z_t)$  governs the transition between high ( $\mathcal{H}$ ) and low regime ( $\mathcal{L}$ ). As standard, the transition function is the logistic transformation of the original  $z_t$ :

$$F(z_t) = \frac{1}{1 + \exp\left(-\theta \left(\frac{z_t - c}{\sigma_z}\right)\right)}. \tag{1.2}$$

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<sup>3</sup>In recent years, this method has been extensively used to assess the effect of structural shocks on the economy. Among others, Tenreyro and Thwaites (2016); Alessandri and Mumtaz (2019) for monetary shocks, Auerbach and Gorodnichenko (2013) for fiscal shocks, Fieldhouse et al. (2018) for public asset purchase shocks.

<sup>4</sup>Specifically, the linear result discussed in this article immediately applies to the categorical case with  $\theta = +\infty$  as this LP is asymptotically equivalent with estimating an SVAR separately on each subsample for the different regimes. We thank Mikkel Plagborg-Møller for suggesting this interpretation.

This transformation normalizes  $z_t$  into the interval  $[0, 1]$  and facilitates the interpretation of the state variable.  $\sigma_z$  is the standard deviation of the interaction variable, whereas the parameter  $c$  controls the fraction of the sample spent in either state.<sup>5</sup> The parameter  $\theta$  determines the smoothness of the transitions between both states: the higher  $\theta$ , the faster  $F(z_t)$  goes toward 0 and 1, i.e. converging to a dummy-regime switching. Both parameters are calibrated, as standard in the literature since the seminal work by Auerbach and Gorodnichenko (2013). First, we set  $c$  at the historical median of the original state variable, so that the resulting state spends half of the time in both regimes. Second, we calibrate  $\theta$  equal to 3, in line with Tenreyro and Thwaites (2016) and Franz (2019). Our results are robust to a large range of other calibrations, as shown in the robustness exercises of the Appendix.

We construct confidence intervals using the block-of-blocks bootstrap approach, suggested for LP by Kilian and Kim (2011) to account for the autocorrelation in time series.<sup>6</sup> For robustness check, we compute confidence intervals using the bootstrap-after-bootstrap method, which corrects for bias in bootstrap estimates (see Kilian (1998); Kilian and Kim (2011)).

## 2.2. Shocks identification

Our identification strategy relies on sign restrictions (Canova and De Nicolò (2002); Uhlig (2005); Rubio-Ramirez et al. (2010)). As in the literature of VAR models, the reduced-form error for horizon  $h$ ,  $u_{t,h} \sim N(0, \Omega_h)$ , can be written as a linear combination of structural shocks  $\epsilon_{t,h} \sim N(0, I)$ :

$$u_{t,h} = \Gamma_h \epsilon_{t,h}, \quad (1.3)$$

with  $\Gamma_h \Gamma_h' = \Omega_h$ . To identify  $\Gamma_h$ , a set of restrictions is needed. We resort to the sign restriction approach to identify shocks that rely on strong theoretical grounding, as opposed to the Orthogonal Impulse Response. In this method, a vector of shock is identified using the sign of the shock on each variable, that must satisfy a set of constraint derived from economic theory and structural models. In this paper, we use the algorithm proposed by Rubio-Ramirez et al. (2010). In a first step, we recover the covariance matrix of the reduced form error  $\hat{\Omega}_h$  from the main equation (1.1) estimated at horizon 1. Second, we compute  $\Upsilon$  the Choleski decomposition of the covariance matrix so that  $\Upsilon \Upsilon' = \hat{\Omega}$ . Then for each

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<sup>5</sup> $z_t > c$  is equivalent to  $F(z_t) > 0.5$ . Defining  $c$  as the  $p$ -th quantile of the historical time series of  $z_t$  makes  $F(z_t)$  spend  $p\%$  of the time below 0.5, i.e. in the low regime.

<sup>6</sup>This method consists in constructing all possible overlapping tuples of  $m$  consecutive dates in the matrix  $Y$  of endogenous variables, along with the corresponding block of regressors for each selected dates, at each horizon of regression (hence the blocks-of-block denomination). We then draw in this family of blocks to construct the bootstrapped time series. We follow Horowitz (2018) recommendation of  $m \propto T^{1/3}$ , resulting in  $m = 5$  following. We thus select blocks of five consecutive dates to build the bootstrap time series.

round, we draw a matrix of independent normal vectors  $W \sim MN(0, I_{N^2})$ , we take  $Q$  from its QR decomposition and we generate the impulse response  $\Upsilon Q$ .<sup>7</sup> If the generated impact matrix verifies the sign conditions, the proposed impulse is accepted and stored, otherwise it is rejected. This process is repeated until a sufficiently large number of draws has been accepted.<sup>8</sup> To compute the representative response from the set of accepted draws we use "Median-Target" strategy proposed in (Fry and Pagan (2011)).<sup>9</sup> We use this method for each of the bootstrapped time series.

### 3. Data

In this section we present data used in our estimation, with a focus on the Households' Debt Service Ratio, which we use as interaction variable.

Our database includes US macro and financial data from 1983Q1 to 2019Q1. As starting date, we select the beginning of the Great Moderation. Depending on the specification, our set of endogenous data includes quarterly growth in real output (GDP), inflation (GDP Deflator), stock prices (S&P500), all in quarterly log-difference, the One Year Government rate, the 30-year fixed rate mortgage rates, the ratio between investments (real gross private domestic investments) and output, the ratio between households' debt (loans and debt securities) and the total value of real estate held by households, in levels. The series of output, inflation, mortgage rate, investment and total value of households' real estate come from Federal Reserve Bank of St. Louis Database (FRED<sup>®</sup>), whereas stock prices come from Yahoo<sup>®</sup>. The use of the one-year government bond rate allows to capture information on the evolution of monetary policy, as such as both conventional and unconventional instruments. This rate can provide information on the future path of policy rates and can better incorporate the forward guidance framework featuring the period of Zero Lower Bound (Gertler and Karadi (2015)). In robustness exercises reported in the Appendix, we replace the One Year Government rate with: i) the shadow short term rate computed by Wu and Xia (2016), which takes into account the non-linearity introduced by the Zero Lower Bound and the role of expansionary non-conventional monetary policy; ii) the observed Effective Federal Funds

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<sup>7</sup>As  $Q$  is orthonormal, we get  $\Upsilon Q(\Upsilon Q)' = \Omega_h$

<sup>8</sup>We take 1000 accepted draws for the point estimate and 50 for the bootstraps. Increasing the latter to 10,000 provides no substantial improvement, while considerably increasing the computational burden

<sup>9</sup>As there are multiple accepted draws for the same  $\hat{\Gamma}$ , each draw implicitly corresponds to a specific *model*, and it is necessary to summarize the information. The Median Target Strategy consists in selecting a single shock among all acceptable shocks, the one that has minimal euclidean distance to the median impact matrix. Another common practice consists in taking the matrix of the median impulse response. However, as pointed in Fry and Pagan (2011), this method is not suited for summarizing information of the models, as this might select structural shocks identified from different draws (i.e. different models).

Rate. In another robustness exercise, we replace the GDP deflator with the Consumer Price Index.

We measure households' debt burden by using the Debt Service Ratio. The DSR is the share of a borrower's income dedicated to debt repayment. In line with Drehmann et al. (2015), at aggregate level, the DSR can be computed as:

$$DSR_t \equiv \frac{D_t}{Y_t} \frac{i_t}{1 - (1 + i_t)^{-m}}, \quad (1.4)$$

where  $Y_t$  is the gross disposable income augmented with gross interest payments,<sup>10</sup>  $D_t$  is the stock of households' debt,  $i_t$  is the effective lending rate,  $m$  is the maturity. The effective lending rate  $i_t$  is computed as the ratio between the gross interest payment and the financial intermediation services over the stock of debt. The DSR captures the debt repayment capacity of a borrower: the higher the DSR, the less financial buffer she has to shoulder an adverse shock deteriorating financial conditions. As such, the use of Debt Service Ratio as transition variable allows to directly capture the effects of households' debt burden on the impulse responses. Moreover, this variable informs on the *vulnerability* of the economy, as opposed to the focus of the literature on crisis variables and thus *realized* risk. In this regard, it is better suited to monitor increasing fragility in the economy.

In our benchmark estimation, the *DSR* is expressed in 3 years difference for two reasons. First, in this way we get rid of the low frequency structural change. Second, the DSR in difference has been showed to be a performing early warning indicator in the prediction of crisis (Lang et al. (2019)). However, for robustness we also estimate the model by using the DSR in levels and we find qualitatively similar results.

We use the series of DSR computed by Drehmann et al. (2015) for the Bank of International Settlements. Since the series starts in 1999, we compute it backward using their methodology.

As shown in Figure 1.1, the DSR in 3 years difference captures well the cycle of financial vulnerability of US households. It has the two highest peaks in the second half of the 1980's and in the run-up to the GFC, whereas its troughs can be found at the beginning in the first half of the 1990's and in the aftermath of the crisis. In blue, we report the evolution of the logistic transformation used as state variable in our estimation.

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<sup>10</sup>gross interest payments are added back to income to logically compute the DSR as a share of income pre-interest payment

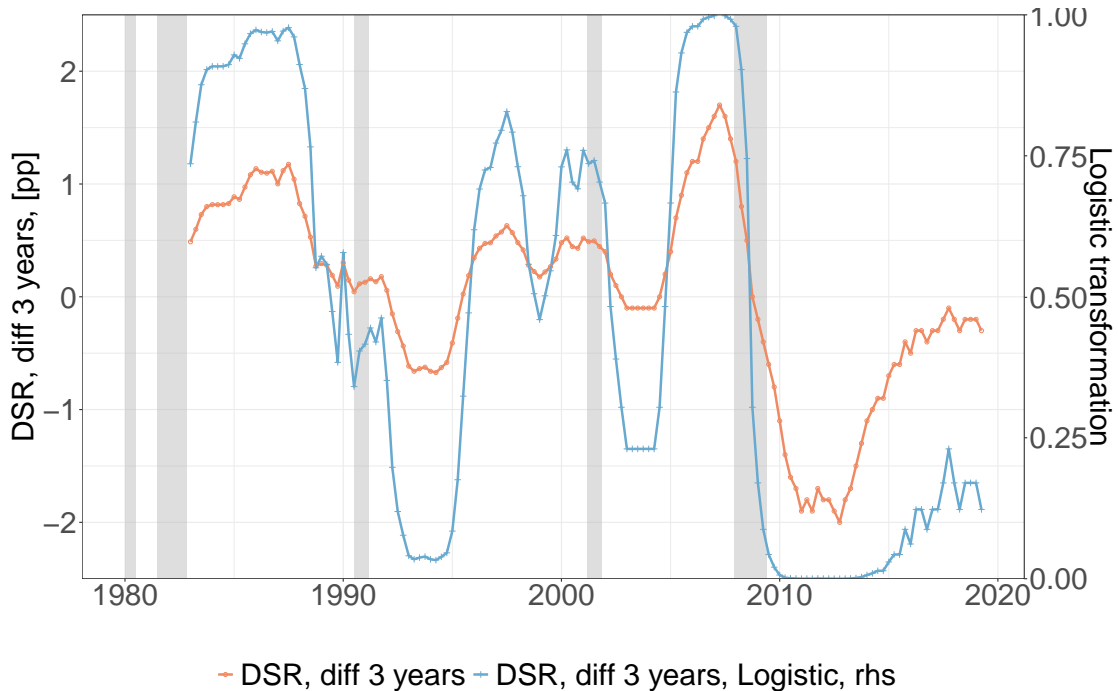


Fig. 1.1. Debt to Service Ratio (DSR) in 3 years difference. Note: the orange line with circles presents the DSR ratios computed by the BIS, in 3-year difference. The blue line with crosses is the transition function from high to low state regimes, obtained in our benchmark estimation with  $c = 0.5$  and  $\theta = 3$ . Grey bars indicate NBER recessions.

## 4. Results

In this section, we present our results highlighting how state effects vary across the different types of financial shocks. First, we present impulse responses from our benchmark specification, where we disentangle financial shocks into housing and credit shocks. In a second specification, we show an additional exercise where we further disentangle credit shocks into credit demand and credit supply shocks. In an alternative exercise, in order to show the importance of disentangling financial shocks according to their origin, we show the impulse responses where a unique type of financial shock is identified. Finally, we conclude this section with a sensitivity analysis to assess robustness of our main estimation results.

### 4.1. *Housing and credit shocks*

The benchmark specification features 2 lags, but results are robust to other lags choices (robustness results using 3 lags can be found in the Appendix). We estimate the response of the economy for 20 quarters.

This specification includes the following set of endogenous variables: real output quarterly growth, quarterly inflation, the ratio between investments and output, the One Year Government rate, stock prices quarterly growth and the ratio between households' total

credit (loans and debt securities) and real estate at market value (flow of funds).

Sign restrictions are built on the identification strategy used by Furlanetto et al. (2017) as reported in Table 1.1.<sup>11</sup> Our identification restrictions are in line with the standard dynamics found in most theoretical and empirical DSGE models. Aggregate Demand, Aggregate Supply shocks and Monetary policy shocks are in line with standard economic theory: output and inflation have a positive co-movement for an Aggregate Demand shock, while the comovement is negative for Aggregate Supply shocks. For monetary policy shocks, we assume that a monetary policy tightening has a positive impact on the One Year Government rate and a negative impact on output and inflation.<sup>12</sup> To disentangle aggregate demand shocks from the investment shocks we add an additional restriction on the ratio between investments and output. If the impact of the shock is positive (negative), we identify an investment shock (Aggregate Demand). This restriction is in line with Smets and Wouters (2007) and Justiniano et al. (2010), for which investments shocks have a stronger impact on investment growth than on output, opposite to the aggregate demand shocks. In order to disentangle investment shocks from financial shocks, we assume that the former have a negative impact on stock prices while the latter have a positive effect. This restriction derives from Christiano et al. (2014), in which investment shocks, by increasing the efficiency in the accumulation law of capital, increase capital supply and decrease its price (i.e. stocks prices). Finally, to disentangle financial shocks in housing and credit shocks we use the ratio between total credit and housing value, assuming that credit (housing) shocks have a positive (negative) impact on this ratio.

In Figure 1.2 we report the responses of our endogenous variables to a housing shock. The lines in red are the responses when debt burden is high ( $F(z_t) = 1$ ), while the line in green are the responses when debt burden is low ( $F(z_t) = 0$ ).

High debt burden substantially amplifies housing shocks. Under high debt burden, the response of output to an housing shock is strongly positive for the first two years and is at least twice as large as the response obtained in the linear model. Conversely, under low debt burden, the response of output is not significant throughout the projection horizon. A one standard deviation housing shock determines on impact a positive reaction of output equal to 0.2%. After two years (8th horizon), the response of output is around 0.6% under high debt

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<sup>11</sup>In our benchmark application, we jointly identify housing, credit and monetary policy shocks, while Furlanetto et al. (2017) follow a two step procedure. In a first exercise, they identify monetary policy and financial shocks, without disentangling credit from housing shocks. In a second exercise, they disentangle housing and credit shocks but exclude the monetary policy shock to ease the computational burden associated with a too large number of structural shocks to identify.

<sup>12</sup>In the context of structural identification through sign restriction, monetary policy is identified imposing a restriction on the policy rate. For this reason, as robustness check, in the Appendix we run the estimation by using the 3-months Federal Funds rate.

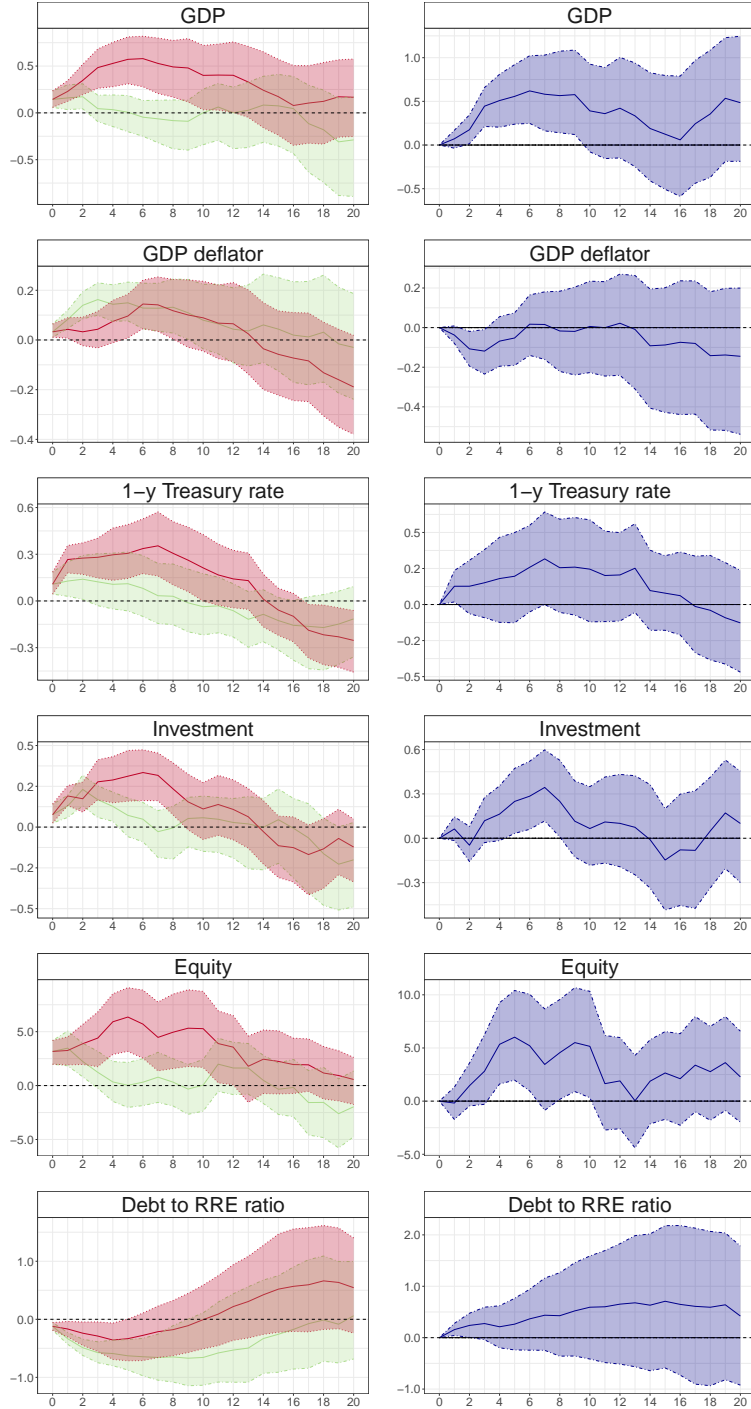


Fig. 1.2. Impulse responses of a selection of the endogenous variables to a housing shock. Note. The responses of output growth and equity price growth are cumulated, while the responses for the ratio of investment/output are in levels. The red (green) lines are the impulses when leverage is high (low). Shaded areas represent the 67% confidence intervals.

burden, and close to 0 under low debt burden. The other variables display similar non-linear dynamics: during the first two years, under high debt burden the responses of investments

over output ratio and of equity prices are from two to four times larger than the response under low debt burden. After six quarters, under high debt burden, the positive effect on the investment over output ratio is above 0.3%, whereas under low debt burden, the effect is not statistically different from zero. Given the expansion of the denominator (output stock), the significant increase in the ratio under high debt burden implies that investments have a more pro-cyclical behaviour than output following an housing shock, in line with expectation. Finally, the ratio between debt and house prices drops in the first part of the projections, although more significantly under low vulnerability, in line with a stronger expansion of debt when the debt burden is high. On the right hand side column, we report the impulse responses as differences between the two states. For all the variables the effect is strongly statistically significant for the overwhelming part of the projection horizon, except for equity prices where statistical significance is found only for some quarters. This important state effect can be interpreted in light of the models studying the role of financial accelerator, from the seminal paper by Kiyotaki and Moore (1997), to the recent stream of papers following the GFC (among others, Guerrieri and Iacoviello (2017); Liu et al. (2016, 2013)). In those models, households can borrow up to a fraction of their collateral, so housing shocks affecting collateral prices directly modify agents' borrowing capacity, potentially amplifying the initial fluctuations. Our results suggest that this effect is stronger after a large increase in the DSR. One explanation for this amplification could be that while the DSR informs on the income buffer of the borrower, and thus her Probability of Default, the collateral value captures the payoff of the lender in case of default, i.e. the Loss Given Default. A large increase in the former ratio is likely to make lenders more sensitive to the latter one, triggering the collateral channel.

Figure 1.18 reports the responses of output growth to a credit shock. Gambetti and Musso (2017); Furlanetto et al. (2017) find that response of output to credit shock in the linear specification is positive on impact and becomes more and more negative along the projection. The use of financial vulnerability as state variable sheds light on this result. In our non-linear estimation, this overall negative effect in the response of output is found only under high debt burden. Quantitatively speaking, under low indebtedness a one standard deviation credit shock is associated to a persistent increase in output equal (+0.6% at its peak three years after the shock arrival). Under the high indebtedness case, the effect reaches -0.8% four years subce the shock arrival. The other endogenous variables feature similar dynamics: investments and equity go through a stronger expansion under low debt burden whereas, under high debt burden, their response becomes negative few quarters after shock arrival. In particular, the positive reaction of the investments/output ratio becomes negative along the projection (-0.5% after three years since the shock arrival). This variation



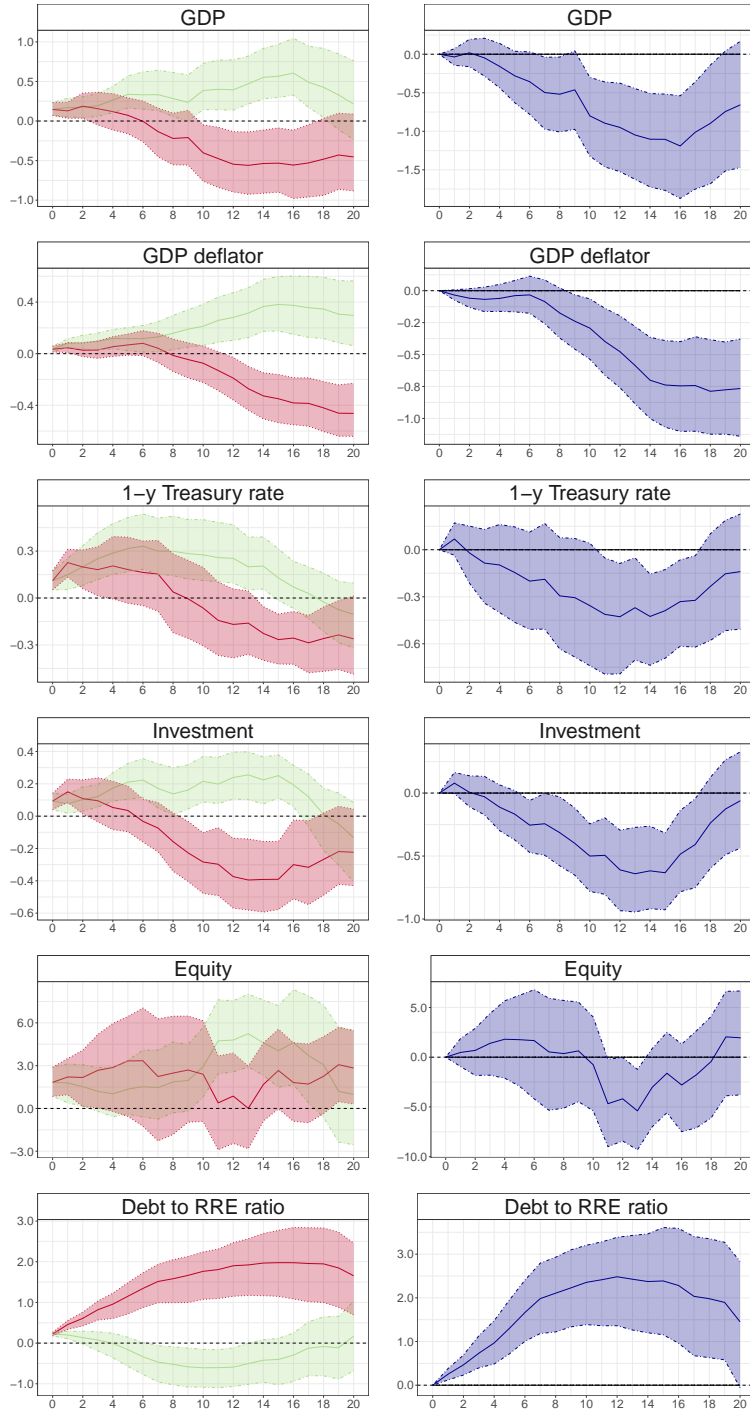


Fig. 1.3. Impulse responses of a of output growth to a credit shock.

Note. The responses of output growth and equity price growth are cumulated, while the responses for the ratio of investment/output are in levels. The red (green) lines are the impulses when leverage is high (low). Shaded areas represent the 67% confidence intervals.

in the ratio implies that the negative effect for investments is even stronger than the one found for output. Finally, the ratio Debt/Houses value shows an important state-effect:

when debt burden is high, the response is strongly positive and significant across all the horizons, whereas under low debt burden, the effect on the Debt/Houses ratio moves around zero across the projection. These results can be explained by households under high debt burden being more subject to debt overhang: the initial credit expansion pushes indebted households to deleverage in the following periods, overturning the initial positive effect of the shocks. The stronger reaction of Debt/House ratio under high debt burden signals that the worth of collateral does not follow the debt expansion, which is consistent with the reversal of the expansionary effect of credit shocks. Conversely, under low debt burden the more stable response of Debt/Houses ratio is in line with a more sustainable credit expansion: debt expansion triggers an increase of collateral and allows agents to fully enjoy the credit expansion without need to deleverage. On the right hand side of the figure 1.18, the differences of the impulse responses between the two states are statistically significant for the whole projection horizon, except for equity prices.

The asymmetric result in the amplification of housing and credit shocks is the key result of the paper. This finding recalls the theoretical result by Justiniano et al. (2015). In this paper, a structural model is used to determine which shock, between housing and credit, is more likely to be at the origin of the credit expansion and the deleveraging observed in the US financial cycles over the Great Recession. According to their results, only the housing shock has the ability to generate a persistent debt expansion as the one observed in the pre-crisis period. The model in Justiniano et al. (2015) features savers and borrowers, the latter borrowing up to a fraction of their collateral. Their result is related to the fact that the housing shock pushes savers and borrowers to increase their spending in housing, producing a persistent positive effect on house prices. This substantial increase in house prices will allow borrowers to expand their debt, generating an important collateral channel. Conversely, the credit shock pushes only borrowers to increase their spending in housing, while the increase in house prices will bring savers to reduce their housing consumption: overall the different reactions between savers and borrowers will produce a milder increase in house prices, triggering a smaller collateral channel. Conversely, models featuring standard borrowing constraints for households or entrepreneurs as the only financial friction of the model generally find similar state effects state effects for housing and credit shocks, as it is the case for Jensen et al. (2020) who study the non-linear amplification of housing and credit shocks through the lens of a structural estimated model featuring occasionally binding borrowing constraints for households and entrepreneurs.

The amplification role of debt burden highlights the stabilization role that macroprudential policies can play concerning housing shock and credit shocks. In terms of benefits, policies aiming to contain households' over-indebtedness (i.e. borrowers' based measures as

caps to individual Debt Service Ratios) can lean against the build-up of financial vulnerability, reducing some of the non-linear effects highlighted so far. For example, if a persistent and strong expansion of indebtedness is expected to bring the DSR to its highest percentile in three years, macroprudential policies can be activated to impose agents to maintain the DSR at a constant level for 3 consecutive years. This would have two potential positive effects. First, after the potential arrival of a recessionary housing shock, the negative effects on output would be halved. Second, the output loss related to the possible debt overhang triggered by an expansionary credit shock could be halved as well.

#### 4.2. *Credit demand and credit supply*

In our benchmark specification we found that, under high debt burden, after an initial expansion, the response of output to credit shocks turns negative, whereas under low vulnerability, their effect remains positive and more persistent. To this extent Justiniano et al. (2019) show that credit shocks can trigger different dynamics whether they are demand (e.g. restrictions to borrowers' credit) or supply shocks (e.g. changes in supply capacity of loans from the financial sector).

To investigate this issue, we disentangle credit demand from credit supply shocks, by modifying the previous specifications in two ways. First, we add the mortgage rate to the set of endogenous variables and use it to disentangle credit demand and supply shocks: an expansionary credit demand (supply) shock increases (reduces) the mortgage rate (Table 1.2). Second, for the sake of parsimony, we follow Furlanetto et al. (2017) and exclude the monetary rate from this specification.<sup>13</sup>

Overall, a high debt burden makes the effects of an initially expansionary credit supply shock to become negative right after the arrival of the shock, in line with what found for the undistinguished credit shock of the benchmark specification. Comparatively, the state effect for the credit demand shock are not statistically significant for output.

The responses to an expansionary credit supply shocks are reported in Figure 1.4. Under low debt burden (green line), the effect on output is positive, statistically significant. The effect equals +0.4% after two years since the shock arrival. Instead, under high debt burden (red line) the initial positive effect turns negative at the end of the first year, becoming statistically significant since the second year. In the second half of the projection, the cumulative negative effect ranges between -0.5% and -0.8%. As partially discussed in the results of the benchmark specification, these important state effects can be read in light of

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<sup>13</sup>In the Robustness Appendix, we report the results obtained including the monetary rate. Given the computational burden, for this latter specification, the IRF of the point estimate is constructed with 1000 accepted draws, instead of the usual 10,000, used in the rest of the paper.

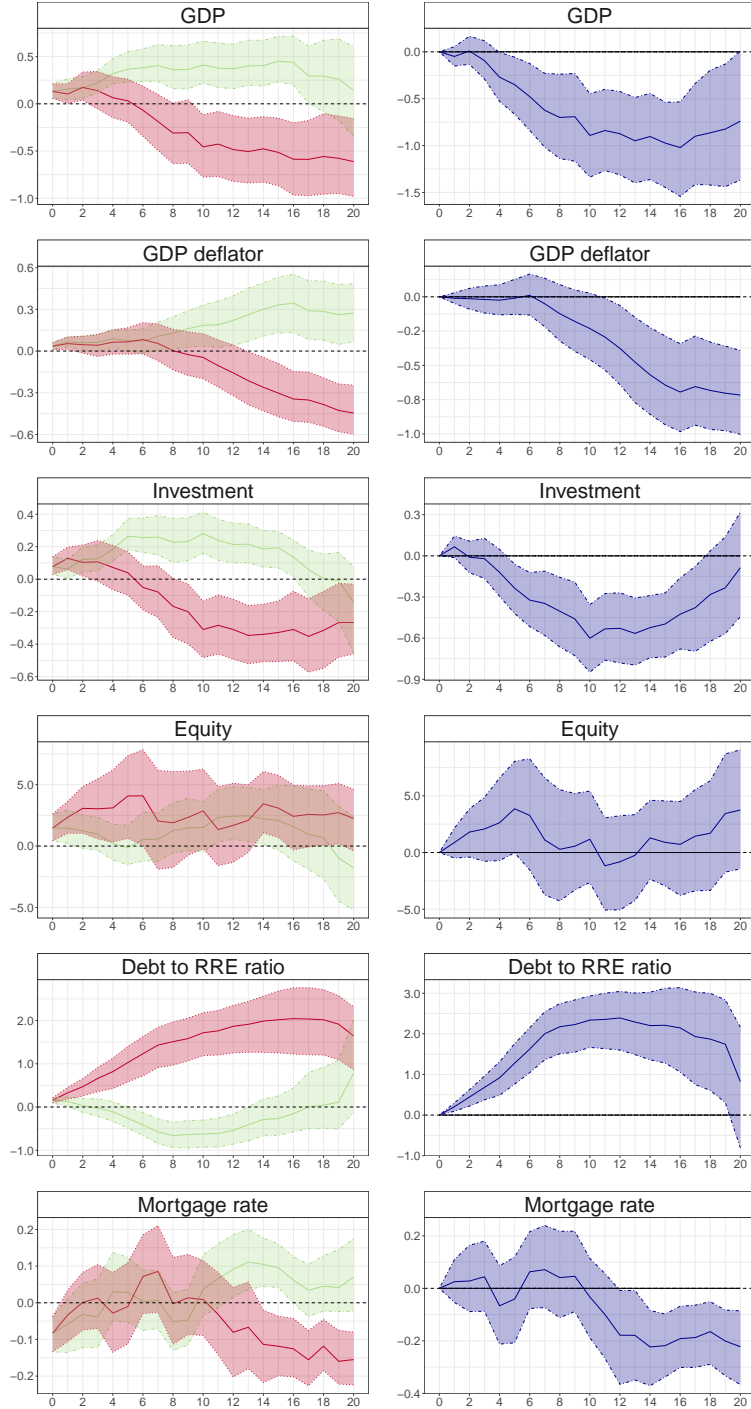


Fig. 1.4. Impulse responses to a credit supply shock.

Note: The responses of output growth and equity price growth are cumulated, while the responses for the ratio of investment/output are in levels. The red (green) lines are the impulses when leverage is high (low). Shaded areas represent the 67% confidence intervals.

two phenomena. Under high debt burden the presence of debt overhang could explain these overall negative effects on output. Instead, under low indebtedness, an increase in credit

supply can be absorbed by borrowers, that can expand their debt, matching the increase in credit supply. This interpretation recalls the finding in Justiniano et al. (2019) who find that the credit supply shock is more effective in increasing credit and housing when both lenders and borrowers are constrained. Conversely, when credit is exclusively constrained because borrowers increased their debt capacity to its maximum (and not because of supply factors), the same shock ends up being less effective. The evolution of the debt to houses ratio seems to confirm this interpretation. To this extent we find that when indebtedness is low, the ratio remains stable during the first year and slightly fluctuates around zero for the rest of the projection, meaning that house prices follow the initial credit expansion when agents are less indebted. When indebtedness is high, the ratio substantially increases, consistent with the fact that the initial credit expansion does not trigger a strong increase in house prices when agents are more indebted. These empirical findings highlight the importance, for theoretical models, of considering financial frictions other than the borrowing constraints, as such the lending constraints, in order to correctly assess the state effects for financial shocks.

In Figure 1.5 we report the responses of the economy to a credit demand shock. Differently from the other shocks analysed in this work, the credit demand shock displays very weak and not statistically significant state effects for most variables. Besides, the differences between the high state and the low state impulse responses (right hand side of the figure) are not statistically significant.

In terms of narrative to reconstruct the financial crisis, our results are consistent with the following reconstruction. First, credit supply shocks arrive in the pre-crisis boom. Thanks to the low indebtedness, the credit supply shock expands credit and housing prices in a persistent way. Second, a recessionary housing shock hit the economy once households indebtedness increased (i.e. high financial vulnerability), triggering the housing and credit bust observed during the financial crisis.

In macroprudential analysis, the activation of macroprudential measures are usually modelled as credit demand shocks (for borrowers' based measures as such as LTV or DSR caps, Jensen et al. (2018)), or as credit supply shocks (Gerali et al. (2010)). Our results provide a reassuring message for policy makers: under high vulnerability, when measures are more needed to tackle financial vulnerability, the effects of activating these measures is not necessarily amplified by the higher households' indebtedness.

### *4.3. Alternative exercise: a unique financial shock*

In this subsection we show the importance of disentangling credit and housing shock rather than considering an undistinguished financial shock. To do so, we present the im-

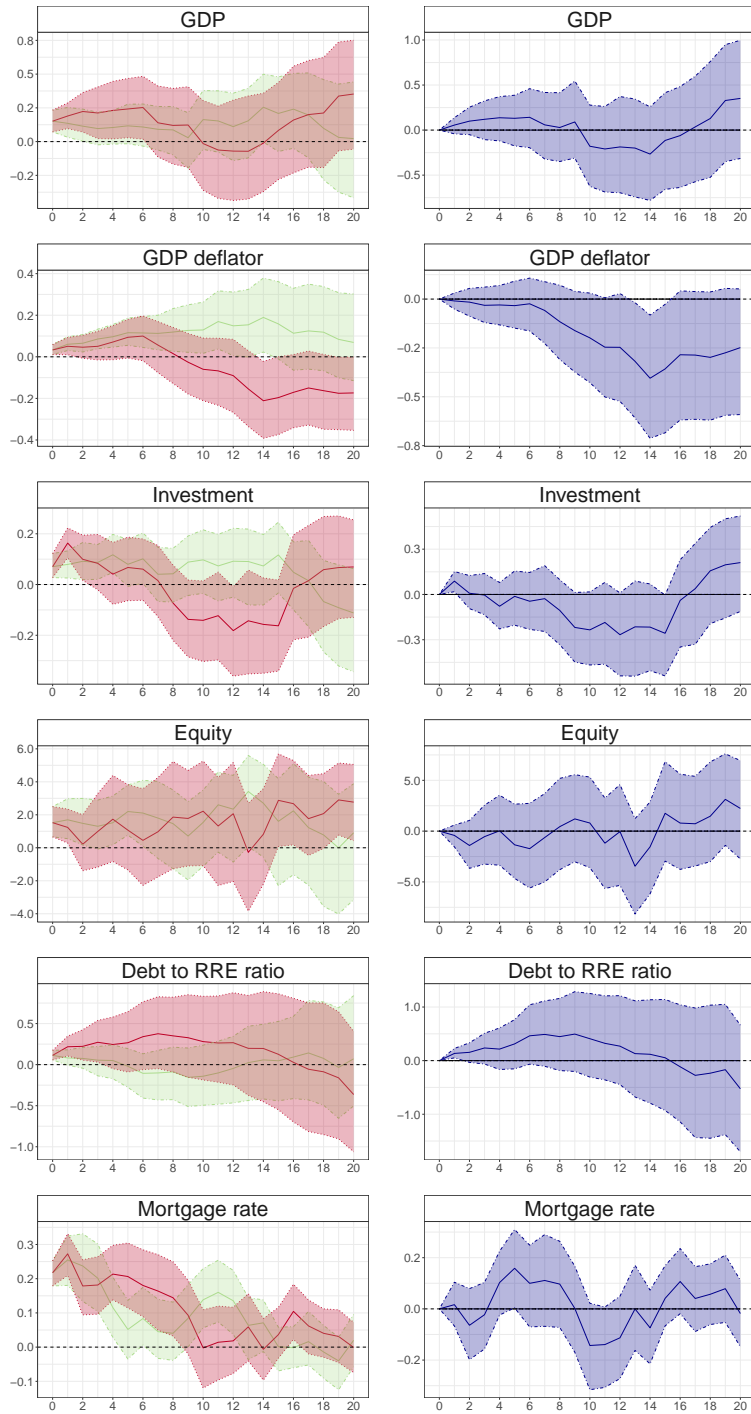


Fig. 1.5. Impulse responses to a credit demand shock.

Note. The responses of output growth and equity price growth are cumulated, while the responses for the ratio of investment/output are in levels. The red (green) lines are the impulses when leverage is high (low). Shaded areas represent the 67% confidence intervals.

pulse responses when a unique financial shock is identified, without disentangling whether it originates in the housing or in the credit sector. This exercise allows to assess the benefits deriving from the joint identification of housing and credit shocks featuring our benchmark specification and to reconcile our results with the ones obtained in the empirical literature (Cheng and Chiu (2020); Barnichon et al. (2016); Colombo and Paccagnini (2020)), who do not explicitly disentangle credit and housing shocks. The identification strategy is in line with the one used in the benchmark specification in Furlanetto et al. (2017). With respect to the identification strategy used in Section 4.1, the credit/houses ratio is replaced by the spread between corporate bond rate and the 10-years government bond rate. The financial shock is distinguished from the investment shock looking at the reaction of the investments/output ratio and in stock prices: after a financial shock, investments/output and stock prices positively comove, whereas the opposite holds for the investment shock, in line with Christiano et al. (2014). Identification restrictions for all the shocks are reported in Table 1.3. No restriction is applied to the response of spread, allowing the use of its response on impact as a double-check to assess the identification strategy.<sup>14</sup> In Figure 1.6, we report the responses of our endogenous variables to the financial shock. An expansionary housing shock has a positive impact on output equal to 0.2%. Under high vulnerability (red line), the response of output is substantially amplified (+1% at the sixth quarter). Under low vulnerability, the response of the shock becomes not statistically significant right after the shock arrival. The other endogenous variables show a similar state effect, with high vulnerability amplifying the expansionary effects of the financial shock. The , not restricted spread response is in line with economic theory: on impact spread decreases by -0.2% and converge to its previous level across the projection. The decrease is more persistent (6 quarters) under high vulnerability rather than under low vulnerability (3 quarters).

This result can be reconciled with the results in Cheng and Chiu (2020); Barnichon et al. (2016); Carriero et al. (2018) who find that credit shocks are amplified under high vulnerability. When we disentangle financial shocks according to their origins, it appears that the state effect of undistinguished financial shocks is actually driven by housing shocks, while credit demand and credit supply shocks exhibit very different behaviours.

#### 4.4. *Sensitivity analysis*

We run a series of robustness checks. In all these exercises, results remain qualitatively and quantitatively similar to what found for the benchmark specification. Results are reported in the Appendix.

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<sup>14</sup>In a robustness check, we estimated an alternative version where we exclude from our benchmark specification the debt/houses price ratio, without adding the spread. Results are quantitatively very robust.

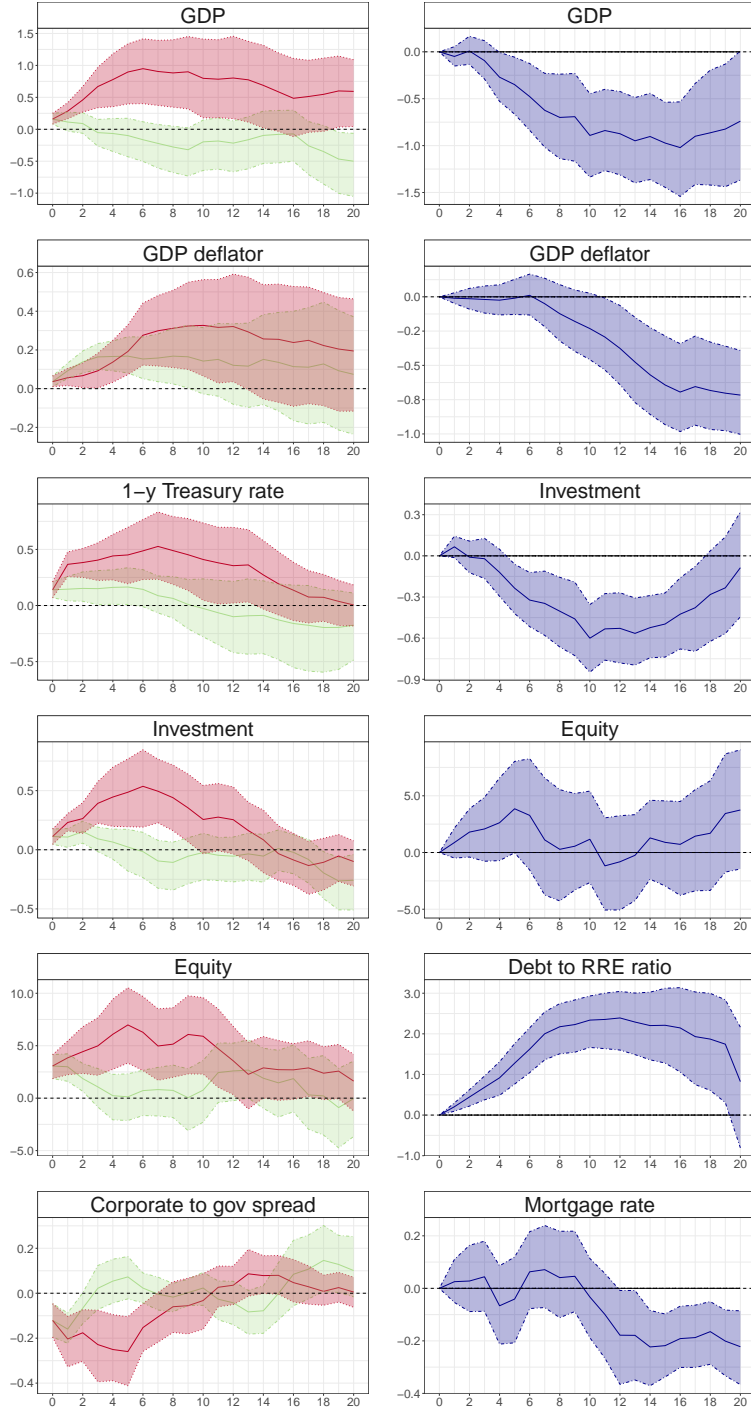


Fig. 1.6. Impulse responses of our endogenous variables to a financial shock.

Note. The responses of output growth and equity price growth are cumulated, while the responses for the ratio of investment/output are in levels. The red (green) lines are the impulses when leverage is high (low). Shaded areas represent the 67% confidence intervals.

First, in order to test the results to different transformations of our state variable, we use different transformations of the DSR. We use the 2 and 5-year difference instead of the



3-year one. Alternatively, we use the DSR expressed in levels: results for the housing shock are somewhat reduced, but again, only the impact is only significant when the DSR is high; results on the credit shock are line with the baseline specification. Finally we use the DSR provided by the Federal Reserve instead of the one from the BIS.

Second, in terms of modelling choice, we run the regressions with three lags, instead of the two lags used in the baseline. Besides, we use lower and higher calibrations for smoothing transition parameter  $\theta = 1.5$  and  $\theta = \infty$ . The last specification is particularly important since it is asymptotically equivalent with estimating a linear SVAR on different subsamples, where the sample is split according to each regime. This consideration theoretically backs our choice of using an identification strategy -sign restrictions- initially conceived for SVAR into a LP framework.

Third, our results are robust to the use of different measures for our regressors. We use the mortgage debt, instead of total debt, to compute the debt to house ratio. Besides, we use alternative inflation measures (Core CPI quarterly variation, CPI quarterly variation). Finally, we use as alternative measures for the policy rate: the Fed Fund Rate and the shadow short term rate computed by Wu and Xia (2016) to take into account unconventional monetary policy.

## 5. Conclusion

In this paper we find that households' debt burden features important non-linear effects on the transmission of financial shocks. We detect that the origin of the financial shock substantially affects state effects in that high debt burden and that among the different types of financial shocks, only the housing shocks is amplified when indebtedness is high. If this state effect is consistent with the outcomes of structural models featuring agents subject to borrowing constraint, this does not hold for credit supply shocks, whose impact is higher when private indebtedness is low and agents can actually match the credit supply loosening. If anything, under high debt burden an expansionary credit supply shock turns negative, more in line with a debt overhang story. Finally, credit demand shocks have very similar propagation independently from the debt burden.

Our results suggest to further explore the asymmetries related to the propagation of housing and credit shocks in structural models, in the wake of the works by Justiniano et al. (2015, 2019) in which the impact of the housing and credit shock is related to the presence of constraints limiting financing decisions of both lenders and borrowers at the time. Our results have key implications for policy makers. On the positive side, they call for the monitoring of households' financial vulnerability, as it is a key determinant of the propagation of financial

shocks. On the normative side, they highlight the important role of macroprudential policies in preventing the excessive build-up of such financial vulnerabilities.

# References

- Alessandri, P. and Mumtaz, H. (2019). Financial regimes and uncertainty shocks. *Journal of Monetary Economics*, 101:31–46.
- Auerbach, A. J. and Gorodnichenko, Y. (2013). Output spillovers from fiscal policy. *American Economic Review*, 103(3):141–46.
- Barnichon, R., Matthes, C., and Ziegenbein, A. (2016). Assessing the non-linear effects of credit market shocks. *CEPR Discussion Paper No. DP11410*.
- Canova, F. and De Nicolò, G. (2002). Monetary disturbances matter for business fluctuations in the g-7. *Journal of Monetary Economics*, 49(6):1131–1159.
- Carriero, A., Galvao, A. B., and Marcellino, M. (2018). Credit conditions and the effects of economic shocks: Amplification and asymmetries. *Economic Modelling and Forecasting Group*.
- Cheng, C. H. J. and Chiu, C.-W. (2020). Nonlinear effects of mortgage spreads over the business cycle. *Journal of Money, Credit and Banking*, 52(6):1593–1611.
- Christiano, L. J., Motto, R., and Rostagno, M. (2014). Risk shocks. *American Economic Review*, 104(1):27–65.
- Colombo, V. and Paccagnini, A. (2020). Does the credit supply shock have asymmetric effects on macroeconomic variables? *Economics Letters*, 188:108958.
- Drehmann, M., Illes, A., Juselius, M., and Santos, M. (2015). How much income is used for debt payments? a new database for debt service ratios. *BIS Quarterly Review September*.
- Fieldhouse, A. J., Mertens, K., and Ravn, M. O. (2018). The macroeconomic effects of government asset purchases: Evidence from postwar us housing credit policy. *The Quarterly Journal of Economics*, 133(3):1503–1560.

- Franz, T. (2019). Monetary policy, housing, and collateral constraints. Technical report, Bundesbank Discussion Paper.
- Fry, R. and Pagan, A. (2011). Sign restrictions in structural vector autoregressions: A critical review. *Journal of Economic Literature*, 49(4):938–60.
- Furlanetto, F., Ravazzolo, F., and Sarferaz, S. (2017). Identification of financial factors in economic fluctuations. *The Economic Journal*, 129(617):311–337.
- Gambetti, L. and Musso, A. (2017). Loan supply shocks and the business cycle. *Journal of Applied Econometrics*, 32(4):764–782.
- Gerali, A., Neri, S., Sessa, L., and Signoretti, F. M. (2010). Credit and banking in a dsge model of the euro area. *Journal of money, Credit and Banking*, 42:107–141.
- Gertler, M. and Karadi, P. (2015). Monetary policy surprises, credit costs, and economic activity. *American Economic Journal: Macroeconomics*, 7(1):44–76.
- Guerrieri, L. and Iacoviello, M. (2017). Collateral constraints and macroeconomic asymmetries. *Journal of Monetary Economics*, 90:28–49.
- He, Z. and Krishnamurthy, A. (2013). Intermediary asset pricing. *American Economic Review*, 103(2):732–70.
- Horowitz, J. L. (2018). Bootstrap methods in econometrics. *arXiv preprint arXiv:1809.04016*.
- Jensen, H., Petrella, I., Ravn, S. H., and Santoro, E. (2020). Leverage and deepening business-cycle skewness. *American Economic Journal: Macroeconomics*, 12(1):245–81.
- Jensen, H., Ravn, S. H., and Santoro, E. (2018). Changing credit limits, changing business cycles. *European Economic Review*, 102:211–239.
- Jordà, Ò. (2005). Estimation and inference of impulse responses by local projections. *American economic review*, 95(1):161–182.
- Jordà, Ò., Schularick, M., and Taylor, A. M. (2013). When credit bites back. *Journal of Money, Credit and Banking*, 45(s2):3–28.
- Juselius, M. and Drehmann, M. (2020). Leverage dynamics and the burden of debt. *Oxford Bulletin of Economics and Statistics*, 82(2):347–364.

- Justiniano, A., Primiceri, G. E., and Tambalotti, A. (2010). Investment shocks and business cycles. *Journal of Monetary Economics*, 57(2):132–145.
- Justiniano, A., Primiceri, G. E., and Tambalotti, A. (2015). Household leveraging and deleveraging. *Review of Economic Dynamics*, 18(1):3–20.
- Justiniano, A., Primiceri, G. E., and Tambalotti, A. (2019). Credit supply and the housing boom. *Journal of Political Economy*, 127(3):1317–1350.
- Kilian, L. (1998). Small-sample confidence intervals for impulse response functions. *Review of economics and statistics*, 80(2):218–230.
- Kilian, L. and Kim, Y. J. (2011). How reliable are local projection estimators of impulse responses? *Review of Economics and Statistics*, 93(4):1460–1466.
- Kiyotaki, N. and Moore, J. (1997). Credit cycles. *Journal of political economy*, 105(2):211–248.
- Lang, J. H., Izzo, C., Fahr, S., and Ruzicka, J. (2019). Anticipating the bust: a new cyclical systemic risk indicator to assess the likelihood and severity of financial crises. *ECB Occasional Paper*, (219).
- Liu, Z., Miao, J., and Zha, T. (2016). Land prices and unemployment. *Journal of Monetary Economics*, 80:86–105.
- Liu, Z., Wang, P., and Zha, T. (2013). Land-price dynamics and macroeconomic fluctuations. *Econometrica*, 81(3):1147–1184.
- Maffezzoli, M. and Monacelli, T. (2015). Deleverage and financial fragility. Technical report, CEPR Discussion Paper No. DP10531.
- Mian, A., Sufi, A., and Verner, E. (2017). Household debt and business cycles worldwide. *The Quarterly Journal of Economics*, 132(4):1755–1817.
- Musso, A., Neri, S., and Stracca, L. (2011). Housing, consumption and monetary policy: How different are the us and the euro area? *Journal of Banking & Finance*, 35(11):3019–3041.
- Plagborg-Møller, M. and Wolf, C. K. (2021). Local projections and vars estimate the same impulse responses. *Econometrica*, 89(2):955–980.
- Rubio-Ramirez, J. F., Waggoner, D. F., and Zha, T. (2010). Structural vector autoregressions: Theory of identification and algorithms for inference. *The Review of Economic Studies*, 77(2):665–696.

- Smets, F. and Wouters, R. (2007). Shocks and frictions in us business cycles: A bayesian dsge approach. *American economic review*, 97(3):586–606.
- Tenreyro, S. and Thwaites, G. (2016). Pushing on a string: Us monetary policy is less powerful in recessions. *American Economic Journal: Macroeconomics*, 8(4):43–74.
- Uhlig, H. (2005). What are the effects of monetary policy on output? results from an agnostic identification procedure. *Journal of Monetary Economics*, 52(2):381–419.
- Walentin, K. (2014). Business cycle implications of mortgage spreads. *Journal of Monetary Economics*, 67:62–77.
- Wu, J. C. and Xia, F. D. (2016). Measuring the macroeconomic impact of monetary policy at the zero lower bound. *Journal of Money, Credit and Banking*, 48(2-3):253–291.

# Tables

|            | Output | Inflation | 1Y Gov. rate | Inv/Out ratio | Stock prices | Credit/RE ratio |
|------------|--------|-----------|--------------|---------------|--------------|-----------------|
| Agg.Demand | +      | +         | +            | -             |              |                 |
| Agg.Supply | +      | -         |              |               | +            |                 |
| Mon.Policy | +      | +         | -            |               |              |                 |
| Investment | +      | +         | +            | +             | -            |                 |
| Housing    | +      | +         | +            | +             | +            | -               |
| Credit     | +      | +         | +            | +             | +            | +               |

Table 1.1: The table presents the sign restrictions assumed on the reaction on impact of endogenous variables (column) to identify the structural shocks (row). When the space is empty, the response is left unrestricted.

|             | GDP | Inflation | Inv/Out ratio | Stock prices | Credit/RE ratio | Mortgage rate |
|-------------|-----|-----------|---------------|--------------|-----------------|---------------|
| AD          | +   | +         | -             |              |                 |               |
| AS          | +   | -         |               | +            |                 |               |
| Investment  | +   | +         | +             | -            |                 |               |
| Housing     | +   | +         | +             | +            | -               | +             |
| Cred supply | +   | +         | +             | +            | +               | -             |
| Cred demand | +   | +         | +             | +            | +               | +             |

Table 1.2: The table presents the sign restrictions assumed on the reaction on impact of endogenous variables (column) to identify the structural shocks (row). When the space is empty, the response is left unrestricted.

|            | Output | Inflation | Interest rate | Inv/Out ratio | Stock prices | Spread |
|------------|--------|-----------|---------------|---------------|--------------|--------|
| Agg.Demand | +      | +         | +             | -             |              |        |
| Agg.Supply | +      | -         |               |               | +            |        |
| Mon.Policy | +      | +         | -             |               |              |        |
| Investment | +      | +         | +             | +             | -            |        |
| Financial  | +      | +         | +             | +             | +            |        |

Table 1.3: The table presents the sign restrictions assumed on the reaction on impact of endogenous variables (column) to identify the structural shocks (row). When the space is empty, the response is left unrestricted.

# Charts

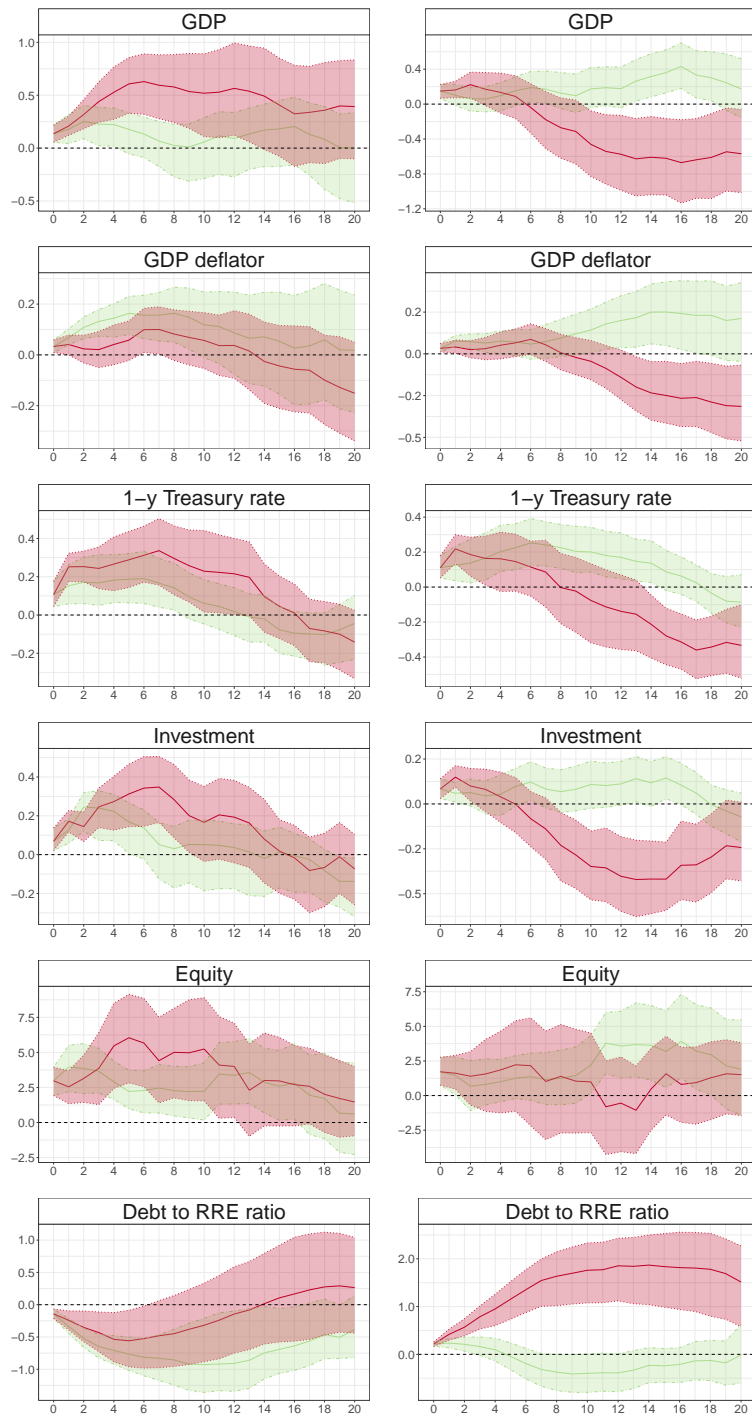


Fig. 1.7. Robustness with 2-year difference in DSR, for housing (left column) and credit (right column) shocks. Note. The responses of output growth and equity price growth are cumulated, while the responses for the ratio of investment/output are in levels. The red (green) lines are the impulses when leverage is high (low). Shaded areas represent the 67% confidence intervals.



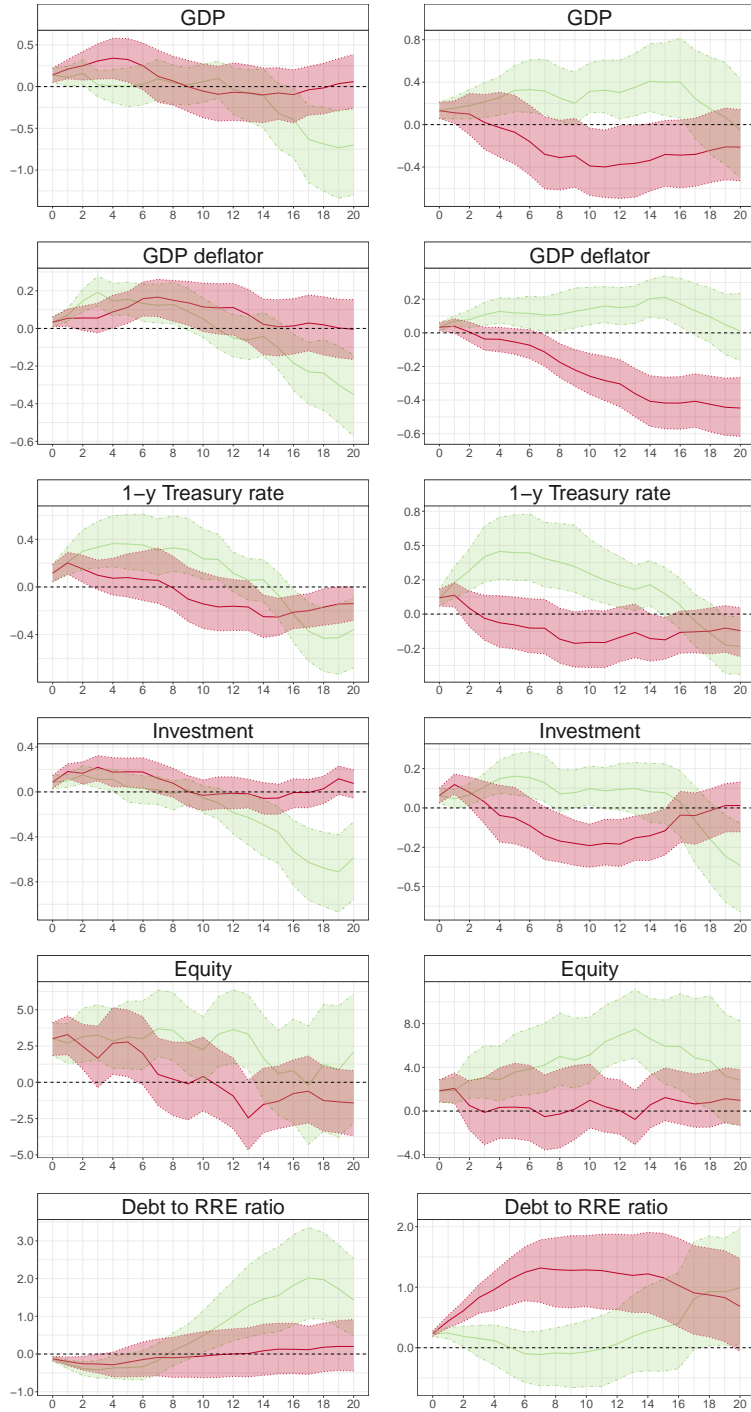


Fig. 1.8. Robustness with 5-year difference in DSR, for housing (left column) and credit (right column) shocks. Note. The responses of output growth and equity price growth are cumulated, while the responses for the ratio of investment/output are in levels. The red (green) lines are the impulses when leverage is high (low). Shaded areas represent the 67% confidence intervals.

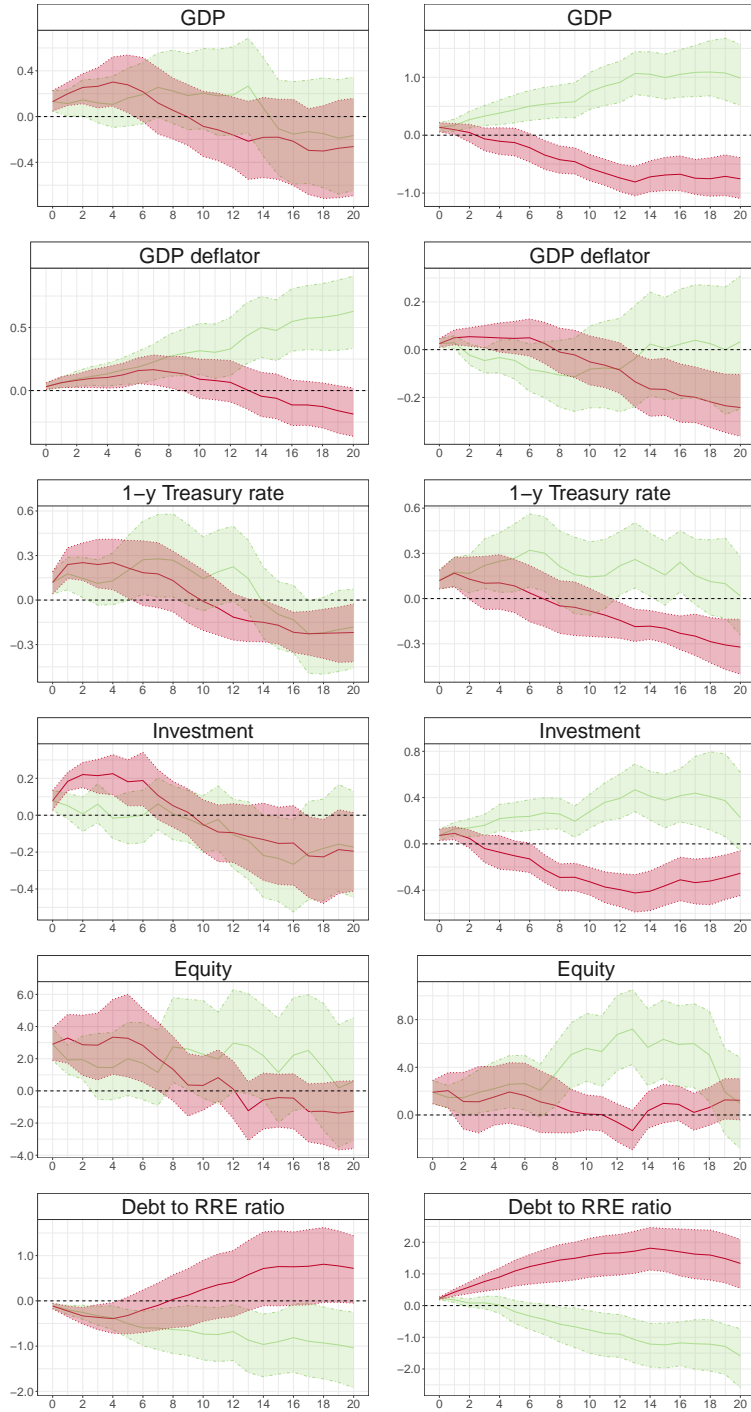


Fig. 1.9. Robustness with DSR in level, for housing (left column) and credit (right column) shocks. Note. The responses of output growth and equity price growth are cumulated, while the responses for the ratio of investment/output are in levels. The red (green) lines are the impulses when leverage is high (low). Shaded areas represent the 67% confidence intervals.

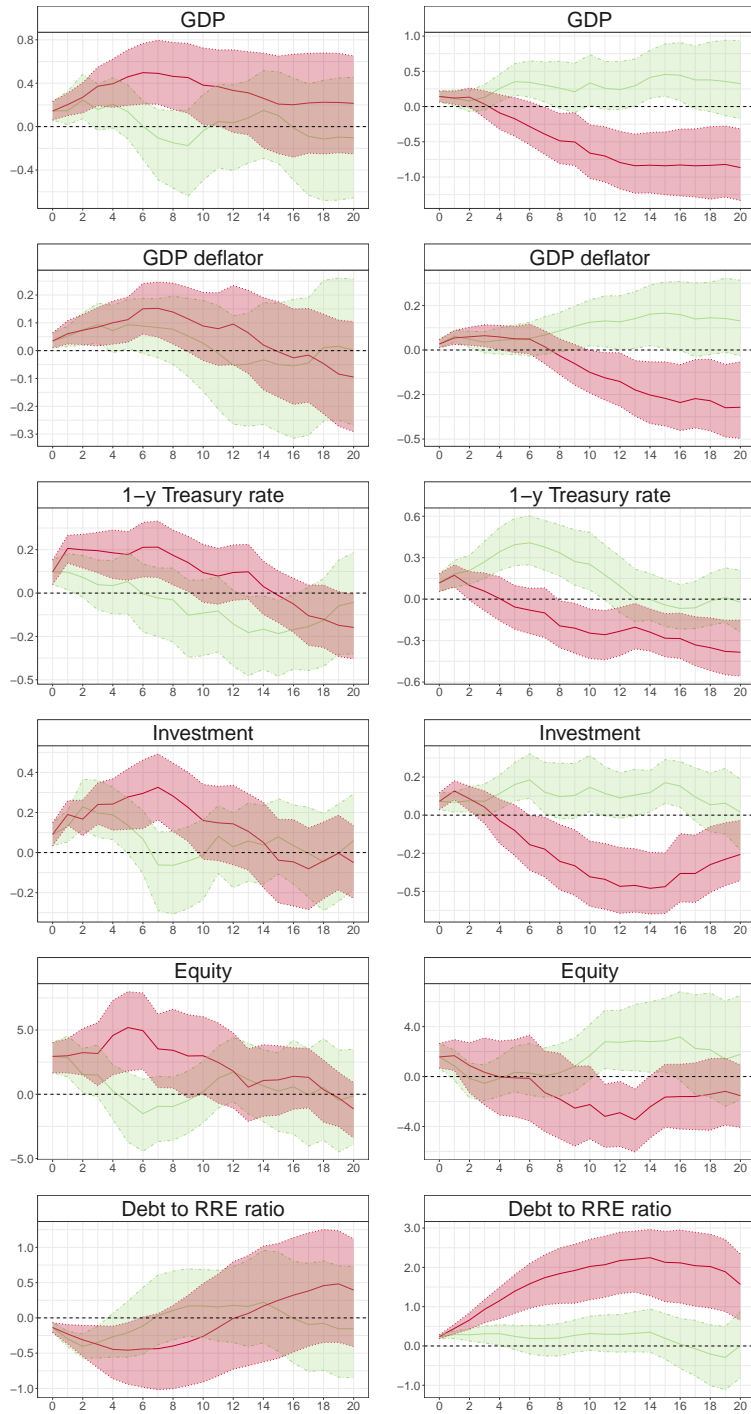


Fig. 1.10. Robustness with DSR from the Fed of Saint Louis, for housing (left column) and credit (right column) shocks. Note. The responses of output growth and equity price growth are cumulated, while the responses for the ratio of investment/output are in levels. The red (green) lines are the impulses when leverage is high (low). Shaded areas represent the 67% confidence intervals.

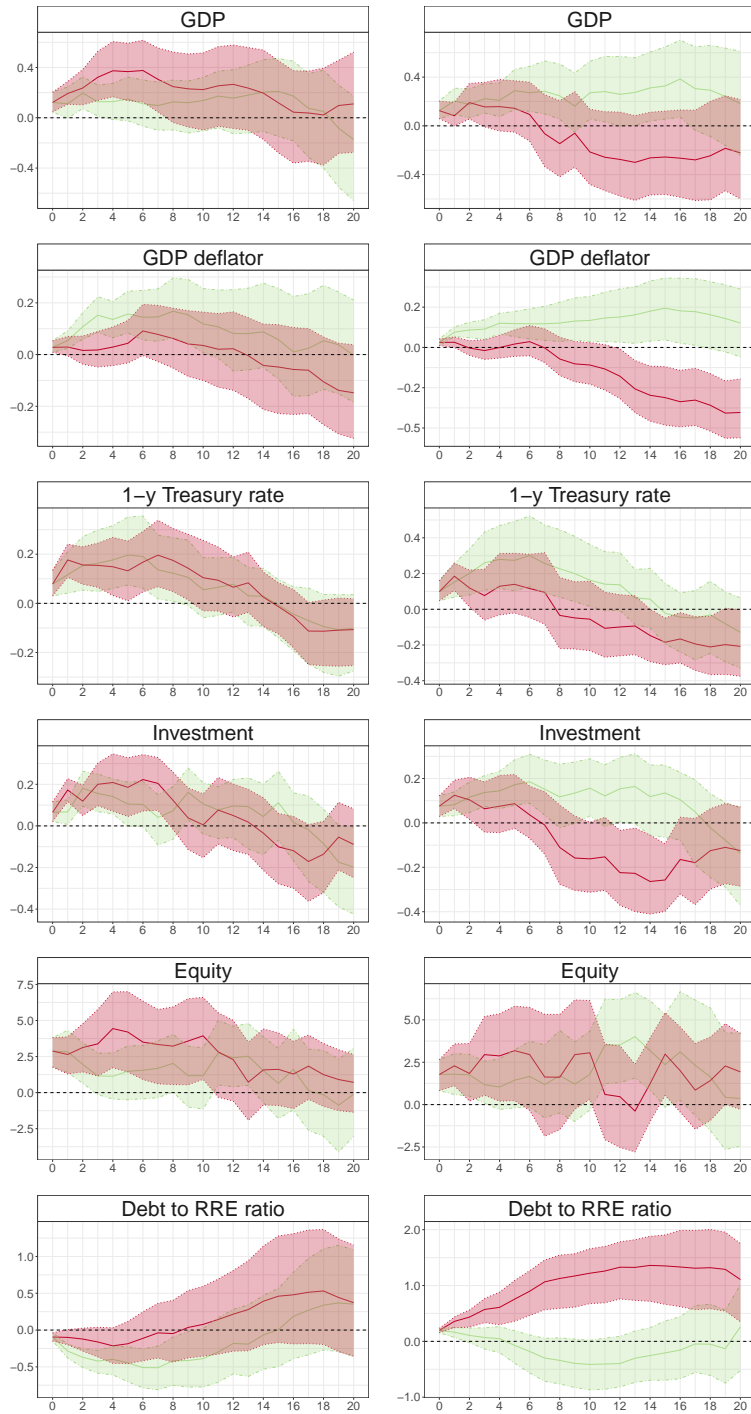


Fig. 1.11. Robustness with 3 lags, for housing (left column) and credit (right column) shocks. Note. The responses of output growth and equity price growth are cumulated, while the responses for the ratio of investment/output are in levels. The red (green) lines are the impulses when leverage is high (low). Shaded areas represent the 67% confidence intervals.

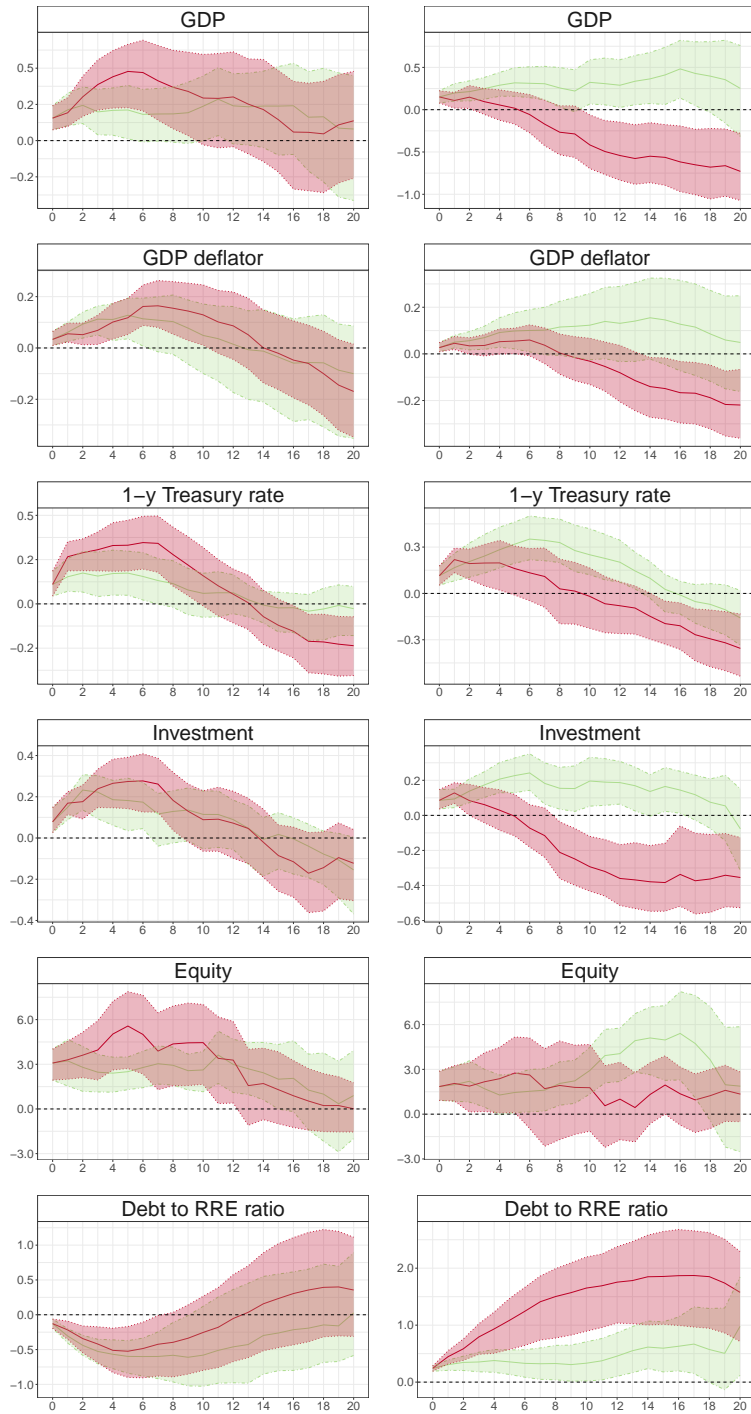


Fig. 1.12. Robustness with  $\theta = \infty$ , for housing (left column) and credit (right column) shocks. Note. The responses of output growth and equity price growth are cumulated, while the responses for the ratio of investment/output are in levels. The red (green) lines are the impulses when leverage is high (low). Shaded areas represent the 67% confidence intervals.

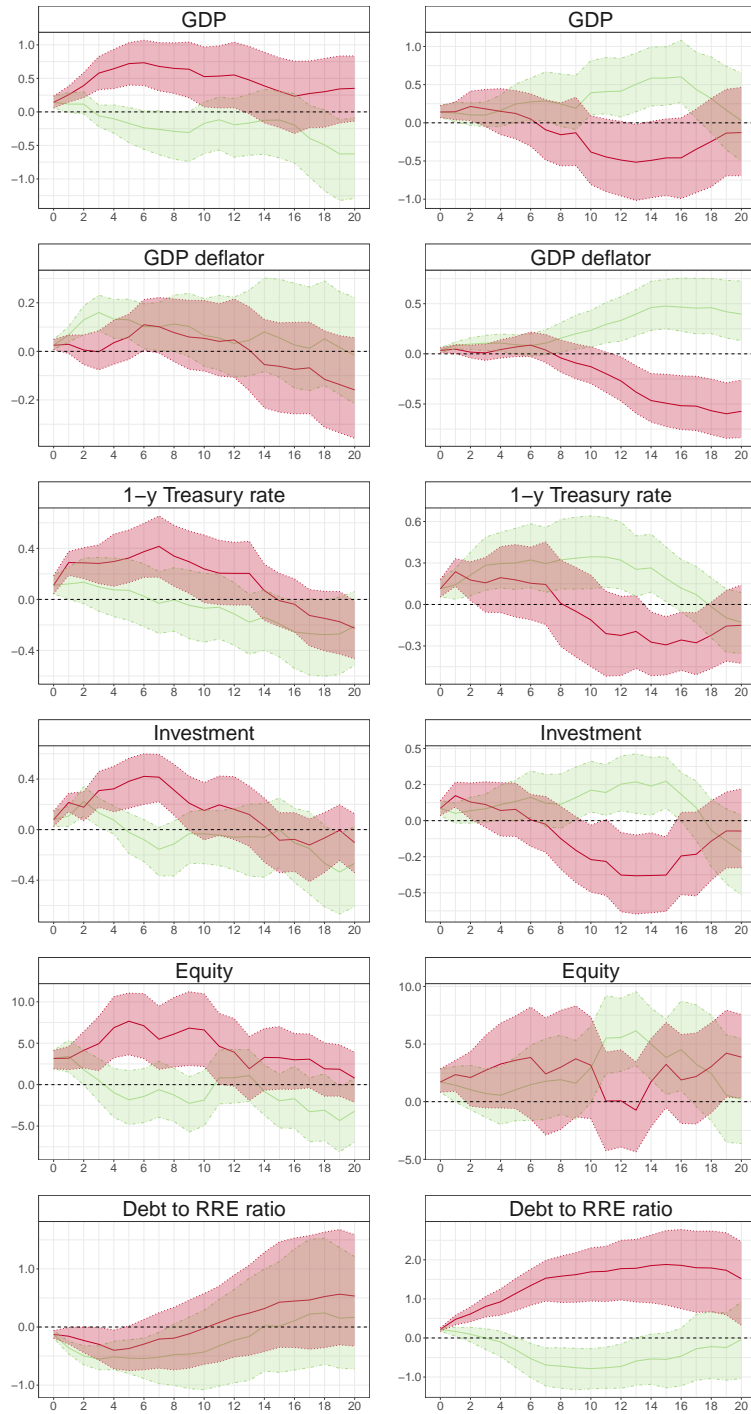


Fig. 1.13. Robustness with  $\theta = 1.5$ , for housing (left column) and credit (right column) shocks. Note. The responses of output growth and equity price growth are cumulated, while the responses for the ratio of investment/output are in levels. The red (green) lines are the impulses when leverage is high (low). Shaded areas represent the 67% confidence intervals.

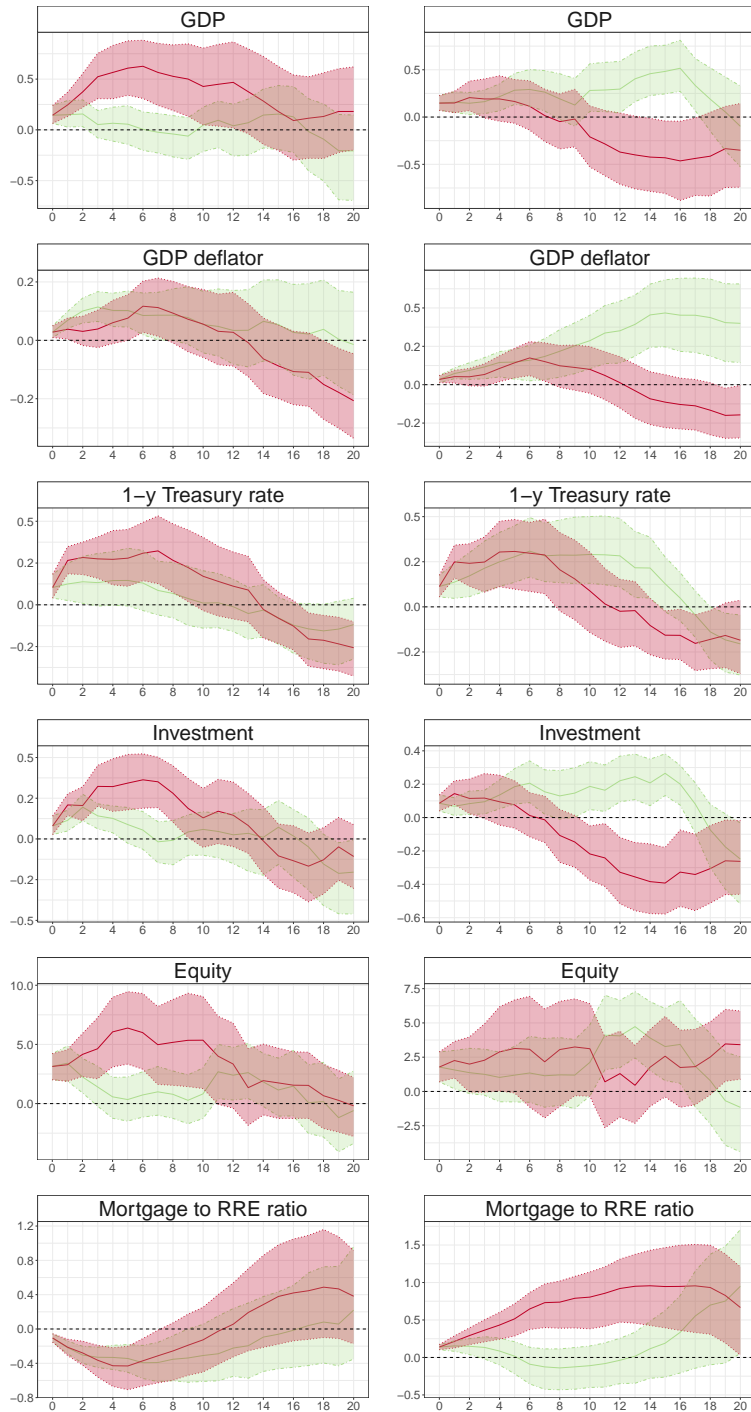


Fig. 1.14. Robustness with the mortgage debt, for housing (left column) and credit (right column) shocks. Note. The responses of output growth and equity price growth are cumulated, while the responses for the ratio of investment/output are in levels. The red (green) lines are the impulses when leverage is high (low). Shaded areas represent the 67% confidence intervals.

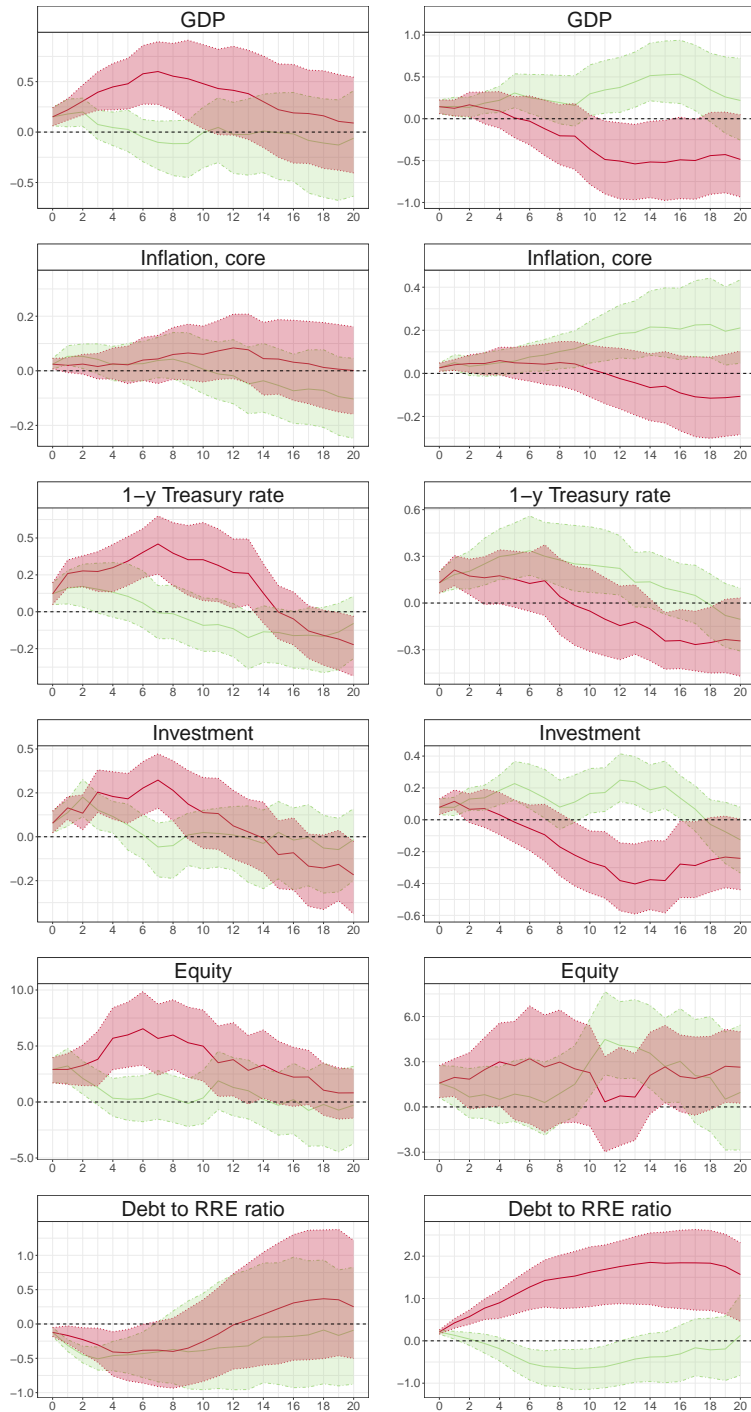


Fig. 1.15. Robustness with CPI core, for housing (left column) and credit (right column) shocks. Note. The responses of output growth and equity price growth are cumulated, while the responses for the ratio of investment/output are in levels. The red (green) lines are the impulses when leverage is high (low). Shaded areas represent the 67% confidence intervals.



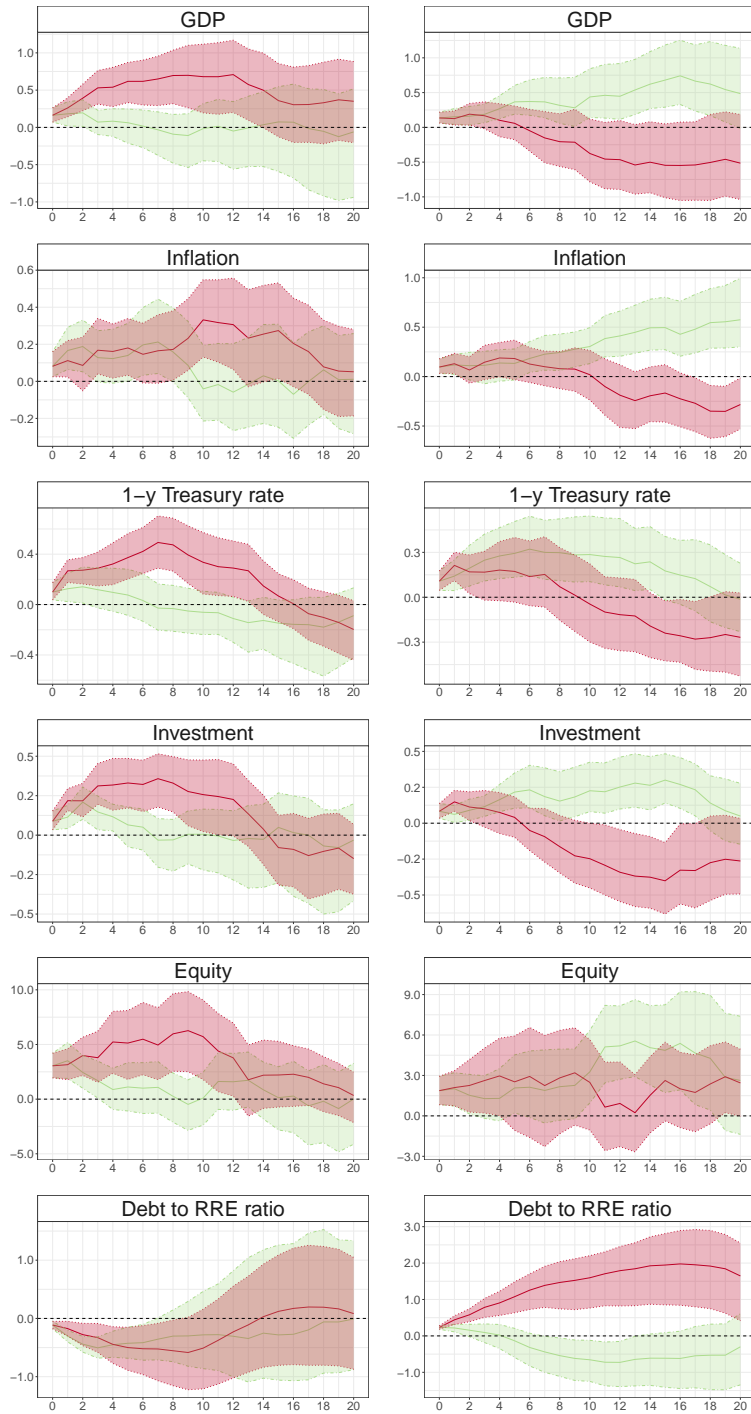


Fig. 1.16. Robustness with CPI, for housing (left column) and credit (right column) shocks. Note. The responses of output growth and equity price growth are cumulated, while the responses for the ratio of investment/output are in levels. The red (green) lines are the impulses when leverage is high (low). Shaded areas represent the 67% confidence intervals.



Fig. 1.17. Robustness with the Shadow Short Term rate from Wu, Xia (2016), for housing (left column) and credit (right column) shocks.

Note. The responses of output growth and equity price growth are cumulated, while the responses for the ratio of investment/output are in levels. The red (green) lines are the impulses when leverage is high (low). Shaded areas represent the 67% confidence intervals.

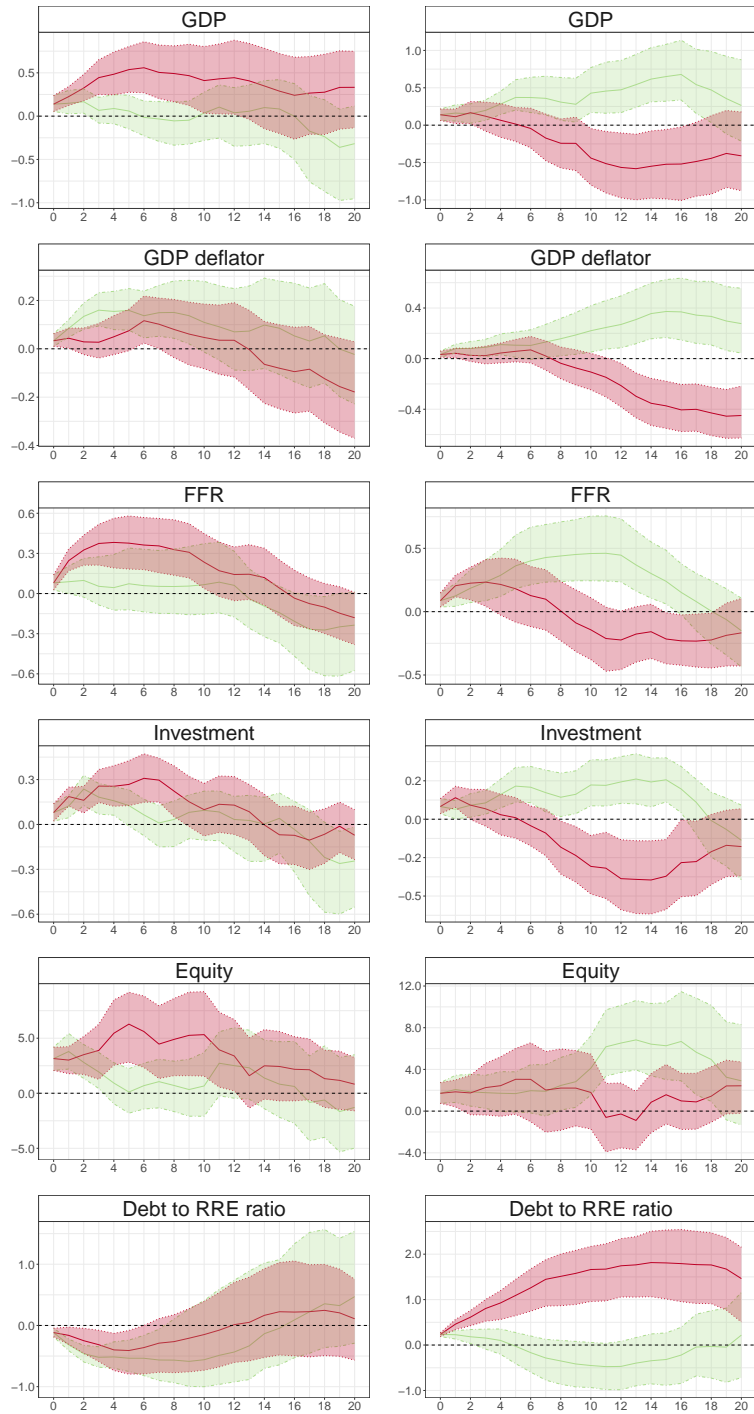


Fig. 1.18. Robustness with the Federal Fund Rate, for housing (left column) and credit (right column) shocks. Note. The responses of output growth and equity price growth are cumulated, while the responses for the ratio of investment/output are in levels. The red (green) lines are the impulses when leverage is high (low). Shaded areas represent the 67% confidence intervals.

# Chapter 2

## How do markets react to tighter bank capital requirements?

*This chapter is based on a paper co-authored with Dorian Henricot (ECB)*

### Abstract

We use hikes in the countercyclical capital buffer [CCyB] to measure how tighter bank capital requirements affect their solvency and value, according to market participants. Two features of the CCyB in Europe allow for a unique identification strategy of the effect of such requirements. First, national authorities make quarterly announcements of CCyB rates. Second, these hikes affect all European banks proportionally to their exposure to the country of activation. We show that CCyB hikes translate in lower CDS spreads for affected banks, indicating that markets perceive higher solvency. On the other hand, bank valuations do not react. Markets therefore consider that higher countercyclical capital requirements translate into more stable banks at no material cost for shareholders. We claim that these effects relate to the capital constraint itself, as opposed to the potential signal conveyed on the state of the financial cycle.

### 1. Introduction

The Great Financial Crisis (GFC) highlighted the need for sufficient bank capital, as banking crises and their companion credit crunches are particularly damaging to the real economy. Consequently, the main regulatory response to the GFC consisted in a large increase in bank capital requirements. Their optimal level is however subject to an ongoing debate among academics and policymakers. While higher requirements are associated with more resilience, they can also induce an inefficient reduction in lending (see for instance Van den Heuvel (2008), Repullo and Suarez (2012), Clerc et al. (2015), Mendicino et al. (2018), Malherbe (2020)). As such, it is key for regulators to strike the appropriate balance between the benefits of more stable banks and the costs of more expensive capital. In this study, we use the institutional setup of the countercyclical capital buffer (CCyB) in

the European Economic Area (EEA), in an event-study framework, to assess how financial markets perceive the costs and benefits of higher capital requirements.

The CCyB is a time-varying bank capital requirement introduced in Basel III and adapted in European regulation, that provides two attractive features for such study. To start with, CCyB levels are homogeneous decisions announced quarterly at the national level, and we can precisely identify announcement dates thanks to press releases. This allows for an event study approach. If announcements were partially anticipated, our estimates would simply be conservative. In contrast, changes to the regulatory framework typically result from years of negotiation, and are largely anticipated. These agreements typically consist in one-off regulatory changes, making it difficult to disentangle the effect of potentially numerous innovations, or to ensure external validity. Since then, the Basel III framework introduced other bank-specific capital requirements, but their computation is often mechanical (e.g. for Global and Other Systemic Banks) and thus easy to anticipate, and/or without a proper communication framework to the markets.<sup>1</sup> Second, the CCyB rate in a given country applies to all banks of the EEA proportionally to the share of that country in their total (relevant) exposures. Consequently, each shock heterogeneously impacts all banks of the EEA, allowing for cross-sectional studies.

CCyB increases could trigger market reactions through two channels. First, they reveal private information that the national regulator may hold on the state of the economy when setting the rate. The interpretation of such signal is *a priori* ambiguous. Macroprudential authorities typically raise the CCyB when the economy is in good shape, but also when financial risks are building up. We label this the *signalling channel*. The second channel relates to the requirement itself, that tightens the capital constraint, potentially forcing banks to adjust their balance sheet. We label this the *capital channel*. Disentangling both channels is key to appropriately interpret results in terms of costs and benefits.

We proceed in three steps.

First, we investigate the impact of CCyB hikes on country-level variables, namely stock indices and sovereign CDS. We find no significant impact: country-level variables do not systematically react to country-level CCyB increases. This is inconsistent with the *signalling channel* and suggests that any impact is likely to transit through the *capital channel*.

Second, we show that the announcement of a national CCyB hike translates into lower CDS spreads for banks exposed to this country. Markets thus recognize that capital require-

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<sup>1</sup>In the European Banking Union, the bank-specific Pillar 2 Guidance is confidential, and the Single Supervisory Mechanism publishes bank-specific Pillar 2 Requirements applying to Significant Institutions only since 2020. See <https://www.bankingsupervision.europa.eu/banking/srep/html/p2r.en.html>. Finally, the UK had pre-GFC bank-specific, time-varying requirement, which has been the focus of Alfons et al. (2005) or Francis and Osborne (2012), but these requirements were confidential.

ments improve bank solvency, consistent with studies highlighting their effect on capital ratios (Alfon et al. (2005)) and risk-taking (Behncke et al. (2020)). The effect is more pronounced for banks with lower capital ratios and higher risk. Indeed, we find a larger spread decrease of banks below the CET1 ratio distribution median, and symmetrically above the CDS spread distribution median. The interpretation is twofold. Markets anticipate more constrained banks to be more likely to adjust their balance sheet towards higher capital ratios, and higher capital ratios have larger effects on solvency for riskier and less capitalised banks.

Finally, we show that CCyB increases are not associated with any stock return regularity. This, in conjunction with the decline in CDS spreads, is again inconsistent with the *signalling channel*: good economic news lowering CDS spreads should also increase stock value. This confirms the activation of the *capital channel*, but in a way that has no significant impact on stock prices. Strong stock prices may be beneficial for a regulator, if they reflect the absence of an inefficient reduction in lending, or if they strengthen domestic banks' ability to raise equity or resist foreign takeovers. The absence of negative stock price reaction would also suggest that the CCyB announcement is well understood by the markets, an important attention point for prudential authorities. Therefore, we interpret the absence of stock price reaction as evidence that CCyB increases have only muted undesirable effects.

In the process, we also show that CCyB releases had a positive effect on bank and country CDS spreads, and were associated with a drop in stock returns. While these results must be interpreted with caution since most releases happened in periods of financial turmoil, they suggest a signalling channel is at play. Markets interpret regulators releases as signs of deteriorating prospects for the economy.

From a policy perspective, our results suggest that macroprudential authorities had room for a more active use of the CCyB to increase bank resilience, while not adversely affecting bank valuations.

Our paper stands at the crossroads of two strands of the literature.

First, a large empirical literature assesses how banks adjust their balance sheets or lending policies to changes in capital requirements. Fraisse et al. (2020) used supervisory borrower-specific data to evidence how banks price higher capital requirements in their lending rates. Mésonnier and Monks (2015) showed how stress-test-induced higher requirements translated in lower lending. Behn et al. (2016) analyzed how banks subject to risk weights hikes (conceptually equivalent to capital requirement increases) after the failure of Lehman Brothers reduced lending more. Jimenez et al. (2017) showed that the Spanish countercyclical dynamic provisioning helped maintain credit supply throughout the GFC. Numerous studies

leveraged the UK framework with bank-specific time-varying requirements to conduct empirical studies. Alfon et al. (2005) showed that banks transferred 50% of regulatory increases into higher capital ratios, and Francis and Osborne (2012) that they adjusted to their idiosyncratic requirement by raising lower quality capital and reducing risk-weights. Aiyar et al. (2014a) argued that cross-border lending to non-core countries suffered most, and Aiyar et al. (2014b) suggested affected banks reduced lending. Several papers also studied the effect of the Swiss sectoral CCyB on real estate exposures, and showed how it translated in a reallocation of lending (Auer and Ongena (2016)), an increase in mortgage rates (Basten (2020)) or a reduction in loan-to-value ratios (Behncke et al. (2020)). Finally, a large literature resorts to structural models to estimate banks reaction to capital requirements (see for instance Van den Heuvel (2008), Clerc et al. (2015), Mendicino et al. (2018), Malherbe (2020)). Our paper brings a complementary view by measuring market participants perception, and investigating how they value potential adjustments.

A second strand of the literature deals with the impact of capital requirements on market valuations. Stress testing exercises have been used to measure the impact of capital requirements. In these exercises, regulators simulate episodes of financial stress to identify under-capitalized banks, whose capital requirements may subsequently be tightened. The 2011-12 European Banking Authority (hereafter EBA) stress tests (Mésonnier and Monks (2015)), as well as the stress tests preceding the launch of the Banking Union in Europe in 2013-14 (Carboni et al. (2017)) entailed negative abnormal stock returns for the weakest banks. Moreover, Mésonnier and Monks (2015) showed that banks with higher capital shortfalls experienced CDS spread increases following announcements: stress tests revealed the fragility of some banks to market participants. Indeed, stress tests differ widely in their setups and convey lots of private information at the bank-level (Morgan et al. (2014), Petrella and Resti (2013)), since one of their objective is to increase market transparency. Therefore event studies of specific stress tests do not capture the mere effect of capital requirements. Conversely, the CCyB setup provides a stable regulatory environment to study capital requirement hikes across multiple announcements. Another series of papers investigates the differentiated impact of regulatory-induced and managers-induced bank capital issuance. Using Japanese data, Cornett and Tehranian (1994) show that regulatory-induced capital issuance trigger weaker negative abnormal returns than voluntary issuance. This is consistent with the latter conveying more private information on possible stock overpricing. By the same token, Elyasiani et al. (2014) show that investors positively valued announcements of Troubled Asset Relief Program capital injections in the US, while they generally negatively receive private seasoned equity offerings. Our results are consistent with these findings: regulatory-driven capital ratio increases do not entail any drop in stock returns.

Finally, some papers focus on the impact of actual leverage on CDS spreads and show that lower leverage is associated with lower CDS spreads (Benbouzid et al. (2017), Annaert et al. (2013)).

To the best of our knowledge, our setup allows us to make the first direct empirical estimation of the impact of capital requirement announcements on financial markets.

The rest of the paper is organized as follow. Section 2 presents the European CCyB framework, Section 3 the empirical strategy and Section 4 the data. Results are housed in Section 4. Section 5 concludes.

## 2. The CCyB framework

The CCyB is a time-varying bank capital requirement introduced with Basel III agreements. It is designed to tackle the procyclicality of bank credit (see for instance Dewatripont and Tirole (2012), Martinez-Miera and Suarez (2014), Davydiuk (2017), Mendicino et al. (2018), Malherbe (2020) for theoretical rationales for countercyclical capital requirements). As explained by the European Systemic Risk Board (ESRB (2014)):

The countercyclical capital buffer is designed to help counter procyclicality in the financial system. Capital should be accumulated when cyclical systemic risk is increasing, creating buffers that increase the resilience of the banking sector during periods of stress when losses materialise. This will help maintain the supply of credit and dampen the downswing of the financial cycle. The countercyclical capital buffer can also help dampen excessive credit growth during the upswing of the financial cycle.

The CCyB has thus two, ranked, objectives: first, improving the resilience of the banking system during financial crises; second, leaning against excessive growth of credit in the upward phase of the financial cycle. Its mechanism is the following. In a boom, authorities raise the CCyB. In reaction, bank managers adjust balance sheet structure, trading off the costs of lower leverage with those of breaching the constraint if capital is too low.<sup>2</sup> This adjustment can take place through three different channels: an increase in equity levels through equity issuance or retained earnings, a decrease in asset size, or a de-risking on the asset side to decrease risk-weights. Then, when an aggregate negative shock occurs

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<sup>2</sup>The CCyB enters the so-called *Combined Buffer Requirement* (CBR). Breaching it triggers restrictions in capital payouts (dividends, share buybacks, bonuses) and requires the bank to present a *Capital Conservation Plan* to supervisors. This also means that CCyB hikes may have a smaller impact on capital ratios than Pillar 1 or Pillar 2 requirements which directly constrain bank balance sheets.



(typically a financial crisis), the authority releases the CCyB.<sup>3</sup> This allows banks to use the freed capital to absorb losses and bear an increase in their portfolio risk-weights, without having to cut on lending or their solvency being questioned. Ultimately, this mitigates the risk of a credit crunch.

The CCyB is expressed in percentage of Risk-Weighted Assets (RWA) and capital is to be raised in the form of common equity tier 1 capital (CET1).<sup>4</sup> In the EEA,<sup>5</sup> each bank must compute a specific CCyB rate, defined as the average of country-level rates fixed by national authorities, weighted by banks capital requirement due to *relevant* risk-weighted exposure to each country (see details in B). Bank-specific CCyB rates can thus be expressed as follows:

$$CCyB_{b,t} = \sum_{c=1}^N \left\{ CCyB_{c,t} * \frac{Requirement_{b,c,t}^{RWA\ relevant}}{\sum_{k=1}^N Requirement_{b,k,t}^{RWA\ relevant}} \right\}, \quad (2.1)$$

with  $b$  the bank,  $t$  the date, and  $c$  in  $1, \dots, N$  the countries.  $CCyB_{c,t}$  is the CCyB rate applying to banks in the EEA for their exposures in country  $c$ .<sup>6</sup> As a result, each country-level CCyB announcement automatically results in an heterogeneous effect on all banks of the EEA, proportional to their relevant exposures to the activating country.

In the European framework, the CCyB is set on a quarterly basis by national authorities. Upon decision, they must publish the rate along with an explanation for their decision. This feature allows us to identify exact announcement days by relevant authorities.<sup>7</sup> They must follow the principle of *guided discretion*: they are free to set the CCyB rate, but must rely on quantitative indicators to ground their decision, in particular on the *buffer guide* - the deviation of the credit-to-GDP ratio from its long-term trend.

The CCyB framework was meant to enter into force on January 1st, 2016. Nevertheless, Norway, Sweden, and Czech Republic opted for early implementation and started using the CCyB back in 2013.

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<sup>3</sup>Therefore, the pass-through of capital requirements is expected to be smaller for CCyB hikes than for usual permanent capital requirements. Indeed, breaching the CCyB should only occur for negative idiosyncratic shocks. See details in B.

<sup>4</sup>CET1 is the purest form of capital consisting mainly of retained earnings and issued capital.

<sup>5</sup>The CCyB was included in the European regulatory financial framework via the EEA relevant *Capital Requirements Directive IV*, and specifically Articles 130, 135, 136, 140 of Directive 2013/36/EU of the European Parliament and of the Council of 26 June 2013: <https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:32013L0036&from=FR> (CRD IV), adopted in 2013 and then transposed into national laws. CRD IV formalizes the capital regulations introduced in Basel III agreements, among which the CCyB.

<sup>6</sup>See B for details on this formula.

<sup>7</sup>The CCyB is set nationally on a quarterly basis by so-called *designated* authorities. In some cases, a distinct *macroprudential authority* is in charge of making CCyB recommendations to the *designated authority*. In the latter case, we take *macroprudential authorities* announcements as the relevant information-producing shock.

### 3. Empirical approach

Our empirical approach consists in studying the impact of CCyB shocks on country-level and bank-level CDS spreads and stock prices. We follow standard methods for event studies (see for instance MacKinlay (1997)). We study events occurring during defined event windows - in our baseline the (0,2) window - considering the event takes place on the day of the announcement and in the two following days. In case investors take time to digest new information, or if announcements are made at the end of business days, this allows us to fully capture market reactions. Our results remain valid in alternative event specifications.

We specify our residuals covariance matrix as in Driscoll and Kraay (1998) so that our estimates are robust to heteroskedasticity and serial cross-correlation of errors, a common feature in financial markets.

We define CCyB shocks as changes in CCyB level. Ideally, one would define shocks as unexpected CCyB changes, in which case the announcement of a constant CCyB could also come as a surprise. However, there are no financial instruments at our disposal to run such a study - as for instance Fed Funds Rate futures in monetary policy. Nevertheless, several arguments support our approach. First, although in law the buffer guide could be a measure of market expectations, in practice CCyB rates implemented substantially differ from it due to the use of guided discretion, making anticipation difficult.<sup>8</sup> Second, anticipation of hikes would only produce a conservative bias in our estimates. Third, in Appendix 2.12, we verify that markets do not react to announcements of constant CCyB rates. Conversely, the systematic reaction of markets upon CCyB changes validates the assumption that these come as (at least partial) surprises.

We follow Andres et al. (2016) in measuring abnormal CDS spread changes in relative rather than absolute terms. We also follow their guidance in specifying normal CDS spread growth with a 4-factor model  $F_t$  including: (i) 10-year AAA European sovereign instantaneous forward rate to measure the level of the risk-free yield curve; (ii) 10-year AAA European sovereign yield to measure the slope of the risk-free yield curve; (iii) VSTOXX to measure equity-implied volatility; (iv) the STOXX600 financials index to measure relevant stock market performance. All 4 factors are expressed in daily growth rates. We also analyze how stock indices respond to CCyB changes, and specify normal stock index returns as a linear function of the European stock index daily return produced by MSCI. We estimate the following regressions:

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<sup>8</sup>See for instance ESRB (2020): “When looking at developments in the Basel credit-to-GDP gap across Member States, a relatively high degree of heterogeneity can be observed in their setting of CCyB rates.”

$$\Delta CDS_{dt} = \beta * \Delta CCYB_{dt} + \gamma_d * \Delta F_t + \nu_d + \epsilon_{dt}, \quad (2.2)$$

$$StockReturn_{dt} = \beta * \Delta CCYB_{dt} + \gamma_d * \Delta StockIndex_{et} + \nu_d + \epsilon_{dt}. \quad (2.3)$$

where  $d$  designates either a country  $c$  or a bank  $b$ ,  $\nu_d$  the corresponding fixed effects,  $\Delta CCYB_{dt}$  the value of the CCyB hike (country or bank-specific). The endogenous variables are alternatively the daily variation in 5-year domestic (bank) CDS spreads, and the daily return of the domestic (bank) stock index.  $StockIndex_{et}$  designates the daily return of the stock index of reference: Europe MSCI for country regressions, the main domestic stock index for bank regressions.

Subsequently, we investigate whether the impact of CCyB hikes depends on banks characteristics. For this purpose, we interact CCyB hikes with a dummy capturing whether the bank belongs to the higher or lower half of the sample on given characteristics:

$$\begin{aligned} \Delta CDS_{bt} = & \beta * \Delta CCYB_{bt} * D_{bt} + \lambda * \Delta CCYB_{bt} * (1 - D_{bt}) + \\ & \gamma_b * \Delta F_t + \nu_b + \epsilon_{bt}, \end{aligned} \quad (2.4)$$

$$\begin{aligned} StockReturn_{bt} = & \beta * \Delta CCYB_{bt} * D_{bt} + \lambda * \Delta CCYB_{bt} * (1 - D_{bt}) + \\ & \gamma_b * \Delta StockIndex_{et} + \nu_b + \epsilon_{bt}, \end{aligned} \quad (2.5)$$

with  $D_{bt}$  capturing in turn bank capitalization (CET1 ratio), and perceived riskiness (level of CDS spread).

## 4. Data

We proceed in four steps to build bank-level CCyB shocks.

First, we collect all quarterly CCyB decisions by national authorities gathered by the European Systemic Risk Board from 2013 to September 2020.<sup>9</sup> Although the framework became operational in 2016, some countries opted for early activations (Norway, Sweden, Czech Republic). We add to this list the decisions taken by the Hong-Kong authority, starting in 2015. In the period of study, 15 countries activated the CCyB (Figure 2.1).

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<sup>9</sup>[https://www.esrb.europa.eu/national\\_policy/ccb/html/index.en.html](https://www.esrb.europa.eu/national_policy/ccb/html/index.en.html)

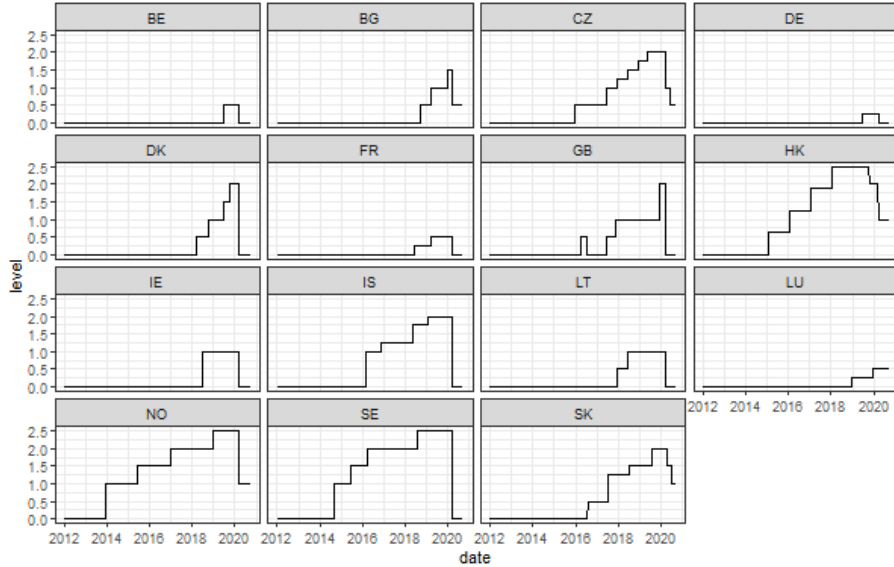


Fig. 2.1. CCyB levels over time for the 15 countries having activated (in %)

Second, we collect the exact date of CCyB announcements on national authorities' websites, taking into account potential differences in national frameworks. We choose the relevant announcement day to be the day of the first announcement of the increase, may it be a recommendation by the macroprudential authority, or a decision by the designated authority. When national authorities use forward guidance, we exclude both the initial guidance and the subsequent official announcement. Details on the identification of announcement dates are presented in A. All increases happened before 2020, while almost all releases occurred between March and July 2020 in the context of the Covid crisis. Two exceptions are the UK release on July 5th, 2016 following the Brexit vote, and the Hong-Kong release of October 14th, 2019 in a context of social protests.

Third, we filter out all dates with confounding shocks. Designated authorities sometimes announce multiple decisions jointly with CCyB changes. For instance, the UK increase of July 5th, 2016 came together with a reduction in PRA buffers, while the Czech release of March 16th, 2020 happened on the same day as a reduction in monetary policy interest rates. We screen press releases individually to identify potential joint announcements, and filter out all dates on which other changes were announced. We finally exclude the Norwegian activation of December 2013, since that increase was to become effective 1 year and 7 months later (in July 2015), thereby departing from the standard of 1 year that prevailed thereafter. Thus, we begin our dataset in 2014.

Fourth, we calculate bank-specific shocks. For that purpose, we limit ourselves to publicly-available information that investors could be using. We rely on country-level bank exposures coming from the EBA annual transparency exercise that provides credit risk expo-

asures on 128 banks, to their 10 largest borrowing countries. Those exercises provide “detailed bank-by-bank data on capital positions, risk exposure amounts, leverage exposures and asset quality” for the largest banks of the European Economic Area (EEA) at the highest level of consolidation.<sup>10</sup>

The EBA dataset informs on geographical exposures and allows disentangling relevant credit risk exposures from non relevant credit risk exposures. In doing so, we use the share of relevant *credit risk* exposures as an approximation for the share of relevant exposures. We disregard the country-allocation of trading book and securitization exposures. Credit risk exposures represent a large share of total risk-weighted exposures, and more detailed public information on country-level exposures are in any case not available. We also neglect any difference between risk-weighted exposure ratios and corresponding capital requirements. Using confidential supervisory data on French banks, we confirm that this approximation is very close to the true weights of national CCyB at the bank level. Therefore, informed market participants are able to measure quite precisely the real impact of the shock using the EBA data set.

We take into account the lag in the release of public information by the EBA. Precisely, the EBA publishes in December of year  $n$  data for the second semester of year  $n - 1$  and the first semester of year  $n$ . We assume that investors estimate CCyB shocks in year  $n + 1$  using data published by the EBA in December of year  $n$  on bank exposures at the end of the first semester of year  $n$ . Since the results of the first transparency exercise were published in December 2015, we use exposures of the second semester of 2014 published in December 2015 to approximate perceived CCyB shocks prior to 2016. Although investors did not have precise information on bank country-level exposures then, we assume they were able to assess them using other public sources. This allows us to include more CCyB changes in our dataset. Our results remain robust to excluding those early announcements.

In some cases, multiple countries announce CCyB changes on the same day, or announcement windows overlap. In this case, we simply sum shocks at the bank-day level, in line with the consequence of those multiple announcements for the bank-specific CCyB. Banks CCyB shocks are thus computed on day  $t$  as:

$$\Delta CCyB_{b,t} = \sum_{c=1}^N \left\{ \Delta CCyB_{c,t} * \frac{RWA_{b,c,t}^{relevant, credit risk}}{\sum_{k=1}^N RWA_{b,k,t}^{relevant, credit risk}} \right\}. \quad (2.6)$$

We match these shocks with bank-level market data on stock prices (from Bloomberg) and 5-year CDS spreads (from Eikon, Markit, Bloomberg and Datastream). We exclude banks with the worst CDS liquidity score as computed by Markit on a scale from 1 to 5. We

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<sup>10</sup><https://eba.europa.eu/risk-analysis-and-data/eu-wide-transparency-exercise>

also exclude banks that underwent nationalization or bankruptcy over the period. We end up with a daily panel of stock returns for 58 European bank, and CDS spreads for 39 banks, out of which respectively 44 and 36 were affected by at least one CCyB shock.<sup>11</sup>

In the period of study, there were exactly 32 CCyB increases and 8 releases with no contemporaneous policy announcement, that affected at least one observed bank. One of these increases affected no bank for which CDS spreads are available. A detailed summary table of all country-level shocks and affected banks can be found in Appendix 2.5. Descriptive statistics of the banks in the sample are referenced in Appendix 2.6.

## 5. Results

### 5.1. *CCyB impact on country-level market variables*

To begin with, we assess the impact of CCyB increases in a jurisdiction on country-level market variables. If CCyB increases convey private information on the state of a country's economy, we would expect those country-level variables to react on announcement days. The estimates of Equation (2.2) and Equation (2.3) for country-level variables are gathered in Table 2.1, and show that country-level variables do not react to CCyB increases. This allows us to rule out the possibility that CCyB increases systematically convey private information on the state of a country's financial cycle. However, we observe a small increase in sovereign CDS spreads upon CCyB releases. Therefore, markets could be interpreting releases as negative news from regulators.

### 5.2. *CCyB impact on bank CDS spreads*

We now turn to the main part of the paper and investigate the impact of CCyB hikes on banks CDS spreads.

To get a graphical idea of this effect, we plot abnormal changes in CDS spreads around announcements of CCyB hikes. First, we estimate a model of normal change in CDS spreads: we estimate Equation (2.2), removing the shock variable and excluding all dates in the (-3,2) window. Using estimated coefficients, we compute abnormal changes in CDS spreads in

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<sup>11</sup>Our sample contains the largest and most internationally active banks which have rated CDS spreads and/or stock prices. There are two reasons why results may differ for smaller banks. First, if capital requirements have a non-linear effect on market prices, then smaller banks may react more strongly since they experience on average larger bank-specific shocks. Second, smaller and non-publicly traded banks may have less room for adjustment if they have a poorer access to equity markets, or are more reliant on their loan portfolios.

Table 2.1: Impact of CCyB increases on domestic variables

|                         | <i>Dependent variable:</i> |                   |                    |                    |                   |                    |
|-------------------------|----------------------------|-------------------|--------------------|--------------------|-------------------|--------------------|
|                         | CDS sov growth             |                   |                    | Stock index return |                   |                    |
|                         | Baseline                   | First             | Release            | Baseline           | First             | Release            |
|                         | (1)                        | (2)               | (3)                | (4)                | (5)               | (6)                |
| $\Delta$ CCyB           | -0.003<br>(0.004)          | -0.006<br>(0.006) |                    | -0.0002<br>(0.001) | 0.0001<br>(0.002) |                    |
| $\Delta$ CCyB, neg      |                            |                   | -0.011*<br>(0.006) |                    |                   | -0.002<br>(0.001)  |
| $\Delta$ CCyB, pos      |                            |                   | -0.003<br>(0.004)  |                    |                   | -0.0002<br>(0.001) |
| Controls                | Yes                        | Yes               | Yes                | Yes                | Yes               | Yes                |
| No. country shocks      | 36                         | 12                | 46                 | 36                 | 12                | 46                 |
| Observations            | 46,957                     | 46,957            | 46,997             | 50,862             | 50,862            | 50,902             |
| R <sup>2</sup>          | 0.110                      | 0.110             | 0.112              | 0.419              | 0.419             | 0.423              |
| Adjusted R <sup>2</sup> | 0.108                      | 0.108             | 0.109              | 0.418              | 0.418             | 0.422              |

*Note:* All country-level CCyB increases (including those having no bank of our sample exposed) are included in the sample, excluding Hong-Kong. All estimations are on a (0,2) event window with country fixed effects. Standard errors are clustered at the day level. Robust standard errors are shown in brackets. \*p<0.1; \*\*p<0.05; \*\*\*p<0.01.

those announcement windows.<sup>12</sup> Figure 2.2 depicts the median cumulative abnormal change in bank CDS spreads around CCyB announcements, separating for each shock affected from unaffected banks. Both have very similar pre-announcement trends, but while CDS spreads of unaffected banks do not react, those of affected banks fall markedly around announcements.

We confirm this result by estimating Equation (2.2) for banks. Results are shown in Table 2.2 and indicate that CCyB increases lead to lower CDS spreads for affected banks. These estimates are economically meaningful: a 1 percentage point increase in bank-level capital requirements leads to 11.8% drop in CDS spreads.<sup>13</sup> The negative impact of CCyB hikes on bank CDS spreads is the key result of this paper. It indicates that market participants consider that higher CCyB rates will lower debtholders expected losses.<sup>14</sup> As such, the CCyB is expected to fulfill its main objective of increasing banks solvency.

<sup>12</sup>This amounts to running the first-step of a two-step event study (see MacKinlay (1997)).

<sup>13</sup>Our point estimate on a (0,2) window should be multiplied by 3 to get the total effect of a 1 pp increase in requirements.

<sup>14</sup>CDS spreads price the probability of default (PD) and the loss given default (LGD) of the underlying, jointly with the risk aversion of parties. Under the assumption of risk neutrality, we have:  $CDS_{spread} = PD * LGD$ .

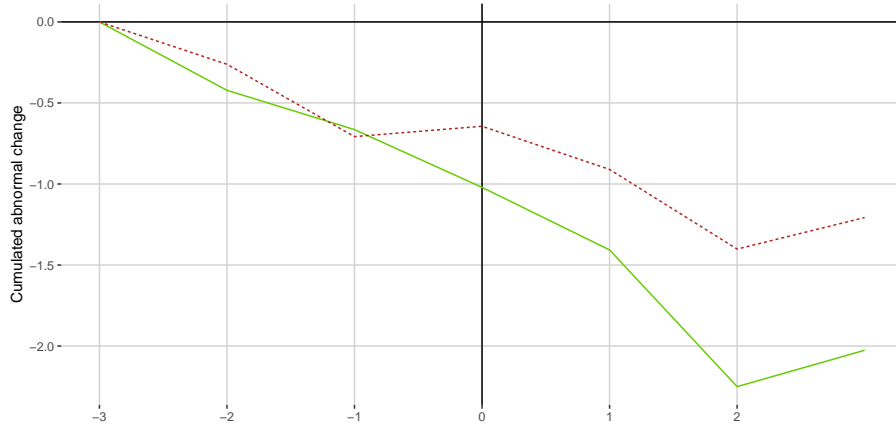


Fig. 2.2. Median cumulated abnormal changes in CDS spreads around CCyB hikes *Note:* Green (red) line indicates median the cumulated abnormal change in CDS spread for (un)affected banks, in basis points. (Un)affected banks are banks receiving a strictly positive (null) CCyB shock on announcement days. CCyB announcements with overlapping event windows are excluded.

We conduct two extensions of the main result. In Column (2), we restrict the sample of events to CCyB activation (i.e. its first increase in a given country). This specification results in a larger effect. When activating, authorities show their willingness to actually use this macroprudential tool, and this activation may raise awareness about the CCyB. Therefore, subsequent hikes may come less as a surprise.

We extend our main result in Column (3) by including CCyB releases along with hikes. We separate hikes from releases in the regression, to assess possible asymmetry in financial markets reaction. It turns out that CCyB announcements work both ways, with releases triggering an increase in CDS spreads. The estimated coefficients are very similar. However, expansionary releases may be more expected in the midst of a crisis, biasing downwards the estimates.<sup>15</sup> On the other hand, since country-level variables also reacted, part of the effect should be attributed to a signalling channel. Therefore, both coefficients are not directly comparable.

Our results are robust to a vast range of alternative specifications gathered in C. Results are very similar using CDS absolute spread variation (Table 2.7). A 1 pp increase in CCyB translates in a 7.0 pp drop in bank CDS spreads. In Table 2.8, we test complementary shock specifications, while in Table 2.9 we verify that our results are robust to alternative specifications of normal CDS spread variations. As shown in Table 2.10, our results are significant on the (0,1) and the (0,2) window, but wear out going forward. In Table 2.11 we

<sup>15</sup>In particular, when the ECB announced a series of prudential loosening on 12 March 2020, it stated that these measures would be “be enhanced by the appropriate relaxation of the countercyclical capital buffer (CCyB) by the national macroprudential authorities”, thereby pre-announcing subsequent releases. See <https://www.bankingsupervision.europa.eu/press/pr/date/2020/html/ssm.pr200312~43351ac3ac.en.html>.



Table 2.2: Impact of CCyB increases on bank CDS spreads

|                         | <i>Dependent variable:</i> |                      |                      |
|-------------------------|----------------------------|----------------------|----------------------|
|                         | CDS growth                 |                      |                      |
|                         | Baseline                   | Activation           | Release              |
|                         | (1)                        | (2)                  | (3)                  |
| $\Delta$ CCyB           | -0.038***<br>(0.013)       | -0.066***<br>(0.017) |                      |
| $\Delta$ CCyB, neg      |                            |                      | -0.033***<br>(0.009) |
| $\Delta$ CCyB, pos      |                            |                      | -0.038***<br>(0.013) |
| Controls                | Yes                        | Yes                  | Yes                  |
| No. dates               | 30                         | 13                   | 35                   |
| No. bank shocks         | 216                        | 123                  | 257                  |
| Observations            | 54,218                     | 54,125               | 54,335               |
| R <sup>2</sup>          | 0.088                      | 0.088                | 0.090                |
| Adjusted R <sup>2</sup> | 0.085                      | 0.085                | 0.087                |

*Notes:* All estimations are on a (0,2) event window with bank fixed effects. Standard errors are clustered at the day level. Robust standard errors are shown in brackets. \*p<0.1; \*\*p<0.05; \*\*\*p<0.01.

show that alternative exclusion thresholds for CDS liquidity scores do not alter our results.

Announcements of no CCyB change may also contain news if markets anticipated rate changes. Results presented in Table 2.12 show that such announcements have actually no impact on bank CDS spreads. This reinforces our claim that CCyB hikes come as a surprise. Finally, the impact of CCyB hikes also remains significant when removing country-level CCyB hikes one by one (Table 2.13), while Placebo tests confirm the validity of our event-study approach (Table 2.14).

Since country-level variables do not react to CCyB hikes, we interpret our results as evidence that markets anticipate banks to adjust their balance sheets in response to higher requirements. In this case, banks closer to their capital constraint should react more.

Table 2.3 houses the results of Equation (2.4). This equation acts as a further robustness test, as poorly capitalized and riskier banks should react more if a capital channel is at play. Results confirm those hypotheses. First, CCyB hikes reduce CDS spreads of both highly and poorly capitalized banks, but the effect is twice larger for less capitalized banks. Second, CCyB hikes reduce more high CDS spreads than low ones, suggesting that investors anticipate a higher increase in solvency for the riskiest banks. It also shows that the relative impact of an additional point of capital ratio is higher for banks with a lower distance to

Table 2.3: Impact of CCyB increases on bank CDS spreads - bank characteristics

|                                 | <i>Dependent variable:</i> |          |
|---------------------------------|----------------------------|----------|
|                                 | CDS growth                 |          |
|                                 | CET1 ratio                 | CDS      |
|                                 | (1)                        | (2)      |
| $\Delta$ CCyB * Low CET1 ratio  | -0.049*                    |          |
|                                 | (0.028)                    |          |
| $\Delta$ CCyB * High CET1 ratio | -0.028**                   |          |
|                                 | (0.012)                    |          |
| $\Delta$ CCyB * Low CDS         |                            | -0.032** |
|                                 |                            | (0.015)  |
| $\Delta$ CCyB * High CDS        |                            | -0.051*  |
|                                 |                            | (0.028)  |
| Controls                        | Yes                        | Yes      |
| No. dates                       | 29                         | 30       |
| No. bank shocks                 | 214                        | 216      |
| Observations                    | 43,683                     | 54,218   |
| R <sup>2</sup>                  | 0.100                      | 0.088    |
| Adjusted R <sup>2</sup>         | 0.096                      | 0.085    |

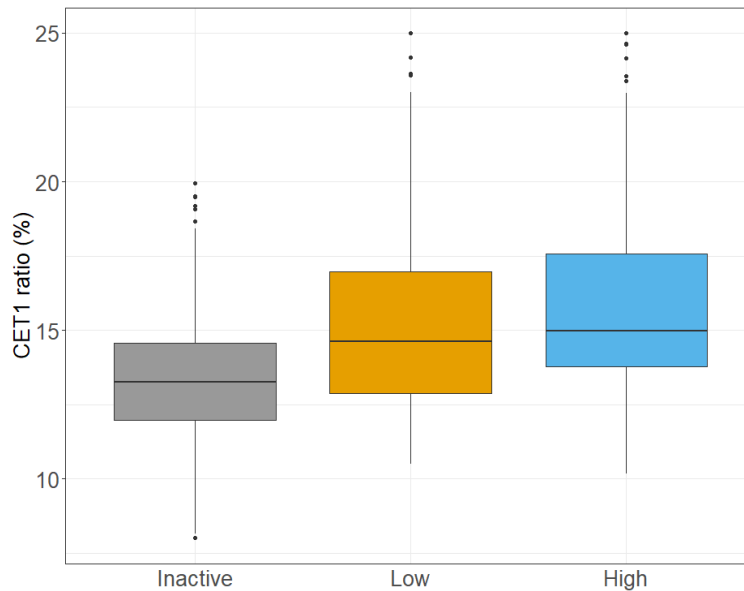
*Notes:* Interaction variables are dummies depending on the bank's position relative to the median. All estimations are on a (0,2) event window with bank fixed effects. Standard errors are clustered at the day level. Robust standard errors are shown in brackets. \*p<0.1; \*\*p<0.05; \*\*\*p<0.01.

default.

One may object to estimating a single parameter for shocks from all countries. For instance, Nordics tended to increase CCyB rates to higher levels than Mediterranean countries (see Figure 2.1). Banks operating in countries with more active macroprudential authorities may thus decide to increase capital ratios preemptively, resulting in muted effects of CCyB increases. Conversely, designated authorities may be keener to increase the CCyB if domestic banks exhibit large management buffers, expecting banks to have enough capital to adjust partially if at all. In Figure 2.3, we compare the distribution of pooled bank capital ratios depending on how active domestic countries were in using the CCyB. Capital ratios appear indeed higher in countries where the CCyB was activated, although there is no significant difference between highly active countries and those who increased the CCyB just once or twice.

In Table 2.15, we find that banks in less active countries reacted more to CCyB increases than others. This could reflect a higher anticipation of shocks in more proactive countries, or the fact that banks in more active countries are (slightly) more capitalized.

Overall, our results show that CCyB hikes trigger a fall in banks CDS spreads, in particular for less capitalized and riskier banks.



*Note:* *Inactive* countries never increased the CCyB, *Low* proactiveness countries increased it once or twice (BE, DE, FR, IE), and *High* proactiveness countries increased it at least three times. CET1 ratios have been truncated at 25% and 8%.

Fig. 2.3. Pooled distribution of bank CET1 ratios by level of residence country proactiveness in increasing the CCyB.

### 5.3. CCyB impact on stock prices

In this section, we estimate Equation (2.3) and assess whether CDS spread drops are associated with changes in stock returns. As the sample of banks with listed stocks is larger than with CDS, we run the regressions on two samples: one including all stocks in the sample, and one covering only banks present in the CDS regressions of Section 5.2.<sup>16</sup> Results are summarized in Table 2.4. CCyB increases are not associated with any systematic stock price movement. These results are robust independent of bank characteristics, as highlighted in Table 2.16, which presents the results of Equation (2.5). CCyB releases on the other hand are associated with a drop in stock returns. This is in line with country-level results, suggesting that markets could perceive releases as an indication of negative prospects for the economy.

We propose three broad categories of rationales that may explain why CCyB hikes leave stock returns unaffected.

First, if banks were to adjust their balance sheet through an increase in capital, pecking-order (Myers and Majluf (1984)) and market timing (Baker and Wurgler (2002)) theories

<sup>16</sup>There are 32 banks with defined stock returns and undefined CDS spreads, and 8 banks with the opposite.

predict this should have no impact on stock prices. Capital structure matters only in the presence of information frictions. Thus, equity issuance due to higher capital requirements do not affect stock prices since they do not convey any private information. As in Cornett and Tehranian (1994), we indeed find that regulatory-driven capital structure adjustments do not affect stock prices since they do not convey any bank manager private information. Besides, as CCyB hikes are relatively modest and announced one year before they become applicable, banks may be able to adjust with retained earnings only and avoid non-informational transaction costs attached to equity issuance.

Second, there may be multiple optimal balance sheet choices for shareholders. In a mean-variance framework à la Markowitz (1952), there is an infinite number of optimal portfolios along the capital market line. In our setting, markets could perceive the CCyB to cause a reduction in bank profits, with risk-adjusted profits remaining constant. Our results are also consistent with the existence of an optimal *range* of balance sheet structures. In trade-off theories, any increased capital requirement would automatically force a firm to deviate from its optimal leverage, and entail lower stock prices (Kraus and Litzenberger (1973)). However, if shareholders target an optimal range of leverage instead of a specific ratio, any CCyB increase allowing banks to remain in that range may come at no cost for shareholders. In other words, the effect of requirements on stock prices may be non-linear depending on whether it forces managers to depart from their optimal balance sheet structure range.

Finally, coordination challenges among competing banks may lead them to choose capital structures inferior to those that could be set by a regulator, for instance if banks are unwilling to individually adjust capital structures out of fear of losing market shares. In that case, shareholders would potentially not object to a regulator setting higher capital requirements across the board.

Disentangling those different effects is beyond the scope of this paper. What we show is that observed CCyB increases did not trigger any stock price decline. This suggests that regulators may have further room to tighten capital requirements at no cost for shareholders.

## 6. Conclusion

In this paper, we exploit the institutional setup of the CCyB in the EEA to *directly* estimate the effect of capital requirements on financial markets. Our identification rests upon two features: CCyB hikes are quarterly announcements by national authorities, and they heterogeneously affect all banks of the EEA. We use this setup to assess how markets factor capital requirement increases in CDS spreads and stock prices.

We show that hikes in CCyB rates are perceived as increasing bank solvency, at no

Table 2.4: Impact of CCyB increases on bank stock returns

|                         | <i>Dependent variable:</i> |                    |                     |                    |                  |                     |
|-------------------------|----------------------------|--------------------|---------------------|--------------------|------------------|---------------------|
|                         | Stock return               |                    |                     |                    |                  |                     |
|                         | All sample                 |                    |                     | CDS sample         |                  |                     |
|                         | Baseline                   | Activation         | With release        | Baseline           | Activation       | With release        |
|                         | (1)                        | (2)                | (3)                 | (4)                | (5)              | (6)                 |
| $\Delta$ CCyB           | 0.004<br>(0.007)           | -0.0003<br>(0.007) |                     | -0.0004<br>(0.011) | 0.009<br>(0.022) |                     |
| $\Delta$ CCyB, neg      |                            |                    | 0.020***<br>(0.004) |                    |                  | 0.018***<br>(0.003) |
| $\Delta$ CCyB, pos      |                            |                    | 0.004<br>(0.007)    |                    |                  | -0.0002<br>(0.011)  |
| Controls                | Yes                        | Yes                | Yes                 | Yes                | Yes              | Yes                 |
| No. dates               | 31                         | 13                 | 37                  | 30                 | 13               | 35                  |
| No. bank shocks         | 318                        | 184                | 375                 | 182                | 102              | 217                 |
| Observations            | 110,049                    | 109,915            | 110,219             | 44,045             | 43,965           | 44,144              |
| R <sup>2</sup>          | 0.399                      | 0.399              | 0.400               | 0.482              | 0.482            | 0.483               |
| Adjusted R <sup>2</sup> | 0.398                      | 0.398              | 0.399               | 0.481              | 0.481            | 0.482               |

*Note:* CDS sample regressions estimate the stock return equation on points of the panel when CDS spreads are defined. All estimations are on a (0,2) event window with bank fixed effects. Standard errors are clustered at the day level. Robust standard errors are shown in brackets. \*p<0.1; \*\*p<0.05; \*\*\*p<0.01.

significant cost for shareholders. We claim that these effects relate to the capital constraint itself, as opposed to the potential signal conveyed on the state of the financial cycle. These results are important to assess the costs and benefits of capital requirements. They suggest that regulators may have room for a more vigorous use of countercyclical capital requirements to improve banks' solvency without material impact on shareholder value. Capital releases seem to have a symmetrically opposite effect, although the effect rather operates through a signalling channel.

Our results pave the way for further research. A similar analysis could be run on systemic risk buffers implemented in the EEA, or alternatively on Pillar 2 requirements now that their level is systematically published by the SSM. It is also key to understand which balance sheet adjustments are priced by markets upon shocks. Key questions include the impact of the CCyB on credit growth, during both the build-up and the release of the CCyB.

# References

- Aiyar, S., Calomiris, C. W., Hooley, J., Korniyenko, Y., and Wieladek, T. (2014a). The international transmission of bank capital requirements: Evidence from the uk. *Journal of Financial Economics*, 113(3):368–382.
- Aiyar, S., Calomiris, C. W., and Wieladek, T. (2014b). Does macro-prudential regulation leak? evidence from a uk policy experiment. *Journal of Money, Credit and Banking*, 46(s1):181–214.
- Alfon, I., Argimón Maza, I., and Bascuñana-Ambrós, P. (2005). How individual capital requirements affect capital ratios in uk banks and building societies. *Documentos de trabajo/Banco de España*, 0515.
- Andres, C., Betzer, A., and Doumet, M. (2016). Measuring abnormal credit default swap spreads. *Available at SSRN 2194320*.
- Annaert, J., De Ceuster, M., Van Roy, P., and Vespro, C. (2013). What determines euro area bank cds spreads? *Journal of International Money and Finance*, 32:444 – 461.
- Auer, R. and Ongena, S. (2016). The countercyclical capital buffer and the composition of bank lending. *BIS Working Papers*, 593.
- Baker, M. and Wurgler, J. (2002). Market timing and capital structure. *The Journal of Finance*, 57(1):1–32.
- Basten, C. (2020). Higher bank capital requirements and mortgage pricing: Evidence from the counter-cyclical capital buffer. *Review of Finance*, 24(2):453–495.
- Behn, M., Haselmann, R., and Wachtel, P. (2016). Pro-cyclical capital regulation and lending. *The Journal of Finance*, 71(2):919–956.
- Behncke, S. et al. (2020). Effects of macroprudential policies on bank lending and credit risks. Technical report, Swiss National Bank.

- Benbouzid, N., Mallick, S. K., and Sousa, R. M. (2017). An international forensic perspective of the determinants of bank cds spreads. *Journal of Financial Stability*, 33:60 – 70.
- Carboni, M., Fiordelisi, F., Ricci, O., and Lopes, F. S. S. (2017). Surprised or not surprised? the investors' reaction to the comprehensive assessment preceding the launch of the banking union. *Journal of Banking & Finance*, 74:122 – 132.
- Clerc, L., Derviz, A., Mendicino, C., Moyen, S., Nikolov, K., Stracca, L., Suarez, J., and Vardoulakis, A. P. (2015). Capital Regulation in a Macroeconomic Model with Three Layers of Default. *International Journal of Central Banking*, 11(3):9–63.
- Cornett, M. M. and Tehranian, H. (1994). An examination of voluntary versus involuntary security issuances by commercial banks: The impact of capital regulations on common stock returns. *Journal of Financial Economics*, 35(1):99 – 122.
- Davydiuk, T. (2017). Dynamic bank capital requirements. *Available at SSRN 3110800*.
- Dewatripont, M. and Tirole, J. (2012). Macroeconomic Shocks and Banking Regulation. *Journal of Money, Credit and Banking*, 44:237–254.
- Driscoll, J. C. and Kraay, A. C. (1998). Consistent covariance matrix estimation with spatially dependent panel data. *The Review of Economics and Statistics*, 80(4):549–560.
- Elyasiani, E., J., L., and Pagano, M. S. (2014). Large capital infusions, investor reactions, and the return and risk-performance of financial institutions over the business cycle. *Journal of Financial Stability*, 11:62 – 81.
- ESRB (2014). Recommendation of the european systemic risk board of 18 june 2014 on guidance for setting countercyclical buffer rates (esrb/2014/1). *Official Journal of the European Union*.
- ESRB (2020). A review of macroprudential policy in the eu in 2019. *ESRB Reports*.
- Fraisse, H., Le, M., and Thesmar, D. (2020). The real effects of bank capital requirements. *Management Science*, 66(1).
- Francis, W. B. and Osborne, M. (2012). Capital requirements and bank behavior in the uk: Are there lessons for international capital standards? *Journal of Banking & Finance*, 36(3):803–816.

- Jimenez, G., Ongena, S., Peydro, J.-L., and Saurina, J. (2017). Macroprudential policy, countercyclical bank capital buffers, and credit supply: Evidence from the spanish dynamic provisioning experiments. *Journal of Political Economy*, 125(6).
- Kraus, A. and Litzenberger, R. H. (1973). A state-preference model of optimal financial leverage. *The Journal of Finance*, 28(4):911–922.
- MacKinlay, A. (1997). Event studies in economics and finance. *Journal of Economic Literature*, 35:13–39.
- Malherbe, F. (2020). Optimal capital requirements over the business and financial cycles. *American Economic Journal: Macroeconomics*, 12(3):139–74.
- Markowitz, H. (1952). Portfolio selection. *The Journal of Finance*, 7(1):77–91.
- Martinez-Miera, D. and Suarez, J. (2014). Banks’ endogenous systemic risk taking. *manuscript, CEMFI*, 42.
- Mendicino, C., Nikolov, K., Suarez, J., and Supera, D. (2018). Optimal dynamic capital requirements. *Journal of Money, Credit and Banking*, 50(6):1271–1297.
- Morgan, D. P., Peristiani, S., and Savino, V. (2014). The information value of the stress test. *Journal of Money, Credit and Banking*, 46(7):1479–1500.
- Myers, S. C. and Majluf, N. S. (1984). Corporate financing and investment decisions when firms have information that investors do not have. *Journal of Financial Economics*, 13(2):187 – 221.
- Mésonnier, J.-S. and Monks, A. (2015). Did the EBA Capital Exercise Cause a Credit Crunch in the Euro Area? *International Journal of Central Banking*, 11(3):75–117.
- Petrella, G. and Resti, A. (2013). Supervisors as information producers: Do stress tests reduce bank opaqueness? *Journal of Banking & Finance*, 37(12):5406–5420.
- Repullo, R. and Suarez, J. (2012). The Procyclical Effects of Bank Capital Regulation. *The Review of Financial Studies*, 26(2):452–490.
- Van den Heuvel, S. J. (2008). The welfare cost of bank capital requirements. *Journal of Monetary Economics*, 55(2):298–320.



## A. Identification of CCyB announcement dates

To identify announcement days, we watch out for two pitfalls. First, there may be distinct *macroprudential* and *designated* authorities, with the former making CCyB recommendations and the latter taking CCyB decisions. Second, authorities may be providing guidance on the path of future CCyB rates.

European law mandates the establishment of both a *macroprudential authority* in charge of conducting macroprudential policy,<sup>17</sup> and a *designated authority* in charge of deciding CCyB rates.<sup>18</sup> Both authorities can be distinct.<sup>19</sup> Among countries that activated, Denmark, Luxembourg, Germany, and Iceland have a distinct macroprudential authority publishing recommendations 1 to 3 month prior to the designated authority decision. In all cases, those recommendations have been followed up by a decision. We consider the relevant announcement day to be the first public announcement of the CCyB change, may it be a *macroprudential authority* recommendation or a *designated authority* decision.

When authorities provide guidance on the path of future CCyB rates, we exclude the initial guidance as well as the subsequent official announcement. Forward guidance announcements would not be directly comparable to official announcements, since they become effective more than a year after they are made. Subsequent announcements should be largely anticipated. In Denmark, the macroprudential authority (the Systemic Risk Council) can provide forward guidance on future recommendations in the same press release as that of the current recommendation (it occurred on April 4, 2018, March 26, 2018 and September 25, 2018). Swedish and British designated authorities also used forward guidance (resp. on July 13, 2018 and June 27, 2017).

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<sup>17</sup>See Recommendation ESRB/2011/3 of the European Systemic Risk Board on the macro-prudential mandate of national authorities: [https://www.esrb.europa.eu/pub/pdf/recommendations/ESRB\\_2011\\_3.en.pdf](https://www.esrb.europa.eu/pub/pdf/recommendations/ESRB_2011_3.en.pdf)

<sup>18</sup>See Article 136(1) of CRD IV.

<sup>19</sup>A full list of countries depending on their institutional arrangement is available here: [https://www.esrb.europa.eu/national\\_policy/shared/pdf/esrb.191125\\_list\\_national%20macroprudential\\_authorities\\_and\\_national\\_designated\\_authorities\\_in\\_EEA\\_Member\\_States.en.pdf](https://www.esrb.europa.eu/national_policy/shared/pdf/esrb.191125_list_national%20macroprudential_authorities_and_national_designated_authorities_in_EEA_Member_States.en.pdf)

## B. The CCyB framework in the EEA

Capital requirements are usually defined by national regulatory authorities as an equal top-up for all their domestic banks. On the contrary, to ensure that banks are sufficiently capitalized relative to their geographic exposures, each national authority must determine a CCyB rate for exposures to all countries in the world. The delay before the entry into force must not exceed one year after the publication of the decision, and can be shorter only under exceptional circumstances. Then, each bank domiciled in country  $d$  must compute a specific CCyB rate, defined as the average of country-level CCyB rates fixed by the authority of country  $d$ , weighted by the bank's capital requirement due to relevant risk-weighted exposure to each country. Relevant exposures include all exposures to the non-financial private sector. The bank-specific CCyB rate can thus be expressed as follows:

$$CCyB_{b,d,t} = \sum_{c=1}^N \left\{ CCy\tilde{B}_{d,c,t} * \frac{Requirement_{b,c,t}^{RWA\text{relevant}}}{\sum_{k=1}^N Requirement_{b,k,t}^{RWA\text{relevant}}} \right\}, \quad (2.7)$$

with  $b$  the bank,  $t$  the date,  $d$  the domestic country and  $c$  in  $1, \dots, N$  the countries.  $CCy\tilde{B}_{d,c,t}$  is the CCyB rate applying to banks domiciled in country  $d$  for their exposures in country  $c$ .

To avoid distortion to the level playing field, the Basel III rules include a reciprocity framework, according to which national authorities should apply to their domestic banks the rate decided in each of the participating countries for its banks' domestic exposures, so that  $CCy\tilde{B}_{d,c,t} = CCy\tilde{B}_{c,t}$ . National authorities have one year after the publication of a new CCyB rate by a foreign authority to apply it on the banks they supervise. This reciprocity applies up to a CCyB rate of 2.5%. Above, the reciprocity is purely voluntary. If some countries do not implement any CCyB (for instance if it is not part of the Basel III agreements), national authorities of participating countries are free to set any CCyB rate  $CCyB_{d,c,t}$  on this country for their banks. This has never occurred so far, meaning that implicitly  $CCy\tilde{B}_{d,c,t} = 0$  for all countries  $d$  in the Basel Group and all countries  $c$  outside it.

The CCyB was included in the European regulatory financial framework via the EEA relevant *Capital Requirements Directive IV* (CRD IV),<sup>20</sup> adopted in 2013 and then transposed into national laws. CRD IV formalizes the capital regulations introduced in Basel III agreements, among which the CCyB.

This directive strengthens the reciprocity framework, making it automatic without need for domestic authorities to formally reciprocate foreign rates: up to 2.5%, banks must auto-

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<sup>20</sup>Articles 130, 135, 136, 140 of Directive 2013/36/EU of the European Parliament and of the Council of 26 June 2013: <https://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:32013L0036&from=FR>

matically apply the CCyB rate set by national authorities (inside and outside the EEA) on their own country.<sup>21</sup> Above 2.5%, the reciprocity remains voluntary. Moreover, designated authorities in the EEA can decide to apply higher CCyB rates on exposures to a given non-EEA country if it deems its current CCyB insufficient. In practice, no CCyB rate has so far exceeded 2.5% and no designated authority in the EEA has decided to top-up non-EEA CCyB rates. Consequently, the CCyB rate that applies to an EEA bank  $b$  exposed to  $N$  countries  $c$ , and up to 2.5%, is:

$$CCyB_{b,t} = \sum_{c=1}^N \left\{ CCyB_{c,t} * \frac{Requirement_{b,c,t}^{RWArelevant}}{\sum_{k=1}^N Requirement_{b,k,t}^{RWArelevant}} \right\} \quad (2.8)$$

In the European stacking order of capital requirements, the CCyB enters the so-called *Combined Buffer Requirement* (hereafter CBR), along with the Capital Conservation Buffer, the Systemic Risk Buffer, the Global Systemically Important Institution buffer and the Other Systemically Important Institution buffer.<sup>22</sup> In the stacking order, the CBR is above the Pillar 1 and the Pillar 2 Requirement but below the Pillar 2 Guidance (Figure 2.4). The breach of the CBR by a bank has two consequences. First, the bank is restricted in the amount of capital it can distribute in dividend and share buyback, by the so-called *Maximum Distributable Amount* (hereafter MDA).<sup>23</sup> Second, the bank has to present a *Capital Conservation Plan*, including profit forecasts and intended measures to bridge the gap in capital. If the supervisor rejects the plan, it can require the institution to increase capital in a specified period and consequently lower the MDA.<sup>24</sup> Dividend restrictions and the negative ensuing signal ensure banks have incentives to comply with the CCyB and even keep a buffer above the CBR.

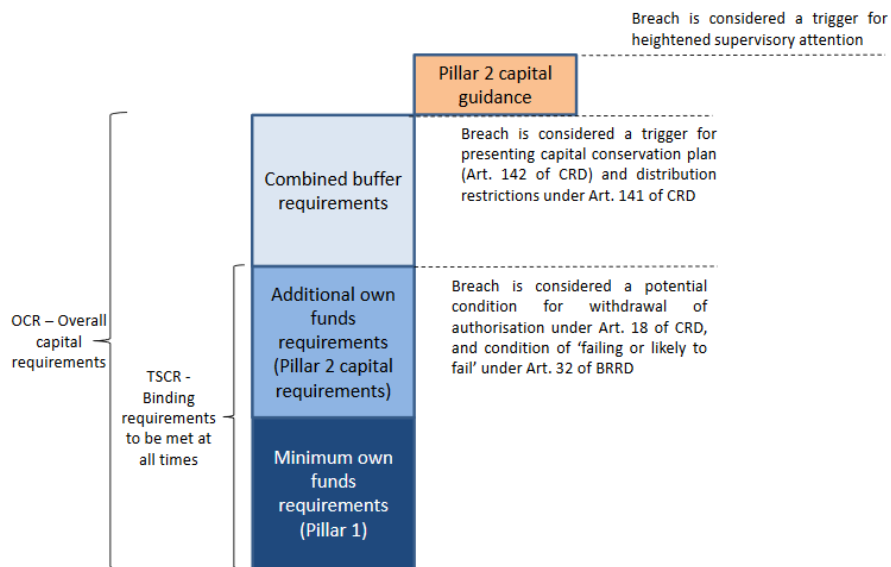
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<sup>21</sup>The rule for implementation delays for EEA banks differs between EEA and non-EEA rates. For the former, the implementation delay is the one decided by the designated authority setting the rate. For countries outside the EEA, the implementation date of the reciprocity is one year after the announcement of the new rate by the foreign state, whatever its domestic implementation delay. Nevertheless, all countries have so far used a one-year implementation delay, making the difference irrelevant.

<sup>22</sup>See [https://eba.europa.eu/single-rule-book-qa/-/qna/view/publicId/2015\\_1759](https://eba.europa.eu/single-rule-book-qa/-/qna/view/publicId/2015_1759)

<sup>23</sup>Article 141 of CRD IV

<sup>24</sup>Article 142 of CRD IV



Source: EBA Pillar 2 Roadmap, p.4

Fig. 2.4. Stacking order of capital requirements, and sanctions for breaching

## C. Additional tables

Table 2.5: Summary statistics of country-level CCyB changes in the sample

| Date           | Country | $\Delta CCYB$ | Banks | CDS | Stock | Median | Mean   | Max     |
|----------------|---------|---------------|-------|-----|-------|--------|--------|---------|
| 2014-09-10     | SE      | 1.00          | 17    | 1   | 9     | 2.30   | 11.79  | 59.92   |
| 2015-01-27     | HK      | 0.62          | 3     | 3   | 1     | 0.32   | 2.58   | 7.18    |
| 2015-06-23     | SE      | 0.50          | 17    | 6   | 9     | 1.15   | 5.90   | 29.96   |
| 2015-12-18     | CZ      | 0.50          | 7     | 3   | 4     | 2.47   | 3.45   | 8.26    |
| 2016-01-14     | HK      | 0.62          | 3     | 3   | 2     | 0.34   | 2.36   | 6.55    |
| 2016-03-15     | SE      | 0.50          | 17    | 6   | 9     | 1.11   | 5.92   | 29.85   |
| 2016-03-29     | GB      | 0.50          | 64    | 25  | 30    | 1.06   | 3.50   | 40.86   |
| 2016-07-26     | SK      | 0.50          | 5     | 2   | 3     | 2.42   | 2.11   | 3.72    |
| 2016-12-15     | NO      | 0.50          | 7     | 6   | 6     | 5.38   | 8.78   | 32.10   |
| 2017-01-27     | HK      | 0.62          | 3     | 3   | 2     | 0.35   | 2.63   | 7.36    |
| 2017-06-13     | CZ      | 0.50          | 8     | 3   | 4     | 3.35   | 4.52   | 9.40    |
| 2017-06-27     | GB      | 0.50          | 77    | 27  | 34    | 1.02   | 3.67   | 40.09   |
| 2017-07-10     | SK      | 0.75          | 7     | 3   | 3     | 4.91   | 4.50   | 8.61    |
| 2017-12-20     | DK      | 0.50          | 9     | 5   | 5     | 12.83  | 20.94  | 50.00   |
| 2017-12-21     | LT      | 0.50          | 3     | 3   | 3     | 3.10   | 2.46   | 3.13    |
| 2018-01-10     | HK      | 0.62          | 3     | 3   | 3     | 7.37   | 5.83   | 9.91    |
| 2018-06-11     | FR      | 0.25          | 70    | 17  | 22    | 0.55   | 3.51   | 25.00   |
| 2018-06-22     | LT      | 0.50          | 4     | 3   | 4     | 2.68   | 2.44   | 3.38    |
| 2018-07-03     | SK      | 0.25          | 7     | 4   | 4     | 1.07   | 1.17   | 2.34    |
| 2018-07-05     | IE      | 1.00          | 14    | 3   | 6     | 6.05   | 19.36  | 97.89   |
| 2018-07-30     | SE      | 0.50          | 24    | 7   | 8     | 2.67   | 10.86  | 50.00   |
| 2018-09-26     | BG      | 0.50          | 5     | 1   | 3     | 3.43   | 12.27  | 46.81   |
| 2018-12-10     | LU      | 0.25          | 34    | 11  | 11    | 0.50   | 3.17   | 24.99   |
| 2018-12-13     | NO      | 0.50          | 12    | 6   | 8     | 6.25   | 14.30  | 50.00   |
| 2019-03-18     | FR      | 0.25          | 69    | 17  | 23    | 0.70   | 3.54   | 24.93   |
| 2019-03-29     | BG      | 0.50          | 6     | 1   | 3     | 2.92   | 10.57  | 48.13   |
| 2019-05-23     | CZ      | 0.25          | 10    | 4   | 5     | 1.44   | 2.14   | 5.33    |
| 2019-06-28     | BE      | 0.50          | 20    | 3   | 6     | 0.95   | 7.52   | 41.60   |
| 2019-06-28     | DE      | 0.25          | 68    | 25  | 27    | 0.96   | 4.97   | 25.00   |
| 2019-07-23     | SK      | 0.50          | 7     | 4   | 4     | 1.74   | 2.25   | 3.86    |
| 2019-10-14     | HK      | -0.50         | 5     | 2   | 3     | -0.33  | -3.29  | -9.23   |
| 2019-11-29     | LU      | 0.25          | 32    | 11  | 14    | 0.49   | 3.61   | 25.00   |
| 2019-12-20     | BG      | 0.50          | 6     | 0   | 3     | 2.92   | 10.57  | 48.13   |
| 2020-03-11     | BE      | -0.50         | 21    | 0   | 2     | -1.21  | -7.85  | -47.65  |
| 2020-03-13     | SE      | -2.50         | 20    | 5   | 5     | -17.74 | -63.34 | -250.00 |
| 2020-03-18     | DE      | -0.25         | 73    | 19  | 23    | -0.66  | -4.02  | -25.00  |
| 2020-03-18     | FR      | -0.50         | 80    | 20  | 26    | -1.23  | -6.81  | -50.00  |
| 2020-03-18     | IE      | -1.00         | 19    | 3   | 3     | -4.06  | -9.80  | -67.33  |
| 2020-03-18     | LT      | -1.00         | 6     | 3   | 3     | -6.99  | -21.99 | -92.45  |
| 2020-07-07     | SK      | -0.50         | 7     | 4   | 4     | -1.54  | -2.17  | -3.96   |
| Total positive |         | 32            | 632   | 219 | 278   | 1.15   | 5.47   | 97.89   |
| Total negative |         | 8             | 229   | 56  | 69    | -1.55  | -11.44 | -250.00 |

Notes: This table describes CCyB changes that we consider as shocks (i.e., excluding forward guidance, shocks that were pre-announced, and shocks coannounced with other policy changes), starting in 2014, when at least one bank in our sample is exposed to the activating country (most Icelandic shocks do not affect any bank in our sample).  $\Delta CCYB$  reports country-level CCyB changes. *Banks* reports the total number of banks affected by each shock in our sample based on EBA country-level credit risk exposures. *CDS* (resp. *Stock*) reports the total number of banks with available CDS spreads (resp. stock prices) that we consider in our baseline regressions. *Median*, *Mean* and *Max* designate the corresponding statistics of bank-specific shocks expressed in basis points (*Max* reports the shock with the largest distance to 0 in absolute value). Two shocks happened on the same day (2019-06-28 BE and DE). For one increase (2020-12-20 BG), and one release (2020-03-11 BE), no bank with defined CDS spreads was affected. In the last two lines, we provide aggregate statistics on positive and negative shocks.

Table 2.7: Impact of CCyB increases on bank CDS spreads delta in pp

|                         | <i>Dependent variable:</i> |                      |                     |
|-------------------------|----------------------------|----------------------|---------------------|
|                         | CDS delta                  |                      |                     |
|                         | Baseline                   | Activation           | Release             |
|                         | (1)                        | (2)                  | (3)                 |
| $\Delta$ CCyB           | -2.330**<br>(0.953)        | -4.333***<br>(1.670) |                     |
| $\Delta$ CCyB, neg      |                            |                      | -1.719**<br>(0.769) |
| $\Delta$ CCyB, pos      |                            |                      | -2.341**<br>(0.966) |
| Controls                | Yes                        | Yes                  | Yes                 |
| No. dates               | 30                         | 13                   | 35                  |
| No. bank shocks         | 216                        | 123                  | 257                 |
| Observations            | 54,218                     | 54,125               | 54,335              |
| R <sup>2</sup>          | 0.079                      | 0.079                | 0.080               |
| Adjusted R <sup>2</sup> | 0.075                      | 0.075                | 0.076               |

Notes: All estimations are on a (0,2) event window with bank fixed effects. Standard errors are clustered at the day level. Robust standard errors are shown in brackets. \*p<0.1; \*\*p<0.05; \*\*\*p<0.01.

Table 2.6: Bank summary statistics

| Statistic    | Unit | N  | Mean   | St. Dev. | Min  | Pctl(25) | Pctl(75) | Max     |
|--------------|------|----|--------|----------|------|----------|----------|---------|
| CDS          | pp   | 36 | 83.2   | 70.7     | 18.6 | 42.8     | 92.8     | 573.9   |
| CDS growth   | %    | 36 | -0.003 | 0.1      | -0.2 | -0.02    | 0.01     | 0.3     |
| Stock return | %    | 44 | -0.003 | 0.03     | -0.2 | -0.01    | 0.01     | 0.2     |
| TA           | bn€  | 41 | 621.7  | 621.3    | 1.9  | 223.8    | 859.1    | 2,510.2 |
| CET1 ratio   | pp   | 50 | 15.4   | 3.5      | 8.1  | 13.4     | 16.6     | 42.1    |

Notes: We focus here on 51 banks with either stock returns (44 banks) or cds spreads (36 banks) defined, and subject to at least one CCyB shock over the panel. N designates the number of banks on which each line's statistics are calculated.

Table 2.8: Robustness to alternative specifications for normal CDS spread variations

|                         | <i>Dependent variable:</i> |                     |                      |                     |                     |
|-------------------------|----------------------------|---------------------|----------------------|---------------------|---------------------|
|                         | CDS growth                 |                     |                      |                     |                     |
|                         | Domestic                   | Foreign             | Large                | Total               | Dummy               |
|                         | (1)                        | (2)                 | (3)                  | (4)                 | (5)                 |
| $\Delta$ CCYB           | -0.028**<br>(0.012)        | -0.105**<br>(0.049) | -0.031***<br>(0.010) | -0.010**<br>(0.005) |                     |
| Dummy                   |                            |                     |                      |                     | -0.005**<br>(0.003) |
| Controls                | Yes                        | Yes                 | Yes                  | Yes                 | Yes                 |
| No. dates               | 12                         | 29                  | 17                   | 30                  | 30                  |
| No. bank shocks         | 31                         | 185                 | 41                   | 213                 | 216                 |
| Observations            | 54,218                     | 54,218              | 54,043               | 54,218              | 54,218              |
| R <sup>2</sup>          | 0.088                      | 0.088               | 0.088                | 0.088               | 0.088               |
| Adjusted R <sup>2</sup> | 0.085                      | 0.085               | 0.085                | 0.085               | 0.085               |

*Notes:* Equation (1) studies the effect of country-level announcements on domestic banks only, and Equation (2) on foreign banks. Equation (3) looks at the effect of shocks in the fourth quartile of magnitude. Equation (4) investigates the effect of country-level shocks assuming markets consider all banks operating in a country to be identically affected by that shock. When multiple country-level shocks affect a single bank on a given day, we exclude the shock. Equation (5) examines the effect of dummy shocks affecting identically all banks subject to a shock in the baseline specification. All estimations are on a (0,2) event window with bank fixed effects. Standard errors are clustered at the day level. Robust standard errors are shown in brackets. \*p<0.1; \*\*p<0.05; \*\*\*p<0.01.

Table 2.9: Robustness to alternative specifications for normal CDS spread variations

|                         | <i>Dependent variable:</i> |                      |                      |                      |                      |                    |
|-------------------------|----------------------------|----------------------|----------------------|----------------------|----------------------|--------------------|
|                         | CDS growth                 |                      |                      |                      |                      |                    |
|                         | Baseline                   | StoxxBanks           | ItraxxSeniorFin      | ItraxxEur            | CDS sov              | No control         |
|                         | (1)                        | (2)                  | (3)                  | (4)                  | (5)                  | (6)                |
| $\Delta$ CCyB           | -0.038***<br>(0.013)       | -0.038***<br>(0.013) | -0.027***<br>(0.010) | -0.033***<br>(0.011) | -0.037***<br>(0.012) | -0.032*<br>(0.016) |
| Controls                | Yes                        | Yes                  | Yes                  | Yes                  | Yes                  | No                 |
| No. dates               | 30                         | 30                   | 30                   | 30                   | 30                   | 30                 |
| No. bank shocks         | 216                        | 216                  | 216                  | 216                  | 216                  | 216                |
| Observations            | 54,218                     | 54,218               | 54,218               | 54,218               | 54,218               | 54,218             |
| R <sup>2</sup>          | 0.088                      | 0.088                | 0.222                | 0.203                | 0.148                | 0.00005            |
| Adjusted R <sup>2</sup> | 0.085                      | 0.085                | 0.219                | 0.200                | 0.145                | -0.001             |

*Notes:* Alternative specifications of the 4-factor model by changing the stock return factor with the growth rates of the following benchmarks: Stoxx600 Bank in equation (2), Itraxx Senior Financial in equation (3), Itraxx Europe in equation (4), sovereign CDS spread of the banks country of residence in equation (5), and no control at all in equation (6). All estimations are on a (0,2) event window with bank fixed effects. Standard errors are clustered at the day level. Robust standard errors are shown in brackets. \*p<0.1; \*\*p<0.05; \*\*\*p<0.01.

Table 2.10: Persistence of the impact of CCyB increases on bank CDS spreads

|                         | <i>Dependent variable:</i> |                    |                      |                   |                  |                  |
|-------------------------|----------------------------|--------------------|----------------------|-------------------|------------------|------------------|
|                         | CDS growth                 |                    |                      |                   |                  |                  |
|                         | (0, 0)                     | (0, 1)             | (0, 2)               | (0, 3)            | (0, 4)           | (0, 5)           |
|                         | (1)                        | (2)                | (3)                  | (4)               | (5)              | (6)              |
| $\Delta$ CCyB           | -0.023<br>(0.032)          | -0.027*<br>(0.015) | -0.038***<br>(0.013) | -0.008<br>(0.013) | 0.001<br>(0.013) | 0.005<br>(0.012) |
| Controls                | Yes                        | Yes                | Yes                  | Yes               | Yes              | Yes              |
| No. dates               | 30                         | 30                 | 30                   | 29                | 29               | 29               |
| No. bank shocks         | 216                        | 216                | 216                  | 210               | 210              | 210              |
| Observations            | 54,591                     | 54,401             | 54,218               | 54,047            | 53,874           | 53,728           |
| R <sup>2</sup>          | 0.093                      | 0.088              | 0.088                | 0.088             | 0.087            | 0.088            |
| Adjusted R <sup>2</sup> | 0.090                      | 0.085              | 0.085                | 0.084             | 0.084            | 0.085            |

*Notes:* Event windows are defined with a tuple where the first element refers to the first day of the event, and the second to the last day. Days are counted relative to day 0 - the day of the announcement itself. Regressions include bank fixed effects. Standard errors are clustered at the day level. Robust standard errors are shown in brackets. \*p<0.1; \*\*p<0.05; \*\*\*p<0.01.



Table 2.11: Robustness to using different samples of CDS depending on their liquidity

|                         | <i>Dependent variable:</i> |                      |                      |                      |                      |
|-------------------------|----------------------------|----------------------|----------------------|----------------------|----------------------|
|                         | CDS growth                 |                      |                      |                      |                      |
|                         | All                        | Baseline (LS<5)      | LS<4                 | LS<3                 | LS<2                 |
|                         | (1)                        | (2)                  | (3)                  | (4)                  | (5)                  |
| $\Delta$ CCYB           | -0.038***<br>(0.013)       | -0.038***<br>(0.013) | -0.037***<br>(0.013) | -0.036***<br>(0.013) | -0.039***<br>(0.013) |
| Controls                | Yes                        | Yes                  | Yes                  | Yes                  | Yes                  |
| No. dates               | 30                         | 30                   | 30                   | 30                   | 30                   |
| No. bank shocks         | 216                        | 216                  | 192                  | 184                  | 173                  |
| Observations            | 54,218                     | 54,218               | 47,486               | 45,945               | 39,741               |
| R <sup>2</sup>          | 0.088                      | 0.088                | 0.085                | 0.086                | 0.086                |
| Adjusted R <sup>2</sup> | 0.085                      | 0.085                | 0.082                | 0.082                | 0.083                |

*Notes:* All uses all available CDS time series. Next regressions successively exclude CDS for which the liquidity score (LS) is above a certain score (5: least liquid; 1: most liquid). We assign to each bank the minimum liquidity score it reached over the period. All estimations are on a (0,2) event window with bank fixed effects. Standard errors are clustered at the day level. Robust standard errors are shown in brackets. \*p<0.1; \*\*p<0.05; \*\*\*p<0.01.

Table 2.12: Impact of announcements of no CCyB change on bank CDS spreads

|                         | <i>Dependent variable:</i> |                  |
|-------------------------|----------------------------|------------------|
|                         | CDS growth<br>Value        | Dummy            |
|                         | (1)                        | (2)              |
| $\Delta$ CCyB           | 0.006<br>(0.004)           |                  |
| Dummy                   |                            | 0.002<br>(0.002) |
| Controls                | Yes                        | Yes              |
| No. dates               | 278                        | 278              |
| No. bank shocks         | 2102                       | 2102             |
| Observations            | 53,569                     | 53,569           |
| R <sup>2</sup>          | 0.088                      | 0.088            |
| Adjusted R <sup>2</sup> | 0.085                      | 0.085            |

*Notes:* *Value* regresses CDS spread growth on a shock equal to bank-specific exposure shares on all dates when some authority announces a constant CCyB rate. *Dummy* regresses CDS spread growth on a shock equal to 1 whenever a bank is exposed to an announcement of no CCyB change by some authority. Dates when any authority announces a CCyB change are excluded from the sample. All estimations are on a (0,2) event window with bank fixed effects. Standard errors are clustered at the day level. Robust standard errors are shown in brackets. \*p<0.1; \*\*p<0.05; \*\*\*p<0.01.

Table 2.13: Robustness to removing one by one the dates of CCyB increases

| Date       | coefficient | p-value |
|------------|-------------|---------|
| 2014-09-10 | -0.036      | 0.024   |
| 2015-01-27 | -0.041      | 0.002   |
| 2015-06-23 | -0.041      | 0.004   |
| 2015-12-18 | -0.040      | 0.003   |
| 2016-01-14 | -0.041      | 0.002   |
| 2016-03-15 | -0.043      | 0.003   |
| 2016-03-29 | -0.040      | 0.004   |
| 2016-07-26 | -0.040      | 0.003   |
| 2016-12-15 | -0.043      | 0.002   |
| 2017-01-27 | -0.040      | 0.003   |
| 2017-06-13 | -0.040      | 0.003   |
| 2017-06-27 | -0.033      | 0.007   |
| 2017-07-10 | -0.039      | 0.004   |
| 2017-12-20 | -0.040      | 0.004   |
| 2017-12-21 | -0.040      | 0.003   |
| 2018-01-10 | -0.038      | 0.004   |
| 2018-06-11 | -0.034      | 0.009   |
| 2018-06-22 | -0.040      | 0.003   |
| 2018-07-03 | -0.040      | 0.003   |
| 2018-07-05 | -0.040      | 0.003   |
| 2018-07-30 | -0.043      | 0.003   |
| 2018-09-26 | -0.040      | 0.003   |
| 2018-12-10 | -0.039      | 0.003   |
| 2018-12-13 | -0.040      | 0.005   |
| 2019-03-18 | -0.044      | 0.001   |
| 2019-03-29 | -0.040      | 0.003   |
| 2019-05-23 | -0.040      | 0.003   |
| 2019-06-28 | -0.037      | 0.009   |
| 2019-07-23 | -0.039      | 0.003   |
| 2019-11-29 | -0.039      | 0.004   |
| 2019-12-20 | -0.040      | 0.003   |

Notes: This robustness test consists in re-estimating the baseline regression, removing one by one the 31 dates on which a CCyB increase affected at least one bank. The first column reports the announcement date removed, while the second and third columns report the point estimate and p-value for the coefficient of  $\Delta CCyB$ . All estimations are on a (0,2) event window with bank fixed effects. Standard errors are clustered at the day level. Robust standard errors are shown in brackets.

Table 2.14: Placebo test

| <i>Dependent variable:</i> |                     |
|----------------------------|---------------------|
|                            | CDS growth<br>Value |
| $\Delta$ CCyB              | -0.018<br>(0.014)   |
| Controls                   | Yes                 |
| Observations               | 54,218              |
| R <sup>2</sup>             | 0.088               |
| Adjusted R <sup>2</sup>    | 0.085               |

*Notes:* For each date of CCyB change, shocks are randomly drawn without replacement in the cross-section of banks. Shocks are then rolled onto a (0,2) event window. Regressions include bank fixed effects. Standard errors are clustered at the day level. Robust standard errors are shown in brackets. \*p<0.1; \*\*p<0.05; \*\*\*p<0.01.

Table 2.15: Impact of CCyB increases on bank CDS spreads depending on country proactiveness

|                                 | <i>Dependent variable:</i> |                      |                        |                        |
|---------------------------------|----------------------------|----------------------|------------------------|------------------------|
|                                 | CDS growth                 |                      |                        |                        |
|                                 | Change value<br>(1)        | Change dummy<br>(2)  | No change value<br>(3) | No change dummy<br>(4) |
| $\Delta$ CCyB * LowProactivity  | -0.115**<br>(0.054)        |                      | -0.024<br>(0.019)      |                        |
| $\Delta$ CCyB * HighProactivity | -0.035***<br>(0.013)       |                      | 0.006<br>(0.004)       |                        |
| Dummy * LowProactivity          |                            | -0.015***<br>(0.002) |                        | -0.008<br>(0.008)      |
| Dummy * HighProactivity         |                            | -0.004<br>(0.003)    |                        | 0.002<br>(0.002)       |
| Controls                        | Yes                        | Yes                  | Yes                    | Yes                    |
| No. dates                       | 30                         | 30                   | 285                    | 285                    |
| No. bank shocks                 | 216                        | 216                  | 2179                   | 2179                   |
| Observations                    | 54,218                     | 54,218               | 54,218                 | 54,218                 |
| R <sup>2</sup>                  | 0.088                      | 0.088                | 0.088                  | 0.088                  |
| Adjusted R <sup>2</sup>         | 0.085                      | 0.085                | 0.085                  | 0.085                  |

*Notes:* *Low proactivity* countries increased the CCyB once or twice over the period (BE, DE, FR, IE). *High proactivity* countries increased the CCyB at least three times. *Change* regressions analyze the effect of CCyB increases on bank CDS spread growth as in the baseline, while *No change* regressions analyze announcements of no CCyB change. All estimations are on a (0,2) event window with bank fixed effects. Standard errors are clustered at the day level. Robust standard errors are shown in brackets. \*p<0.1; \*\*p<0.05; \*\*\*p<0.01.

Table 2.16: Impact of CCyB increases on bank stock returns - bank characteristics

|                                 | <i>Dependent variable:</i> |                   |
|---------------------------------|----------------------------|-------------------|
|                                 | Stock return               |                   |
|                                 | CET1 ratio                 | CDS               |
|                                 | (1)                        | (2)               |
| $\Delta$ CCyB * Low CET1 ratio  | 0.021<br>(0.020)           |                   |
| $\Delta$ CCyB * High CET1 ratio | 0.002<br>(0.005)           |                   |
| $\Delta$ CCyB * Low CDS         |                            | 0.004<br>(0.005)  |
| $\Delta$ CCyB * High CDS        |                            | -0.014<br>(0.023) |
| Controls                        | Yes                        | Yes               |
| No. dates                       | 30                         | 31                |
| No. bank shocks                 | 308                        | 234               |
| Observations                    | 83,114                     | 62,824            |
| R <sup>2</sup>                  | 0.413                      | 0.454             |
| Adjusted R <sup>2</sup>         | 0.412                      | 0.453             |

*Notes:* Interaction variables are dummies depending on the bank's position relative to the median. All estimations are on a (0,2) event window with bank fixed effects. Standard errors are clustered at the day level. Robust standard errors are shown in brackets. \*p<0.1; \*\*p<0.05; \*\*\*p<0.01.

# Chapter 3

## What are banks' actual capital targets?

### Abstract

How do banks set their target capital ratio? How do they adjust to reach it? This paper answers these questions using an original dataset of capital ratio targets directly announced to investors by European banks, materially improving data quality compared to usual estimated implicit target. It provides the following key lessons. First, targets are affected by capital requirements and a procyclical behavior consistent with market pressure. Second, banks do not distinguish between the different types of capital requirements for setting their targets, suggesting weak usability of the regulatory buffers. Third, the distance between actual CET1 ratio and the target is a valuable predictor of future balance-sheet adjustment, suggesting that banks actively drive their capital ratios toward their announced targets, through capital accumulation and portfolio rebalancing. Fourth, this adjustment occurs both above and below targets, but banks below target adjust faster, suggesting stronger pressure. These results provide important lessons for policymakers regarding the design of the prudential framework and the effectiveness of countercyclical policies.

### 1. Introduction

Setting the capital structure is a key step of business management, in particular for banks. Indeed, authorities impose a range of capital requirements banks must comply with, while maturity transformation and, more generally, asset-liability management are at the heart of their business models. As such, investigating banks' target capital ratios, their determinants and their impact on banks' future behavior is a key area of financial research.

Indeed, banks' capital ratios are key drivers of their lending policy and, more generally, of their strategic decisions (Berrospide et al. (2010)). Most of the capital requirements of the European and American banking regulations are expressed in terms of the CET1 ratio, i.e. the ratio of Common Equity Tier 1, the purest form of capital consisting mostly of issued equity and retained earnings, over Risk Weighted Assets (RWA), which corresponds to a bank's Total Original Exposures (TOE) weighted by their estimated risks. The CET1 ratio is also the main capital ratio used by investors to assess a bank's solvency. As such, the distance between a bank's actual CET1 ratio and its target can be an important predictor of its future balance-sheet adjustment. Indeed, a bank below (above) its target should act to increase (reduce) its CET1 ratio, through three main channels: its stock of CET1, its TOE and its Risk Weight density, the ratio between RWA and TOE. First, it can increase its stock of CET1 by improving its profitability, by issuing equity or by diminishing its capital

payouts (dividends and share buybacks). Second, it can reduce the size of its total exposures at constant outstanding CET1. Finally, at constant asset size, it can rebalance its portfolio toward safer assets to reduce risk weight density and thus RWA. On the contrary, a bank above its target can return capital to investors through larger payouts, increase its balance-sheet or rebalance it toward riskier assets.

In turn, (target) capital structure has strong normative implications, affecting the effectiveness of public measures, either directly, for prudential policies (Aiyar et al. (2016)), or indirectly, for the channelling of monetary policy (Gambacorta and Shin (2018)). In particular, regarding capital requirements, the Great Financial Crisis (GFC) has highlighted the need for banks being sufficiently capitalised to weather a systemic crisis, and hence the use of countercyclical prudential policies to mitigate procyclical bank reactions and credit rationing during crisis. Consequently, the Basel III reform of international financial regulation has introduced two new types of instruments. First, it creates *usable* buffers, i.e. requirements that banks must meet in normal times but which they can on which they can draw in case of trouble. Second, it has introduced a time-varying countercyclical capital requirement. Regulators can increase it during the expansionary phase of the financial cycle to create a "*prudential space*". They can then relax it during crisis to support credit supply without endangering banks solvency (see, among others, Jiménez et al. (2017) for empirical evidence of the effectiveness of countercyclical requirements and Dewatripont and Tirole (2012) for theoretical rational). Nevertheless, this strategy crucially depends on banks' reaction to capital requirements and the macroeconomic environment. Should banks not react to change in capital requirements, or treat usable buffers as hard requirements, this would impede the countercyclical objective of the regulatory framework. On the contrary, market pressure could force banks to procyclically target higher capital ratios during crisis, leading to credit rationing.

How do banks set their capital ratio targets? Do those targets inform us on banks' future behaviour? I answer those questions using an original dataset of targets that European banks publicly announce as part of their investor communication. Since the seminal paper of Flannery and Rangan (2008), the literature has relied on partial adjustment models to estimate unobserved banks' capital targets (based on the evolution of actual capital ratios) and, in turn, assess banks' adjustment toward their targets. Exploiting announced targets instead provides several key advantages. First, it allows for directly regressing an observed variable rather than estimating an unobserved one, typically producing much more accurate estimations. Second, it explicitly disentangles shocks affecting only the capital ratio from those affecting the target itself. Third, it breaks the link between the estimations of target determinants and adjustment toward targets, as the latter step does not rely on the estimations produced in the former. As such, estimation errors are not compounded. To the best of my knowledge, this is the first paper exploiting a dataset of *observed* bank capital targets.

I first investigate target determinants. Using partial adjustment models, Berger et al. (2008) show that American banks hold excess capital on top of regulatory requirements and adjust quickly when poorly capitalised. Using a sample of American and European banks, Gropp and Heider (2010) find that deposit insurance and capital requirements played a secondary role in explaining capital ratios in 1991-2004, which rather converged toward bank-specific, time invariant levels. De Jonghe and Öztekin (2015) and Bakkar et al. (2019) find similar results, based on an international sample of banks. This paper contributes to this literature by removing the need for partial adjustment model, using instead observed targets, allowing for a more precise estimate of the drivers of the targets and the speed of adjustment. Moreover, this paper also investigates the differentiated impact of the distinct components of the capital requirements stack introduced by the Basel III reform. This informs in particular on the usability of the regulatory buffers, that are designed

to be drawn on by troubled banks at the cost of restriction on capital payout, acting as a countercyclical cushion during crisis. A lower coefficient for those buffers than for stricter requirements would indicate that banks see lower cost in breaching the former, suggesting willingness to dip into them in case of need. To the best of my knowledge, this is the first paper to investigate this issue. I uncover two key target determinants. First, capital requirements have a material but lower than unity impact on target: banks do not adjust one for one to change in capital requirements, suggesting that they balance the risk of breaching requirements with their perceived costs of having a high capital ratio. Importantly, this impact is not significantly different for the diverse components of the capital requirements stack. This suggests that banks do not distinguish between hard and usable requirements, impeding the countercyclical objective of the regulatory framework. Second, targets are procyclical, as a fall in expected GDP growth tends to increase targets. This is consistent with banks being under pressure and trying to reassure investors regarding their solvency in adverse time.

Then, I show that capital targets contain important information on the future evolution of banks' balance-sheet, exploring the speed and channels of adjustment toward targets. At the macroeconomic level, a strand of the literature aggregates individual bank-level distances to (estimated) targets into a single representative time series fed into macroeconomic models. Mésonnier and Stevanovic (2017) find that large shocks to such macroeconomic distance to capital target explain a large part of the variance in credit to business and real activities. At the micro level, De Jonghe and Öztekin (2015) find that banks increase their capital ratios toward target through equity growth rather than balance-sheet reduction. Using monthly German data, Memmel and Raupach (2010) confirm that the most important contribution to adjustment comes from the liability side, despite faster adjustment on the asset side. Bakkar et al. (2019) find that Systemically Important Financial Institutions (SIFI) adjust differently than other banks and Maurin and Toivanen (2012) that banks adjust proportionally more their security holdings than their loans to reach their targets. Removing the need to estimate unobserved targets, I find that banks are serious about the targets they announce. This adjustment occurs whatever the initial sign of the distance to target, but it is substantially faster for banks below their targets, in line with strong pressure from investors to protect the franchise value and avoid costly regulatory breach. Most of the adjustment occurs through their stock of capital, in line with De Jonghe and Öztekin (2015) and Memmel and Raupach (2010). Nevertheless, about one third of the adjustment occurs through asset side management via RWA reduction, mostly thanks to portfolio shift. In particular, banks adjust their Non-Financial Corporate (NFC) credit exposures, which typically carry high risk weights. Moreover, banks below their targets tend to reduce Non-Performing Exposure (NPE) recognition. Those results raise concerns regarding procyclical behaviour during crisis, when banks suffer losses and tend to announce higher targets, as this suggests that they delay loss recognition and procyclically cut on NFC credit supply to plug the gap when firms need credit the most. On the flip side, it suggests that reducing capital requirements in crisis time would have a strong expansionary effect by reducing capital targets.

Those results provide key lessons for policymakers regarding the impact of capital requirements on targets, and, in turn, the effectiveness of the regulatory framework. This paper suggests that banks do not consider regulatory buffers to be *usable*, contrary to the intention of the regulator, as the framework was designed for banks to draw on buffers during a crisis in order to absorb losses rather than cutting credit supply. However, *releasable* buffers could mitigate banks' procyclical behaviour, as a countercyclical reduction in requirements can lower CET1 ratio targets, offset banks tendency to increase targets in crisis time. By reducing targets, this would encourage banks to increase credit supply, in particular corporate credit. Finally, monitoring banks' announced targets and the distance between their targets and actual



CET1 ratios would inform on banks' future behaviour, thus informing policymakers when setting monetary or prudential policies.

The rest of the article is organised as follows. Section 2 presents the announced target dataset and compares it with partial adjustment models. Section 3 introduces the econometric specifications and data. Section 4 houses the results and Section 5 concludes.

## 2. Announced banks target CET1 ratios

### 2.1. The use of announced targets

In the absence of data on observed banks' target capital ratios, the literature has so far relied on estimated implicit targets, pinned down through partial adjustment models introduced for bank capital by Flannery and Rangan (2008). Such an approach depends on two key assumptions. First, the target is unobserved but relies on a set of observed variables  $X$ , and can thus be defined as:

$$CET1_{i,t+1}^* = \theta X_{i,t} \quad (3.1)$$

Second, banks move sluggishly toward those targets at a constant unobserved speed  $\lambda$ :

$$CET1_{i,t+1} = \lambda CET1_{i,t+1}^* + (1 - \lambda) CET1_{i,t} \quad (3.2)$$

Such behaviour can be rationalised with convex adjustment costs, so that banks are better off with slow adjustment rather than with a single large jump.<sup>1</sup> Then, injecting (3.1) in (3.2) and rearranging to get rid of the unobserved components provides:

$$\begin{aligned} CET1_{i,t+1} &= \alpha CET1_{i,t} + \beta X_t + u_{i,t}, \\ \lambda &= 1 - \alpha, \theta = \beta / (1 - \alpha) \end{aligned} \quad (3.3)$$

with  $\alpha = 1 - \lambda$  and  $\beta = \theta(1 - \alpha)$ . Equation 3.3 can be estimated econometrically and, using  $\lambda = 1 - \alpha$  and  $\theta = \beta / (1 - \alpha)$ , one can thus recover the unobserved target with:  $\widehat{CET1}_{i,t+1}^* = \widehat{\beta}(1 - \widehat{\alpha})X_{i,t}$

In a second step, the distance between the actual CET1 ratio and estimated target is injected in a regression model to assess the elasticity of a collection of banking variable to this distance:

$$\Delta Y_{i,t} = \gamma (CET1_{i,t-1} - \widehat{CET1}_{i,t-1}^*) + \delta Z_{i,t-1} + \epsilon_{i,t}, \quad (3.4)$$

with  $\gamma$  being the coefficient of interest. This partial adjustment approach is intellectually clear and convenient, but also suffers from important drawbacks. First, the dependence on a model of the unobserved target mechanically implies the presence of noise in the estimation of the first step. It is especially true as the CET1 ratio is a rather sluggish variable, meaning that  $\widehat{\alpha}$  could be close to 1, making  $\widehat{\theta}$  unstable. Second, this approach relies on the assumption of a constant adjustment speed  $\lambda$ .<sup>2</sup> Third, Equation 3.3 implicitly

<sup>1</sup>Fast deleveraging would entail high liquidation costs, while rapid balance-sheet expansion would imply low screening and/or low prices.

<sup>2</sup>Berger et al. (2008) proposes a three-step method to estimate time-variant  $\lambda$ , also used in Öztekin and Flannery (2012); De Jonghe and Öztekin (2015); Bakkar et al. (2019). The first step consists in estimating

assumes that all the impact of  $X_{t-1}$  on  $CET1_t$  works through  $CET1_t^*$ , ruling out the possibility of a direct impact on  $CET1_t$  alone. There is no clear rationale behind this assumption. For instance, a bank suffering a one-off loss may not be able to immediately issue equity or liquidate assets, and would thus experience a fall in  $CET1_t$  while  $CET1_t^*$  is unchanged. Alternatively, this fall in profitability could both affect  $CET1_t$  directly and make the bank readjust its target  $CET1_t^*$ . Those two possibilities make necessary to disentangle both impacts. Fourth, the output of the first step (Equation 3.3) is transmitted as an input in the second one (Equation 3.4), where the literature often treats the estimated distance to target as observed and not as the result of a noisy estimate.<sup>3</sup>

In both steps, using explicit, observed targets provides material improvements. In the first one, using observed targets allows for direct regressions, reducing the uncertainty surrounding estimated elasticity and in particular removing the need for a dynamic panel. Second, it also allows for direct estimation of the speed of adjustment, rather than dealing with an indirect evaluation of the unobserved  $\lambda$ . Third, the use of announced targets explicitly disentangles the impact of variables  $X_{t-1}$  on  $CET1_t^*$  and on  $CET1_t$ , so that an impact on the latter is not mechanically interpreted as a sign of an impact on the former. Finally, in the second step, the use of an observed variable removes the need to consider the estimation noise around target determinants.

## 2.2. A new dataset of announced targets

This paper uses an original data set on announced bank CET1 ratio targets. Observations were manually collected on banks' websites and financial communication documentation. Figure 3.1 presents examples of what banks' announcements of CET1 targets look like. Banks typically announce those targets in slide decks or financial documents as part of their investor communication. Those documents are generally published quarterly, sometimes yearly, in particular for non-listed banks. In compiling those targets, I collect four key elements: (i) the value of the target; (ii) the nature of the target: level of CET1 ratio or distance to capital requirements; (iii) the definition of the CET1 ratio: Fully Loaded (FL) or Phased-In (PI); and (iv) the horizon of the target: some targets apply at all time, others are defined for a precise horizon (2022 for instance) and others are defined over a qualitative horizon ("medium term"). The majority of banks express their targets in absolute level (e.g. 13%) but some express them as a distance to capital requirements (e.g. 200 basis points), most of the time above the so-called Maximum Distributable Amount trigger (thereafter MDA) below which a non-compliant bank is restricted in capital distribution<sup>4</sup> and has to present a *Capital Conservation Plan*, including profit forecasts and intended measures to bridge the gap in capital. If the supervisor rejects the plan, it can require the institution to increase capital over a specified period and consequently lower the MDA<sup>5</sup>. Finally, due to financial reforms following the GFC, the definition of CET1 has been revised toward stricter definition of the eligibility criteria. As such, a part of existing outstanding

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Equation 3.3, to recover the estimated  $\widehat{k}_{i,t}^*$  target capital ratio and thus the distance to target  $\widehat{DEV}_{i,t}^*$ . In a second step, they estimate  $k_{i,t} - DNK_{i,t} = (\Lambda Z_{i,t}) \widehat{DEV}_{i,t}^* + \epsilon_{i,t}$  with  $DNK_{i,t}$  the capital ratio that the bank would have reached by keeping its dividend policy constant from the last quarter and issuing no share, and  $Z_{i,t}$  a set of variables expected to affect adjustment speed, allowing to get  $\lambda_{i,t} = \Lambda Z_{i,t}$ . Finally, the first step is re-estimated using this time-varying bank specific speed. This method however crucially depends on a fixed speed adjustment for initialisation that feeds into the estimation of  $\lambda_{i,t}$

<sup>3</sup>In this regard, Bakkar et al. (2019) use the bootstrap procedure from Pagan (1984) to tackle this issue

<sup>4</sup>Article 141 of CRD IV

<sup>5</sup>Article 142 of CRD IV

CET1 is excluded from the *Fully Loaded* new definition of the CET1. To ensure smooth transition, such items are "grandfathered" and progressively phased-out from CET1. CET1 ratios using this temporary definition are deemed *Phased in*. Most banks announce CET1 targets in FL terms, as the definition is both more stable and set to become the norm. Nevertheless, some announce PI targets. The collection exercise covered the 117 European banks deemed Significant Institutions (SI) due to their size and complexity and directly supervised by the Single Supervisory Mechanism (SSM), as well as listed European banks, excluding subsidiaries of non-euro area banks and state-owned banks. Both categories generally do not publish CET1 targets due to their reduced interactions with investors. Moreover, the support of their parent institution or of a government distorts their incentives and make them inherently different from standalone banks.

One could express concerns regarding the trustworthiness of those targets. Indeed, managers may be tempted to announce unchallenging targets, so as to limit the risk of missing them, which is detrimental for stock prices and for their career. Nevertheless, two factors mitigate this concern. First, announcing excessively low target comes at a cost, as investors could interpret that as a negative signal on managers' private knowledge of the bank outlook, specifically its internal capital generation capacity. Second, exceeding target capital ratio is not necessarily a good thing for managers. Indeed, contrary to high profitability, high capitalisation is not always good news for investors. They can interpret that as a sign of suboptimal capital allocation and call for capital distribution or larger asset expansion. Mathematically speaking, the optimal CET1 ratio has an interior solution, at least in the eyes of investors. As such, overshooting a CET1 target is not necessarily desirable, as it could signal an inefficient capital structure. In practice, many banks announcing targets well below their actual CET1 ratio explicitly commit to return capital to shareholders. Overall, bank managers have no interest in systematically announcing low targets. This is confirmed by the results of this paper, which shows that banks tend to converge toward their targets, also in case that when they are originally above them.

In total the collected dataset is an unbalanced panel of 1171 observations from 70 banks. It covers banks from all countries in the euro area except Lithuania, Latvia and Slovakia. The sample period spans from Q1 2014 to Q4 2020. The dataset covers a large and increasing share of the European banking system: as more and more banks announce target CET1 ratios, the sample captures about 66% of Total asset of euro area banks since 2018, compared to about 40% at the beginning of the sample period.

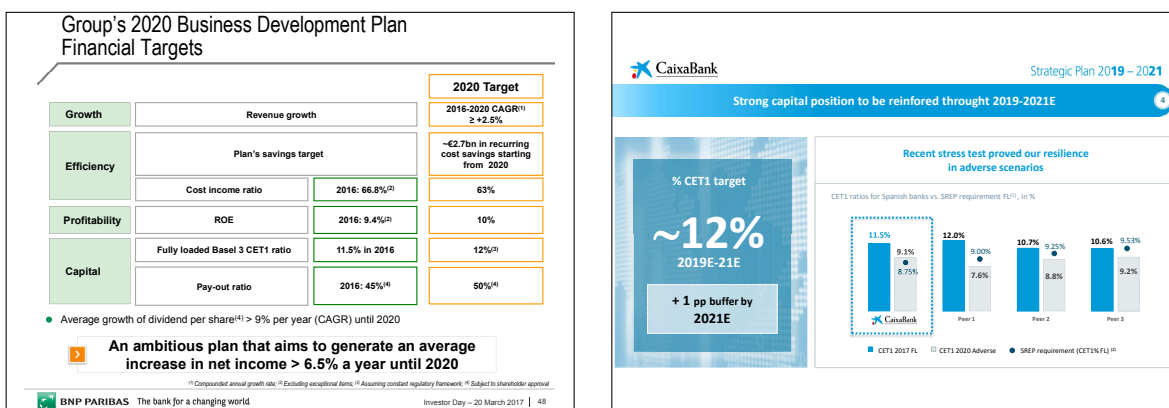
Figure 3.2 reports the time series of announced CET1 targets. Banks have progressively increased their targets until mid-2017, as the new regulatory framework and its implementation process were clarified and the European economy gradually recovered from the European sovereign debt crisis. They have since then mostly evolved in a stable interval, with the interquartile range staying in the 12.5%-15% interval. Nevertheless, in Q1 2020, European and national authorities have adopted a series of capital relief measures in face of the Covid-19 pandemic outbreak, leading to a decrease in CET1 requirements.<sup>6</sup> This has resulted in some downward adjustment in banks CET1 targets, but undershooting the fall in requirements. Nevertheless, the relative stability of the distribution masks bank-level variations: banks announcing targets in level have on average updated their targets every six quarters since Q2 2017.

As one could expect for the long run, the distribution of the distances between actual CET1 ratio and the targets is centered around zero, as presented in Figure 3.3. Since the COVID-19 pandemic, the distribution of distance to target has shifted upward, reflecting a rather muted target adjustment to a series of prudential measures supporting CET1 ratios (such as the delaying of IRFS 9 implementation or the front loading of a

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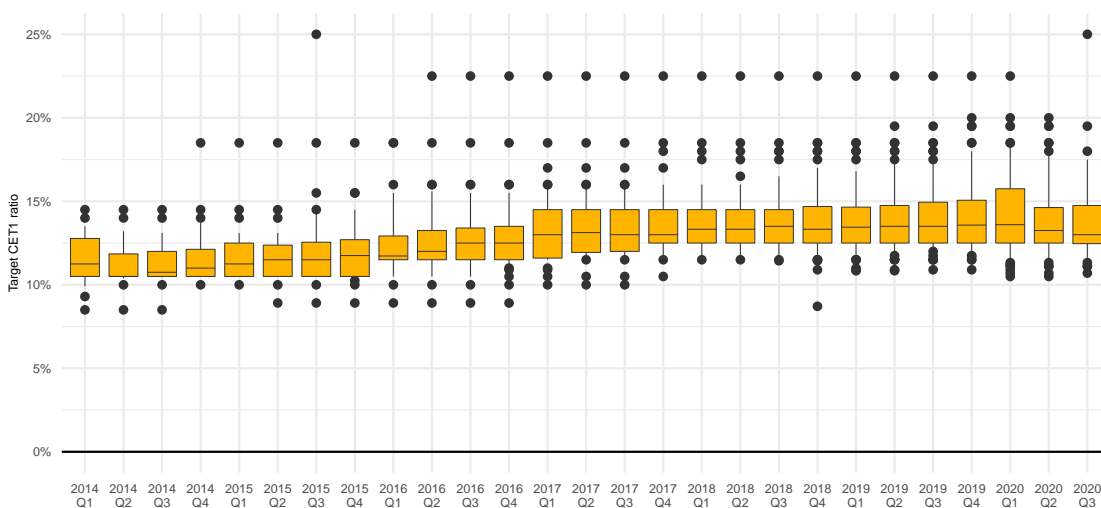
<sup>6</sup>See in particular <https://www.bankingsupervision.europa.eu/press/pr/date/2020/html/ssm.pr200312~43351ac3ac.en.html>

Fig. 3.1. Examples of announced target CET1 ratios



Source: Banks websites

Fig. 3.2. Banks' target CET1 ratios - %



Source: Banks websites, author's calculations

reform of the so-called SME Supporting Factor reducing risk weights on some loans to SMEs)<sup>7</sup>.

### 3. Econometric settings and data

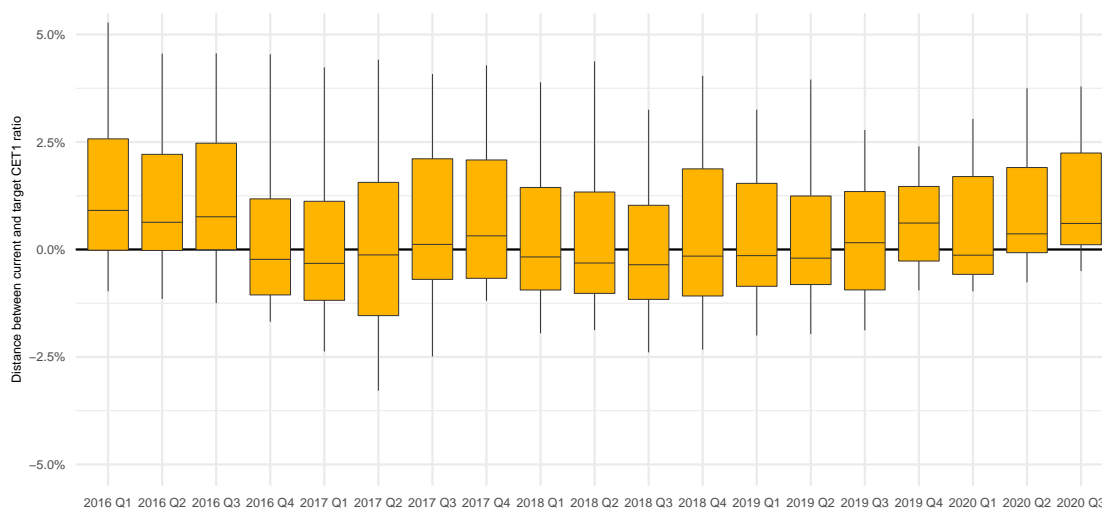
The use of announced targets allows for a direct panel regression of the CET1 ratio targets on a set of banking characteristics and macrofinancial variables:

$$Target_{i,t+1} = \zeta X_{i,t} + \kappa_i + \eta_{i,t+1}, \quad (3.5)$$

The first key expected driver of banks' CET1 ratio targets is the stack of capital requirements they must

<sup>7</sup>For more details on the so-called "Banking Package", see [https://ec.europa.eu/commission/presscorner/detail/en/qanda\\_20\\_757](https://ec.europa.eu/commission/presscorner/detail/en/qanda_20_757)

Fig. 3.3. Distance of banks CET1 ratios to targets



Source: Banks websites, author's calculations

comply with. The European regulatory framework distinguishes between two types of capital requirements which sum define the MDA trigger. First, the minimum requirements or *Total SREP Capital Requirement* (TSCR) that banks must meet at all time.<sup>8</sup> Failure to meet the TSCR triggers material supervisory intervention, potentially costly to shareholders and managers, with measures ranging from forced asset disposal to the resolution of the bank. The TSCR is composed of the system-wide Pillar 1 (P1, 8% or RWA) and the bank-specific Pillar 2 Requirement (P2R), revised annually. The P1 and, since 2020 as part of the banking package adopted in reaction to the Covid-19 pandemic, the P2R can be met with a mix of CET1 and less pure forms of capital, the so-called Additional Tier 1 (AT1) and Tier 2 (T2).<sup>9</sup> A failure to have enough AT1 or T2 creates a shortfall that banks must plug with additional CET1. Second, on top of the TSCR lie the so-called *combined buffer requirements* (CBR),<sup>10</sup> fully composed of CET1, that are meant to be *usable*, meaning that banks under stress can dip into the CBR: this activates the MDA, constraining dividends, but does not constitute a regulatory breach *stricto sensus*. The TSCR and the CBR together constitute the *Overall Capital Requirements* (OCR). On top of the OCR, European supervisors also set a capital demand, the so-called *Pillar 2 Guidance*,<sup>11</sup> which indicates to banks the adequate level of capital to be maintained to provide a sufficient buffer to withstand stressed situations. Unlike the P2R, the P2G is not legally binding.<sup>11</sup> The expected impact of capital requirements on targets is positive but below one. Indeed, in a trade-off approach of the capital structure, banks may balance the cost of higher risk of breach due

<sup>8</sup>SREP stands for *Supervisory Review and Evaluation Process*, the review of banks risk and core capital requirements conducted annually by European supervisors.

<sup>9</sup>Banks must fulfil both P1 and P2R with a minimum of 56.25% of CET1 and can meet the rest with AT1 and T2, with at most 25% of T2. As such, the 8% Pillar 1 can be met with 4.5% CET1, 1.5% AT1 and 2% T2.

<sup>10</sup>The CBR consist in (i) a Conservation Buffer (CCoB) of 2.5%, (ii) a Countercyclical Capital Buffer (CCyB) whose bank-specific rate is an average of national rates weighted by relevant exposures, (iii) a Systemic Risk Buffer (SRB) imposed by the domestic authority to all or a subset of banks and (iv) the Global and Other Systemic Institution Buffers (G-SII and O-SII) that depend on the size and materiality of the bank for the financial system

<sup>11</sup>See <https://www.bankingsupervision.europa.eu/banking/srep/html/p2r.en.html>

to low CET1 ratio with the cost of high CET1 ratio.<sup>12</sup> Consequently, banks are expected to operate with a management buffer above requirements, i.e. extra CET1, and to absorb part of hikes in requirement by reducing this buffer. As changes in the CBR are implemented with a phase-in period, meaning that future requirements are known well before their enter into place,<sup>13</sup> I use *announced* capital requirements rather than *implemented* ones, in line with the forward-looking nature of targets in banks' strategic planning. The baseline regression includes three types of requirements: (i) the pure CET1 OCR,<sup>14</sup> (ii) the AT1 and T2 shortfalls and (iii) the P2G. This informs on the perceived stringency of those different requirements: one could expect the coefficient to increase with the cost of breach. Indeed, while banks must cover the first item with CET1, they may plan future issuance of AT1 and T2 to plug the shortfall, making the second item less important for setting forward-looking CET1 ratio target. Finally, the P2G should have the lowest coefficient, as its breach triggers no direct supervisory action. If not, this suggests that managers treat the P2G as a hard requirement, contrary to the objective of this tool. In a robustness exercise, I further decompose the pure CET1 OCR into pure CET1 TSCR and the CBR, as breaching the second only activates the MDA, constraining capital payout and forcing banks to issue a recovery plan, while breaching the TSCR additionally triggers direct supervisory intervention and can ultimately lead to the withdrawal of authorisation or even to the resolution of the bank. Similar coefficients for those two components would suggest that banks do not value them differently. In particular, this would imply that they do not consider the CBR more usable than the TSCR, while this feature is a key component of the regulatory framework.

The list of other explanatory variables includes a vast range of potential drivers of banks' CET1 ratio targets. The log of Total Assets captures banks' size, as larger banks generally hold lower CET1 ratios, which can be rationalised by a too-big-too-fail phenomenon. The Return on Asset (RoA) accounts for banks' profitability. Asset quality is captured through the risk weight density (i.e. Risk Weighted Assets divided by Total Original Exposures) and the ratios of impaired assets and provision to total assets. The impact of profitability on targets is *a priori* unclear: more profitable banks and those with better assets have higher internal capital generation capacity and as such need less outstanding capital, but shareholders may want to protect their high franchise value with larger capital buffers (Marcus (1984)). Banks' business models are captured with the credit ratio, defined as the share of total credit exposures in the total assets, and the off-balance-sheet exposure ratio over total assets. The impact of deposits is captured with the cost of deposits and the deposit ratio. The 5-year ahead consensus forecast of domestic GDP growth rate from the Survey of Professional Forecasters accounts for expectations regarding future the macrofinancial environment and business opportunities. An adverse macrofinancial environment may increase investors' risk aversion; to avoid a detrimental flight-to-quality, banks may then announce larger CET1 ratio targets in adverse times to commit to high solvency and reassure investors. On the contrary, during good times, banks may underestimate risk (Fonseca and González (2010)). I also include the 5-year ahead consensus forecast of domestic inflation. The impacts of conventional and unconventional monetary policy are captured respectively by the 3-month Euribor rate and the ratio of Targeted Long Term Refinancing Operations (TLTRO) uptake in total liabilities. Tables A1 and A2 in the Appendix present the summary statistics and correlation matrix of the variables in the baseline model. In robustness checks, the 5-year ahead domestic

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<sup>12</sup>Whether or not capital is actually costly has produced a vast literature and is beyond the scope of this paper. The simple fact that many investors and managers perceive capital to be costly rationalises this trade-off approach.

<sup>13</sup>For instance, the O-SII and G-SII buffers announced in late 2015 and the CCoB were associated with a phase-in period from 2016 to 2019. Increase in the CCyB are typically associated with a one-year delay.

<sup>14</sup>the 4.5% P1, the CET1 part of the P2R (100% before 2020, 56.25% since then) and the CBR

GDP growth rate forecast is replaced with the euro area GDP growth forecast (capturing the international nature of many banks in the sample).

In a second step, I assess the speed of adjustment, i.e. the change in the distance to target:

$$Gap_{i,t} = \tau Gap_{i,t-1} + \phi Gap_{i,t-1} Z_{i,t-1} + u_{i,t}, \quad (3.6)$$

With  $Gap_{i,t} = CET1_{i,t} - Target_{i,t}$  the deviation from target and  $Z_{i,t}$  a set of variables affecting the speed of adjustment, making it time and bank-dependent with  $\lambda_{i,t} = \rho + \phi Z_{i,t-1}$ . In line with the literature relying on partial adjustment models, I conduct a pooled regression with interaction terms only, excluding the stand alone impact of  $Z_{i,t-1}$  and the bank fixed-effects  $\iota_i$ .<sup>15</sup> I include those parameters in robustness checks.

Finally, I investigate the informational content of targets on future banks' behaviour by regressing the change in a set of balance-sheet and financial account variables on the distance to target:

$$\Delta Y_{i,t} = \chi Gap_{i,t-1} + \psi Z_{i,t-1} + \iota_i + \epsilon_{i,t}, \quad (3.7)$$

With  $\Delta Y_{i,t}$  being the quarterly change in a vast range of bank-level variables: CET1 ratio, CET1 outstanding (in euro), Risk Weight density, interest rates to NFC and Households (in quarterly difference), Risk Weighted Assets (total and credit only), Total Original Exposures, loans and debt securities exposures to Non-Financial Corporations, loans to households, exposure to General Government (in quarterly growth).

To estimate the speed of adjustment and the elasticity of balance-sheet adjustment to the distance to target, I control at the bank level for Return on Asset, impairment ratio, loan to deposit ratio, NIM, Total Asset (in log) and the ratio of TLTRO loans in total liabilities. Macroeconomic controls, aiming at capturing overall credit demand and credit risk, include domestic quarterly growth in GDP and HICP, the domestic unemployment rate, the 10-year domestic sovereign rate and the 3-month Euribor rate. I also include a set of post-Covid country fixed effects to capture the emergency measures adopted to support banks and credit supply, such as credit guarantee schemes and loan moratoria. In both steps, I also conduct an extension exercise where I distinguish between positive and negative distance to target, in order to investigate potential asymmetry, suggesting more intense pressure for adjustment on one side of the target.

Bank data come from European banking supervision reports, namely the COREP and FINREP. The definitions of the indicators used in the regressions from those templates are produced by the European Banking Authority.<sup>16</sup> Macroeconomic data come from the Statistical Data Warehouse of the ECB. Explanatory variables are lagged by one quarter. Banks data are winsorised at the 2.5% and 97.5% level.

## 4. Results

### 4.1. Determinants of CET1 targets

#### 4.1.1. Announced targets

Table 3.1 presents the estimation of Equation 3.5. The main regression is presented in Column (1). It provides two key lessons.

<sup>15</sup>An intercept (pooled or at bank-level) would imply a trend in distance to target and so ultimately a trend in CET1 ratio and/or target. For further details, see Berger et al. (2008)

<sup>16</sup><https://eba.europa.eu/eba-updates-methodological-guidance-on-risk-indicators-and-analysis-tools>

Table 3.1: Determinants of target CET1 ratio

|                          | <i>Dependent variable:</i> |                      |                     |                      |                      |                      |                     |                      |
|--------------------------|----------------------------|----------------------|---------------------|----------------------|----------------------|----------------------|---------------------|----------------------|
|                          | Target                     |                      |                     |                      |                      |                      |                     |                      |
|                          | (1)                        | (2)                  | (3)                 | (4)                  | (5)                  | (6)                  | (7)                 | (8)                  |
| OCR strict               | 0.292***<br>(0.085)        | 0.476***<br>(0.115)  | 0.487***<br>(0.182) | 0.136*<br>(0.072)    | 0.292***<br>(0.087)  | 0.320***<br>(0.089)  |                     |                      |
| TSCR strict              |                            |                      |                     |                      |                      |                      | 0.069<br>(0.132)    | 0.523***<br>(0.139)  |
| CBR                      |                            |                      |                     |                      |                      |                      | 0.728***<br>(0.138) | 0.375*<br>(0.219)    |
| AT1 and T2 shortfall     | 0.059<br>(0.127)           | 0.633***<br>(0.172)  | 0.339<br>(0.223)    | 0.028<br>(0.095)     | 0.029<br>(0.126)     | 0.048<br>(0.127)     | 0.065<br>(0.129)    | 0.623***<br>(0.174)  |
| P2G                      | 0.165*<br>(0.093)          | 0.430***<br>(0.140)  | 0.453<br>(0.315)    | 0.129*<br>(0.076)    | 0.164*<br>(0.095)    | 0.158*<br>(0.088)    | 0.149*<br>(0.087)   | 0.429***<br>(0.139)  |
| Total Assets, log        | -0.019*<br>(0.011)         | 0.002<br>(0.002)     | -0.002<br>(0.003)   | -0.005<br>(0.007)    | -0.021*<br>(0.011)   | -0.013<br>(0.010)    | -0.019*<br>(0.010)  | 0.002<br>(0.003)     |
| Return on Asset          | 0.359<br>(0.340)           | 0.038<br>(0.429)     | 0.419<br>(0.502)    | 0.208<br>(0.311)     | 0.324<br>(0.354)     | 0.109<br>(0.328)     | 0.373<br>(0.334)    | 0.040<br>(0.424)     |
| Off Balance-sheet        | 0.007<br>(0.024)           | -0.018<br>(0.019)    | -0.016<br>(0.021)   | 0.010<br>(0.031)     | 0.009<br>(0.025)     | 0.013<br>(0.024)     | 0.008<br>(0.028)    | -0.020<br>(0.019)    |
| Credit ratio             | 0.033*<br>(0.020)          | 0.070***<br>(0.025)  | 0.018<br>(0.029)    | 0.048***<br>(0.014)  | 0.029<br>(0.019)     | 0.030*<br>(0.018)    | 0.035*<br>(0.020)   | 0.072***<br>(0.025)  |
| RW                       | -0.028<br>(0.018)          | -0.007<br>(0.017)    | -0.001<br>(0.026)   | -0.010<br>(0.017)    | -0.031*<br>(0.018)   | -0.011<br>(0.016)    | -0.031*<br>(0.018)  | -0.004<br>(0.019)    |
| Impairment ratio         | -0.098**<br>(0.045)        | -0.110**<br>(0.045)  | -0.114**<br>(0.055) | -0.096***<br>(0.035) | -0.105**<br>(0.046)  | -0.093**<br>(0.042)  | -0.096**<br>(0.046) | -0.107**<br>(0.045)  |
| Provisions               | 0.261<br>(0.334)           | -0.785*<br>(0.469)   | -0.568<br>(0.534)   | -0.047<br>(0.323)    | 0.153<br>(0.322)     | 0.299<br>(0.370)     | 0.244<br>(0.327)    | -0.813*<br>(0.464)   |
| Deposit ratio            | -0.015<br>(0.015)          | -0.021<br>(0.015)    | -0.001<br>(0.016)   | -0.014<br>(0.012)    | -0.017<br>(0.016)    | -0.020<br>(0.016)    | -0.021<br>(0.016)   | -0.020<br>(0.016)    |
| Cost of deposits         | -2.041<br>(1.387)          | -4.801***<br>(1.391) | -1.967<br>(1.537)   | -2.435**<br>(0.967)  | -2.038<br>(1.364)    | -1.820<br>(1.265)    | -1.452<br>(1.206)   | -5.029***<br>(1.292) |
| TLTRO                    | -0.011<br>(0.011)          | -0.044***<br>(0.015) | -0.017<br>(0.014)   | -0.034***<br>(0.011) | -0.012<br>(0.011)    | -0.004<br>(0.011)    | -0.008<br>(0.011)   | -0.046***<br>(0.015) |
| GDP growth for. 5y, dom. | -0.605**<br>(0.283)        | -0.910***<br>(0.239) | -0.999**<br>(0.413) | -0.772***<br>(0.199) |                      | -0.642**<br>(0.270)  | -0.435<br>(0.279)   | -0.960***<br>(0.261) |
| GDP growth for. 5y, EA   |                            |                      |                     |                      | -0.854**<br>(0.390)  |                      |                     |                      |
| CPI growth for. 5y, dom. | 0.001<br>(0.003)           | 0.004<br>(0.005)     | 0.008<br>(0.006)    | 0.003<br>(0.004)     | 0.001<br>(0.004)     | 0.002<br>(0.003)     | -0.0002<br>(0.003)  | 0.004<br>(0.005)     |
| EURIBOR                  | -0.018***<br>(0.006)       | -0.012<br>(0.009)    | 0.017<br>(0.020)    | -0.026***<br>(0.006) | -0.017***<br>(0.006) | -0.015***<br>(0.006) | -0.011<br>(0.007)   | -0.013<br>(0.010)    |
| 10-year sov. yield       | 0.259<br>(0.170)           | 0.120<br>(0.203)     | 0.330*<br>(0.196)   | 0.305**<br>(0.122)   | 0.346*<br>(0.185)    | 0.293**<br>(0.149)   | 0.291<br>(0.182)    | 0.105<br>(0.210)     |
| CET1 ratio               |                            |                      |                     |                      |                      | 0.173*<br>(0.093)    |                     |                      |
| Constant                 |                            | 0.017<br>(0.067)     | 0.138<br>(0.091)    |                      |                      |                      |                     | -0.002<br>(0.085)    |
| Bank FE                  | Yes                        | No                   | No                  | Yes                  | Yes                  | Yes                  | Yes                 | No                   |
| Nb banks                 | 61                         | 61                   | 55                  | 61                   | 61                   | 61                   | 61                  | 61                   |
| Observations             | 950                        | 950                  | 115                 | 810                  | 950                  | 950                  | 950                 | 950                  |
| R <sup>2</sup>           | 0.282                      | 0.462                | 0.329               | 0.364                | 0.232                | 0.309                | 0.317               | 0.463                |
| Adjusted R <sup>2</sup>  | 0.218                      | 0.452                | 0.211               | 0.297                | 0.165                | 0.248                | 0.256               | 0.452                |

*Notes:* \*p<0.1; \*\*p<0.05; \*\*\*p<0.01. Column (1) presents the results of the baseline panel regression with bank fixed effects while column (2) reports the results of the pooled regression and column (3) the regression on new targets only. Column (4) repeats the regression of Column (1) with the sample period ending in Q4 2019, while Column (5) repeats it with euro area GDP growth forecast instead of domestic GDP. Column (6) adds the lagged CET1 ratio as explanatory variable. Column (7) decomposes the OCR CET into Total SREP Capital Requirements (Pillar 1 and Pillar 2 Requirements) and Combined Buffer Requirements. Column (8) repeats this regression but on pooled regression. Explanatory variables include announced the CET1 Overall Capital Requirement, the AT1 and T2 shortfalls, the P2G, the log of Total asset, the Return on Asset, the ratio of off-balance-sheet exposures to total assets, the ratio of credit exposures to total assets, the Risk Weight density, the impairment ratio, the provision ratio, the deposit ratio, the cost of deposits, the TLTRO ratio over total assets, the 5-year ahead GDP growth and inflation forecast of the Survey of Professional Forecasters (domestic or euro area GDP), the 3-month EURIBOR rate and the 10-year sovereign yield. All explanatory variables are lagged by one quarter. Errors are clustered at the bank level.



First, an increase in capital requirements has a statistically significant and economically material impact on targets. Nevertheless, this impact is less than unity. This suggests that banks reduce their target excess capital when requirements increase. This is consistent with a trade-off theory of bank capital, in which managers balance the expected cost of regulatory breach due to thinner excess capital against the perceived cost of holding a large capital ratio. Consequently, they hold a management buffer over requirements that they progressively reduce to smooth the impact of requirement hikes: a 1pp increase in requirements drives the target up by  $\sim 0.3pp$ , implying a reduction in management buffer by  $\sim 0.7pp$ . A key finding is the similar coefficients for OCR and P2G. We could expect the latter to have a smaller impact, as it is not a requirement *stricto sensu* and as banks do not face immediate consequences in case of breach, while breaching the OCR triggers the MDA, limiting banks' ability to distribute dividends. Uncovering very similar coefficients suggests that banks actually do not consider this difference when setting their targets, implying that they treat the P2G as a requirement and not as a usable buffer they can draw on.

Second, banks tend to adjust their capital targets procyclically, as captured by the negative impact of GDP growth forecast, in line with results from partial adjustment models in Fonseca and González (2010) and Francis and Osborne (2012). In adverse economic environment, investors tend to become more risk averse and fly to quality, while uncertainty increases. To reassure investors and show they can cover unexpected losses, banks react by committing to higher CET1 targets. Such behaviour has strong economic implications: to reach those higher targets, banks can typically reduce their credit supply when it is the most necessary to help firms and households shoulder an economic crisis. As such, those results confirm banks' procyclical behaviour in crisis.

Together, those two results suggest that countercyclical capital requirements could be useful tools to mitigate financial crisis. By raising requirements in good times to push CET1 ratios higher, authorities can lower them when a crisis hits, mitigating banks' procyclical behaviour and thus alleviating its economic cost.

The regressions also provide some complementary lessons. Higher impairment ratio is associated with lower targets, suggesting that banks holding troubled asset acknowledge their difficulty in building up their capital ratio: a 1pp increase in impairment ratio translates into around a 0.1pp decrease in target CET1 ratio. A higher policy rate reduces the target CET1 ratio, in line with Marcus (1983) finding that an increase in interest rate is associated with lower capital ratios. Finally, more credit-oriented banks tend to target higher CET1 ratios.

I run a series of robustness check. In column (2) I run the regression at the pooled level, removing banks' fixed effects. Indeed, as most of the variables in the regression model are sluggish, a large part of the sample variance come from the cross-section rather than the time series. The individual fixed effects absorb this variance, potentially distorting the estimated elasticities. In Column (3), I focus on *new targets*, i.e. targets that differ from the previous quarter, meaning that the bank reassessed its target. Due to the small size of the sample, this regression is also run at the pooled level. For both regressions, the results are qualitatively unchanged. Nevertheless, the impact of CET1 requirements on targets is materially higher. A first explanation is that, as mentioned above, banks adjust their targets in a lumpy fashion and not every quarter. When announcing new targets, they materially adjust to their capital requirements, while using the whole series of announced targets may bias downward the estimated elasticity. Using announced targets, I can explicitly quantify and control by this bias by using a set of new targets only. A second explanation comes from the inclusion of banks' fixed effects in the baseline regressions. Gropp and Heider (2010); De Jonghe and Öztekin (2015); Bakkar et al. (2019) argue that time-invariant banks fixed effects are the primary determinants of their target CET1 ratio, implying that the inclusion of those fixed effects is key for unbiased

target estimates. Indeed, a regression on bank-fixed effects alone explains 78% of announced targets, close to the 85% found by De Jonghe and Öztekin (2015) with partial adjustment model on an international sample of banks. Adding the other explanatory variables only increases the  $R^2$  to 84%, suggesting that they play only a marginal role in explaining banks' targets. Nevertheless, the opposite exercise, including all regressors but banks' fixed effects, returns an  $R^2$  of 56%, suggesting a substantial explanatory power. Several of the bank-level explanatory variables evolve sluggishly, meaning that most of their variance is cross-sectional and thus filtered out by banks' fixed effects. As such, the inclusion of bank-level fixed effect is necessary to appropriately fit banks' targets, but may lead to inaccurate elasticities for time-variant but sluggish explanatory variables. Moreover, those papers are based on pre-Basel III bank data, when capital requirements were materially lower and thus constrained much less banks' targets, which could revolve more easily toward bank specific time invariant targets.

Column (4) reproduces the same regressions than Column (1) but ending the sample period in Q4 2019, thus removing the COVID-19 pandemic, characterised by a huge economic shock and uncertainty triggering important fiscal, monetary and prudential measures that may affect the regression results. All results are qualitatively unchanged. In column (5) I replace domestic with euro area GDP growth forecast. This allows for the inclusion of banks whose domestic economies are not covered by the SPF, and accounts for the international reach of many banks in the sample, which often have a material share of their activities and income abroad. This does not affect the results. In column (6) I add the lagged CET1 ratio as an additional explanatory variable.<sup>17</sup> This creates an endogeneity issue, as targets move sluggishly and affect the actual CET1 ratio. Nevertheless, this provides a useful robustness check to determine if banks announce their targets taking into account their current CET1 ratio to limit the necessary adjustment. As expected, a higher ratio is associated with a higher target buffer, leaving the other results qualitatively unchanged.

In columns (7) and (8) I disentangle the pure CET1 OCR into the pure TSCR and the CBR. One should expect a larger coefficient for the TSCR since the cost of breach is largely higher, encouraging banks to operate with a larger management buffer on top of it. This hypothesis is not supported by the data. In Column (7), the CBR has a significantly higher impact than the P2G, while the AT1 and T2 shortfalls and, surprisingly, the TSCR have no significant impact. Using a pooled regression in Column (8) returns more interpretable coefficients but confirms the absence of strict pecking order. All coefficients are around 0.5 and the difference is not statistically significant. This suggests that banks do not consider the CBR as less stringent than the minimum requirements, implying that they consider the cap on capital distribution the breach of the CBR triggers to be very costly. This result has important positive and normative implications. On the positive side, it implies that banks are committed to service regular dividend to their investors and do not want to send a negative signal by breaching regulatory requirements, even those designed to be used in case of need. On the normative side, this suggests that the usability of those buffers is mitigated by banks' unwillingness to draw on them, impeding their countercyclical purpose. Banks suffering losses would prefer to cut back on lending to reduce their RWA and increase their CET1 ratio rather than absorbing their losses by dipping into the CBR, which would activate dividend restriction. This is consistent with banks' communication at the outbreak of the COVID-19 pandemic, when they largely communicated on their ability and willingness to navigate through the crisis with ample excess capital over the MDA trigger. Consequently, this calls in favor of designing large countercyclical buffers that regulatory authorities can release during times of stress, so that banks could use the freed capital to absorb losses without triggering

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<sup>17</sup>The definition of the CET1 ratio used here, Phased-in or Fully-loaded is in line with the one used by the bank to define its target.

restriction on dividend distribution.

#### 4.1.2. Comparison with partial adjustment model

One of the main contributions of this paper is the use of announced targets instead of estimated targets recovered from partial adjustment models. To inform on the usefulness of this contribution, I run the partial adjustment model of Equation 3.3 using the same set of explanatory variables that for Table 3.1. As standard for dynamic panel data, and partial adjustment models in particular, I use a General Method of Moments (GMM) setting, relying on the standard system GMM proposed by Blundell and Bond (1998). The confidence intervals for long term coefficients are built with bootstrap, which are convenient since long term coefficients estimates in partial adjustment model are a non-linear combination of the estimated short-term coefficients ( $\theta = \beta/(1 - \alpha)$  in Equation 3.3). For the sake of comparison, I produce confidence intervals with bootstrap too for regressions with announced targets. For partial adjustment models, I use recursive wild bootstraps, appropriate for dynamic panel data (see Gonçalves and Kaffo (2015)). For announced targets, I use standard wild bootstrap, as the model is not dynamic and thus recursive bootstrap pointless.<sup>18</sup> I run the partial adjustment model on two datasets: first on the same set of banks present in the dataset of announced targets, for the sake of comparability; second on all banks consolidated at the euro area level, to capture the fact that partial adjustment models do not require announced targets and can thus be applied on a larger set of banks.

Figure 3.4 compares the confidence intervals obtained with the three regressions: the one with announced targets and the two with partial adjustment model. The direct regression of announced targets clearly produces substantially smaller confidence intervals than the two partial adjustment regressions. For capital requirements, it is four times smaller than with the partial adjustment model. This produces more precise estimated elasticities and make some variables statistically significant. Such difference in accuracy does not come as a surprise. The long term coefficients of partial adjustment models are determined as  $\hat{\theta} = \hat{\beta}/(1 - \hat{\alpha})$ . With  $\alpha$  being the autocorrelation coefficient typically lower but close to unity,  $\hat{\theta}$  is obtained with a division by a term close to zero, resulting in unstable estimates and often implausibly large long-term coefficients.

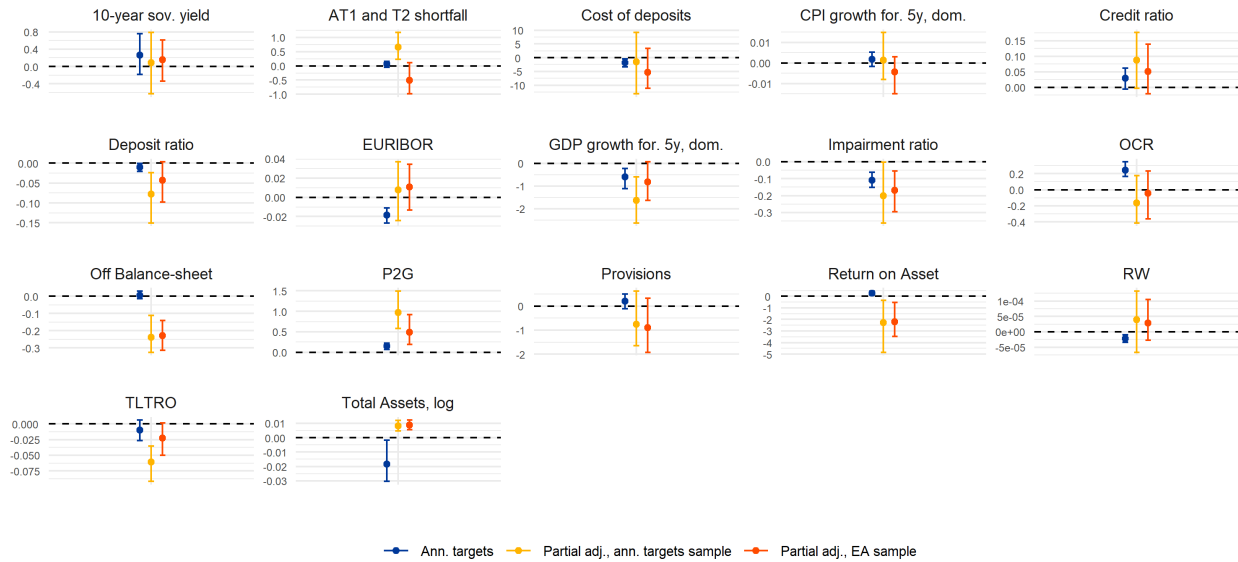
Another issue should also be considered when comparing both models. It is well known that the GMM for short dynamic panel data should be used with caution, due to the risk of instrument proliferation and overidentification (see Roodman (2009b)), their complexity and the diversity of possible specifications, relying on different and easily breached assumptions (see Roodman (2009a)). The direct regression panel allowed by the use of announced target considerably reduces this model uncertainty. As such, using announced targets allows for lower model risk and, for a given model, produces thinner confidence intervals than partial adjustment models.

Figure 3.5 compares the distance between actual announced targets and the fitted values of the three regressions. It appears that partial adjustment models produce distributions well centered around zero, meaning that their fitted values do not systematically deviate from announced targets. Nevertheless, their distribution of distance to announced target is quite large, with an interquartile range of more than 2.5pp, a material value for targets mostly ranging between 12.5 and 15%, and a few very large misestimates. In comparison, the regressions on announced target produces an interquartile range about four times smaller. This confirms that partial adjustment models produce noisy estimates of banks' targets and should be considered a second-best approach when announced targets are not available (e.g. for non-listed banks).

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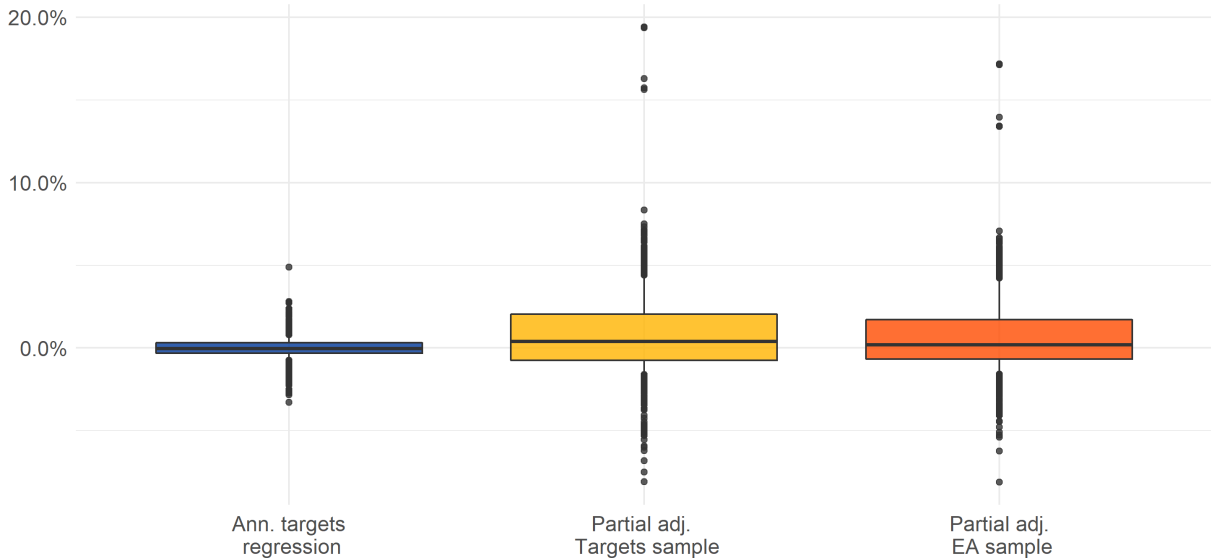
<sup>18</sup>For both models I use 100 draws.

Fig. 3.4. Comparison of long term elasticities - announced targets and partial adjustment models



*Note:* Confidence intervals for panel regression on announced targets (blue) and partial adjustment models on banks announcing targets (yellow) and ultimate parent banks in the euro area (orange). The partial adjustment models are estimated with difference GMM. Confidence intervals are built with wild bootstrap for the OLS panel regression and recurvise wild bootstrap for the GMM partial adjustment models.

Fig. 3.5. Comparison of fit quality - announced targets and partial adjustment models



*Note:* Distance between fitted value and actual target from regression on announced targets (blue) and partial adjustment models on banks announcing targets (yellow) and ultimate parent banks in the euro area (orange). The partial adjustment models are estimated with difference GMM.

## 4.2. Speed of adjustment

In a second step, I estimate Equation 3.6 to recover the adjustment speed. In a first exercise, I conduct a pooled regression including no  $Z$  variable. As such, the estimated  $\tau$  is simply the autocorrelation parameter of the  $Gap$ . Next, I include a vector  $Z$  of explanatory variables to assess how the speed of adjustment varies with banks characteristics. Following De Jonghe and Öztekin (2015); Bakkar et al. (2019), I standardise the variables of the  $Z$  vector to facilitate interpretation. As such,  $\tau$  is the average speed of adjustment and  $\psi$  the average impact of a 1pp deviation from target. In both specifications, I run an extended version splitting the  $Gap_{i,t-1}$  variable into  $Gap_{i,t-1}^+$  and  $Gap_{i,t-1}^-$ , to determine whether the adjustment speed depends on the sign of the deviation. For all those regressions, I exclude the observations corresponding to a change in target, in order to estimate the adjustment speed toward a constant target from one period to the other. Including new targets does not qualitatively affect the results.

Table 3.2 presents the results of equation 3.6. Banks take their targets seriously. Indeed, the coefficient on lagged target distance to target is significantly within the  $(0, 1)$  interval, implying that banks do reduce their distance to target over time. The autocorrelation parameter is around 95%, implying a  $\lambda$  around 5%. This is somewhat slower than the existing literature, which typically finds adjustment speed between 8 and 20%.<sup>19</sup> Column (2) presents a key extension disentangling the impact of positive and negative distances to target. The result is twofold. First, banks adjust from both sides of the targets, with the autocorrelation coefficients again significantly in the  $(0, 1)$  interval at the 1% level. This confirms that banks do not treat target announcement as a minimum threshold to set as low as possible to be sure to overpass it. On the contrary, when above target, they act to reduce their CET1 ratio. Second, banks below their targets adjust significantly faster than those above their target, with an adjustment speed of  $\sim 17\%$  versus  $\sim 2\%$ . The difference between both speeds of adjustment is significant at the 1% level. Rolling over both coefficients, this means that after one year (two years) banks below their targets have closed more than 50% (75%) of the distance against 8% (15%) for banks above their targets. This suggests that the former are under greater pressure to adapt. This is consistent with investors being primarily concerned about the solvency of a bank, and less about high capitalisation suggesting a suboptimal use of funds. This also implies that many European banks have been able to retain large capital ratios despite commitment to return capital to shareholders in a context of low profitability.

From a policy perspective, this result sheds important light on the impact of countercyclical capital requirement adjustment in crisis time. Previous results imply that a 1pp decrease in requirement translate in a 0.3pp drop in target. For banks below their target in crisis time (a likely case due to loss absorption on the one hand and procyclical target adjustment on the other) this would result in a 15bps expansionary fall in CET1 ratio over one year. However, this fall would only equal a muted 2.4bps ( $0.3 * 8\%$ ) for banks above target, consistent with the idea that those banks have slack capital and thus do not materially react to change in requirements.

As robustness checks, I then interact lagged distance to target with a set of banks' characteristics and macrofinancial variables, to assess how they affect the adjustment speed. For the sake of space, only the main coefficients are reported in Table 3.2, while the full set of results is presented in Table A3 in Appendix. Overall, the speed of adjustment appears relatively unaffected by other variables. Columns (5) and (6) reproduce for robustness the regressions of Columns (1) and (2) but using the pre-Covid data only results are quantitatively unchanged and quantitatively very similar.

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<sup>19</sup>This comparison converts into quarterly speed  $\lambda$  estimated on yearly data for a large part of the literature.

Table 3.2: Speed of adjustment

|   | <i>Dependent variable:</i> |                     |                     |                     |                     |                     |
|---|----------------------------|---------------------|---------------------|---------------------|---------------------|---------------------|
|   | distance to Target         |                     |                     |                     |                     |                     |
|   | (1)                        | (2)                 | (3)                 | (4)                 | (5)                 | (6)                 |
| dist. Target                                    | 0.954***<br>(0.013)        |                     | 0.949***<br>(0.014) |                     | 0.933***<br>(0.015) |                     |
| dist. Target, pos.                              |                            | 0.979***<br>(0.011) |                     | 0.977***<br>(0.011) |                     | 0.968***<br>(0.015) |
| dist. Target, neg.                              |                            | 0.834***<br>(0.030) |                     | 0.817***<br>(0.031) |                     | 0.816***<br>(0.037) |
| Wald test dist. target = 1                      | 11.69***                   |                     | 12.41***            |                     | 20.06***            |                     |
| Wald test pos. dist. target = 1                 |                            | 3.87**              |                     | 4.25**              |                     | 4.27**              |
| Wald test neg. dist. target = 1                 |                            | 30.74***            |                     | 34.87***            |                     | 25.3***             |
| Wald test pos. dist. target = neg. dist. target |                            | 21.2***             |                     | 24.11***            |                     | 14.68***            |
| Bank FE   | No                         | No                  | No                  | No                  | No                  | No                  |
| Nb banks  | 69                         | 69                  | 68                  | 68                  | 67                  | 67                  |
| Observations                                    | 929                        | 929                 | 817                 | 817                 | 875                 | 875                 |
| R <sup>2</sup>                                  | 0.900                      | 0.901               | 0.896               | 0.897               | 0.900               | 0.899               |
| Adjusted R <sup>2</sup>                         | 0.900                      | 0.901               | 0.896               | 0.897               | 0.899               | 0.897               |

*Notes:* \*p<0.1; \*\*p<0.05; \*\*\*p<0.01. Column (1) presents the results of the pooled regression of the CET1 ratio distance to target on its lag while columns (2) distinguishes between positive and negative lagged distance to target. Columns (3) and (4) reproduce the same regressions with the sample period ending in Q4 2019. Columns (5) and (6) include a set of explanatory variables interacted with the lagged distance to target. Those variables are the horizon of the target (in quarters), the return on asset, the impairment ratio, the log of Total asset, the TLTRO ratio, the annual real GDP growth, the inflation rate, the 3-month EURIBOR rate and the 10-year sovereign yield. All explanatory variables are lagged by one quarter. Errors are clustered at the bank level.

### 4.3. Impact on balance-sheet adjustment

In a final step, I estimate Equation 3.7. This informs on the insight the gap between actual and target CET1 ratios provides on banks future behaviour and the channels through which banks adjust toward their targets.

Table 3.3 presents the results. Confirming previous results, the CET1 ratio Fully Loaded adjusts upward (downward) when the distance to target is negative (positive). This adjustment of the ratio occurs through both a higher outstanding CET1 (the numerator) and a lower RWA (denominator). Rolling over the estimated coefficients to assess the evolution of outstanding CET1 and RWA until the distance to target becomes negligible, it appears that the increase in outstanding CET1 accounts for two thirds of the total adjustment while change in RWA accounts for the remaining third.<sup>20</sup> This is consistent with De Jonghe and Öztekin (2015) and Memmel and Raupach (2010) who find that banks below their target adjust through equity growth rather than asset reduction. Equity adjustment occurs through both issued capital and retained earnings. Nevertheless, the material impact on RWA suggests effect on the asset side.

This effect can be of two sorts: change in Total Original Exposure or in Risk Weight density. Results imply that both types of adjustments are at play. In particular, banks below (above) their target lend less (more) to NFC, either through loans or debt securities, which both reduces assets and risk weight density,

<sup>20</sup>Strictly speaking, the breakdown depends on the initial and target CET1 ratio. In practice, the 2/3 vs 1/3 breakdown is valid throughout the set of actual and target values observed in the sample.

as those exposures typically carry high risk weights. The impact is materially larger for debt securities holdings than for loans, as in Maurin and Toivanen (2012), consistent with the higher liquidity of the former. Combining results of Tables 3.1 and 3.3, a back-of-the-envelope calculation implies that a 1pp hike in capital requirements increases the target, and consequently the distance to target, by 0.30 pp, triggering a quarterly  $0.30 \times 0.24 = 0.07pp$  negative shock on NFC loan quarterly growth, or 2.8pp on annual growth rate. Moreover, the distance to target seems to affect banks' loss recognition, as a 1pp larger distance to target triggers a 37bps hike in Non-Performing Exposure ratio. This suggests that banks are more willing to recognise losses when it does not put at risk their ability to meet their target CET1 ratio.

Those results confirm the procyclical behaviour of banks' credit supply previously identified. When faced with economic crisis, banks tend to increase their CET1 targets. Simultaneously, their retained earnings fall due to weaker economic activity and credit losses. Both effects have a negative impact on the distance to target. Banks react by reducing their credit supply to NFC to reduce their risk weight density and by becoming more reluctant to recognise losses to spare capital, both reactions increasing their CET1 ratio.

In an extension of the previous regression, and in line with the analysis of the speed of adjustment, I re-run the regressions separating positive and negative distances to target, to determine whether the choice and magnitude of adjustment channels depend on the sign of the distance. The results housed in Table 3.4 confirm that the adjustment occurs on both sides of the targets and that it is faster for banks under their targets, in particular through stronger adjustment of credit exposures to NFC. Banks below their target increase their CET1 ratio about three times faster than banks above targets reduce theirs, the coefficients being significantly different at the 10% level. Consistently, the adjustment in loans to NFCs is four times quicker for banks below target, and the impact of change in capital requirements jumps to  $0.30 \times 0.51 = 0.15pp$ . By the same token, the effect on the NPE ratio is concentrated on banks below their target, suggesting impeded loss recognition. Those results confirm bank procyclical behavior in crisis time, as well as the potential expansionary effect of a requirement release.

I conduct a range of robustness analyses.

In a key robustness check, I control for the distance to capital requirement (the MDA trigger). Indeed, as targets are affected by capital requirements, the impacts estimated above may purely come from the influence of the capital requirements. Results are presented in Table 3.5. Despite the correlation between both distances, the impact of distance to target is qualitatively unchanged, while the impact of the distance to requirement is often not significant. This provides two lessons. First, targets affect banks' behaviour on their own right, and not only by channeling the impact of capital requirements, as otherwise the impact would be absorbed by the distance to capital requirements. Second, the impact of the distance to requirement has relatively low statistical significance in a horse race with the distance to target. This suggests that this impact of capital requirements is actually channelled through the CET1 targets, rather than having a direct impact on balance-sheet adjustment. This reinforces the case for further analysis and monitoring of those targets, as they appear as the key channel of prudential policy.

Other robustness exercises are reported in Appendix for the sake of space. In Table A4, I end the sample period in Q4 2019 to exclude the COVID-19 pandemic period, marked by largely distorted macroeconomic forecasts and strong fiscal, monetary and prudential support measures. Results remain qualitatively unchanged. Then, in Table A5 I add time fixed effect to better take into account unobserved system-wide shocks. Finally, in line with the regressions in Section 4.2, I run pooled regressions without intercept when the endogenous variable is a change in a ratio. Indeed, intercepts, both at the bank or pooled levels, suggest a permanent drift in those ratios, incompatible with their interval of definition. Results are reported in Table

Table 3.3: Impact of distance to target

|                         | <i>Dependent variable:</i> |                                 |                      |                      |                     |                      |                      |                            |                      |                      |                      |                      |                        |                           |
|-------------------------|----------------------------|---------------------------------|----------------------|----------------------|---------------------|----------------------|----------------------|----------------------------|----------------------|----------------------|----------------------|----------------------|------------------------|---------------------------|
|                         | CET1, FL<br>(1)            | CET1 € <sub>t</sub> , FL<br>(2) | RWA<br>(3)           | TOE<br>(4)           | RW<br>(5)           | RWA, Credit<br>(6)   | Loans NFC<br>(7)     | Debt securities NFC<br>(8) | Loans HH<br>(9)      | Loans GG<br>(10)     | Cash<br>(11)         | NPE<br>(12)          | Issued capital<br>(13) | Retained earnings<br>(14) |
| Target dist.            | -0.199***<br>(0.037)       | -1.140***<br>(0.259)            | 0.409***<br>(0.088)  | 0.183*<br>(0.108)    | 0.110***<br>(0.040) | 0.279***<br>(0.107)  | 0.244**<br>(0.113)   | 1.126*<br>(0.620)          | 0.110<br>(0.103)     | 0.564<br>(0.719)     | -1.271*<br>(0.750)   | 0.037**<br>(0.018)   | -0.061***<br>(0.018)   | -0.066**<br>(0.027)       |
| Target horizon          | -0.001**<br>(0.0003)       | -0.005**<br>(0.002)             | 0.002*<br>(0.001)    | 0.002*<br>(0.001)    | 0.0001<br>(0.001)   | 0.001<br>(0.001)     | 0.0001<br>(0.001)    | 0.007<br>(0.008)           | -0.0003<br>(0.001)   | -0.003<br>(0.006)    | 0.022**<br>(0.011)   | 0.0001<br>(0.0001)   | -0.0002<br>(0.0002)    | -0.0003<br>(0.0003)       |
| Total Assets, log       | 0.001<br>(0.004)           | 0.094**<br>(0.036)              | -0.045***<br>(0.016) | -0.051**<br>(0.022)  | 0.013<br>(0.009)    | -0.061***<br>(0.019) | -0.056**<br>(0.022)  | -0.321***<br>(0.070)       | -0.060***<br>(0.023) | -0.299***<br>(0.099) | -0.174<br>(0.156)    | 0.011***<br>(0.003)  | 0.003<br>(0.003)       | 0.004<br>(0.004)          |
| Return on Asset         | -0.172<br>(0.130)          | -1.069<br>(1.103)               | -0.910**<br>(0.406)  | -0.392<br>(0.773)    | -0.062<br>(0.291)   | -0.995**<br>(0.433)  | -0.490<br>(0.508)    | 1.174<br>(3.160)           | -0.518<br>(0.467)    | 0.991<br>(2.752)     | 8.294*<br>(4.783)    | -0.179<br>(0.111)    | 0.191***<br>(0.060)    | -0.481**<br>(0.208)       |
| Credit ratio            | -0.009<br>(0.009)          | -0.002<br>(0.100)               | 0.042<br>(0.033)     | 0.110*<br>(0.063)    | -0.013<br>(0.025)   | 0.011<br>(0.041)     | 0.006<br>(0.065)     | -0.131<br>(0.288)          | -0.061<br>(0.054)    | -0.135<br>(0.249)    | 2.143***<br>(0.518)  | 0.024***<br>(0.006)  | 0.004<br>(0.008)       | -0.004<br>(0.011)         |
| Impairment ratio        | -0.010<br>(0.031)          | -0.171<br>(0.259)               | -0.137<br>(0.112)    | -0.131<br>(0.138)    | -0.027<br>(0.052)   | -0.109<br>(0.161)    | -0.256***<br>(0.097) | -0.655<br>(0.736)          | -0.171*<br>(0.093)   | 0.044<br>(0.558)     | -0.263<br>(0.801)    | -0.028<br>(0.018)    | 0.029*<br>(0.016)      | 0.004<br>(0.018)          |
| Provisions              | 0.126<br>(0.110)           | 4.404***<br>(1.194)             | -0.339<br>(0.449)    | -3.556***<br>(1.007) | 1.213***<br>(0.347) | -1.282*<br>(0.671)   | -0.679<br>(0.610)    | -11.105***<br>(3.950)      | 0.123<br>(0.594)     | -2.422<br>(5.750)    | -7.598<br>(7.292)    | 0.271<br>(0.185)     | 0.093<br>(0.066)       | 0.193**<br>(0.097)        |
| Deposit ratio           | 0.010<br>(0.010)           | 0.088<br>(0.087)                | -0.009<br>(0.038)    | -0.011<br>(0.055)    | 0.0003<br>(0.020)   | 0.044<br>(0.051)     | -0.032<br>(0.076)    | -0.107<br>(0.221)          | -0.023<br>(0.056)    | 0.009<br>(0.227)     | -0.168<br>(0.442)    | -0.014*<br>(0.008)   | 0.001<br>(0.006)       | -0.002<br>(0.008)         |
| TLTRO                   | -0.006<br>(0.005)          | -0.043<br>(0.036)               | -0.034<br>(0.022)    | -0.049**<br>(0.023)  | 0.009<br>(0.008)    | -0.030<br>(0.028)    | -0.076**<br>(0.030)  | -0.341***<br>(0.113)       | -0.016<br>(0.026)    | -0.101<br>(0.141)    | 0.448***<br>(0.170)  | -0.013***<br>(0.004) | -0.0002<br>(0.003)     | 0.003<br>(0.006)          |
| GDP                     | -0.013*<br>(0.008)         | -0.053<br>(0.048)               | 0.087**<br>(0.035)   | 0.043<br>(0.039)     | 0.021<br>(0.018)    | 0.077**<br>(0.035)   | 0.115**<br>(0.048)   | 0.062<br>(0.198)           | -0.014<br>(0.031)    | 0.135<br>(0.272)     | 0.049<br>(0.218)     | -0.013**<br>(0.005)  | -0.017***<br>(0.005)   | 0.001<br>(0.007)          |
| HICP                    | -0.121**<br>(0.054)        | -0.900**<br>(0.447)             | 0.008<br>(0.221)     | 0.012<br>(0.256)     | 0.021<br>(0.101)    | -0.001<br>(0.278)    | 0.205<br>(0.294)     | -0.848<br>(1.548)          | -0.130<br>(0.249)    | -1.065<br>(1.769)    | -0.787<br>(2.408)    | -0.024<br>(0.028)    | -0.038<br>(0.043)      | -0.077<br>(0.051)         |
| Unemployment            | 0.0004<br>(0.0003)         | 0.001<br>(0.002)                | -0.003*<br>(0.001)   | -0.002<br>(0.001)    | -0.0002<br>(0.0003) | -0.002<br>(0.002)    | -0.002<br>(0.001)    | -0.011*<br>(0.006)         | 0.001<br>(0.001)     | -0.015**<br>(0.006)  | 0.021***<br>(0.007)  | -0.0002<br>(0.0002)  | 0.001***<br>(0.0002)   | 0.0003<br>(0.0003)        |
| 10-year sov. yield      | -0.087<br>(0.074)          | -0.353<br>(0.571)               | 0.842***<br>(0.253)  | 0.994**<br>(0.445)   | -0.116<br>(0.198)   | 0.576*<br>(0.304)    | 0.248<br>(0.350)     | 2.499<br>(1.524)           | -0.206<br>(0.244)    | 6.951***<br>(1.889)  | -7.737***<br>(2.762) | 0.120*<br>(0.064)    | -0.013<br>(0.044)      | -0.109<br>(0.078)         |
| EURIBOR                 | 0.003<br>(0.004)           | 0.026<br>(0.024)                | -0.015<br>(0.014)    | -0.016<br>(0.014)    | -0.0002<br>(0.007)  | -0.005<br>(0.021)    | 0.001<br>(0.017)     | -0.022<br>(0.078)          | -0.017<br>(0.013)    | 0.067<br>(0.080)     | 0.020<br>(0.110)     | -0.004**<br>(0.002)  | -0.002<br>(0.003)      | -0.002<br>(0.003)         |
| Bank Fixed effects      | Yes                        | Yes                             | Yes                  | Yes                  | Yes                 | Yes                  | Yes                  | Yes                        | Yes                  | Yes                  | Yes                  | Yes                  | Yes                    | Yes                       |
| Observations            | 999                        | 984                             | 999                  | 985                  | 984                 | 999                  | 999                  | 940                        | 999                  | 993                  | 948                  | 999                  | 999                    | 982                       |
| R <sup>2</sup>          | 0.152                      | 0.132                           | 0.093                | 0.094                | 0.070               | 0.067                | 0.083                | 0.042                      | 0.067                | 0.041                | 0.103                | 0.139                | 0.059                  | 0.066                     |
| Adjusted R <sup>2</sup> | 0.064                      | 0.040                           | -0.002               | -0.001               | -0.029              | -0.030               | -0.012               | -0.058                     | -0.030               | -0.059               | 0.005                | 0.050                | -0.038                 | -0.033                    |

Notes: \*p<0.1; \*\*p<0.05; \*\*\*p<0.01. Explanatory variables include the distance between bank's actual CET1 ratio and its target, the number of quarters before target must be reached (*Horizon*), the bank's Return on Asset, its Net Interest Margin, its Impairment ratio, its log of TA, its TLTRO ratio, the annual growth in real GDP and HICP, the unemployment rate, the 10-year sovereign yield and the 3-month EURIBOR rate. All explanatory variables are lagged by one quarter. Errors clustered at the bank level.



Table 3.4: Impact of distance to target - Sign-dependent effect

|                         | <i>Dependent variable:</i> |                      |                      |                      |                     |                      |                      |                       |                      |                      |                      |                      |                      |                     |
|-------------------------|----------------------------|----------------------|----------------------|----------------------|---------------------|----------------------|----------------------|-----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|---------------------|
|                         | CET1, FL                   | CET1 €, FL           | RWA                  | TOE                  | RW                  | RWA, Credit          | Loans NFC            | Debt securities NFC   | Loans HH             | Loans GG             | Cash                 | NPE                  | Issued capital       | Retained earnings   |
|                         | (1)                        | (2)                  | (3)                  | (4)                  | (5)                 | (6)                  | (7)                  | (8)                   | (9)                  | (10)                 | (11)                 | (12)                 | (13)                 | (14)                |
| Target dist., pos       | -0.178***<br>(0.050)       | -0.969***<br>(0.314) | 0.416***<br>(0.117)  | 0.279**<br>(0.131)   | 0.082<br>(0.055)    | 0.274**<br>(0.135)   | 0.123<br>(0.148)     | 1.036<br>(0.817)      | -0.060<br>(0.113)    | -0.517<br>(0.965)    | -0.699<br>(0.972)    | 0.007<br>(0.015)     | -0.044**<br>(0.020)  | -0.082**<br>(0.033) |
| Target dist., neg       | -0.244***<br>(0.045)       | -1.515***<br>(0.407) | 0.393***<br>(0.135)  | -0.024<br>(0.196)    | 0.169*<br>(0.090)   | 0.288*<br>(0.172)    | 0.507***<br>(0.174)  | 1.301<br>(1.124)      | 0.480***<br>(0.164)  | 2.908***<br>(1.116)  | -2.628*<br>(1.367)   | 0.101**<br>(0.042)   | -0.098**<br>(0.041)  | -0.032<br>(0.054)   |
| Target horizon          | -0.001**<br>(0.0003)       | -0.006**<br>(0.002)  | 0.002*<br>(0.001)    | 0.002*<br>(0.001)    | 0.0002<br>(0.001)   | 0.001<br>(0.001)     | 0.0003<br>(0.001)    | 0.007<br>(0.008)      | -0.00001<br>(0.001)  | -0.001<br>(0.006)    | 0.021*<br>(0.011)    | 0.0001<br>(0.0002)   | -0.0002<br>(0.0002)  | -0.0003<br>(0.0003) |
| Total Assets, log       | 0.001<br>(0.004)           | 0.094***<br>(0.036)  | -0.045***<br>(0.016) | -0.051**<br>(0.022)  | 0.013<br>(0.009)    | -0.061***<br>(0.019) | -0.056***<br>(0.021) | -0.322***<br>(0.072)  | -0.060***<br>(0.023) | -0.299***<br>(0.100) | -0.175<br>(0.156)    | 0.011***<br>(0.003)  | 0.003<br>(0.003)     | 0.004<br>(0.004)    |
| Return on Asset         | -0.163<br>(0.124)          | -1.005<br>(1.091)    | -0.906**<br>(0.404)  | -0.345<br>(0.757)    | -0.074<br>(0.281)   | -0.997**<br>(0.430)  | -0.541<br>(0.493)    | 1.165<br>(3.141)      | -0.589<br>(0.459)    | 0.542<br>(2.761)     | 8.697*<br>(4.691)    | -0.192*<br>(0.100)   | 0.198***<br>(0.059)  | -0.487**<br>(0.205) |
| Credit ratio            | -0.009<br>(0.009)          | 0.003<br>(0.102)     | 0.042<br>(0.033)     | 0.114*<br>(0.063)    | -0.014<br>(0.026)   | 0.011<br>(0.042)     | 0.003<br>(0.063)     | -0.136<br>(0.297)     | -0.065<br>(0.053)    | -0.165<br>(0.249)    | 2.156***<br>(0.519)  | 0.023***<br>(0.006)  | 0.004<br>(0.007)     | -0.004<br>(0.011)   |
| Impairment ratio        | -0.011<br>(0.032)          | -0.181<br>(0.264)    | -0.138<br>(0.113)    | -0.138<br>(0.136)    | -0.025<br>(0.051)   | -0.108<br>(0.161)    | -0.248***<br>(0.095) | -0.648<br>(0.748)     | -0.159*<br>(0.093)   | 0.120<br>(0.540)     | -0.307<br>(0.797)    | -0.026<br>(0.018)    | 0.028*<br>(0.017)    | 0.005<br>(0.018)    |
| Provisions              | 0.108<br>(0.108)           | 4.274***<br>(1.208)  | -0.346<br>(0.438)    | -3.633***<br>(0.999) | 1.236***<br>(0.350) | -1.278*<br>(0.663)   | -0.573<br>(0.611)    | -11.049***<br>(3.944) | 0.272<br>(0.598)     | -1.474<br>(5.857)    | -7.995<br>(7.186)    | 0.296*<br>(0.177)    | 0.078<br>(0.061)     | 0.207**<br>(0.095)  |
| Deposit ratio           | 0.010<br>(0.010)           | 0.082<br>(0.087)     | -0.009<br>(0.039)    | -0.015<br>(0.057)    | 0.001<br>(0.021)    | 0.045<br>(0.051)     | -0.028<br>(0.075)    | -0.104<br>(0.226)     | -0.018<br>(0.054)    | 0.045<br>(0.223)     | -0.184<br>(0.446)    | -0.013*<br>(0.007)   | 0.001<br>(0.006)     | -0.002<br>(0.008)   |
| TLTRO                   | -0.006<br>(0.005)          | -0.046<br>(0.036)    | -0.034<br>(0.022)    | -0.051**<br>(0.023)  | 0.009<br>(0.008)    | -0.030<br>(0.028)    | -0.074**<br>(0.029)  | -0.339***<br>(0.114)  | -0.014<br>(0.024)    | -0.082<br>(0.141)    | 0.437**<br>(0.175)   | -0.012***<br>(0.005) | -0.0005<br>(0.003)   | 0.003<br>(0.006)    |
| GDP                     | -0.014*<br>(0.008)         | -0.058<br>(0.049)    | 0.087**<br>(0.035)   | 0.041<br>(0.040)     | 0.022<br>(0.018)    | 0.077**<br>(0.035)   | 0.117**<br>(0.047)   | 0.066<br>(0.198)      | -0.010<br>(0.029)    | 0.159<br>(0.274)     | 0.034<br>(0.219)     | -0.013**<br>(0.006)  | -0.017***<br>(0.005) | 0.002<br>(0.007)    |
| HICP                    | -0.126**<br>(0.054)        | -0.936**<br>(0.450)  | 0.007<br>(0.220)     | -0.009<br>(0.256)    | 0.027<br>(0.102)    | 0.0003<br>(0.279)    | 0.233<br>(0.300)     | -0.835<br>(1.550)     | -0.090<br>(0.249)    | -0.815<br>(1.730)    | -0.891<br>(2.416)    | -0.017<br>(0.029)    | -0.042<br>(0.042)    | -0.073<br>(0.051)   |
| Unemployment            | 0.0004<br>(0.0003)         | 0.002<br>(0.002)     | -0.003*<br>(0.001)   | -0.002<br>(0.001)    | -0.0002<br>(0.0003) | -0.002<br>(0.001)    | -0.002*<br>(0.001)   | -0.011*<br>(0.006)    | 0.001<br>(0.001)     | -0.016**<br>(0.006)  | 0.021***<br>(0.007)  | -0.0002<br>(0.0002)  | 0.001***<br>(0.0001) | 0.0003<br>(0.0003)  |
| 10-year sov. yield      | -0.097<br>(0.074)          | -0.433<br>(0.584)    | 0.839***<br>(0.251)  | 0.952**<br>(0.442)   | -0.104<br>(0.197)   | 0.578*<br>(0.300)    | 0.303<br>(0.345)     | 2.535<br>(1.557)      | -0.129<br>(0.249)    | 7.430***<br>(1.944)  | -8.032***<br>(2.763) | 0.133**<br>(0.061)   | -0.021<br>(0.046)    | -0.102<br>(0.078)   |
| EURIBOR                 | 0.003<br>(0.004)           | 0.025<br>(0.024)     | -0.015<br>(0.014)    | -0.016<br>(0.014)    | -0.0001<br>(0.007)  | -0.005<br>(0.021)    | 0.001<br>(0.017)     | -0.022<br>(0.079)     | -0.017<br>(0.013)    | 0.068<br>(0.078)     | 0.019<br>(0.110)     | -0.004**<br>(0.002)  | -0.002<br>(0.003)    | -0.002<br>(0.003)   |
| Bank Fixed effects      | Yes                        | Yes                  | Yes                  | Yes                  | Yes                 | Yes                  | Yes                  | Yes                   | Yes                  | Yes                  | Yes                  | Yes                  | Yes                  | Yes                 |
| Wald test pos = neg     | 0.92                       | 1.06                 | 0.02                 | 1.67                 | 0.54                | 0                    | 2.61                 | 0.03                  | 6.22**               | 4.3**                | 1.13                 | 3.87**               | 1.21                 | 0.58                |
| Observations            | 999                        | 984                  | 999                  | 985                  | 984                 | 999                  | 999                  | 940                   | 999                  | 993                  | 948                  | 999                  | 999                  | 982                 |
| R <sup>2</sup>          | 0.154                      | 0.134                | 0.093                | 0.096                | 0.070               | 0.067                | 0.085                | 0.042                 | 0.073                | 0.045                | 0.104                | 0.148                | 0.062                | 0.067               |
| Adjusted R <sup>2</sup> | 0.065                      | 0.041                | -0.003               | -0.001               | -0.029              | -0.031               | -0.011               | -0.059                | -0.025               | -0.056               | 0.004                | 0.058                | -0.037               | -0.033              |

Notes: \*p<0.1; \*\*p<0.05; \*\*\*p<0.01. Explanatory variables include the distance between bank's actual CET1 ratio and its target, separated between positive and negative distance, the number of quarters before target must be reached (*Horizon*), the bank's Return on Asset, its Net Interest Margin, its Impairment ratio, its log of TA, its TLTRO ratio, the annual growth in real GDP and HICP, the unemployment rate, the 10-year sovereign yield and the 3-month EURIBOR rate. All explanatory variables are lagged by one quarter. Errors clustered at the bank level.

Table 3.5: Impact of distance to target, robustness with distance to requirements

|                         | <i>Dependent variable:</i> |                      |                      |                      |                     |                      |                      |                            |                     |                      |                      |                     |                        |                           |
|-------------------------|----------------------------|----------------------|----------------------|----------------------|---------------------|----------------------|----------------------|----------------------------|---------------------|----------------------|----------------------|---------------------|------------------------|---------------------------|
|                         | CET1, FL<br>(1)            | CET1 €, FL<br>(2)    | RWA<br>(3)           | TOE<br>(4)           | RW<br>(5)           | RWA, Credit<br>(6)   | Loans NFC<br>(7)     | Debt securities NFC<br>(8) | Loans HH<br>(9)     | Loans GG<br>(10)     | Cash<br>(11)         | NPE<br>(12)         | Issued capital<br>(13) | Retained earnings<br>(14) |
| Target dist.            | -0.144***<br>(0.046)       | -1.087***<br>(0.309) | 0.394***<br>(0.127)  | 0.227**<br>(0.106)   | 0.079<br>(0.049)    | 0.319**<br>(0.158)   | 0.388***<br>(0.110)  | 0.808<br>(0.817)           | 0.112<br>(0.110)    | 0.727<br>(0.735)     | -1.308<br>(1.118)    | 0.026<br>(0.023)    | -0.042*<br>(0.025)     | -0.007<br>(0.036)         |
| Cap. req. dist.         | -0.068*<br>(0.035)         | -0.007<br>(0.213)    | -0.012<br>(0.098)    | -0.094<br>(0.096)    | 0.049<br>(0.037)    | -0.094<br>(0.123)    | -0.211*<br>(0.113)   | 0.373<br>(0.574)           | -0.021<br>(0.067)   | -0.845<br>(0.676)    | -0.274<br>(0.912)    | 0.023*<br>(0.013)   | -0.020<br>(0.025)      | -0.075***<br>(0.023)      |
| Target horizon          | -0.001**<br>(0.0003)       | -0.005**<br>(0.002)  | 0.002*<br>(0.001)    | 0.002*<br>(0.001)    | 0.0001<br>(0.001)   | 0.002<br>(0.001)     | 0.0003<br>(0.001)    | 0.007<br>(0.008)           | -0.0003<br>(0.001)  | -0.002<br>(0.006)    | 0.022**<br>(0.011)   | 0.00004<br>(0.0002) | -0.0002<br>(0.0002)    | -0.0002<br>(0.0003)       |
| Total Assets, log       | 0.001<br>(0.004)           | 0.106***<br>(0.039)  | -0.051***<br>(0.016) | -0.055**<br>(0.025)  | 0.013<br>(0.009)    | -0.070***<br>(0.019) | -0.067***<br>(0.023) | -0.290***<br>(0.067)       | -0.060**<br>(0.027) | -0.433***<br>(0.119) | -0.215<br>(0.162)    | 0.013***<br>(0.003) | 0.003<br>(0.004)       | 0.002<br>(0.004)          |
| Return on Asset         | -0.079<br>(0.155)          | -1.225<br>(1.085)    | -0.950**<br>(0.442)  | -0.454<br>(0.877)    | -0.084<br>(0.288)   | -0.887*<br>(0.523)   | -0.227<br>(0.551)    | 1.534<br>(3.306)           | -0.690<br>(0.519)   | 3.840<br>(3.796)     | 10.095**<br>(4.996)  | -0.216**<br>(0.105) | 0.209**<br>(0.085)     | -0.365*<br>(0.198)        |
| Credit ratio            | -0.010<br>(0.010)          | 0.008<br>(0.103)     | 0.043<br>(0.032)     | 0.108*<br>(0.063)    | -0.013<br>(0.025)   | 0.012<br>(0.042)     | 0.001<br>(0.068)     | -0.059<br>(0.288)          | -0.059<br>(0.057)   | -0.257<br>(0.273)    | 2.039***<br>(0.517)  | 0.026***<br>(0.006) | 0.004<br>(0.008)       | -0.005<br>(0.011)         |
| Impairment ratio        | -0.002<br>(0.037)          | -0.121<br>(0.274)    | -0.130<br>(0.113)    | -0.110<br>(0.138)    | -0.031<br>(0.059)   | -0.100<br>(0.160)    | -0.225**<br>(0.109)  | -0.423<br>(0.701)          | -0.179*<br>(0.100)  | -0.365<br>(0.638)    | -0.394<br>(0.842)    | -0.022<br>(0.017)   | 0.032*<br>(0.018)      | 0.012<br>(0.017)          |
| Provisions              | 0.254*<br>(0.129)          | 4.988***<br>(1.223)  | -0.843**<br>(0.382)  | -3.627***<br>(1.058) | 1.057**<br>(0.411)  | -1.718***<br>(0.601) | -0.989<br>(0.742)    | -9.291***<br>(3.438)       | 0.082<br>(0.703)    | -7.920<br>(5.028)    | -8.331<br>(7.516)    | 0.306*<br>(0.183)   | 0.149**<br>(0.074)     | 0.269***<br>(0.102)       |
| Deposit ratio           | 0.010<br>(0.010)           | 0.092<br>(0.090)     | -0.005<br>(0.039)    | -0.013<br>(0.057)    | 0.0004<br>(0.021)   | 0.051<br>(0.053)     | -0.025<br>(0.080)    | 0.002<br>(0.224)           | -0.023<br>(0.058)   | -0.082<br>(0.228)    | -0.186<br>(0.446)    | -0.012*<br>(0.007)  | 0.001<br>(0.006)       | -0.001<br>(0.008)         |
| TLTRO                   | -0.007<br>(0.005)          | -0.039<br>(0.037)    | -0.029<br>(0.020)    | -0.058**<br>(0.026)  | 0.015<br>(0.009)    | -0.029<br>(0.028)    | -0.074**<br>(0.030)  | -0.340***<br>(0.111)       | -0.026<br>(0.030)   | -0.124<br>(0.150)    | 0.393**<br>(0.182)   | -0.012**<br>(0.005) | -0.001<br>(0.003)      | 0.004<br>(0.006)          |
| GDP                     | -0.018**<br>(0.007)        | -0.056<br>(0.043)    | 0.098***<br>(0.030)  | 0.039<br>(0.038)     | 0.027<br>(0.019)    | 0.081**<br>(0.032)   | 0.112**<br>(0.044)   | 0.017<br>(0.194)           | -0.013<br>(0.032)   | 0.197<br>(0.247)     | 0.031<br>(0.225)     | -0.013**<br>(0.006) | -0.018***<br>(0.005)   | -0.004<br>(0.007)         |
| HICP                    | -0.110**<br>(0.053)        | -0.903*<br>(0.475)   | -0.072<br>(0.207)    | -0.047<br>(0.251)    | 0.013<br>(0.097)    | -0.040<br>(0.271)    | 0.175<br>(0.281)     | -1.023<br>(1.602)          | -0.128<br>(0.243)   | -1.345<br>(1.712)    | -0.862<br>(2.459)    | -0.024<br>(0.029)   | -0.033<br>(0.043)      | -0.046<br>(0.052)         |
| Unemployment            | 0.0003<br>(0.0003)         | 0.001<br>(0.002)     | -0.003**<br>(0.001)  | -0.002<br>(0.001)    | -0.0002<br>(0.0004) | -0.002<br>(0.002)    | -0.003*<br>(0.002)   | -0.008<br>(0.007)          | 0.001<br>(0.001)    | -0.016**<br>(0.007)  | 0.022***<br>(0.007)  | -0.0002<br>(0.0002) | 0.001***<br>(0.0002)   | 0.0003<br>(0.0003)        |
| 10-year sov. yield      | -0.028<br>(0.075)          | -0.312<br>(0.552)    | 0.813***<br>(0.272)  | 1.074**<br>(0.441)   | -0.163<br>(0.192)   | 0.612**<br>(0.310)   | 0.371<br>(0.379)     | 1.914<br>(1.510)           | -0.183<br>(0.259)   | 7.703***<br>(1.799)  | -7.444***<br>(2.851) | 0.099<br>(0.069)    | 0.008<br>(0.048)       | -0.058<br>(0.076)         |
| EURIBOR                 | 0.001<br>(0.004)           | 0.030<br>(0.027)     | -0.027*<br>(0.015)   | -0.034**<br>(0.016)  | 0.003<br>(0.007)    | -0.016<br>(0.021)    | -0.017<br>(0.018)    | -0.054<br>(0.081)          | -0.018<br>(0.013)   | 0.028<br>(0.093)     | -0.037<br>(0.119)    | -0.004<br>(0.002)   | -0.003<br>(0.002)      | -0.003<br>(0.003)         |
| Bank Fixed effects      | Yes                        | Yes                  | Yes                  | Yes                  | Yes                 | Yes                  | Yes                  | Yes                        | Yes                 | Yes                  | Yes                  | Yes                 | Yes                    | Yes                       |
| Observations            | 985                        | 972                  | 985                  | 973                  | 972                 | 985                  | 985                  | 929                        | 985                 | 979                  | 935                  | 985                 | 985                    | 968                       |
| R <sup>2</sup>          | 0.162                      | 0.133                | 0.103                | 0.100                | 0.070               | 0.074                | 0.090                | 0.040                      | 0.066               | 0.050                | 0.104                | 0.140               | 0.063                  | 0.083                     |
| Adjusted R <sup>2</sup> | 0.073                      | 0.039                | 0.007                | 0.002                | -0.031              | -0.025               | -0.007               | -0.064                     | -0.034              | -0.053               | 0.003                | 0.048               | -0.037                 | -0.017                    |

Notes: \*p<0.1; \*\*p<0.05; \*\*\*p<0.01. Explanatory variables include the distance between actual CET1 ratio and the target CET1 ratio (*Targetdist.*) and the MDA trigger (*Cap.req.dist.*), the number of quarters before target must be reached (*Horizon*), the bank's Return on Asset, Impairment ratio, Loan to deposit ratio, Net Interest Margin and log of TA (demeaned at the quarterly level in the cross-section), quarterly growth in real GDP and HICP, unemployment rate, credit demand index of the Bank Lending Survey and the interest rate of the Main Refinancing Operations of the ECB. All explanatory variables are lagged by one quarter. Errors clustered at the bank level.

A6. The impact of the distance to target remains qualitatively unchanged in all those robustness exercises.

Overall, those results confirm that (distance to) announced target provide valuable information on future balance-sheet evolution, as banks move toward their targets by adjusting mostly their outstanding capital but also their asset side through portfolio reallocation.

## 5. Conclusion

This article builds on an original dataset of CET1 ratio targets European banks publicly announce to their investors. This materially complements the existing literature which depends on partial adjustment models to estimate unobserved targets. The analysis of observed targets provides three key lessons. First, announced targets increase with capital requirements and adverse macroeconomic environment. Capital requirements materially affect targets, but not one for one. This is consistent with the trade-off theory according to which banks balance the expected cost of regulatory breach versus the cost of high capital ratios. Moreover, banks seem to perceive similarly the different types of capital requirements in the regulatory framework, suggesting weak usability of regulatory buffers. Banks also tend to increase their targets when faced with adverse economic environment, suggesting stronger market pressure and banks' willingness not to be discriminated against. Second, banks are serious about their targets, converging toward them, from both below and above. Importantly, the adjustment is materially faster for banks initially below their targets, suggesting higher pressure to build up solvency than to return capital to investors. Third, target CET1 ratios have important informational content on banks future balance-sheet adjustments. Banks away from their targets adjust their CET1 ratios to reach it, mainly through their stock of CET1 and portfolio rebalancing, with material impact on corporate credit supply. This adjustment occurs for banks both below and above their CET1 ratio targets, but it is much stronger in the former case, in line with banks below their targets being under greater pressure to adjust.

Those results provide important lessons for prudential authorities. They call for the monitoring of banks' announced targets in order to anticipate credit development and to assess the effectiveness of prudential policies. They also indicate that banks are unwilling to reduce their capital ratios during adverse times and to draw on their regulatory buffers, raising concerns regarding their usability. Simultaneously, this calls for the build-up of appropriate countercyclical capital requirements that the regulator could release in crisis times, to mitigate banks' procyclical reaction. Appropriate communication and forward guidance could also influence banks' anticipations and, in turn, CET1 targets and credit policy. Further ahead, this paper paves the way for further analysis of banks' strategic targets, in particular their targets for return on equity and payout ratio, their drivers and their consequences on banks' behaviour.

# References

- Aiyar, S., Calomiris, C. W., and Wieladek, T. (2016). How does credit supply respond to monetary policy and bank minimum capital requirements? *European Economic Review*, 82:142–165.
- Bakkar, Y., De Jonghe, O., and Tarazi, A. (2019). Does banks' systemic importance affect their capital structure and balance sheet adjustment processes? *Journal of Banking & Finance*, page 105518.
- Berger, A. N., DeYoung, R., Flannery, M. J., Lee, D., and Öztekin, Ö. (2008). How do large banking organizations manage their capital ratios? *Journal of Financial Services Research*, 34(2-3):123–149.
- Berrospide, J. M., Edge, R. M., et al. (2010). The effects of bank capital on lending: What do we know, and what does it mean? *International Journal of Central Banking*, 6(34):1–50.
- Blundell, R. and Bond, S. (1998). Initial conditions and moment restrictions in dynamic panel data models. *Journal of econometrics*, 87(1):115–143.
- De Jonghe, O. and Öztekin, Ö. (2015). Bank capital management: International evidence. *Journal of Financial Intermediation*, 24(2):154–177.
- Dewatripont, M. and Tirole, J. (2012). Macroeconomic shocks and banking regulation. *Journal of Money, Credit and Banking*, 44:237–254.
- Flannery, M. J. and Rangan, K. P. (2008). What caused the bank capital build-up of the 1990s? *Review of Finance*, 12(2):391–429.
- Fonseca, A. R. and González, F. (2010). How bank capital buffers vary across countries: The influence of cost of deposits, market power and bank regulation. *Journal of banking & finance*, 34(4):892–902.
- Francis, W. B. and Osborne, M. (2012). Capital requirements and bank behavior in the uk: Are there lessons for international capital standards? *Journal of Banking & Finance*, 36(3):803–816.
- Gambacorta, L. and Shin, H. S. (2018). Why bank capital matters for monetary policy. *Journal of Financial Intermediation*, 35:17–29.
- Gonçalves, S. and Kaffo, M. (2015). Bootstrap inference for linear dynamic panel data models with individual fixed effects. *Journal of Econometrics*, 186(2):407–426.
- Gropp, R. and Heider, F. (2010). The determinants of bank capital structure. *Review of finance*, 14(4):587–622.

- Jiménez, G., Ongena, S., Peydró, J.-L., and Saurina, J. (2017). Macroprudential policy, countercyclical bank capital buffers, and credit supply: Evidence from the spanish dynamic provisioning experiments. *Journal of Political Economy*, 125(6):2126–2177.
- Marcus, A. J. (1983). The bank capital decision: a time series—cross section analysis. *The Journal of Finance*, 38(4):1217–1232.
- Marcus, A. J. (1984). Deregulation and bank financial policy. *Journal of banking & finance*, 8(4):557–565.
- Maurin, L. and Toivanen, M. (2012). Risk, capital buffer and bank lending: a granular approach to the adjustment of euro area banks. *ECB working paper*.
- Mommel, C. and Raupach, P. (2010). How do banks adjust their capital ratios? *Journal of Financial Intermediation*, 19(4):509–528.
- Mésonnier, J.-S. and Stevanovic, D. (2017). The macroeconomic effects of shocks to large banks' capital. *Oxford Bulletin of Economics and Statistics*, 79(4):546–569.
- Öztekin, Ö. and Flannery, M. J. (2012). Institutional determinants of capital structure adjustment speeds. *Journal of financial economics*, 103(1):88–112.
- Pagan, A. (1984). Econometric issues in the analysis of regressions with generated regressors. *International Economic Review*, pages 221–247.
- Roodman, D. (2009a). How to do xtabond2: An introduction to difference and system gmm in stata. *The stata journal*, 9(1):86–136.
- Roodman, D. (2009b). A note on the theme of too many instruments. *Oxford Bulletin of Economics and statistics*, 71(1):135–158.

## A. Appendix

Table A1: Summary statistics

| Statistic                | N     | Mean   | St. Dev. | Min     | Pctl(25) | Pctl(75) | Max     |
|--------------------------|-------|--------|----------|---------|----------|----------|---------|
| Target                   | 1,168 | 0.134  | 0.024    | 0.085   | 0.117    | 0.145    | 0.250   |
| OCR strict               | 1,059 | 0.101  | 0.012    | 0.070   | 0.092    | 0.108    | 0.151   |
| AT1 and T2 shortfall     | 1,051 | 0.010  | 0.009    | 0.000   | 0.000    | 0.015    | 0.044   |
| P2G                      | 1,128 | 0.009  | 0.009    | 0.000   | 0.000    | 0.015    | 0.038   |
| Total Assets, log        | 1,074 | 25.804 | 1.507    | 21.240  | 24.833   | 27.035   | 28.526  |
| Return on Asset          | 1,074 | 0.002  | 0.003    | -0.018  | 0.002    | 0.004    | 0.019   |
| Off Balance-sheet        | 1,074 | 0.208  | 0.107    | 0.014   | 0.138    | 0.291    | 0.750   |
| Credit ratio             | 1,074 | 0.808  | 0.095    | 0.459   | 0.775    | 0.873    | 0.971   |
| RW                       | 1,088 | 0.988  | 14.649   | 0.032   | 0.294    | 0.413    | 344.680 |
| Impairment ratio         | 1,066 | 0.023  | 0.031    | 0.0001  | 0.004    | 0.025    | 0.160   |
| Provisions               | 1,066 | 0.007  | 0.006    | 0.00001 | 0.003    | 0.010    | 0.037   |
| Deposit ratio            | 1,074 | 0.662  | 0.141    | 0.193   | 0.577    | 0.765    | 0.931   |
| Cost of deposits         | 1,104 | 0.002  | 0.001    | -0.001  | 0.001    | 0.002    | 0.006   |
| TLTRO                    | 1,074 | 0.058  | 0.101    | 0.000   | 0.000    | 0.064    | 0.489   |
| GDP growth for. 5y, dom. | 1,089 | 0.015  | 0.006    | -0.0005 | 0.011    | 0.017    | 0.036   |
| CPI growth for. 5y, dom. | 1,089 | 1.503  | 0.266    | 0.791   | 1.322    | 1.719    | 2.018   |
| EURIBOR                  | 1,151 | -0.249 | 0.174    | -0.472  | -0.329   | -0.258   | 0.299   |
| 10-year sov. yield       | 1,138 | 0.010  | 0.010    | -0.005  | 0.003    | 0.015    | 0.115   |

*Notes:* This table provides the summary statistics for all the regression variables used in the baseline regression.

Table A2: Correlation Matrix

|                          | (1)    | (2)    | (3)    | (4)    | (5)    | (6)    | (7)    | (8)    | (9)    | (10)   | (11)   | (12)   | (13)   | (14)   | (15)   | (16)   | (17)  | (18) |
|--------------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|-------|------|
| Target                   | 1      |        |        |        |        |        |        |        |        |        |        |        |        |        |        |        |       |      |
| OCR strict ann.          | 0.264  | 1      |        |        |        |        |        |        |        |        |        |        |        |        |        |        |       |      |
| AT1 and T2 shortfall     | 0.160  | -0.099 | 1      |        |        |        |        |        |        |        |        |        |        |        |        |        |       |      |
| P2G                      | 0.196  | -0.121 | -0.045 | 1      |        |        |        |        |        |        |        |        |        |        |        |        |       |      |
| Total Assets, log        | -0.223 | 0.052  | -0.537 | -0.121 | 1      |        |        |        |        |        |        |        |        |        |        |        |       |      |
| Return on Asset          | 0.133  | -0.020 | -0.155 | 0.034  | 0.024  | 1      |        |        |        |        |        |        |        |        |        |        |       |      |
| Off Balance-sheet        | -0.194 | -0.102 | -0.240 | -0.210 | 0.610  | -0.033 | 1      |        |        |        |        |        |        |        |        |        |       |      |
| Credit ratio             | 0.224  | -0.115 | 0.359  | 0.068  | -0.588 | 0.095  | -0.311 | 1      |        |        |        |        |        |        |        |        |       |      |
| RW                       | -0.176 | -0.013 | 0.261  | -0.120 | -0.160 | 0.109  | 0.011  | -0.156 | 1      |        |        |        |        |        |        |        |       |      |
| Impairment ratio         | -0.209 | -0.090 | 0.413  | -0.099 | -0.288 | -0.338 | 0.048  | 0.208  | 0.374  | 1      |        |        |        |        |        |        |       |      |
| Provisions               | -0.338 | -0.216 | 0.047  | -0.020 | 0.045  | -0.258 | 0.177  | 0.083  | 0.108  | 0.188  | 1      |        |        |        |        |        |       |      |
| Deposit ratio            | 0.035  | -0.146 | 0.396  | 0.189  | -0.415 | -0.025 | -0.213 | 0.596  | 0.099  | 0.317  | 0.171  | 1      |        |        |        |        |       |      |
| Cost of deposits         | -0.316 | 0.040  | -0.207 | -0.093 | 0.320  | -0.129 | -0.072 | -0.188 | -0.133 | -0.133 | 0.190  | -0.291 | 1      |        |        |        |       |      |
| TLTRO                    | -0.129 | -0.315 | 0.157  | 0.106  | -0.129 | -0.126 | 0.234  | 0.145  | 0.157  | 0.343  | 0.119  | 0.206  | -0.354 | 1      |        |        |       |      |
| GDP growth for. 5y, dom. | -0.126 | 0.240  | 0.085  | 0.080  | -0.052 | 0.135  | -0.357 | 0.061  | 0.166  | 0.067  | -0.063 | 0.226  | 0.189  | -0.314 | 1      |        |       |      |
| CPI growth for. 5y, dom. | 0.165  | 0.196  | -0.181 | 0.422  | -0.073 | 0.120  | -0.234 | 0.073  | -0.213 | -0.357 | 0.009  | 0.069  | 0.072  | -0.180 | 0.280  | 1      |       |      |
| EURIBOR                  | -0.239 | 0.002  | 0.166  | -0.525 | 0.041  | -0.079 | 0.058  | -0.011 | 0.087  | 0.255  | 0.039  | -0.107 | 0.256  | -0.185 | 0.213  | -0.287 | 1     |      |
| 10-year sov. yield       | -0.164 | -0.255 | 0.366  | 0.006  | -0.105 | -0.113 | 0.199  | 0.136  | 0.369  | 0.585  | 0.165  | 0.304  | -0.170 | 0.504  | -0.010 | -0.266 | 0.233 | 1    |

*Notes:* This table reports the correlation matrix of the main regression variables for the sample of banks in the main regression, containing 950 bank-quarter observations.

Table A3: Speed of adjustment

|   | <i>Dependent variable:</i> |                     |                     |                     |                     |                     |
|---|----------------------------|---------------------|---------------------|---------------------|---------------------|---------------------|
|   | Distance to Target         |                     |                     |                     |                     |                     |
|   | (1)                        | (2)                 | (3)                 | (4)                 | (5)                 | (6)                 |
| dist. Target                                    | 0.954***<br>(0.013)        |                     | 0.949***<br>(0.014) |                     | 0.933***<br>(0.015) |                     |
| dist. Target, pos.                              |                            | 0.979***<br>(0.011) |                     | 0.977***<br>(0.011) |                     | 0.968***<br>(0.015) |
| dist. Target, neg.                              |                            | 0.834***<br>(0.030) |                     | 0.817***<br>(0.031) |                     | 0.816***<br>(0.037) |
| dist. Target:dist. Target, neg.                 |                            |                     |                     |                     | -0.022**<br>(0.009) |                     |
| dist. Target:Return on Asset                    |                            |                     |                     |                     | 0.005<br>(0.017)    |                     |
| dist. Target:Impairment ratio                   |                            |                     |                     |                     | -0.057**<br>(0.025) |                     |
| dist. Target:Total Assets, log                  |                            |                     |                     |                     | -0.044*<br>(0.025)  |                     |
| dist. Target:TLTRO                              |                            |                     |                     |                     | 0.012<br>(0.019)    |                     |
| dist. Target:GDP                                |                            |                     |                     |                     | 0.018*<br>(0.010)   |                     |
| dist. Target:HICP                               |                            |                     |                     |                     | -0.026<br>(0.020)   |                     |
| dist. Target:10-year sov. yield                 |                            |                     |                     |                     | -0.038<br>(0.036)   |                     |
| dist. Target:EURIBOR                            |                            |                     |                     |                     | 0.036<br>(0.028)    |                     |
| dist. Target, pos.:dist. Target, neg.           |                            |                     |                     |                     |                     | -0.013<br>(0.009)   |
| dist. Target, neg.:dist. Target, neg.           |                            |                     |                     |                     |                     | -0.022<br>(0.046)   |
| dist. Target, pos.:Return on Asset              |                            |                     |                     |                     |                     | -0.006<br>(0.011)   |
| dist. Target, neg.:Return on Asset              |                            |                     |                     |                     |                     | 0.022<br>(0.017)    |
| dist. Target, pos.:Impairment ratio             |                            |                     |                     |                     |                     | -0.030<br>(0.022)   |
| dist. Target, neg.:Impairment ratio             |                            |                     |                     |                     |                     | -0.047<br>(0.037)   |
| dist. Target, pos.:Total Assets, log            |                            |                     |                     |                     |                     | -0.015<br>(0.025)   |
| dist. Target, neg.:Total Assets, log            |                            |                     |                     |                     |                     | 0.005<br>(0.041)    |
| dist. Target, pos.:TLTRO                        |                            |                     |                     |                     |                     | -0.046**<br>(0.023) |
| dist. Target, neg.:TLTRO                        |                            |                     |                     |                     |                     | 0.054<br>(0.036)    |
| dist. Target, pos.:GDP                          |                            |                     |                     |                     |                     | 0.017<br>(0.013)    |
| dist. Target, neg.:GDP                          |                            |                     |                     |                     |                     | -0.039<br>(0.034)   |
| dist. Target, pos.:HICP                         |                            |                     |                     |                     |                     | -0.040*<br>(0.020)  |
| dist. Target, neg.:HICP                         |                            |                     |                     |                     |                     | 0.050<br>(0.039)    |
| dist. Target, pos.:10-year sov. yield           |                            |                     |                     |                     |                     | -0.018<br>(0.028)   |
| dist. Target, neg.:10-year sov. yield           |                            |                     |                     |                     |                     | 0.021<br>(0.048)    |
| dist. Target, pos.:EURIBOR                      |                            |                     |                     |                     |                     | 0.014<br>(0.017)    |
| dist. Target, neg.:EURIBOR                      |                            |                     |                     |                     |                     | 0.027<br>(0.067)    |
| Wald test dist. target = 1                      | 11.69***                   |                     | 12.41***            |                     | 20.06***            |                     |
| Wald test pos. dist. target = 1                 |                            | 3.87**              |                     | 4.25**              |                     | 4.27**              |
| Wald test neg. dist. target = 1                 |                            | 30.74***            |                     | 34.87***            |                     | 25.3***             |
| Wald test pos. dist. target = neg. dist. target |                            | 21.2***             |                     | 24.11***            |                     | 14.68***            |
| Bank FE   | No                         | No                  | No                  | No                  | No                  | No                  |
| Nb banks  | 69                         | 69                  | 68                  | 68                  | 67                  | 67                  |
| Observations                                    | 929                        | 929                 | 817                 | 817                 | 875                 | 875                 |
| R <sup>2</sup>                                  | 0.900                      | 0.901               | 0.896               | 0.897               | 0.900               | 0.899               |
| Adjusted R <sup>2</sup>                         | 0.900                      | 0.901               | 0.896               | 0.897               | 0.899               | 0.897               |

Notes: \*p<0.1; \*\*p<0.05; \*\*\*p<0.01. Column (1) presents the results of the pooled regression of the CET1 ratio distance to target on its lag while columns (2) distinguishes between positive and negative lagged distance to target. Columns (3) and (4) reproduce the same regressions with the sample period ending in Q4 2019. Columns (5) and (6) include a set of explanatory variables interacted with the lagged distance to target. Those variables are the horizon of the target (in quarters), the return on asset, the impairment ratio, the log of Total asset, the TLTRO ratio, the annual real GDP growth, the inflation rate, the 3-month EURIBOR rate and the 10-year sovereign yield. All explanatory variables are lagged by one quarter. Errors are clustered at the bank level.



Table A4: Impact of distance to target - preCovid

|                         | Dependent variable:   |                      |                      |                      |                      |                      |                     |                            |                      |                      |                      |                      |                        |                           |
|-------------------------|-----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|---------------------|----------------------------|----------------------|----------------------|----------------------|----------------------|------------------------|---------------------------|
|                         | CET1, FL<br>(1)       | CET1 €, FL<br>(2)    | RWA<br>(3)           | TOE<br>(4)           | RW<br>(5)            | RWA, Credit<br>(6)   | Loans NFC<br>(7)    | Debt securities NFC<br>(8) | Loans HH<br>(9)      | Loans GG<br>(10)     | Cash<br>(11)         | NPE<br>(12)          | Issued capital<br>(13) | Retained earnings<br>(14) |
| Target dist.            | -0.227***<br>(0.041)  | -1.316***<br>(0.305) | 0.432***<br>(0.095)  | 0.180<br>(0.123)     | 0.119**<br>(0.048)   | 0.283***<br>(0.107)  | 0.228*<br>(0.127)   | 0.979<br>(0.758)           | 0.069<br>(0.117)     | 1.219*<br>(0.721)    | -1.370*<br>(0.826)   | 0.044**<br>(0.019)   | -0.068***<br>(0.021)   | -0.081***<br>(0.027)      |
| Target horizon          | -0.001***<br>(0.0004) | -0.008***<br>(0.003) | 0.002*<br>(0.001)    | 0.003**<br>(0.001)   | 0.0002<br>(0.001)    | 0.002<br>(0.001)     | -0.0003<br>(0.001)  | 0.005<br>(0.011)           | -0.001<br>(0.001)    | -0.003<br>(0.007)    | 0.006<br>(0.013)     | 0.0002<br>(0.0002)   | -0.0003<br>(0.0002)    | -0.0003<br>(0.0003)       |
| Total Assets, log       | 0.003<br>(0.004)      | 0.116***<br>(0.035)  | -0.048***<br>(0.017) | -0.061***<br>(0.023) | 0.015<br>(0.010)     | -0.069***<br>(0.019) | -0.051**<br>(0.023) | -0.325***<br>(0.095)       | -0.070***<br>(0.024) | -0.213**<br>(0.096)  | -0.303**<br>(0.134)  | 0.013***<br>(0.003)  | 0.004<br>(0.004)       | 0.004<br>(0.005)          |
| Return on Asset         | -0.137<br>(0.159)     | -0.822<br>(1.223)    | -0.973**<br>(0.430)  | -0.544<br>(0.723)    | -0.032<br>(0.299)    | -1.053**<br>(0.448)  | -0.510<br>(0.540)   | 1.764<br>(3.386)           | -0.366<br>(0.506)    | 2.005<br>(2.827)     | 4.838<br>(4.794)     | -0.168<br>(0.109)    | 0.199***<br>(0.062)    | -0.443**<br>(0.194)       |
| Credit ratio            | -0.008<br>(0.010)     | 0.023<br>(0.102)     | 0.045<br>(0.040)     | 0.112*<br>(0.067)    | -0.006<br>(0.027)    | 0.023<br>(0.047)     | 0.001<br>(0.070)    | -0.236<br>(0.327)          | -0.062<br>(0.060)    | -0.414<br>(0.284)    | 2.014***<br>(0.518)  | 0.024***<br>(0.007)  | 0.007<br>(0.008)       | -0.008<br>(0.013)         |
| Impairment ratio        | -0.026<br>(0.033)     | -0.227<br>(0.267)    | -0.115<br>(0.133)    | -0.143<br>(0.155)    | -0.007<br>(0.055)    | -0.111<br>(0.183)    | -0.233**<br>(0.103) | -0.459<br>(0.855)          | -0.219**<br>(0.097)  | 0.338<br>(0.610)     | -0.587<br>(0.707)    | -0.017<br>(0.018)    | 0.028<br>(0.018)       | -0.0002<br>(0.018)        |
| Provisions              | -0.012<br>(0.116)     | 2.830**<br>(1.436)   | 0.127<br>(0.492)     | -2.494**<br>(1.192)  | 1.045***<br>(0.396)  | -1.006<br>(0.670)    | 0.088<br>(0.540)    | -12.294**<br>(5.742)       | 0.627<br>(0.566)     | 5.976<br>(6.255)     | -1.554<br>(7.027)    | 0.247<br>(0.181)     | 0.047<br>(0.064)       | 0.119<br>(0.098)          |
| Deposit ratio           | 0.002<br>(0.009)      | 0.135*<br>(0.079)    | 0.033<br>(0.040)     | -0.059<br>(0.049)    | 0.035<br>(0.022)     | 0.086<br>(0.052)     | -0.031<br>(0.072)   | 0.062<br>(0.258)           | -0.056<br>(0.065)    | 0.011<br>(0.262)     | -0.468<br>(0.495)    | -0.012<br>(0.008)    | -0.0001<br>(0.006)     | -0.005<br>(0.008)         |
| TLTRO                   | -0.013**<br>(0.005)   | -0.108***<br>(0.040) | -0.021<br>(0.024)    | -0.012<br>(0.024)    | 0.007<br>(0.011)     | -0.018<br>(0.032)    | -0.063**<br>(0.031) | -0.335**<br>(0.158)        | -0.025<br>(0.031)    | -0.021<br>(0.121)    | 0.749***<br>(0.197)  | -0.011**<br>(0.005)  | -0.001<br>(0.004)      | -0.005<br>(0.006)         |
| GDP                     | 0.023**<br>(0.007)    | 0.039<br>(0.066)     | -0.051<br>(0.051)    | 0.018<br>(0.084)     | -0.033<br>(0.025)    | -0.020<br>(0.048)    | -0.054<br>(0.048)   | -0.067<br>(0.434)          | 0.074<br>(0.045)     | -0.933***<br>(0.248) | -0.238<br>(0.232)    | -0.035***<br>(0.009) | -0.014<br>(0.010)      | 0.023***<br>(0.006)       |
| HICP                    | -0.142**<br>(0.058)   | -0.913**<br>(0.450)  | 0.052<br>(0.230)     | -0.119<br>(0.260)    | 0.078<br>(0.102)     | 0.105<br>(0.298)     | 0.041<br>(0.306)    | -1.367<br>(1.685)          | -0.190<br>(0.262)    | 0.274<br>(1.741)     | -1.101<br>(2.389)    | -0.033<br>(0.029)    | -0.049<br>(0.045)      | -0.074<br>(0.050)         |
| Unemployment            | 0.0003<br>(0.0003)    | 0.002<br>(0.003)     | -0.002<br>(0.001)    | -0.002<br>(0.001)    | -0.00004<br>(0.0003) | -0.001<br>(0.001)    | -0.002<br>(0.002)   | -0.009<br>(0.007)          | 0.001<br>(0.001)     | -0.014**<br>(0.007)  | 0.025***<br>(0.008)  | -0.0003<br>(0.0002)  | 0.001***<br>(0.0002)   | 0.0001<br>(0.0003)        |
| 10-year sov. yield      | -0.052<br>(0.075)     | -0.314<br>(0.598)    | 0.672***<br>(0.238)  | 0.982**<br>(0.486)   | -0.189<br>(0.219)    | 0.360<br>(0.288)     | 0.288<br>(0.358)    | 1.886<br>(1.548)           | -0.137<br>(0.242)    | 6.486***<br>(1.965)  | -8.163***<br>(2.589) | 0.125**<br>(0.058)   | -0.006<br>(0.043)      | -0.080<br>(0.083)         |
| EURIBOR                 | 0.001<br>(0.004)      | 0.024<br>(0.025)     | -0.005<br>(0.016)    | -0.014<br>(0.015)    | 0.006<br>(0.007)     | 0.004<br>(0.023)     | 0.003<br>(0.018)    | -0.018<br>(0.086)          | -0.021<br>(0.014)    | 0.082<br>(0.085)     | 0.050<br>(0.113)     | -0.003*<br>(0.002)   | -0.003<br>(0.003)      | -0.003<br>(0.003)         |
| Bank Fixed effects      | Yes                   | Yes                  | Yes                  | Yes                  | Yes                  | Yes                  | Yes                 | Yes                        | Yes                  | Yes                  | Yes                  | Yes                  | Yes                    | Yes                       |
| Observations            | 848                   | 833                  | 848                  | 834                  | 834                  | 848                  | 848                 | 793                        | 848                  | 844                  | 809                  | 848                  | 848                    | 836                       |
| R <sup>2</sup>          | 0.136                 | 0.104                | 0.067                | 0.052                | 0.032                | 0.048                | 0.038               | 0.027                      | 0.053                | 0.033                | 0.079                | 0.118                | 0.054                  | 0.053                     |
| Adjusted R <sup>2</sup> | 0.047                 | 0.010                | -0.029               | -0.047               | -0.069               | -0.050               | -0.061              | -0.075                     | -0.044               | -0.067               | -0.021               | 0.027                | -0.043                 | -0.046                    |

Notes: \*p<0.1; \*\*p<0.05; \*\*\*p<0.01. Explanatory variables include the distance between actual CET1 ratio and the target, the number of quarters before target must be reached (*Horizon*), the bank's Return on Asset, Impairment ratio, Loan to deposit ratio, Net Interest Margin and log of TA (demeaned at the quarterly level in the cross-section), quarterly growth in real GDP and HICP, unemployment rate, credit demand index of the Bank Lending Survey and the interest rate of the Main Refinancing Operations of the ECB. All explanatory variables are lagged by one quarter. Errors clustered at the bank level.

Table A5: Impact of distance to target - with time fixed effects

|                         | <i>Dependent variable:</i> |                      |                      |                      |                     |                      |                     |                            |                      |                     |                     |                      |                        |                           |
|-------------------------|----------------------------|----------------------|----------------------|----------------------|---------------------|----------------------|---------------------|----------------------------|----------------------|---------------------|---------------------|----------------------|------------------------|---------------------------|
|                         | CET1, FL<br>(1)            | CET1 €, FL<br>(2)    | RWA<br>(3)           | TOE<br>(4)           | RW<br>(5)           | RWA, Credit<br>(6)   | Loans NFC<br>(7)    | Debt securities NFC<br>(8) | Loans HH<br>(9)      | Loans GG<br>(10)    | Cash<br>(11)        | NPE<br>(12)          | Issued capital<br>(13) | Retained earnings<br>(14) |
| Target dist.            | -0.188***<br>(0.032)       | -1.032***<br>(0.212) | 0.426***<br>(0.085)  | 0.184*<br>(0.105)    | 0.119***<br>(0.040) | 0.286***<br>(0.104)  | 0.267***<br>(0.104) | 1.150**<br>(0.573)         | 0.115<br>(0.109)     | 0.469<br>(0.715)    | -1.261**<br>(0.624) | 0.035**<br>(0.016)   | -0.062***<br>(0.017)   | -0.063**<br>(0.026)       |
| Target horizon          | -0.001**<br>(0.0003)       | -0.005**<br>(0.002)  | 0.001<br>(0.001)     | 0.002<br>(0.001)     | 0.0002<br>(0.0005)  | 0.001<br>(0.001)     | -0.00004<br>(0.001) | 0.007<br>(0.008)           | -0.001<br>(0.001)    | -0.004<br>(0.006)   | 0.018*<br>(0.011)   | 0.0001<br>(0.0001)   | -0.0002<br>(0.0002)    | -0.0002<br>(0.0003)       |
| Total Assets, log       | -0.004<br>(0.004)          | 0.059<br>(0.039)     | -0.034*<br>(0.018)   | -0.047**<br>(0.022)  | 0.017**<br>(0.008)  | -0.051**<br>(0.020)  | -0.037<br>(0.023)   | -0.286***<br>(0.070)       | -0.066***<br>(0.024) | -0.173**<br>(0.078) | -0.192<br>(0.162)   | 0.013***<br>(0.003)  | 0.002<br>(0.004)       | -0.0003<br>(0.004)        |
| Return on Asset         | -0.043<br>(0.098)          | -0.323<br>(0.940)    | -1.166***<br>(0.365) | -0.355<br>(0.725)    | -0.147<br>(0.258)   | -1.262***<br>(0.411) | -0.786*<br>(0.470)  | -0.525<br>(3.620)          | -0.479<br>(0.450)    | -1.550<br>(2.469)   | 9.521**<br>(4.684)  | -0.198*<br>(0.107)   | 0.214***<br>(0.060)    | -0.416*<br>(0.233)        |
| Credit ratio            | -0.003<br>(0.009)          | -0.031<br>(0.104)    | -0.002<br>(0.038)    | 0.144**<br>(0.061)   | -0.040<br>(0.026)   | -0.047<br>(0.049)    | -0.029<br>(0.068)   | -0.209<br>(0.277)          | -0.036<br>(0.057)    | -0.502**<br>(0.238) | 2.528***<br>(0.509) | 0.025***<br>(0.006)  | 0.008<br>(0.008)       | 0.00004<br>(0.011)        |
| Impairment ratio        | -0.023<br>(0.028)          | -0.106<br>(0.238)    | -0.033<br>(0.120)    | -0.203<br>(0.144)    | 0.029<br>(0.046)    | -0.002<br>(0.177)    | -0.175*<br>(0.099)  | -0.494<br>(0.820)          | -0.243**<br>(0.096)  | 0.398<br>(0.569)    | -1.010<br>(1.003)   | -0.029<br>(0.020)    | 0.023<br>(0.020)       | -0.005<br>(0.019)         |
| Provisions              | 0.009<br>(0.100)           | 3.869***<br>(0.990)  | -0.402<br>(0.451)    | -3.801***<br>(0.968) | 1.353***<br>(0.333) | -1.355**<br>(0.635)  | -0.501<br>(0.650)   | -11.566***<br>(4.401)      | -0.138<br>(0.644)    | -2.737<br>(5.248)   | -8.371<br>(7.532)   | 0.325*<br>(0.171)    | 0.104<br>(0.074)       | 0.128<br>(0.107)          |
| Deposit ratio           | 0.009<br>(0.009)           | 0.040<br>(0.080)     | -0.025<br>(0.039)    | 0.025<br>(0.055)     | -0.014<br>(0.021)   | 0.011<br>(0.059)     | -0.017<br>(0.081)   | -0.214<br>(0.216)          | -0.012<br>(0.059)    | 0.011<br>(0.206)    | 0.327<br>(0.412)    | -0.010<br>(0.007)    | 0.005<br>(0.006)       | -0.001<br>(0.009)         |
| TLTRO                   | -0.010*<br>(0.005)         | -0.047<br>(0.042)    | -0.013<br>(0.022)    | -0.045**<br>(0.022)  | 0.017**<br>(0.008)  | -0.006<br>(0.027)    | -0.052*<br>(0.029)  | -0.298**<br>(0.145)        | -0.032<br>(0.025)    | -0.079<br>(0.140)   | 0.443**<br>(0.179)  | -0.011**<br>(0.005)  | -0.001<br>(0.003)      | -0.003<br>(0.006)         |
| GDP                     | 0.021***<br>(0.008)        | 0.011<br>(0.069)     | -0.015<br>(0.043)    | 0.069<br>(0.067)     | -0.042<br>(0.026)   | 0.003<br>(0.047)     | -0.027<br>(0.044)   | -0.141<br>(0.366)          | 0.084**<br>(0.040)   | -0.528*<br>(0.288)  | 0.150<br>(0.255)    | -0.033***<br>(0.008) | -0.014<br>(0.009)      | 0.021***<br>(0.006)       |
| HICP                    | -0.114*<br>(0.067)         | -0.990*<br>(0.583)   | -0.200<br>(0.308)    | -0.025<br>(0.371)    | -0.096<br>(0.154)   | -0.035<br>(0.378)    | 0.450<br>(0.409)    | 1.429<br>(1.974)           | -0.140<br>(0.295)    | 2.111<br>(2.268)    | -2.554<br>(2.993)   | 0.037<br>(0.034)     | -0.073<br>(0.056)      | -0.026<br>(0.063)         |
| Unemployment            | -0.00004<br>(0.00003)      | 0.003<br>(0.003)     | 0.0002<br>(0.002)    | -0.004**<br>(0.002)  | 0.002***<br>(0.001) | 0.002<br>(0.002)     | -0.001<br>(0.002)   | -0.003<br>(0.010)          | 0.0001<br>(0.001)    | 0.008<br>(0.008)    | -0.011<br>(0.010)   | -0.0003<br>(0.0003)  | 0.0002<br>(0.0002)     | -0.0001<br>(0.0004)       |
| 10-year sov. yield      | 0.092<br>(0.086)           | 0.415<br>(0.802)     | 0.446<br>(0.316)     | 1.181**<br>(0.596)   | -0.403*<br>(0.242)  | -0.164<br>(0.374)    | -0.575<br>(0.389)   | 1.963<br>(1.998)           | -0.186<br>(0.338)    | 1.574<br>(1.396)    | -4.947<br>(4.481)   | 0.107<br>(0.093)     | 0.030<br>(0.050)       | 0.072<br>(0.086)          |
| NA                      | (0.003)                    | (0.011)              | (0.010)              | (0.009)              | (0.006)             | (0.010)              | (0.014)             | (0.052)                    | (0.013)              | (0.131)             | (0.098)             | (0.002)              | (0.001)                | (0.002)                   |
| Bank Fixed effects      | Yes                        | Yes                  | Yes                  | Yes                  | Yes                 | Yes                  | Yes                 | Yes                        | Yes                  | Yes                 | Yes                 | Yes                  | Yes                    | Yes                       |
| Time Fixed effects      | Yes                        | Yes                  | Yes                  | Yes                  | Yes                 | Yes                  | Yes                 | Yes                        | Yes                  | Yes                 | Yes                 | Yes                  | Yes                    | Yes                       |
| Observations            | 999                        | 984                  | 999                  | 985                  | 984                 | 999                  | 999                 | 940                        | 999                  | 993                 | 948                 | 999                  | 999                    | 982                       |
| R <sup>2</sup>          | 0.136                      | 0.089                | 0.068                | 0.064                | 0.067               | 0.053                | 0.058               | 0.037                      | 0.074                | 0.028               | 0.091               | 0.145                | 0.046                  | 0.049                     |
| Adjusted R <sup>2</sup> | 0.025                      | -0.030               | -0.052               | -0.058               | -0.055              | -0.070               | -0.064              | -0.089                     | -0.045               | -0.098              | -0.034              | 0.035                | -0.077                 | -0.076                    |

Notes: \*p<0.1; \*\*p<0.05; \*\*\*p<0.01. Explanatory variables include the distance between actual CET1 ratio and the target, the number of quarters before target must be reached (*Horizon*), the bank's Return on Asset, Impairment ratio, Loan to deposit ratio, Net Interest Margin and log of TA (demeaned at the quarterly level in the cross-section), quarterly growth in real GDP and HICP, unemployment rate, credit demand index of the Bank Lending Survey and the interest rate of the Main Refinancing Operations of the ECB. All explanatory variables are lagged by one quarter. Errors clustered at the bank level.

Table A6: Impact of distance to target - pooled regressions without intercept

|                         | <i>Dependent variable:</i> |                       |                     |
|-------------------------|----------------------------|-----------------------|---------------------|
|                         | CET1, FL                   | CET1, PI              | RW                  |
|                         | (1)                        | (2)                   | (3)                 |
| Target dist.            | -0.067***<br>(0.017)       | -0.053***<br>(0.016)  | 0.070***<br>(0.025) |
| Target horizon          | -0.0002<br>(0.0002)        | -0.0001<br>(0.0002)   | 0.0001<br>(0.0003)  |
| Total Assets, log       | -0.001***<br>(0.0002)      | -0.0005**<br>(0.0002) | 0.001*<br>(0.001)   |
| Return on Asset         | -0.012<br>(0.087)          | -0.001<br>(0.086)     | -0.092<br>(0.163)   |
| Credit ratio            | -0.003<br>(0.004)          | -0.002<br>(0.003)     | 0.007<br>(0.006)    |
| Impairment ratio        | -0.013<br>(0.011)          | 0.006<br>(0.012)      | 0.003<br>(0.039)    |
| Provisions              | -0.001<br>(0.060)          | 0.003<br>(0.059)      | -0.063<br>(0.061)   |
| Deposit ratio           | 0.006**<br>(0.002)         | 0.004*<br>(0.002)     | -0.0005<br>(0.003)  |
| TLTRO                   | -0.011***<br>(0.003)       | -0.009***<br>(0.003)  | 0.013**<br>(0.005)  |
| GDP                     | -0.013<br>(0.008)          | -0.019***<br>(0.007)  | 0.030**<br>(0.012)  |
| HICP                    | -0.153***<br>(0.050)       | -0.123***<br>(0.047)  | 0.019<br>(0.100)    |
| Unemployment            | -0.0001<br>(0.0001)        | -0.00002<br>(0.0001)  | 0.00000<br>(0.0001) |
| 10-year sov. yield      | 0.018<br>(0.056)           | -0.041<br>(0.061)     | -0.074<br>(0.138)   |
| EURIBOR                 | -0.001<br>(0.002)          | -0.001<br>(0.002)     | 0.003<br>(0.005)    |
| Bank Fixed effects      | No                         | No                    | No                  |
| Observations            | 999                        | 996                   | 984                 |
| R <sup>2</sup>          | 0.088                      | 0.079                 | 0.064               |
| Adjusted R <sup>2</sup> | 0.062                      | 0.053                 | 0.036               |

*Notes:* \*p<0.1; \*\*p<0.05; \*\*\*p<0.01. Pooled regressions without intercepts with change in ratios defined on the [0, 1] interval. Explanatory variables include the distance between actual CET1 ratio and the target, the number of quarters before target must be reached (*Horizon*), the bank's Return on Asset, Impairment ratio, Loan to deposit ratio, Net Interest Margin and log of TA (demeaned at the quarterly level in the cross-section), quarterly growth in real GDP and HICP, unemployment rate, credit demand index of the Bank Lending Survey and the interest rate of the Main Refinancing Operations of the ECB. All explanatory variables are lagged by one quarter. Errors clustered at the bank level.

# Conclusion

This PhD thesis contributes to the research on financial systemic risk, financial regulation and bank capital. It is composed of four independent chapters.

Chapter 1 investigates the impact of housing, credit supply and credit demand shocks on the US economy depending on households' debt burden. In this chapter we find that households' debt burden features important non-linear effects on the transmission of financial shocks. We detect that the origin of the financial shock substantially affects state effects in that high debt burden and that among the different types of financial shocks, only the housing shocks is amplified when indebtedness is high. If this state effect is consistent with the outcomes of structural models featuring agents subject to borrowing constraint, this does not hold for credit supply shocks, whose effectiveness is higher when private indebtedness is low and agents can actually match the credit supply loosening. If anything, under high vulnerability an expansionary credit supply shock turns negative, more in line with a debt overhang story. Finally, credit demand shocks have very similar propagation independently from the level of indebtedness. Our results suggest to further explore the asymmetries related to the propagation of housing and credit shocks in structural models, in the wake of the works by Justiniano et al. (2015, 2019) in which the effectiveness of the housing and credit shock is related to the presence of constraints limiting financing decisions of both lenders and borrowers at the time. Our results have key implications for policy makers. On the positive side, they call for the monitoring of households' financial vulnerability, as it is a key determinant of the propagation of financial shocks. On the normative side, they highlight the important role of macroprudential policies in preventing the excessive build-up of such financial vulnerabilities.

Chapter 2 investigates the impact of announced changes in the rates of the Countercyclical Capital Buffer on banks' stock prices and CDS spreads. In this chapter, we exploit the institutional setup of the CCyB in the EEA to *directly* estimate the effect of capital requirements on financial markets. Our identification rests upon two features: CCyB hikes are quarterly announcements by national authorities, and they heterogeneously affect all banks of the EEA. We use this setup to assess how markets factor capital requirement increases in CDS spreads and stock prices. We show that hikes in CCyB rates are perceived as increasing bank solvency, at no significant cost for shareholders. We claim that these effects relate to the capital constraint itself, as opposed to the potential signal conveyed on the state of the financial cycle. These results are important to assess the costs and benefits of capital requirements. They suggest that regulators may have room for a more vigorous use of countercyclical capital requirements to improve banks' solvency without material impact on shareholder value. Capital releases seem to have a symmetrically opposite effect, although the effect rather operates through a signalling channel. Our results pave the way for further research. A similar analysis could be run on systemic risk buffers implemented in the EEA, or alternatively on Pillar 2 requirements now that their level is systematically published by the SSM. It is also key to understand which balance sheet

adjustments are priced by markets upon shocks. Key questions include the impact of the CCyB on credit growth, during both the build-up and the release of the CCyB.

Finally, in chapter 3, I investigate banks' CET1 ratio targets and how they adjust to reach them. This chapter builds on an original dataset of CET1 ratio targets European banks publicly announce to their investors. This materially complements the existing literature which depends on partial adjustment models to estimate unobserved targets. The analysis of observed targets provides three key lessons. First, announced targets increase with capital requirements and adverse macroeconomic environment. Capital requirements materially affect targets, but not one for one. This is consistent with the trade-off theory according to which banks balance the expected cost of regulatory breach versus the cost of high capital ratios. Moreover, banks seem to perceive similarly the different types of capital requirements in the regulatory framework, suggesting weak usability of regulatory buffers. Banks also tend to increase their targets when faced with adverse economic environment, suggesting stronger market pressure and banks' willingness not to be discriminated against. Second, banks are serious about their targets, converging toward them, from both below and above. Importantly, the adjustment is materially faster for banks initially below their targets, suggesting higher pressure to build up solvency than to return capital to investors. Third, target CET1 ratios have important informational content on banks future balance-sheet adjustments. Banks away from their targets adjust their CET1 ratios to reach it, mainly through their stock of CET1 and portfolio rebalancing, with material impact on corporate credit supply. This adjustment occurs for banks both below and above their CET1 ratio targets, but it is much stronger in the former case, in line with banks below their targets being under greater pressure to adjust. Those results provide important lessons for prudential authorities. They call for the monitoring of banks' announced targets in order to anticipate credit development and to assess the effectiveness of prudential policies. They also indicate that banks are unwilling to reduce their capital ratios during adverse times and to draw on their regulatory buffers, raising concerns regarding their usability. Simultaneously, this calls for the build-up of appropriate countercyclical capital requirements that the regulator could release in crisis times, to mitigate banks' procyclical reaction. Appropriate communication and forward guidance could also influence banks' anticipations and, in turn, CET1 targets and credit policy. Further ahead, this paper paves the way for further analysis of banks' strategic targets, in particular their targets for return on equity and payout ratio, their drivers and their consequences on banks' behaviour.

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Systeme financier et économie réelle :  
interactions et régulations

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Soutenue le 19 avril, 2022

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# Résumé

Systeme financier et économie réelle : interactions et régulations



La grande crise financière de 2008-09 a été un rappel douloureux des dommages qu'un système financier instable peut causer à l'économie réelle. Un tel système financier peut favoriser l'apparition d'un *risque systémique*, c'est-à-dire "le risque que l'instabilité financière devienne si répandue qu'elle altère le fonctionnement d'un système financier au point que la croissance économique et le bien-être en souffrent substantiellement" (ECB (2009)). En réaction, les régulateurs financiers ont mis au point des indicateurs pour suivre l'évolution des risques systémiques et ont conçu des outils réglementaires pour atténuer l'augmentation de ces risques et améliorer la résilience du système financier face à leur occurrence. Simultanément, ces questions ont suscité un regain d'intérêt de la part des économistes, afin de soutenir les décideurs politiques dans la conception théorique et empirique de la nouvelle réglementation.

Cette thèse de doctorat contribue aux trois principales composantes de la régulation financière : premièrement l'estimation du risque systémique, deuxièmement le calibrage des instruments de politique adéquats et troisièmement l'évaluation *ex-post* de leur impact. Le chapitre 1 contribue à la première étape, les chapitres 2 et 3 aux deuxième et troisième étapes.

La contribution du chapitre 1 consiste à étudier comment l'impact macroéconomique des chocs d'offre et de demande de crédit et des chocs immobiliers varie en fonction de l'endettement des ménages. La vulnérabilité financière des ménages affecte considérablement la propagation des chocs financiers. Le fait que ces chocs proviennent du secteur du logement, de l'offre ou de la demande de crédit est essentiel pour déterminer leurs effets et la réponse politique appropriée (par exemple, l'ajustement de la production de logements, la modification des exigences de capital des banques ou des limites d'endettement des emprunteurs, respectivement). Grâce à un modèle macroéconomique empirique non linéaire appliqué à l'économie américaine, nous étudions comment les réponses aux chocs de logement et de crédit varient en fonction de l'évolution de l'endettement des ménages. Nous trouvons qu'en cas de vulnérabilité élevée, seuls les chocs de logement sont amplifiés et leur effet d'état est conforme à la théorie économique. Inversement, les chocs d'offre de crédit expansifs ont plus d'effet lorsque la vulnérabilité est faible, alors que leur effet devient fortement récessif lorsque la vulnérabilité est élevée, ce qui suggère un effet de surendettement.

Dans le chapitre 2, nous étudions comment les investisseurs réagissent aux changements annoncés dans les exigences de capital des banques. Nous utilisons les hausses du coussin de fonds propres contracyclique (CCyB) pour mesurer la façon dont les marchés réagissent au resserrement des exigences de fonds propres des banques. Notre stratégie d'identification s'appuie sur deux caractéristiques uniques du cadre institutionnel du CCyB en Europe. Premièrement, toutes les autorités nationales annoncent trimestriellement les taux du CCyB.

Deuxièmement, ces hausses affectent toutes les banques européennes proportionnellement à leur exposition au pays d'activation. Nous montrons que les hausses du taux CCyB se traduisent par une baisse des taux (*spreads*) de CDS pour les banques concernées, en particulier celles dont le ratio de capital est plus faible. En revanche, les valorisations des banques ne réagissent pas. Les marchés considèrent donc que des exigences de fonds propres contracycliques plus élevées rendent les banques plus stables, sans coût substantiel pour les actionnaires. Nous affirmons que ces effets sont liés à la contrainte de capital elle-même, par opposition au signal potentiel véhiculé sur l'état du cycle financier. Ces résultats suggèrent qu'il est possible d'utiliser davantage le CCyB pour améliorer la solvabilité des banques sans coût significatif pour les actionnaires.

Le chapitre 3 étudie comment les banques fixent leur ratio de fonds propres cible et comment elles s'ajustent pour l'atteindre. Ce chapitre répond à ces questions en utilisant une nouvelle base de données sur les cibles de ratio de capital directement annoncés aux investisseurs par les banques européennes, ce qui améliore sensiblement la qualité des données par rapport à l'estimation habituelle des objectifs implicites. Il fournit les principaux enseignements suivants. Premièrement, les cibles sont affectées par les exigences de fonds propres et un comportement procyclique cohérent avec la pression du marché. Deuxièmement, les banques ne font pas de distinction entre les différents types d'exigences de fonds propres pour fixer leurs cibles, ce qui suggère qu'elles ne considèrent pas les coussins réglementaires comme réellement utilisables. Troisièmement, la distance entre le ratio CET1 réel et la cible est un prédicteur valable de l'ajustement futur du bilan des banques, ce qui suggère que les banques conduisent activement leurs ratios de capital vers les cibles annoncées, par l'accumulation de capital et le rééquilibrage de leur portefeuille. Quatrièmement, cet ajustement se produit aussi bien au-dessus qu'en dessous de la cible, mais les banques situées en dessous de leur cible s'ajustent plus rapidement, ce qui suggère une pression plus forte. Ces résultats fournissent des enseignements importants pour les décideurs politiques concernant la conception du cadre prudentiel et l'efficacité des politiques contracycliques.

Je présente maintenant plus en détail les chapitres qui composent cette thèse.

## **Chapitre 1 : Comment la vulnérabilité financière amplifie-t-elle les chocs liés au logement et au crédit ?**

L'endettement des ménages est un facteur clé de la stabilité financière et un amplificateur bien connu des crises financières (Jordà et al. (2013); Mian et al. (2017)).

En particulier, leur ratio du service de la dette (par la suite DSR, selon l'acronyme

anglais), c'est-à-dire la part de leur revenu que les ménages utilisent chaque période pour rembourser leur dette, est un indicateur clé de leur résilience financière. Il est probable que le même choc de crédit n'ait pas le même impact lorsque les ménages remboursent peu leurs dettes et disposent donc d'une grande marge de manœuvre financière que lorsqu'ils sont déjà au bord du surendettement. De même, un choc lié au logement, dû par exemple à une plus grande préférence pour le logement, est susceptible d'avoir un impact plus important lorsque les ménages disposent de grandes capacités financières pour financer l'achat d'un logement.

Dans ce document, nous séparons les chocs de logement et de crédit et étudions comment leur impact varie avec le cycle d'endettement des ménages. À cette fin, nous utilisons une projection locale à transition lisse (*Smooth Transition Local Projection*), dans laquelle l'impact d'un choc dépend de la variation sur trois ans du ratio du service de la dette des ménages. Nous identifions les chocs de crédit et de logement avec des restrictions de signe, en utilisant le cadre proposé par Furlanetto et al. (2017). Nous estimons le modèle sur des données américaines pour la période allant de 1983 à 2019. Nous découvrons trois résultats principaux.

Premièrement, un endettement élevé amplifie la réponse des chocs de logement, alors qu'il n'amplifie pas les chocs de demande de crédit. Cette asymétrie des effets de l'état d'endettement est cohérente avec les résultats théoriques de Justiniano et al. (2015)). Dans leur modèle macroéconomique, les agents sont soumis à une contrainte d'emprunt et ne peuvent emprunter que jusqu'à une fraction de leur collatéral. Si la valeur du collatéral augmente en raison d'un choc lié au logement, la limite d'endettement augmente également : les agents pourront augmenter leur effet de levier et dépenser davantage, activant un canal du collatéral qui amplifie la fluctuation initiale. Au contraire, lorsqu'un choc de demande de crédit frappe l'économie, les emprunteurs achètent davantage de maisons, tandis que les épargnants en achètent moins, déclenchant une redistribution des logements des épargnants vers les emprunteurs, sans générer une augmentation substantielle des prix des maisons et de la limite d'endettement.

Notre deuxième résultat clé indique que les chocs expansifs d'offre de crédit ont un impact positif en cas de faible vulnérabilité financière, mais s'avèrent préjudiciables à moyen terme lorsque la vulnérabilité est élevée. En cas de faible vulnérabilité, les effets sur la production d'un choc d'offre de crédit sont positifs et persistants, tandis que le ratio dette/logement reste globalement constant tout au long de la projection, conformément au fait que les prix des logements et la dette évoluent positivement en réponse au choc. En revanche, un endettement élevé annule les effets positifs initiaux des chocs de crédit expansionnistes, produisant des effets cumulés négatifs sur la production, quelques trimestres après l'arrivée du choc. Le fait qu'un choc d'offre de crédit expansionniste ait un effet plus persistant en cas de faible

vulnérabilité rappelle les conclusions de Justiniano et al. (2019). Dans leur modèle, lorsque l'endettement est faible et que les contraintes de prêt sont contraignantes, une augmentation de la capacité de prêt augmente le crédit et déclenche un co-mouvement positif du prêt et des prix des maisons. En revanche, lorsque l'endettement est élevé, les contraintes de prêt ne sont pas nécessairement contraignantes, ce qui réduit l'effet expansionniste du choc d'offre de crédit. Dans notre estimation, nous constatons qu'en cas d'endettement élevé, un choc d'offre de crédit expansionniste finit par avoir un effet récessif, conformément à un mécanisme de surendettement, qui incite les agents se désendetter lorsque leur endettement est trop élevé.

Dans un exercice alternatif, nous répétons notre estimation sans séparer les chocs de logement et de crédit et nous constatons que le choc financier non distingué présente des effets d'état similaires à ceux du choc de logement. Cet exercice souligne notre contribution par rapport à la littérature empirique qui détecte des effets non linéaires pour les chocs financiers (Carriero et al. (2018); Colombo and Paccagnini (2020); Cheng and Chiu (2020); Barnichon et al. (2016)). Ces travaux ne dissocient pas les chocs financiers en chocs de logement et de crédit et trouvent que les variations exogènes des conditions de crédit sont amplifiées en période de crise. Dans cette mesure, notre article contribue à cette littérature en montrant comment les effets d'état diffèrent selon les différents types de chocs financiers.

## **Chapitre 2 : Comment les marchés réagissent-ils au renforcement des exigences en matière de fonds propres des banques?**

La grande crise financière (GFC selon l'acronyme anglais) a mis en évidence la nécessité de disposer de fonds propres bancaires suffisants, car les crises bancaires et les resserrements du crédit qui les accompagnent sont particulièrement dommageables pour l'économie réelle. En conséquence, la principale réponse réglementaire à la GFC a consisté en une forte augmentation des exigences de fonds propres des banques. Leur niveau optimal fait toutefois l'objet d'un débat permanent entre universitaires et décideurs politiques. Si des exigences plus élevées sont associées à une plus grande résilience, elles peuvent également induire une réduction inefficace des prêts (voir par exemple : Van den Heuvel (2008), Repullo and Suarez (2012), Clerc et al. (2015), Mendicino et al. (2018), Malherbe (2020)). À ce titre, il est essentiel que les régulateurs trouvent un équilibre approprié entre les avantages de banques plus stables et les coûts d'un capital plus onéreux. Dans cette étude, nous utilisons le dispositif institutionnel du coussin de fonds propres contracyclique (CCyB) dans l'Espace Économique

Européen (EEE), dans un cadre d'étude d'événements (ou *event study*), pour évaluer comment les marchés financiers perçoivent les coûts et les avantages d'exigences de fonds propres plus élevées.

Le CCyB est une exigence de capital bancaire variable dans le temps, introduite dans Bâle III et adaptée dans la réglementation européenne, qui présente deux caractéristiques intéressantes pour une telle étude. Tout d'abord, les niveaux de CCyB sont des décisions homogènes annoncées trimestriellement au niveau national, et nous pouvons identifier précisément les dates d'annonce grâce à des communiqués de presse. Ceci permet une approche d'étude d'événement. Si les annonces étaient partiellement anticipées, nos estimations seraient simplement conservatrices. Par opposition, les modifications du cadre réglementaire habituellement étudiées dans la littérature résultent généralement d'années de négociation et sont largement anticipées. Ces accords consistent généralement en des changements réglementaires ponctuels, ce qui rend difficile de démêler l'effet d'innovations potentiellement nombreuses, ou d'assurer une validité externe. De plus, le cadre de Bâle III a introduit d'autres exigences de fonds propres spécifiques aux banques, mais leur calcul est souvent mécanique (par exemple pour les banques d'importance systémique mondiale et les autres banques systémiques) et donc facile à anticiper, et/ou sans cadre de communication approprié pour les marchés.<sup>1</sup> Deuxièmement, le taux de CCyB d'un pays donné s'applique à toutes les banques de l'EEE proportionnellement à la part de ce pays dans leurs expositions totales (pertinentes). Par conséquent, chaque choc a un impact hétérogène sur toutes les banques de l'EEE, ce qui permet des études transversales.

Les hausses de CCyB pourraient déclencher des réactions du marché par deux canaux. Premièrement, elles révèlent des informations privées que le régulateur national peut détenir sur l'état de l'économie au moment de fixer le taux. L'interprétation d'un tel signal est *a priori* ambiguë. Les autorités macroprudentielles relèvent généralement le CCyB lorsque l'économie est en bonne santé, mais aussi lorsque les risques financiers s'accumulent. Nous appelons cela le *canal du signal*. Le second canal est lié à l'exigence elle-même, qui renforce la contrainte de fonds propres, obligeant potentiellement les banques à ajuster leur bilan. Nous l'appelons le *canal du capital*. Il est essentiel de démêler ces deux canaux pour interpréter correctement les résultats en termes de coûts et d'avantages.

Nous procédons en trois étapes.

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<sup>1</sup>Dans l'Union bancaire européenne, les niveaux du Pillier 2 Indicatif (*Pillar 2 Guidance*) spécifiques aux banques sont confidentielles, et le Mécanisme de Surveillance Unique publie les exigences du Pillier 2 réglementaire spécifiques aux banques qui s'appliquent aux établissements importants seulement depuis 2020. Voir <https://www.bankingsupervision.europa.eu/banking/srep/html/p2r.en.html>. Enfin, le Royaume-Uni disposait avant la GFC d'une exigence spécifique aux banques et variable dans le temps, étudié par Alfon et al. (2005) et par Francis and Osborne (2012), mais ces exigences étaient confidentielles.

Tout d’abord, nous étudions l’impact des hausses de la CCyB sur des variables au niveau des pays, à savoir les indices boursiers et les CDS souverains. Nous ne trouvons aucun impact significatif : les variables au niveau des pays ne réagissent pas systématiquement aux augmentations de la CCyB au niveau national. Ce résultat est incompatible avec le *canal du signal* et suggère que tout impact est susceptible de transiter par le *canal du capital*.

Deuxièmement, nous montrons que l’annonce d’un relèvement du taux de CCyB national se traduit par une baisse des spreads de CDS pour les banques exposées à ce pays. Les marchés reconnaissent donc que les exigences de fonds propres améliorent la solvabilité des banques, ce qui est cohérent avec les études soulignant leur effet sur les ratios de fonds propres (Alfon et al. (2005)) et la prise de risque (Behncke et al. (2020)). L’effet est plus prononcé pour les banques ayant des ratios de capital plus faibles et un risque plus élevé. En effet, nous constatons une diminution plus importante des spreads des banques situées en dessous de la médiane du ratio de CET1, et symétriquement au-dessus de la médiane des spreads CDS. L’interprétation est double. Les marchés anticipent que les banques plus contraintes seront plus susceptibles d’ajuster leur bilan vers des ratios de capital plus élevés, et une même hausse du ratio de capital a un effet plus importants sur la solvabilité des banques plus risquées et moins capitalisées.

Enfin, nous montrons que les augmentations de CCyB ne sont pas associées à une quelconque réaction significative des rendements boursiers. Ceci, en conjonction avec la baisse des spreads de CDS, est à nouveau incompatible avec le *canal du signal* : de bonnes nouvelles économiques faisant baisser les spreads de CDS devraient également augmenter la valeur des actions. Cela confirme l’activation du *canal du capital*, mais d’une manière qui n’a pas d’impact significatif sur les prix des actions. Or des cours boursiers élevés peuvent être bénéfiques pour un régulateur, s’ils reflètent l’absence d’une réduction inefficace des prêts, ou s’ils renforcent la capacité des banques nationales à lever des fonds ou à résister aux rachats étrangers. L’absence de réaction négative des cours boursiers suggère également que l’annonce de la CCyB est bien comprise par les marchés, un point d’attention important pour les autorités prudentielles. Par conséquent, nous interprétons l’absence de réaction des cours boursiers comme une preuve que les augmentations du CCyB n’ont que des effets indésirables atténués.

D’un point de vue politique, nos résultats suggèrent que les autorités macroprudentielles ont la possibilité d’utiliser plus activement le CCyB pour accroître la résilience des banques, sans pour autant nuire à leur valorisation.

A notre connaissance, notre configuration nous permet de faire la première estimation empirique directe de l’impact des annonces d’exigences de capital sur les marchés financiers.

## Chapitre 3 : Quels sont les objectifs réels des banques en matière de capital?

La définition de la structure du capital est une étape clé de la gestion d'une entreprise, en particulier pour les banques. En effet, les autorités imposent une série d'exigences en matière de fonds propres auxquelles les banques doivent se conformer, alors que la transformation des échéances et, plus généralement, la gestion actif-passif sont au cœur de leurs modèles économiques. À ce titre, l'étude des ratios de capital cibles des banques, de leurs déterminants et de leur impact sur le comportement futur des banques est un domaine clé de la recherche financière.

En effet, les ratios de fonds propres des banques sont les principaux moteurs de leur politique de prêt et, plus généralement, de leurs décisions stratégiques (Berrospide et al. (2010)). La plupart des exigences en matière de fonds propres prévues par les réglementations bancaires européenne et américaine sont exprimées sous la forme du ratio CET1, c'est-à-dire le rapport entre les fonds propres de base (Common Equity Tier 1), la forme la plus pure de fonds propres, constituée essentiellement de capitaux propres émis et de bénéfices non distribués, et les actifs pondérés en fonction des risques (Risk Weighted Assets, RWA), qui correspondent aux expositions initiales totales (Total Original Exposures, TOE) d'une banque pondérées par leurs risques estimés. Le ratio CET1 est également le principal ratio de capital réglementaire utilisé par les investisseurs pour évaluer la solvabilité d'une banque. Par conséquent, l'écart entre le ratio CET1 réel d'une banque et sa cible peut être un indicateur important de l'ajustement futur de son bilan. En effet, une banque en dessous (au-dessus) de sa cible devrait agir pour augmenter (réduire) son ratio CET1, par le biais de trois canaux principaux : son stock de CET1, son TOE et sa densité de pondération des risques, c'est à dire le rapport entre RWA et TOE. Premièrement, elle peut augmenter son stock de CET1 en améliorant sa rentabilité, en émettant des actions ou en diminuant ses versements de capital (dividendes et rachats d'actions). Ensuite, elle peut réduire la taille de ses expositions totales à encours CET1 constant. Enfin, à taille d'actifs constante, elle peut rééquilibrer son portefeuille vers des actifs plus sûrs pour réduire la densité de pondération des risques et donc les RWA. Au contraire, une banque qui dépasse sa cible peut restituer du capital aux investisseurs par des versements plus importants, augmenter son bilan ou le rééquilibrer vers des actifs plus risqués.

À son tour, la structure du capital (cible) a de fortes implications normatives, affectant l'efficacité des mesures publiques, soit directement, pour les politiques prudentielles (Aiyar et al. (2016)), soit indirectement, pour la conduite de la politique monétaire (Gambacorta and Shin (2018)). En particulier, en ce qui concerne les exigences de fonds propres, la

grande crise financière de 2008-09 (GFC) a mis en évidence la nécessité pour les banques d'être suffisamment capitalisées pour surmonter une crise systémique, et donc le recours à des politiques prudentielles contracycliques pour atténuer les réactions procycliques des banques et le rationnement du crédit en cas de crise. En conséquence, la réforme de Bâle III de la réglementation financière internationale a introduit deux nouveaux types d'instruments. Premièrement, elle crée des coussins *utilisables*, c'est-à-dire du capital que les banques doivent détenir en temps normal mais qu'elles peuvent utiliser en cas de problème. Deuxièmement, elle a introduit une exigence de fonds propres contracyclique variant dans le temps : le coussin de fond propre contracyclique (CCyB). Les régulateurs peuvent l'augmenter pendant la phase d'expansion du cycle financier afin de créer un " *espace prudentiel*". Ils peuvent ensuite le réduire en période de crise pour soutenir l'offre de crédit sans mettre en danger la solvabilité des banques (voir, entre autres, Jiménez et al. (2017) pour les preuves empiriques de l'efficacité des exigences contracycliques et Dewatripont and Tirole (2012) pour le rationnel théorique). Néanmoins, cette stratégie dépend essentiellement de la réaction des banques aux exigences de fonds propres et de l'environnement macroéconomique. Si les banques ne réagissent pas aux modifications des exigences de fonds propres ou traitent les coussins utilisables comme des exigences strictes, l'objectif contracyclique du cadre réglementaire s'en trouverait compromis. Au contraire, la pression du marché pourrait contraindre les banques à viser de manière procyclique des ratios de fonds propres plus élevés en période de crise, ce qui entraînerait un rationnement du crédit.

Comment les banques fixent-elles leur cible en matière de ratios de fonds propres ? Ces cibles nous renseignent-elles sur le comportement futur des banques ? Je réponds à ces questions en utilisant une nouvelle base de données sur les cibles que les banques européennes annoncent publiquement dans le cadre de leur communication aux investisseurs. Depuis l'article fondateur de Flannery and Rangan (2008), la littérature s'est appuyée sur des modèles d'ajustement partiel pour estimer les objectifs de fonds propres non observés des banques (sur la base de l'évolution des ratios de fonds propres réels) et, ensuite, évaluer l'ajustement des banques vers leur cible. L'exploitation des cibles annoncées présente plusieurs avantages importants. Premièrement, elle permet de régresser directement une variable observée plutôt que d'estimer une variable non observée, ce qui produit généralement des estimations beaucoup plus précises. Deuxièmement, elle permet de démêler explicitement les chocs affectant uniquement le ratio de capital de ceux affectant la cible elle-même. Troisièmement, elle rompt le lien entre les estimations des déterminants de la cible et de l'ajustement vers la cible, puisque cette dernière étape ne repose pas sur les estimations produites dans la première. Ainsi, les erreurs d'estimation ne sont pas composées. À ma connaissance, il s'agit du premier article qui exploite un ensemble de données sur les cibles de fonds propres



bancaires *observés*.

J'étudie d'abord les déterminants des cibles. En utilisant des modèles d'ajustement partiel, Berger et al. (2008) montre que les banques américaines détiennent un excédent de capital en plus des exigences réglementaires et s'ajustent rapidement lorsqu'elles sont mal capitalisées. À partir d'un échantillon de banques américaines et européennes, Gropp and Heider (2010) constatent que la garantie des dépôts et les exigences en matière de fonds propres ont joué un rôle secondaire dans l'explication des ratios de fonds propres entre 1991 et 2004, qui ont plutôt convergé vers des niveaux invariants dans le temps et propres à chaque banque. De Jonghe and Öztekin (2015) et Bakkar et al. (2019) trouvent des résultats similaires, basés sur un échantillon international de banques. Cet article contribue à cette littérature en supprimant la nécessité d'un modèle d'ajustement partiel, en utilisant à la place les cibles observés, ce qui permet une estimation plus précise des déterminants des cibles et de la vitesse d'ajustement. En outre, ce papier étudie également l'impact différencié des divers types d'exigences de fonds propres introduites par la réforme de Bâle III. Cela nous renseigne en particulier sur l'utilité des coussins réglementaires, qui sont conçus pour être utilisés par les banques en difficulté au prix d'une restriction de la distribution de capital, agissant comme une soupape contracyclique en période de crise. Un coefficient plus faible pour ces réserves que pour des exigences plus strictes indiquerait que les banques considèrent qu'il est moins coûteux d'enfreindre les premières, ce qui suggère une volonté d'y puiser en cas de besoin. À ma connaissance, il s'agit du premier article à étudier cette question. Je mes en avant deux déterminants clés de la cible. Premièrement, les exigences en matière de fonds propres ont un impact important, mais inférieur à l'unité, sur la cible : les banques ne s'adaptent pas complètement aux modifications des exigences en matière de fonds propres, ce qui suggère qu'elles mettent en balance le risque de violation des exigences et les coûts perçus d'un ratio de fonds propres élevé. Il est important de noter que cet impact n'est pas significativement différent pour les diverses composantes de la pile des exigences de fonds propres. Cela suggère que les banques ne font pas la distinction entre les exigences contraignantes et les exigences utilisables, contrairement à l'objectif contracyclique du cadre réglementaire. Deuxièmement, les cibles sont procycliques, car une baisse de la croissance attendue du PIB tend à augmenter les cibles. Ceci est cohérent avec le fait que les banques sont sous pression et tentent de rassurer les investisseurs quant à leur solvabilité en période défavorable.

Ensuite, je montre que les cibles de capital contiennent des informations importantes sur l'évolution future du bilan des banques, en explorant la vitesse et les canaux d'ajustement vers les cibles. Au niveau macroéconomique, un volet de la littérature agrège les distances individuelles des banques aux cibles (estimés) en une seule série temporelle représentative

introduite dans des modèles macroéconométriques. Mésonnier and Stevanovic (2017) constatent que des chocs importants sur cette distance macroéconomique à la cible de capital expliquent une grande partie de la variance du crédit aux entreprises et aux activités réelles. Au niveau microéconomique, De Jonghe and Öztekin (2015) constate que les banques augmentent leurs ratios de fonds propres vers la cible par le biais de la croissance des capitaux propres plutôt que par la réduction du bilan. En utilisant des données mensuelles allemandes, Memmel and Raupach (2010) confirme que la contribution la plus importante à l’ajustement provient du côté du passif, malgré un ajustement plus rapide du côté de l’actif. Bakkar et al. (2019) constate que les institutions financières d’importance systémique (SIFI) s’ajustent différemment des autres banques et ? que les banques ajustent proportionnellement plus leurs titres que leurs prêts pour atteindre leur cibles. En éliminant la nécessité d’estimer les cibles non observés, je constate que les banques prennent au sérieux les cibles qu’elles annoncent. Cet ajustement se produit quel que soit le signe initial de la distance par rapport à la cible, mais il est nettement plus rapide pour les banques qui se situent en dessous de leur cibles, ce qui correspond à la forte pression exercée par les investisseurs pour protéger la valeur de la franchise et éviter une violation coûteuse de la réglementation. La majeure partie de l’ajustement se produit par le biais de leur stock de capital, conformément à De Jonghe and Öztekin (2015) et Memmel and Raupach (2010). Néanmoins, environ un tiers de l’ajustement s’opère par la gestion de l’actif via la réduction des RWA, principalement grâce à la réorientation du portefeuille. En particulier, les banques ajustent leurs expositions au crédit des sociétés non financières (SNF), qui sont généralement assorties de pondérations de risque élevées. En outre, les banques qui se situent en dessous de leurs objectifs ont tendance à réduire la prise en compte des expositions non performantes (ou NPE). Ces résultats soulèvent des inquiétudes quant au comportement procyclique en période de crise, lorsque les banques subissent des pertes et ont tendance à annoncer des cibles plus élevés, car cela suggère qu’elles retardent la reconnaissance des pertes et réduisent de manière procyclique l’offre de crédit aux SNF pour rattraper leur cible lorsque les entreprises ont le plus besoin de crédit. D’un autre côté, cela suggère que la réduction des exigences de fonds propres en période de crise aurait un fort effet expansionniste en réduisant les cibles de fonds propres.

Ces résultats fournissent des leçons essentielles pour les décideurs politiques concernant l’impact des exigences de capital sur les cibles et, par conséquent, l’efficacité du cadre réglementaire. Ce document suggère que les banques ne considèrent pas les coussins réglementaires comme *utilisables*, contrairement à l’intention du régulateur, car le cadre a été conçu pour que les banques puisent dans les coussins en cas de crise afin d’absorber les pertes plutôt que de réduire l’offre de crédit. Cependant, les coussins *relâchables* pourraient atténuer le comportement procyclique des banques, car une réduction contracyclique des

exigences peut abaisser les cibles de ratio CET1, contrebalançant la tendance des banques à augmenter les cibles en temps de crise. En réduisant les cibles, cela encouragerait les banques à augmenter l'offre de crédit, en particulier le crédit aux entreprises. Enfin, le suivi des cibles annoncés par les banques et de l'écart entre leurs cibles et les ratios effectifs CET1 réels permettrait d'anticiper le comportement futur des banques, ce qui éclairerait les décideurs lors de la définition des politiques monétaires ou prudentielles.

# References

- Aiyar, S., Calomiris, C. W., and Wieladek, T. (2016). How does credit supply respond to monetary policy and bank minimum capital requirements? *European Economic Review*, 82:142–165.
- Alfon, I., Argimón Maza, I., and Bascuñana-Ambrós, P. (2005). How individual capital requirements affect capital ratios in uk banks and building societies. *Documentos de trabajo/Banco de España*, 0515.
- Bakkar, Y., De Jonghe, O., and Tarazi, A. (2019). Does banks’ systemic importance affect their capital structure and balance sheet adjustment processes? *Journal of Banking & Finance*, page 105518.
- Barnichon, R., Matthes, C., and Ziegenbein, A. (2016). Assessing the non-linear effects of credit market shocks. *CEPR Discussion Paper No. DP11410*.
- Behncke, S. et al. (2020). Effects of macroprudential policies on bank lending and credit risks. Technical report, Swiss National Bank.
- Berger, A. N., DeYoung, R., Flannery, M. J., Lee, D., and Öztekin, Ö. (2008). How do large banking organizations manage their capital ratios? *Journal of Financial Services Research*, 34(2-3):123–149.
- Berrosptide, J. M., Edge, R. M., et al. (2010). The effects of bank capital on lending: What do we know, and what does it mean? *International Journal of Central Banking*, 6(34):1–50.
- Carriero, A., Galvao, A. B., and Marcellino, M. (2018). Credit conditions and the effects of economic shocks: Amplification and asymmetries. *Economic Modelling and Forecasting Group*.
- Cheng, C. H. J. and Chiu, C.-W. (2020). Nonlinear effects of mortgage spreads over the business cycle. *Journal of Money, Credit and Banking*, 52(6):1593–1611.

- Clerc, L., Derviz, A., Mendicino, C., Moyen, S., Nikolov, K., Stracca, L., Suarez, J., and Vardoulakis, A. P. (2015). Capital Regulation in a Macroeconomic Model with Three Layers of Default. *International Journal of Central Banking*, 11(3):9–63.
- Colombo, V. and Paccagnini, A. (2020). Does the credit supply shock have asymmetric effects on macroeconomic variables? *Economics Letters*, 188:108958.
- De Jonghe, O. and Öztekin, Ö. (2015). Bank capital management: International evidence. *Journal of Financial Intermediation*, 24(2):154–177.
- Dewatripont, M. and Tirole, J. (2012). Macroeconomic shocks and banking regulation. *Journal of Money, Credit and Banking*, 44:237–254.
- ECB (2009). The concept of systemic risk. *Financial Stability Review*, pages 134–142.
- Flannery, M. J. and Rangan, K. P. (2008). What caused the bank capital build-up of the 1990s? *Review of Finance*, 12(2):391–429.
- Francis, W. B. and Osborne, M. (2012). Capital requirements and bank behavior in the uk: Are there lessons for international capital standards? *Journal of Banking & Finance*, 36(3):803–816.
- Furlanetto, F., Ravazzolo, F., and Sarferaz, S. (2017). Identification of financial factors in economic fluctuations. *The Economic Journal*, 129(617):311–337.
- Gambacorta, L. and Shin, H. S. (2018). Why bank capital matters for monetary policy. *Journal of Financial Intermediation*, 35:17–29.
- Gropp, R. and Heider, F. (2010). The determinants of bank capital structure. *Review of finance*, 14(4):587–622.
- Jiménez, G., Ongena, S., Peydró, J.-L., and Saurina, J. (2017). Macroprudential policy, countercyclical bank capital buffers, and credit supply: Evidence from the spanish dynamic provisioning experiments. *Journal of Political Economy*, 125(6):2126–2177.
- Jordà, Ò., Schularick, M., and Taylor, A. M. (2013). When credit bites back. *Journal of Money, Credit and Banking*, 45(s2):3–28.
- Justiniano, A., Primiceri, G. E., and Tambalotti, A. (2015). Household leveraging and deleveraging. *Review of Economic Dynamics*, 18(1):3–20.
- Justiniano, A., Primiceri, G. E., and Tambalotti, A. (2019). Credit supply and the housing boom. *Journal of Political Economy*, 127(3):1317–1350.

- Malherbe, F. (2020). Optimal capital requirements over the business and financial cycles. *American Economic Journal: Macroeconomics*, 12(3):139–74.
- Memmel, C. and Raupach, P. (2010). How do banks adjust their capital ratios? *Journal of Financial Intermediation*, 19(4):509–528.
- Mendicino, C., Nikolov, K., Suarez, J., and Supera, D. (2018). Optimal dynamic capital requirements. *Journal of Money, Credit and Banking*, 50(6):1271–1297.
- Mésonnier, J.-S. and Stevanovic, D. (2017). The macroeconomic effects of shocks to large banks' capital. *Oxford Bulletin of Economics and Statistics*, 79(4):546–569.
- Mian, A., Sufi, A., and Verner, E. (2017). Household debt and business cycles worldwide. *The Quarterly Journal of Economics*, 132(4):1755–1817.
- Repullo, R. and Suarez, J. (2012). The Procyclical Effects of Bank Capital Regulation. *The Review of Financial Studies*, 26(2):452–490.
- Van den Heuvel, S. J. (2008). The welfare cost of bank capital requirements. *Journal of Monetary Economics*, 55(2):298–320.