s:fi
RESEARCH

Swiss Finance Institute Research Paper Series N°20-113

(When) Do Banks React to Anticipated Capital Reliefs?

Guillaume Arnould
Bank of England

Benjamin Guin
Bank of England

Steven Ongena
University of Zurich, KU Leuven, Swiss Finance Institute, and CEPR

Paolo Siciliani
Bank of England

(When) do banks react to anticipated capital reliefs?

Guillaume Arnould[1] Benjamin Guin[1] Steven Ongena[2] Paolo Siciliani[1]

This version: 27 January 2023

We study how banks react to policy announcements during the representative policy cycle of consultation and policy publication. We use unique data covering the population of all mortgage transactions in the UK complemented with regulatory risk assessments of banks and their supervisory interactions. We show that banks likely to benefit from lower capital requirements increase the size of this capital relief by permanently investing into low-risk assets after the publication of the policy. Within this group, those banks with a higher frequency of supervisory interactions already react to the first step of policy development, the publication consultation. We show how these results can be used to estimate a lower bound on the cost of capital for smaller banks, for which such estimates are typically difficult to obtain.

Keywords: Bank Regulation, Mortgage Lending, Supervisory Review Process, Capital Requirements

JEL-Codes: G21

---

[1] Bank of England (BoE); [2] University of Zurich, Swiss Finance Institute, KU Leuven and CEPR. For comments and discussions we would like to thank Thorsten Beck, Chris Frank, Kathryn Inglis, Daniel Paravisini and Neeltje van Horen. We also thank Jack Leslie for his early involvement in this project and Laavaniya Srithar for excellent research assistance. Any views expressed are solely those of the authors. They should not be taken to represent those of the Bank of England or as a statement of Bank of England policy. This paper should not be reported as representing the views of members of the Monetary Policy Committee, Prudential Regulation Committee or Financial Policy Committee. Ongena acknowledges financial support from *ERC ADG 2016 - GA 740272 lending*.

1. Introduction

While much is known about the role of forward guidance when communicating monetary policy (McKay et al., 2016; Andrade et al., 2019), there is still a lack of understanding about banks' reactions to anticipated changes in regulation communicated at various stages of the policy cycle. Understanding the exact announcement mechanism is important, as changes in minimum capital requirements affect bank lending (Gropp et al., 2019) and the real economy (Fraisse et al., 2019). In this paper, we investigate a salient change in policy, which creates an incentive for banks to change their asset composition in order to decrease their capital requirements. We examine whether banks react to anticipated reliefs of capital requirements and we analyse to which of the announcements in the policy lifecycle they react and how.

We examine a policy that is aimed at reducing minimum capital requirements for some small banks that are, essentially, considered to be well managed while leaving them unchanged for others. The reduction is based on the riskiness of their loan portfolios at the time of their supervisory review. In our set-up, we follow announcements of the policy at two steps of the typical policy cycle: (i) publication of a consultation paper, which solicits industry feedback on the planned policy; and (ii) publication of the final policy in the form of a policy statement. In addition, we explore the role of bilateral communication between banks and their appointed supervisors which are part and parcel of the routine process of supervisory oversight.

We undertake a difference-in-differences analysis with multiple treatment dates in the spirit of Rodnyansky and Darmouni (2017). We examine whether banks that were reasonably likely to be eligible reacted to these communications. Specifically, we examine if they preposition in low-risk assets to increase their expected capital relief, relative to other banks that were reasonably certain about their ineligibility. To this end, we use unique data on the population of all mortgage transactions in the United Kingdom between 2016 and 2019. They come from the FCA's Product Sales Database which is well established in the existing literature (Cloyne et al., 2019). We complement these data with confidential information on banks' regulatory risk scores and the exact dates of their supervisory reviews. In addition, we employ unique regulatory data on the frequency of bilateral communications (i.e., meetings, site visits and calls) between banks and their supervisors.

Our results suggest that banks likely to receive capital reliefs invest in low-risk assets prior to the supervisory review, which implements the policy at the bank. In turn, this prepositioning by banks leads to a reduction in the riskiness of their overall portfolio, which is persistent even after the implementation of the policy. By contrast, we find that banks unlikely to be eligible for capital relief move in the opposite direction, increasing their exposure to riskier mortgages. This suggests that the two types of banks are close competitors.

Dynamic Effect? strengthen weaken

By the same token, we find evidence of a first-mover advantage in the sense that banks that have more time to adjust their asset composition fail to do so compared to banks that had to react immediately after the publication of the policy statement.

We also find evidence that banks with a high frequency of supervisory interactions adjust their asset composition in response to the issuance of the consultation paper. Whereas banks with a comparatively lower frequency of supervisory interaction wait until the publication of the policy statement. These results suggest that a higher frequency of supervisory interactions allows banks to better understand whether they are likely to be under the scope of the proposed policy.

This paper relates to three strands of the literature. First, we contribute to extant work on the announcement effects of bank regulation. The existing literature examines market reactions to new regulation (Bruno et al, 2018; Schäfer et al, 2017). To the best of our knowledge, there is no evidence on how regulated banks react to these announcements. The present paper addresses this gap by examining a specific policy which allows regulated banks to react, namely, to increase exposure to low-risk assets, in order to increase the expected reduction in capital requirements.

Second, our paper contributes to the very limited literature on how regulatory uncertainty, specifically about the level of capital requirements, affects bank lending. It is well established that banks react to increased uncertainty about their ability to meet minimum capital requirements by holding (costly) voluntary capital buffers as a precaution (e.g., Jokipii and Milne, 2008; Stolz and Wedow, 2011; Valencia, 2016), and that this is typically the result of reduced lending (e.g., Buch et al., 2016; Soto, 2020; Kara and Yook, 2019).[1] In this literature, uncertainty entails a downside risk in the form of a costly breach of minimum capital requirements. By contrast, in our case regulatory uncertainty entails an upside risk for banks in the form of a reduction in capital requirements. We complement the literature by finding that banks with more frequent supervisory interaction are more responsive in adjusting their asset composition. This behaviour is consistent with maximising the expected benefit of the policy proposal. It suggests that these banks are more confident about their eventual eligibility once the policy is finalised.

Third, our results are informative for banks' cost of capital considerations (Kisin and Manela, 2016). For small banks, which are not listed on stock markets, such estimates typically do not exist. We address this gap by proposing a conceptual framework which showcases how our estimates can be used to gauge a lower bound of the implied cost of regulatory capital for such banks. We find that the cost of capital for small banks is relatively insensitive to the size of the bank, and it is in the same ballpark as for large banks at about 11%.

[1] Eckley et al. (2021) find similar results when the source of uncertainty is, specifically, the future level of capital requirements.

The remainder of the paper proceeds as follows. Section 2 sketches the background of the policy. Section 3 introduces our data. Section 4 discusses our empirical methodology. Section 5 presents the main results. Section 6 lays out an application with respect to the estimation of the shadow cost of capital for small banks. Section 7 concludes.

2. Background on the policy

Under the Basel's Pillar 2 framework,[2] supervisors can impose bank-specific capital requirements in order to capture risks that are not adequately, or not at all, captured under the standard Pillar 1 minimum capital requirements, whereby banks are required to hold capital resources of at least 8% of their risk-weighted assets bases. Credit risk typically represents the main component of banks' risk-weighted assets bases. Banks have two options to calculate risk weights: (i) they can estimate their own risk weights under the internal ratings-based (IRB) modelling approach, which is subject to explicit supervisory approval to ensure the integrity of these internal risk assessments; or (ii) they can adopt the standardised approach (SA) where risk weights are set in a standardised manner, supported by external credit assessments. The latter approach is typically adopted by smaller, less established, and sophisticated banks.

In February 2017, the Prudential Regulation Authority (henceforth, the regulator) published a consultation paper proposing refinements to its approach to setting bank specific capital requirements under the Pillar 2 framework.[3] Specifically, the regulator sought to address concerns over higher risk weights under SA compared to those under IRB models. This was especially the case for residential mortgages with low loan-to-value (LTV) ratios where SA risk-weights can be up to seven times higher than under IRB, as shown in Table 1.[4]

Table 1. IRB vs SA gap in risk weights for residential mortgages

LTV bands	Risk weights under SA	Risk weights under IRB
0% ≤ LTV < 50%	35.0%	5.3%
50% ≤ LTV < 60%	35.0%	9.1%
60% ≤ LTV < 70%	35.0%	11.6%
70% ≤ LTV < 80%	35.0%	16.6%
80% ≤ LTV < 90%	36.0%	22.4%
90% ≤ LTV < 100%	43.0%	33.3%

[2] See Basel Committee on Banking Supervision, 'Pillar 2 (Supervisory Review Process)' (January 2001), available at https://www.bis.org/publ/bcbsca08.pdf.
[3] PRA, 'Refining the PRA's Pillar 2A capital framework', February 2017, available at https://www.bankofengland.co.uk/-/media/boe/files/prudential-regulation/consultation-paper/2017/cp317.
[4] Benetton et al. (2020) found that the gap in risk-weights for UK residential mortgages between banks on IRB vs SA allows the former to undercut the latter, and thus pushes the latter to increase their exposure in riskier high LTV segments. These findings corroborated the view that the IRB vs SA gap at low LTV is too wide.

Note: Risk weights under IRB are average risk weights based on exposure amounts. They are calculated based on expected and unexpected losses.[5]

Under the proposals, the regulator would allow supervisors to exercise judgement and reduce bank specific variable Pillar 2A capital requirements for banks and building societies (henceforth, simply "banks") under the SA where appropriate. In assessing capital needs, supervisors would take into account the greater degree of conservatism that may apply to risk weights derived under the SA (Table 1, column 2) compared to those from IRB models for certain types of exposures, using so-called IRB credit risk benchmarks (Table 1, column 3). These are average risk weights for different types of exposure across banks that use IRB models. The aim of the policy is to address the concern that capital standards are overly prudent for banks using the SA for credit risk exposures. An excessive IRB vs SA gap might disadvantage SA banks in safer low LTV bands, thus inducing them to increase their exposure in riskier high LTV bands.

In October 2017, the regulator finalized this policy by publishing a policy statement, with implementation date of 1 January 2018.[6] Subsequently, this new approach has been implemented as part of the Supervisory Review and Evaluation Process (SREP) reviews under the Pillar 2 framework. Specifically, whilst the largest systemic banks are subject to this review process annually and concomitantly, smaller ones (i.e., those targeted by this policy) are reviewed on a rolling 2 or 3-year cycle (from 2018 to 2020) which is staggered over time. This proportionate approach also takes into consideration the limited supervisory resources available to oversee a large population of smaller banks.[7]

Under the SREP framework, banks are required to first undertake an Internal Capital Adequacy Assessment Process (ICAAP) in order to assess on an ongoing basis their own capital adequacy depending on the level and nature of the risks to which they are or might be exposed. The regulator will then review the submitted ICAAP as part of the SREP. This internal assessment (ICAAP) is based on the latest available annualised financial statement data, thus typically at the end of the year that precedes the SREP.

[5] PRA, 'The PRA's methodologies for setting Pillar 2 capital – Statement of Policy' Updated in February 2020, available at https://www.bankofengland.co.uk/-/media/boe/files/prudential-regulation/statement-of-policy/2020/the-pras-methodologies-for-setting-pillar-2a-capital-update-february-2020.pdf?la=en&hash=4EB02F435F5BF46507222B09F0DE271333A5409E.

[6] PRA, 'Refining the PRA's Pillar 2A capital framework', October 2017, available at www.bankofengland.co.uk/pra/Pages/publications/cp/2017/cp317.aspx.

[7] It is worth noting that the PRA expects banks to publicly disclose the amount of total capital requirements (given by the sum of P1 and P2 requirements) which apply to them. See PRA, 'The Internal Capital Adequacy Assessment Process (ICAAP) and the Supervisory Review and Evaluation Process (SREP)', March 2019, available at https://www.bankofengland.co.uk/-/media/boe/files/prudential-regulation/supervisory-statement/2019/ss3115-update-march-2019.

The calculation of the reduction in the Pillar 2A capital framework does not follow mechanically from the comparison with IRB benchmarks. Supervisors maintain full discretion informed by a business model analysis, including consideration of whether the benchmark was representative of bank-specific risk profiles. Banks considered to be relatively low-risk and well managed would be considered eligible for capital reliefs. By contrast, banks that do not ensure a sound management and coverage of its risks or have concentrated exposures to asset classes for which the regulator does not have sufficient data to produce a reliable IRB benchmark, would be considered ineligible. In addition, the published eligibility criteria of the policy were left relatively flexible to allow scope for supervisory judgment. As a result, banks on the SA faced uncertainty as to whether they were eligible.

In conclusion, one aim of this policy was to incentivise SA banks to rebalance their portfolio from riskier high LTV residential mortgages towards safer low LTV ones. This was deemed to be beneficial not only in terms of competition by levelling the playing field between IRB and SA banks (Benetton et al., 2021), but also with regards to the safety and soundness of these relatively less sophisticated SA banks.

Given that the calculation of the reduction in capital requirements is based on the portfolio allocation reported by banks as part of their ICAAP preceding the SREP, banks have the opportunity to increase their exposure in low LTV residential mortgages before the actual policy implementation (i.e., a behaviour we label as “to preposition”), in order to increase not only the potential benefits from the implementation in terms of capital requirements, but also the likelihood of being considered eligible in the first place. This possible change in viewpoint is because the resulting safer portfolio allocation would in turn ameliorate the overall risk profile of the bank in question, which is one of the eligibility criteria outlined in the consultation paper and confirmed in the policy statement.

For example, the SREP of a bank in May 2019 would have used balance sheet information from its ICAAP based on data dated typically at the end of the previous year. Therefore, the bank had the opportunity to increase its exposure to low LTV mortgages during 2018. In doing so, however, the bank would have to depart from what the bank considers to be the best portfolio allocation given the current capital requirements. As lower LTV mortgages are typically priced at lower rates than high LTV mortgages, prepositioning in low LTV mortgages would entail an opportunity cost. It comes from adjusting the current allocation to the one that would maximise the expected benefit from the policy implementation. It is a function of the probability of being eligible and the magnitude of capital relief.

3. Data

3.1. Bank eligibility criteria

Both the consultation paper and the policy statement highlight criteria which determine whether a bank is eligible for capital relief under the policy, or not. Specifically, the consultation paper mentions three criteria which are relevant for banks' eligibility considerations: (i) banks should have a sound management; (ii) they should have a low-risk profile; and (iii) they should have no concentrated exposure to asset classes for which the regulator does not have an IRB benchmark.[8] In addition, banks that use the IRB approach to capitalize credit risk are not eligible. We translate these criteria into metrics that allow us to build a list of banks that are likely consider themselves as eligible.

Criteria 1: sound management

We use the list of banks with a risk management and governance (RM&G) scalar to incorporate these criteria.[9] We think that a bank will consider itself as having a sound management as long as the regulator did not flag its risk management practice as bad. In other words, the baseline assumption of our approach is that all banks have a sound management. Supervisors may flag significantly weak risk management and governance to banks whose capital requirements are increased as a result via a RM&G scalar.[10] Hence, we argue that banks that have a RM&G scalar will consider themselves as not eligible to the policy.

Criteria 2: low-risk profile

Supervisors rank banks over a cardinal scale on a number of risk drivers (i.e., from low to high risk).[11] Those risk scores are for internal purposes only and, thus, are not communicated to banks. However, banks have regular communication with their supervisors, which culminates in a holistic assessment of their specific risk profile. This feedback can help banks understand how risky they are perceived to be by their supervisors and, thus, whether they are likely to be eligible. The idea is that a bank below a certain threshold should consider itself as being perceived as a low-risk bank by its supervisors. Specifically, using risk scores from June 2017, we build two proxies of the true criterion in order to

[8] The policy applied to all asset categories that could give rise to a gap in risk weights between SA and IRB, although the by far most prominent one was residential mortgages, which is the focus of our analysis.

[9] Under the European Banking Authority's SREP guidelines, competent authorities should set additional own funds requirements to cover risks posed by RM&G weaknesses where appropriate as an interim measure, while the deficiencies are addressed: see EBA, Guidelines on common procedures and methodologies for the supervisory review and evaluation process (SREP) (EBA/GL/2014/13, December 2014), available at https://eba.europa.eu/sites/default/documents/files/documents/10180/935249/4b842c7e-3294-4947-94cd-ad7f94405d66/EBA-GL-2014-13%20(Guidelines%20on%20SREP%20methodologies%20and%20processes).pdf.

[10] For more details on this supervisory approach, see PRA, Assessing capital adequacy under Pillar 2, Policy Statement (PS17/15, July 2015), available at https://www.bankofengland.co.uk/-/media/boe/files/prudential-regulation/policy-statement/2015/ps1715update.pdf?la=en&hash=6ADA6A6C146FD095999E25E78A6A52605D4EA77B.

[11] For more details on the internal risk scoring methodology, see PRA, The Prudential Regulation Authority's approach to banking supervision (October 2018), Chapter 3, available at https://www.bankofengland.co.uk/-/media/boe/files/prudential-regulation/approach/banking-approach-2018.pdf; and also Bholat et al. (2017).

construct the list of eligible banks: (i) no risk score above two thirds of the maximum score; and (ii) an average risk score below less than half of the maximum score.

Both proxies rely on the idea that the safest banks can gauge whether they are considered as relatively low risk. However, the first proxy is more precise and, arguably, demanding for banks to be able to infer their eligibility, in the sense that they need to have received supervisory feedback focussed on specific issues. Supervisors provide formal and informal communication to banks that would have helped them gauge their eventual eligibility. To examine if banks with at least one high risk score are indeed likely to know about it, we also reviewed a sample of formal letters which supervisors sent to banks at the end of their SREP. We checked if the tone of the letter regarding a specific risk area changes once supervisors have given a high score. We then compared the tone of these letters with letters from banks that are not considered to be high risk with respect to the area in question. We found that letters to banks with a high-risk score do tend to clearly signal supervisors' concerns about the specific area in question.[12] Accordingly, we adopt the first criterion based on no risk score above two thirds of the maximum score as our main approach. We also keep the other approach based on low average risk score as an alternative proxy for robustness analysis.

Criteria 3: exposure to assets with no IRB benchmark

We do not capture explicitly this criterion in our analysis, as we restrict our analysis to banks that only have some material exposures to residential mortgages, that is, with no less than 500 mortgages originated over the sample period.[13] The consultation paper includes a list of asset classes of credit risk IRB benchmarks. We focus our analysis on residential mortgages, which are differentiated by LTV. We do this for two reasons: first, residential mortgages constitute the most material asset class for the majority of retail banks; second, it is the asset class for which the gap in risk weights between the SA and the IRB approach is the widest.

Criteria 4: no IRB modelling

We restrict our sample to banks using the SA. The target of the policy is to reduce the gap in risk weights between banks using SA and banks using IRB models. Banks that have an IRB licence could be eligible for the policy if they use the SA for a fraction of their portfolio. However, it is unlikely that banks with an IRB licence use SA for their mortgage portfolio given that risk weights are notably higher under SA. Therefore, we consider that banks that have an IRB licence (at the entity level or at the

[12] Table A1 in the Annex illustrates these differences in wording. Banks with low-risk scores tend to have a more positive tone (suggesting ways to improve), while banks with high risk scores have a more direct tone in their letter, pointing out the area they must improve upon. See Bholat et al. (2017) for a more in-depth analysis of the semantic content of those supervisory letters.

[13] Accordingly, we excluded three banks with less than 500 residential mortgage originations over the sample period. The inclusion of these small lenders in the sample does not alter the results.

group level) always use the IRB approach for their mortgage portfolio and will not deem themselves eligible. In addition, we also exclude these IRB banks from the control group of ineligible banks. This is because, compared to the type of banks likely to be eligible, banks using IRB models tend to be very large and with a significant competitive advantage in terms of cost of funding.[14] Therefore, for the sake of comparability, we restrict both our treatment and control groups to banks under SA.

Table 2 summarizes the eligibility criteria set out in the consultation paper and confirmed with the policy statement, and how we take them into account in our analyses. Out of 47 banks in our sample, we classify 30 as being eligible based on our first approach to proxy for the risk profile of banks, while only 8 satisfied the alternative approach based on the average risk score criterion.

Table 2. Eligibility criteria – Consultation paper

Eligibility criteria from CP	Our proxy
Sound management	Banks with an RM&G scalar are not eligible
Low-risk profile	Bank with no risk score above two-thirds of the maximum score are eligible (alternative criterion: an average of risk score below less than half of the maximum score).
No concentrated exposure to assets w/o benchmark	We restrict our analysis to banks with substantial mortgage exposure as a robustness test
Using the Standardized Approach	Banks using the internal ratings-based (IRB) approach are not eligible

We complement this information with the exact date of the supervisory review (SREP) for each of the banks we include in our sample. Banks differ in the year of their initial SREP and in the length of their SREP cycle until their next SREP: whilst the vast majority of banks in our sample are on a 3-year cycle, there are a few banks that are on a 2-year or on a 1-year cycle. In order to create clearly defined cohorts of banks, we reattribute the latter to the following SREP cohorts: e.g., a bank on a 2-year cycle with SREP in 2018, is also added to the 2020 cohort.

In our empirical analyses, we focus on the sample of 34 banks which had their SREP in 2019 and 2020, and not on the previous cohorts.[15] Regarding the cohort of banks with a SREP in 2018, the publication of the policy statement in Q4 2017 was too late for them to properly preposition by the

[14] See, e.g., Financial Conduct Authority (FCA), 'Strategic Review of Retail Banking Business Models', December 2018, available at https://www.fca.org.uk/publication/multi-firm-reviews/strategic-review-retail-banking-business-models-final-report.pdf.

[15] Therefore, we drop 13 banks on a 3-year cycle with SREP in 2018. The remaining banks in the 2018 cohort and all the banks with SREP in 2017 are reallocated to the 2019 and 2020 cohorts according to the length of their respective cycles.

end the same year (i.e., the cut-off date for the collection of annual data to be used in the ICAAP submission). In summary, there are 13 banks that had their SREP in 2019, of which 9 were deemed to be eligible (under the criterion that the bank has no risk score above two-thirds of the maximum score);[16] and 21 had their SREP in 2020, with 10 eligible. Nevertheless, as explained in Section 5.4, our main empirical analyses and results are focussed on the cohort of banks with SREP in 2019.

In Table 3, we compare the characteristics of 2019 SREP banks deemed eligible relative to banks classified as ineligible based on key bank characteristics following Gropp et al (2019). The two sets of banks are very similar in terms of the average LTV of mortgages originated in 2016, before the publication of the consultation paper. Moreover, they are similar in terms of importance of the mortgage portfolio relative to total assets and reliance on deposits as the main source of funding. However, ineligible banks tend to be smaller on average and slightly better capitalised.

Table 3. Differences in bank characteristics in 2016

Variable	Eligible	Not eligible	Difference
LTV	55.37	56.21	-0.84
Mortgage / Total assets	0.79	0.75	0.05
Deposits / Total assets	0.75	0.70	0.05
CET1 / Risk weighted assets	0.18	0.23	-0.05
Total assets (in million £)	1,671	1,100	571

Note: This table shows mean differences of key bank characteristics as of 2016 of banks, which had their SREP in 2019 by eligibility (below two-thirds criterion). LTV is the average LTV of the flow of new mortgages in 2016. LTV is winsorized at 1% and 99% to account for outliers. We get the data on LTV from the Product Sales Database (see below for more information) and collect data manually from banks' reports for all other variables. We lack data on Mortgage / Total assets for four banks, one of which is ineligible.

[16] Under the alternative criterion (average risk score), there are 13 banks that had their SREP in 2019, of which 3 were deemed to be eligible; and 21 with a SREP in 2020, 2 of which eligible.

3.2. Mortgage transactions

For each of the 13 banks with a SREP in 2019, we match mortgage transactions of all mortgages granted from 2016 Q1 until 2019 Q4. These data come from FCA's Product Sales Database. In this data set, we observe new mortgages and mortgages refinanced with a new bank ("switchers"). It includes the exact quarter of each of these transactions as well as further mortgage and borrower characteristics. Table 4 shows these characteristics in our sample. We exclude the two quarters of the publication of the consultation paper and policy statement as these quarters are not clearly attributable to the time before publication or after. Our final sample consists of 62,977 mortgage transactions.

Most importantly for our analyses, our sample includes the loan-to-value ratio, LTV, of each mortgage which is 66% on average (Table 4, column 1, row 1).[17] We use this variable to create a dummy variable denoting whether a mortgage is below a certain LTV threshold or not. In our main analyses, we classify mortgages with an LTV below 60% as being at low LTV. Below this threshold, IRB risk weights are less than one third of the corresponding ones under SA (Table 1, rows 1 to 4). Thus, they entail a material disadvantage for banks using SA. This threshold also identifies the lowest pricing band conventionally used by banks (i.e., to qualify for the lowest available rates). About one third of all mortgage transactions display a LTV of less than 60% (Table 4, column 1, row 3). We also adopt two alternative thresholds: (i) LTV below 80%, which is more conservative, and (ii) LTV below 50%, where the gap in risk weights is at its widest (Table 1, row 1). About 60% of all mortgages show LTVs of below 80% (Table 4, column 1, row 2), about one fourth have an LTV below 50% (Table 4, column 1, row 4).

The Product Sales Database also provides a set of other important mortgage contract terms. Regarding the purpose of the mortgage transaction, on average about 43% of all mortgages are taken by refinancers (Table 4, column 1). The majority of mortgages in our sample are priced at a fixed rate (86% - Table 4, penultimate row, column 1). Finally, with respect to the length of the initial incentive period,[18] 42% of all mortgage transactions are 2 years or shorter (Table 4, last row, column 1).

[17] The distribution of LTV is winsorized at 1% and 99% to account for outliers.

[18] In the United Kingdom, mortgages are on a teaser rate, which typically lasts 2 years. After this period, the mortgage rate reverts to a relatively higher standard variable rate (SVR).

Table 4. Summary statistics

	Mean	St.Dev.	Min	Max	Observations
LTV					
LTV	66.43	24.65	6.33	95.00	62,977
LTV (<80%)	0.60	0.49	0.00	1.00	62,977
LTV (<60%)	0.34	0.47	0.00	1.00	62,977
LTV (<50%)	0.26	0.44	0.00	1.00	62,977
Control variables					
Refinancing	0.43	0.50	0.00	1.00	62,977
Fixed rate	0.86	0.35	0.00	1.00	62,977
Short incentive period	0.42	0.49	0.00	1.00	62,977

Note: This table shows the summary statistics of the variables displayed in the regression tables. The sample includes observations between 2016 Q1 until 2019 Q4. LTV is winsorized at 1% and 99% to account for outliers.

3.3. Frequency of bilateral supervisory Interaction

We complement this data set with information on the number of interactions between banks and their supervisors. We use a confidential database that records all interactions banks and supervisors since 2017. It was created due to a requirement for supervisors to keep records of all meetings with banks. These interactions can take the form of in-person meetings, either at the regulator or at the bank, or they take the form of phone calls. Among other information, we know the date when the meeting took place.

The number of interactions can vary substantially across banks and years. To account for these differences, we do not use the absolute number of bank-supervisor interactions. Instead, we employ a measure of divergence from the median number of interactions within the four supervisory categories of banks. Within each of these categories, we then estimate the median of the number of interactions in 2018 or in 2019.[19] We employ the median instead of the mean as it is robust to outliers of banks with very frequent interactions.

We consider a bank to have a high number of supervisory interactions if it met its supervisor more than 1.5 times the median of the bank category. We chose 1.5 times the median to capture only banks that had significantly more interactions with their supervisors than the remaining banks of their category. We create a dummy variable which assigns the value of one for banks with high supervisory interactions (and zero otherwise). In our sample of 13 banks with a supervisory review in 2019, we observe that 5 banks have a high number of supervisory interactions.

[19] We use the average of the median only for 2018 and 2019 given that 2017 is incomplete.

4. Empirical strategy

Our empirical strategy follows Rodnyansky and Darmouni (2017). They use a difference-in-differences setup with three treatment dates to examine the effects of quantitative easing on bank lending behaviour. In our main specification, we estimate the following regression model using OLS.

$$Low\ LTV_{i,b,t} = \beta_1\ x\ Eligible_b\ x\ Post\ PS_t + \beta_2\ x\ Eligible_b\ x\ Post\ CP_t + \beta_3\ x\ Post\ PS_t + \beta_4\ x\ Post\ CP_t + \gamma_b + X_{i,b,t} + \varepsilon_{i,b,t}$$

where $Low\ LTV_{i,b,t}$ is an indicator variable which equals one if the mortgage *i* by bank *b* at point in quarter *t* has a loan to value ratio of less than 60% and equals zero otherwise. In other specifications, we use alternative thresholds and contrast them with a continuous measure of LTV. The comparison with a continuous measure of LTV is especially relevant from a policy evaluation perspective, in that it would be an unintended policy consequence if eligible banks increased their exposure at very high LTV (i.e., where interest rates are higher) to compensate for the increase at low LTV (i.e., polarised portfolio allocation), which might leave the average LTV unchanged. Therefore, the result desired from a policy perspective would be an increase at low LTV alongside a reduction in the continuous measure of LTV.

$Post\ CP_t$ is a time dummy variable which indicates whether the mortgage transaction was made in the quarters following the consultation paper publication, i.e., in 2017 Q2 or later (the variable equals zero otherwise). $Post\ PS_t$ is an indicator of whether the mortgage transaction was made in the quarters after the policy statement publication, i.e., in 2018 Q1 or later (zero otherwise). The coefficient of this variable can be interpreted as the marginal effect of the publication of the policy statement net of the effect of the publication of the consultation paper. We exclude the quarters of the two treatment dates, consultation paper (2017 Q1) and policy statement (2017 Q4) as these quarters include both days before the publications as well as days after the publications. We interact the time dummy variables with $Eligible_b$ which indicates whether a 2019 SREP bank *b* was deemed eligible, using our no-risk-score-above-two-thirds criterion in our baseline analyses. γ_b is the vector of bank fixed effects which controls for time-invariant bank characteristics. This dummy variable absorbs the main effect of $Eligible_b$ which does not appear in our regression equation. $X_{i,b,t}$ is a vector of contract characteristics of mortgage transaction *i* (incentive period as well as the type of the interest rate, i.e., fixed rate). It also includes dummy variables to account for the geographic variation in the 12 UK regions included in our sample. We also interact these regional fixed effects with time.[20]

[20] We are grateful to an anonymous referee for this helpful suggestion. We employ dummy variables for each quarter.

In addition, in an alternative specification, we interact the time dummy variables and the eligibility dummy variables with a third dummy variable, denoted as $Supervision\ (high)_b$. It indicates whether bank *b* was subject to a high frequency of bilateral supervisory interaction. The aim of this triple-interacted term is to uncover whether eligible banks with a higher degree of supervisory interaction responded more promptly to the publications of the consultation paper and the policy statement (especially the former) than eligible banks with a lower degree of supervisory interaction.[21]

We double-cluster standard errors at the Bank x Time level. Our sample includes observations in the four years from 2016 Q1 until 2019 Q4. Hence, our estimated coefficients for the consultation paper ($Post\ CP_t$) and its interactions with $Eligible_b$ and $Supervision\ (high)_b$ can be interpreted as the treatment effects relative to the pre-event period from 2016 Q1 until 2016 Q4. Similarly, our estimated coefficients of policy statement ($Post\ PS_t$) and its interactions with $Eligible_b$ and $Supervision\ (high)_b$ can be interpreted as additional treatment effects relative to the effect of the consultation paper.

Similar to Rodnyansky and Darmouni (2017), we also estimate the effect of each of the time quarters included in our sample relative to 2016 Q1 until 2016 Q3. Undertaking these quarter-by-quarter analyses is relevant for two reasons: First, allows us to examine the validity of the parallel trends assumption of our difference-in-differences design. Specifically, we can examine whether eligible banks had started prepositioning before the publication of the consultation paper. Second, it allows us to examine the persistence of the effects over time. This is important from a policy evaluation perspective, in that a reversal of the prepositioning effect after the date relevant to the submission of the ICAAP (i.e., at the end of 2018 for the cohort of banks with a SREP in 2019) would raise suspicions of "window-dressing". By contrast, the persistency of the prepositioning effect would be in line with the aim of the policy. Regarding the second reason, there might be a pre-existing trend in our data with eligible banks investing in low LTV mortgages prior to the announcement of the policy. This would invalidate the parallel trends assumption in our difference-in-differences design. Formally, we estimate the following regression model using OLS.

$$Low\ LTV_{i,b,t} = \sum_{t=-1}^{T} \beta_t\ x\ Eligible_b\ x\ Time_t + \sum_{t=-1}^{T} \gamma_t\ x\ Time_t + \gamma_b + X_{i,b,t} + \varepsilon_{i,b,t}$$

[21] We limit the estimation of this alternative specification to the cohort of banks with SREP in 2019, as those in the 2020 cohort did not face the same degree of urgency to preposition in response to the consultation paper.

where $Time_t$ is an indicator of whether the observation is in quarter t (zero otherwise). For example, $Time_{t-1}$ indicates whether the mortgage transaction was done in 2016 Q4, the quarter before the publication of the consultation paper (zero otherwise). In the absence of prepositioning before the publication of the consultation paper, we expect the estimate of β_{-1} not to be statistically significantly different from zero. If it was negative, there might be evidence of prepositioning. Compared to the previous regression equation, we now include the quarters of the two treatment dates, consultation paper (2017 Q1) and policy statement (2017 Q4). All coefficients are estimated relative to 2016 Q1 as it allows us to estimate the effect of the three last quarters before the publication, from 2016 Q2 until 2016 Q4.

5. Results

5.1. The effect of capital reliefs on prepositioning

In Table 5, we examine whether banks with a SREP in 2019 preposition in low LTV after the two event dates, i.e., the publication of the consultation paper in February 2017 and the publication of the policy statement in October 2017. It shows simple differences in mean LTV where column 1 shows average LTV before the publication of the CP, column 2 shows average LTV after the publication of the CP and before the publication of the PS and column 3 shows average LTV after the publication of the PS. Column 4 tests mean differences between mean LTV before any publication and mean LTV after the publication of the PS. In summary, starting from broadly similar levels, eligible banks reduced their average LTV after the publication of the PS, whereas non-eligible firms moved in the opposite direction. Both results are statistically significant at the 1% level.

Table 5. Difference in average LTV across eligibility and over time

	Before	Post (CP)	Post (PS)	Difference
	(1)	(2)	(3)	(3) - (1)
Eligble	66.743	69.029	61.744	-4.999***
Non-eligible	64.498	63.494	73.728	9.229***

Note: This table shows the results of mean LTV across bank eligibility and time. It shows the results for banks that had their SREP in 2019 as well as banks with SREP in 2017 on a 1-/2-year cycle and banks with SREP in 2018 on a 1-year cycle. The first column shows average LTV in the period before the CP was published. The second column shows average LTV in the period after the CP was published and before the PS was published. The third column shows average LTV in the period after the PS was published. The last column tests differences in mean LTV between the first and the third column. ***, **, * denote statistical significance at the 0.01, 0.05 and 0.10-level respectively.

To further explore this apparent opposition, Table 6 shows the results of a linear regression model outlined above. In columns 1-2, the dependent variable is the propensity of banks granting a low LTV mortgage with an LTV of less than 60% (conditional on granting a mortgage). In columns 3-4, we show the effects changing the dependent variable to a continuous measure of LTV (again conditional on granting a mortgage). Explanatory variables are indicators of bank eligibility (using the below-two-thirds criterion) as well two time dummy variables, which correspond to the quarters of the two policy publications.

Table 6. The average effect of capital reliefs on prepositioning

Dependent variable	LTV (<60%)		LTV	
	(1)	(2)	(3)	(4)
Eligible x Post (CP)	-0.056	-0.031	2.168	1.643
	(0.054)	(0.048)	(2.638)	(2.586)
Eligible x Post (PS)	0.138***	0.127***	-7.227***	-7.076***
	(0.050)	(0.045)	(2.273)	(2.261)
Post (CP)	0.066		-2.305	
	(0.050)		(2.481)	
Post (PS)	-0.122***		5.702***	
	(0.045)		(2.022)	
Bank FE	YES	YES	YES	YES
Region FE	YES	NO	YES	NO
Region x Time FE	NO	YES	NO	YES
Contract variables	YES	YES	YES	YES
Observations	62,977	62,977	62,977	62,977
Number of banks	13	13	13	13
Eligible banks	9	9	9	9
Mean of dep. variable	0.344	0.344	66.433	66.433
R2	0.269	0.271	0.380	0.382
Clustered S.E.	YES	YES	YES	YES
Method	OLS	OLS	OLS	OLS

Note: This table shows the results of a linear regression model estimated using OLS on the mortgage transaction level. In columns 1 & 2, the dependent variable is the propensity of granting a low LTV loan below 60%. In columns 3 & 4, the dependent variable is the continuous variable, LTV. In all columns, this table shows the results for banks that had their SREP in 2019 as well as banks with SREP in 2017 on a 1-/2-year cycle and banks with SREP in 2018 on a 1-year cycle. Explanatory variables are a time dummy variable as well as its interaction with bank eligibility. In all columns, we control for contract variables and Bank FE. In columns (1) & (3), we include Region FE. In columns (2) & (4), we include Region x Time FE. Standard errors are clustered on the Bank x Time level. ***, **, * denote statistical significance at the 0.01, 0.05 and 0.10-level respectively.

The prepositioning effect is very pronounced in the aftermath of the publication of the policy statement. In fact, following the publication of the policy statement, eligible banks increased their propensity of investing in a low LTV mortgage (<60%) by almost 14 percentage points relative to ineligible banks and it is statistically significant at the 1 percent significance level (column 1). This

estimated effect decreases slightly by one percentage point once we control for regional X time fixed effects, but it remains statistically significant at the 1 percent significance level (column 2).

Results in columns 3-4 suggest that not only the share of low LTV mortgages increased but also the overall LTV composition of new mortgages decreased. That is, banks did not offset lending into low LTV mortgages by simultaneously increasing the share of lending to very high LTV borrowers. In fact, following the publication of the policy statement eligible banks decreased the average LTV of new mortgages by 7 percentage points relative to ineligible banks. These estimated effects are statistically significant at the 1 percent significance levels. This result is consistent with the aim of the policy as eligible banks also materially reduced the LTV level across their residential mortgage books. I

The sharpness of these results is strengthened in light of the fact that the coefficient of the non-interacted term, Post (PS), which captures the reaction of ineligible banks, is statistically significant at the 1 percent significance level (columns 1 and 3), but with an opposite sign. This contrast indicates that ineligible banks reacted to the prepositioning of eligible banks following the publication of the PS by adjusting their portfolios in the opposite direction, thus suggesting that the two set of banks are close competitors in the sense that ineligible banks are forced to accommodate the expansion of eligible banks in low LTV segments by repositioning towards higher LTV segments. This 'crowding-out' effect could be considered to be an unintended consequence of the policy in question, given that two of the eligibility criteria are that banks should have sound management and have a low risk profile.

There is no statistically significant effect in response to the publication of the consultation paper in February 2017. This is somewhat remarkable as it was very likely that the policy proposal consulted upon was going to be ultimately confirmed and thus implemented in January 2018. This is because the UK regulator had already signalled in 2016 its commitment to reduce the IRB vs SA gap in risk weights for residential mortgages by reviewing the methodology for setting P2A capital requirements.[22] Therefore, this suggests that regulated banks wait for the finalisation of the policy before reacting to it, no matter how well anticipated the policy in question. Another factor that could explain this delayed reaction from banks is the uncertainty of their eventual eligibility under the proposed scoping criteria.

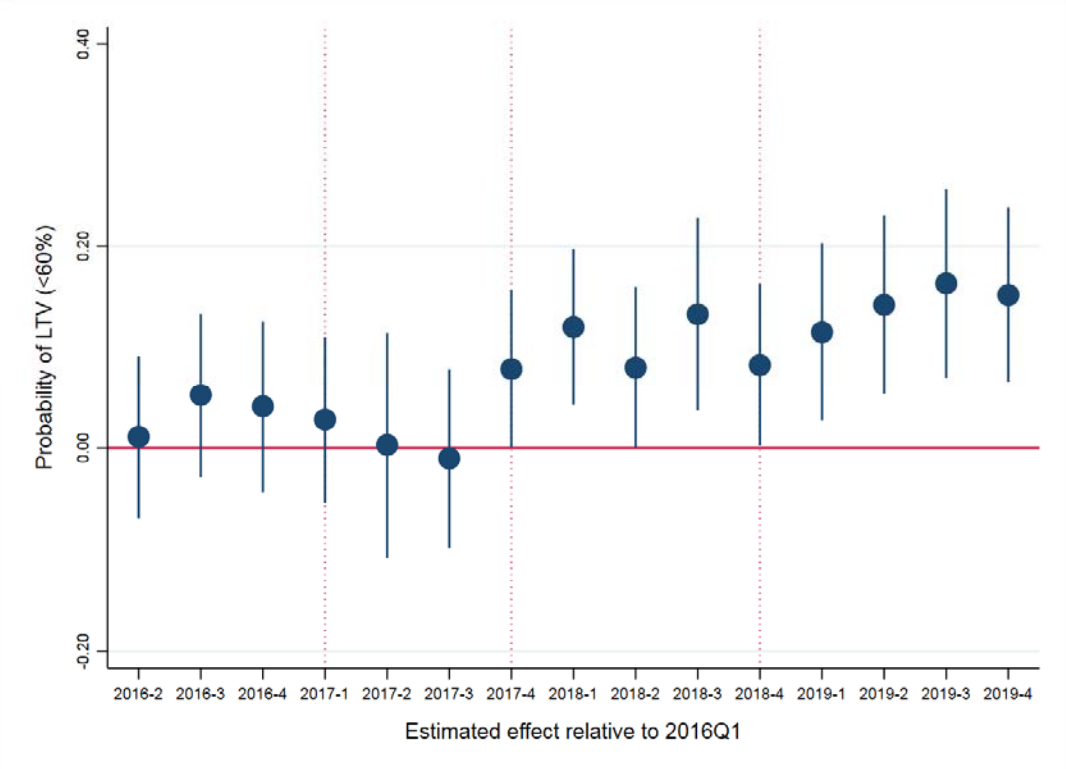
[22] See Sam Woods (Deputy Governor, Prudential Regulation and Chief Executive Officer, Prudential Regulation Authority), The revolution is over. Long live the revolution!, Speech at the City Banquet, Mansion House, London, 28 October 2016, p. 8, available at http://www.bankofengland.co.uk/publications/Documents/speeches/2016/speech933.pdf ("I have long been troubled, as I know have members of the Treasury Committee, by the gap in risk-weights for low-LTV mortgages between banks who use models to calculate them and (typically smaller) banks who use a standardised, and therefore relatively crude, weighting provided by regulators. Now of course the leverage ratio is an essential complement to the risk-weighted framework which mitigates the effect of such disparities. Nevertheless they still bother me both in light of our secondary competition objective, given the risk of an un-level playing field, but importantly also in light of our safety and soundness objective because of the economic incentive it provides for standardised banks to concentrate on higher-LTV lending. […] I intend that we will bring forward proposals under our Pillar 2 regime which should also reduce the risk that our capital standards are overly prudent for smaller banks using the standardised approach to credit risk to calculate their requirements – essentially by looking at capital requirements in the round rather than assuming that a simple "sum of the parts" approach will necessarily deliver the right answer.")

5.2. The persistency of effects of capital reliefs on prepositioning

In this section, we analyse the persistence of prepositioning by eligible banks. By doing so, we examine the validity of the parallel trends assumption of our difference-in-difference design. To that end, we estimate the effect of each of the time quarters included in our sample relative to the time period 2016 Q1 until 2016 Q3, in the spirit of Rodnyansky and Darmouni (2017).

In Figure 1a, we display the estimated quarterly coefficients and 90% confidence intervals employing LTV (<60%) as our dependent variable. The estimated coefficient in the quarter 2016 Q4 is close to zero and statistically insignificant. We conclude that there is no evidence that eligible banks prepositioned in the quarter before the publication of the consultation paper. In line with our previous results, we do not see evidence of prepositioning in the quarters following the publication of the consultation paper in 2017 Q1. Yet, banks start prepositioning in the quarter following the publication of the policy statement, 2018 Q1. Interestingly, the effects seem to be persistent over time. This is important evidence from a policy evaluation perspective, as the persistency of prepositioning is in line with the intention of the policy.

Figure 1a. Prepositioning into low LTV (<60%)

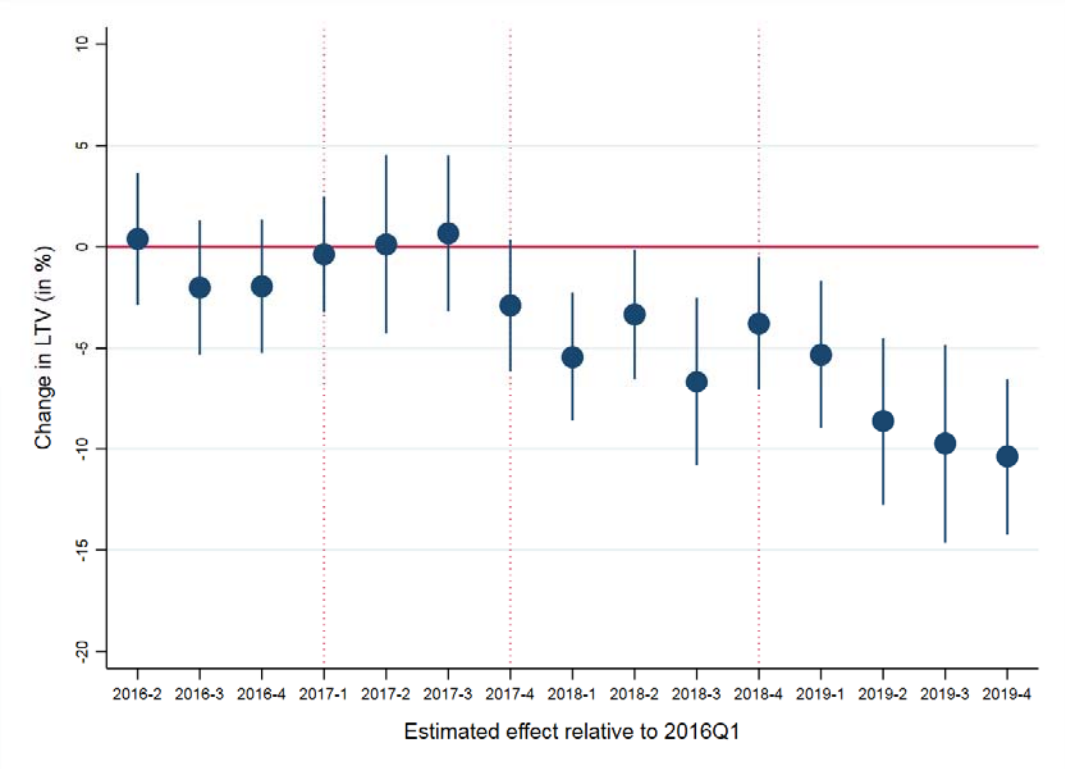


Note: Figure 1a shows the results of a linear regression model estimated using OLS on the mortgage transaction level. The dependent variable is the propensity of granting a low LTV loan below 60%. The coefficients displayed are the time dummy variables interacted with bank eligibility (below two thirds criterion). This figure shows the coefficients for banks that had their SREP in 2019 incl. banks with SREP in 2017 on a 1-/2-year cycle and banks

with SREP in 2018 on a 1-year cycle. The first dotted, vertical line relates to the quarter of the publication of the CP, 2017 Q1. The second dotted, vertical line relates to the quarter of the publication of the PS, 2017 Q4. The third dotted, vertical line relates to the last quarter of the year before banks had their SREP assessments, 2018 Q4. The horizontal line illustrates no effect relative to 2016 Q1. Standard errors are clustered on the bank x time level. The figure shows 90% confidence intervals.

In Figure 1b, we replicate our analyses on the estimated quarterly coefficients where the continuous measure, LTV, is our dependent variable. Again, the estimated coefficient in the quarter 2016 Q4 is close to zero and statistically insignificant. This confirms that there is no evidence of a violation of the parallel trends assumption. Moreover, the estimated effects are persistent over time. That is, the overall LTV composition of new mortgage lending decreased permanently following the publication of the policy statement.

Figure 1b. Prepositioning into LTV (continuous measure)



Note: Figure 1b shows the results of a linear regression model estimated using OLS on the mortgage transaction level. The dependent variable is the continuous variable, LTV. The coefficients displayed are the time dummy variables interacted with bank eligibility (below two thirds criterion). This figure shows the coefficients for banks that had their SREP in 2019 incl. banks with SREP in 2017 on a 1-/2-year cycle and banks with SREP in 2018 on a 1-year cycle. The first dotted, vertical line relates to the quarter of the publication of the CP, 2017 Q1. The second dotted, vertical line relates to the quarter of the publication of the PS, 2017 Q4. The third dotted, vertical line relates to the last quarter of the year before banks had their SREP assessments, 2018 Q4. The horizontal line illustrates no effect relative to 2016 Q1. Standard errors are clustered on the bank x time level. The figure shows 90% confidence intervals.

5.3. The role of supervisory interactions

Our findings on prepositioning may mask heterogeneity among the group of eligible banks driven by the frequency of their supervisory interactions. It is arguable that a bank with a higher number of supervisory interactions shall face a lower degree of uncertainty regarding its eligibility status one way or the other. For example, whilst more interaction may be due to a period of closer scrutiny to address specific concerns raised by supervisors, the affected bank can glean a better understanding of what concrete mitigating steps could be taken to secure eligibility.[23] To further investigate the impact of interaction with supervisors, we employ unique regulatory data on the bilateral interaction between banks and their supervisors.

We posit that *eligible* banks with a comparatively high frequency of supervisory interaction are more certain about their eligibility status and, therefore, more likely to be responsive to the publication of the consultation paper. It could be argued that at the consultation stage banks could have been uncertain about the likelihood of the proposal being confirmed or the likelihood of being eligible. However, as explained in Section 5.1, the PRA clearly signalled its firm intention to implement the proposal well in advance of the publication of the consultation paper. Therefore, the only residual source of uncertainty faced by banks was arguably around their eventual eligibility under the proposed scoping criteria.

In Table 7, we replicate our main analyses for our two dependent variables *LTV (<60%)* and *LTV* in columns (1) and (3), respectively. In the specifications shown in columns (2) and (4), we then add a triple-interacted term combining the time, eligibility, and high-frequency dummy variables. The specification in column (2) shows a coefficient on our triple-interaction term *Eligible x Post (CP) x Supervision (high)* of 21 percentage points at the 5 percent significance level, while the double-interacted coefficient of *Eligible x Post (CP)* is not statistically significant. This suggests that eligible banks with a high frequency of bilateral supervisory interactions already respond to the publication of the consultation paper by prepositioning into low LTV segments.

Once more, the salience of this result is amplified in light of the fact that the double interacted *Post (CP) x Supervision (high)* is of similar magnitude but of opposite sign, meaning that non-eligible banks with a high frequency of interaction with their supervisors also reacted earlier in response to the publication of the CP, but in an opposite direction to that of eligible banks. This makes intuitive sense. Finally, it is also to be expected that the triple and double interacted coefficients with respect to the

[23] It is worth pointing out that the two key determinants of ineligibility are supervisory concerns in terms of governance and riskiness of the business model.

publication of the PS are reverted, given the comparatively later response of both eligible and non-eligible banks with lower degree of supervisory interaction as reported in the previous section.

Table 7. The heterogeneous role of supervisory interactions

Dependent variable	LTV (<60%)		LTV	
	(1)	(2)	(3)	(4)
Eligible x Post (CP)	-0.031	-0.072	1.643	1.395
	(0.048)	(0.061)	(2.586)	(3.128)
Eligible x Post (PS)	0.127***	0.116**	-7.076***	-5.657*
	(0.045)	(0.054)	(2.261)	(3.103)
Eligible x Post (CP) x Supervision (high)		0.211**		-6.174
		(0.102)		(5.731)
Eligible x Post (PS) x Supervision (high)		-0.148**		5.251
		(0.061)		(3.883)
Post (CP) x Supervision (high)		-0.191**		8.523*
		(0.082)		(4.568)
Post (PS) x Supervision (high)		0.223***		-10.076***
		(0.036)		(2.210)
Bank FE	YES	YES	YES	YES
Region FE	NO	NO	NO	NO
Region x Time FE	YES	YES	YES	YES
Contract variables	YES	YES	YES	YES
Observations	62,977	62,977	62,977	62,977
Number of banks	13	13	13	13
Eligible banks	9	9	9	9
Supervision (high)	5	5	5	5
Mean of dep. variable	0.344	0.344	66.433	66.433
R2	0.271	0.272	0.382	0.383
Clustered S.E.	YES	YES	YES	YES
Method	OLS	OLS	OLS	OLS

Note: This table shows the results of a linear regression model estimated using OLS on the mortgage transaction level. In columns 1 & 2, the dependent variable is the propensity of granting a low LTV loan below 60%. In columns 3 & 4, the dependent variable is the continuous variable, LTV. In all columns, this table shows the results for firms that had their SREP in 2019 (or in 2017 on a 1-/2-year cycle or in 2018 on a 1-year cycle). Explanatory variables are a time dummy variable as well as its interaction with lender eligibility. In all columns, we control for contract variables and Bank FE. We also include Region x Time FE. Standard errors are clustered on the Bank x Time level. ***, **, * denote statistical significance at the 0.01, 0.05 and 0.10-level respectively.

5.4. The timing of policy implementation via SREP cycles

The fact that the prepositioning of banks with a SREP in 2019 persists throughout 2019 may have weakened the ability of the following cohort of eligible banks, those with a SREP in 2020, to do the same. In our main analyses in Table 5, we had shown that the sign, magnitude and significance of the non-interacted time dummies for the publications of the consultation paper and the policy statement indicated that the prepositioning of eligible banks crowed out to some extend non-eligible banks in the same cohort of banks with SREP in 2019. By the same token, the persistency of prepositioning for the 2019 SREP cohort may have prevented eligible banks in the 2020 SREP cohort from following suit. This is indeed what transpires when we replicate our main specification comparing eligible and non-eligible banks in the 2020 SREP cohort in that we find no evidence of prepositioning.

To investigate this further, we compare the two groups of eligible banks in the 2019 and 2020 cohorts over the eight consecutive quarters in 2018 and 2019. Compared to Table 5, we now replace the control group, i.e., those banks that had their SREP in 2019 but were ineligible, with banks that had their SREP in 2020 but were considered eligible. We then compare their prepositioning with banks that had their SREP in 2019 and were considered eligible.

Table 8 shows these results. The coefficient of the interaction term *Eligible x Post (PS)* is not statistically different from zero. This implies that there is no evidence that eligible banks in the 2019 SREP started prepositioning in comparison to the following cohort of eligible banks, those with SREP in 2020. The non-significance of the non-interacted *Post (PS)* time dummy variable indicates that eligible banks in the 2020 SREP cohort did not moved in the opposite direction. These results make intuitive sense, in that, although eligible banks in the 2020 cohort failed to replicate the prepositioning of the previous cohort of eligible banks, they did not reduce their presence in the low LTV segments as the non-eligible banks in the previous cohort.

Table 8. The impact on other SREP cohorts

Dependent variable	LTV (<60%)		LTV	
	(1)	(2)	(3)	(4)
Eligible x Post (CP)	0.103	0.101	-3.999	-4.262
	(0.064)	(0.062)	(2.913)	(2.834)
Eligible x Post (PS)	-0.023	0.004	0.598	0.139
	(0.063)	(0.058)	(2.780)	(2.638)
Post (CP)	-0.078		1.871	
	(0.062)		(2.843)	
Post (PS)	0.025		-0.175	
	(0.061)		(2.706)	
Bank FE	YES	YES	YES	YES
Region FE	YES	NO	YES	NO
Region x Time FE	NO	YES	NO	YES
Contract variables	YES	YES	YES	YES
Observations	82,012	82,012	82,012	82,012
Number of banks	18	18	18	18
SREP 2020 & eligible banks	10	10	10	10
SREP 2019 & eligible banks	8	8	8	8
Mean of dep. variable	0.307	0.307	68.720	68.720
R2	0.261	0.261	0.376	0.376
Clustered S.E.	YES	YES	YES	YES
Method	OLS	OLS	OLS	OLS

Note: This table shows the results of a linear regression model estimated using OLS on the mortgage transaction level using the subsample. In columns 1 & 2, the dependent variable is the propensity of granting a low LTV loan below 60%. In columns 3 & 4, the dependent variable is the continuous variable, LTV. In all columns, this table shows the results for firms that had their SREP in 2019 (or in 2017 on a 2-year cycle or in 2018 on a 1-year cycle) and were ineligible as well as firms that had their SREP in 2020 (or 2018 on a 2-year cycle) and were eligible. Explanatory variables are a time dummy variable as well as its interaction with bank eligibility. In all columns, we control for contract variables and Bank FE. In columns (1) & (3), we include Region FE. In columns (2) & (4), we include Region x Time FE. Standard errors are clustered on the Bank x Time level. ***, **, * denote statistical significance at the 0.01, 0.05 and 0.10-level respectively.

5.5. Refinements of our main analyses

In this subsection, we conduct two refinements of our main analyses. First, we show our main results employing two alternative thresholds for low LTV, below 50% and below 80%. Looking at LTV below 50%, compared to LTV below 60% as shown in columns (1)-(2) of Table 6, the prepositioning effect is almost half the size and significant only at the 5 percent significance level. By contrast, columns (3)-(4) indicate that the effect is much stronger in magnitude and statistically significance at the 1 percent level once we employ the more conservative criterion of LTV below 80%.

These results are intuitive. As shown in Table 1, the gaps in risk weights between IRB and SA, which drive the expected benefits in terms of capital relief from the policy implementation, are already material at LTV levels below 80%. Therefore, we would expect to see the posited prepositioning effect throughout the LTV bands below 80%. As a result, the lower the treatment LTV threshold and the weaker the prepositioning effect would tend to be, as higher LTV bands where prepositioning ought to already be taking place are excluded. In this respect, as shown in Table 4, 34% of mortgage originations are between 50% and 80%, as opposed to 26% at LTV below 50%. This distribution also entails that eligible banks must rely on relatively higher LTV bands as part of their prepositioning adjustments.

In summary, the results presented in table 9 confirm that banks that prepositioned did so across the entire spectrum of low LTV bands where a gap in risk weights between SA and IRB exist rather than just at the very low LTV end.

Table 9. The average effect of capital reliefs on prepositioning (alternative dependent variables)

Dependent variable	LTV (<50%)		LTV (<80%)	
	(1)	(2)	(3)	(4)
Eligible x Post (CP)	-0.022	-0.008	-0.086	-0.079
	(0.039)	(0.039)	(0.065)	(0.054)
Eligible x Post (PS)	0.077**	0.075**	0.191***	0.196***
	(0.032)	(0.032)	(0.058)	(0.050)
Post (CP)	0.037		0.066	
	(0.035)		(0.063)	
Post (PS)	-0.068**		-0.148**	
	(0.027)		(0.056)	
Bank FE	YES	YES	YES	YES
Region FE	YES	NO	YES	NO
Region x Time FE	NO	YES	NO	YES
Contract variables	YES	YES	YES	YES
Observations	62,977	62,977	62,977	62,977
Number of banks	13	13	13	13
Eligible banks	9	9	9	9
Mean of dep. variable	0.257	0.257	0.596	0.596
R2	0.253	0.254	0.307	0.308
Clustered S.E.	YES	YES	YES	YES
Method	OLS	OLS	OLS	OLS

Note: This table shows the results of a linear regression model estimated using OLS on the mortgage transaction level. In columns 1 & 2, the dependent variable is the propensity of granting a low LTV loan below 50%. In columns 3 & 4, the dependent variable is the propensity of granting a low LTV loan below 80%. In all columns, this table shows the results for firms that had their SREP in 2019. Explanatory variables are a time dummy variable as well as its interaction with bank eligibility. In all columns, we control for contract variables and Bank FE. In columns (1) & (3), we include Region FE. In columns (2) & (4), we include Region x Time FE. Standard errors are clustered on the Bank x Time level. ***, **, * denote statistical significance at the 0.01, 0.05 and 0.10-level respectively.

Second, we replicate our main analyses using an alternative eligibility criterion defining a bank to be eligible if it has an average risk score less than half of the maximum risk score.[24] Looking at the results in table 10, both the prepositioning effect and the reduction of the overall LTV level are slightly stronger in magnitude and at the same significance level to the ones presented in Table 6, especially when we control for the double regional x time fixed effect (columns 2 and 4). The prepositioning effect is less strong and only significant at the 10 percent confidence level in the specification with just the regional fixed effect (column 1).

[24] It is worth reminding that the number of banks deemed eligible falls from 9 to 3 under this alternative selection criterion.

Table 10. The average effect of capital reliefs on prepositioning (alternative eligibility criterion)

Dependent variable	LTV (<60%)		LTV	
	(1)	(2)	(3)	(4)
Eligible (avg. risk) x Post (CP)	-0.004	-0.041	1.693	3.033
	(0.043)	(0.038)	(2.087)	(2.000)
Eligible (avg. risk) x Post (PS)	0.093*	0.150***	-6.003***	-9.016***
	(0.046)	(0.036)	(2.194)	(1.672)
Post (CP)	0.037		-1.835	
	(0.042)		(2.005)	
Post (PS)	-0.061		2.774	
	(0.045)		(2.118)	
Bank FE	YES	YES	YES	YES
Region FE	YES	NO	YES	NO
Region x Time FE	NO	YES	NO	YES
Contract variables	YES	YES	YES	YES
Observations	62,977	62,977	62,977	62,977
Number of banks	13	13	13	13
Eligible banks	3	3	3	3
Mean of dep. variable	0.344	0.344	66.433	66.433
R2	0.267	0.271	0.379	0.382
Clustered S.E.	YES	YES	YES	YES
Method	OLS	OLS	OLS	OLS

Note: This table shows the results of a linear regression model estimated using OLS on the mortgage transaction level. In columns 1 & 2, the dependent variable is the propensity of granting a low LTV loan below 60%. In columns 3 & 4, the dependent variable is the continuous variable, LTV. In all columns, this table shows the results for firms that had their SREP in 2019. Explanatory variables are a time dummy variable as well as its interaction with lender eligibility. In all columns, we control for contract variables and Bank FE. In columns (1) & (3), we include Region FE. In columns (2) & (4), we include Region x Time FE. Standard errors are clustered on the Bank x Time level. ***, **, * denote statistical significance at the 0.01, 0.05 and 0.10-level respectively.

6. Application: Estimating the shadow cost of capital for small banks

This section discusses how our estimates of the adjustment in the portfolio allocation ahead of the SREP can be used to quantify a lower bound of the shadow cost of small banks' regulatory equity capital requirements. This is because the portfolio adjustment thereof is costly in that it entails a departure from what must have been considered to be the optimal portfolio allocation under the existing regulatory treatment.[25] Accordingly, the cost of prepositioning must be lower than the benefits from the expected capital relief that can be accrued by the bank from the next supervisory

[25] We are implicitly assuming that the current optimal portfolio allocation is constant over the prepositioning period.

review onward. Regarding the latter, the determining factor is the cost of equity capital, which is typically unobservable for small and unsophisticated banks targeted by this policy. In this section, we propose a way to gauge the minimum (unobservable) cost of equity capital faced by these opaque banks by employing the (observable) cost of prepositioning which we estimate.

In the following exposition, we assume that the balance sheet size is not constant. Banks can increase their lending by raising more liabilities (i.e., typically in the form of retail deposits). However, banks are not able to increase equity resources at their discretion. This entails that, when they are bound by regulatory capital requirements (as we assume), an expansion of the balance sheet is only possible in response to a reduction in capital requirements (i.e., thanks to the capital relief). In this respect, under the SA, the risk weight for low LTV residential mortgages is slightly lower than the one at high LTV: $RW_{SA}^{H} > RW_{SA}^{L}$. This means that for any unit of lending at high LTV, they can invest $\frac{RW_{SA}^{H}}{RW_{SA}^{L}} > 1$ units at low LTV.

An eligible bank incurs the cost of propositioning in the initial period, i.e., the announcement of the policy but before its SREP. It is equal to the opportunity cost of investing in a high-risk asset (relative to a low-risk asset). Opportunity costs come from a lower return for low LTV mortgages (i.e., $r_L < r_H$).[26] This, however, is partly offset by a slightly higher nominal amount as the risk weight for low LTV mortgages is lower (i.e., $RW_{SA}^{L} < RW_{SA}^{H}$). Accordingly, the cost of prepositioning can be formulated as follows:

$$Cost\ of prepositioning = \Delta\theta_l \left(r_H * \frac{RW_{SA}^{L}}{RW_{SA}^{H}} - r_L \right)$$

where $\Delta\theta_l$ is the degree of prepositioning (i.e., the change in the share of lending to low-risk assets), r_H is the return on high-risk assets and r_L is the return on low-risk assets. We assume that banks that preposition by expanding their exposure at low LTV maintain that allocation until the following supervisory review (i.e., in line with the aim of the policy).

Banks benefit from a capital relief at the time of the supervisory review which happens after the announcement of the policy. From capital budgeting purposes, we assume that banks can reinvest the extra amount of equity resources at the corresponding cost of equity capital r_E until the following supervisory review. Therefore, both the cost of prepositioning and the expected benefits from it are

[26] In this respect, we implicitly assume that the reduction in interest rate is not at least partly compensated by correspondingly lower provisions for expected losses. We believe that this is a defensible assumption given that, as shown in Table 3, the average LTV for eligible firms before prepositioning was already lower than 60%.

subject to the same timeframe corresponding to the 3-year SREP cycle. This simplifies the analysis in that we can ignore discounting on both sides. Therefore, we arrive at the following inequality:[27]

$$\Delta\theta_l \left(r_H * \frac{RW_{SA}^L}{RW_{SA}^H} - r_L \right) \leq E[Capital\ relief] * r_E$$

Numerical example

In this subsection, we provide a numerical example of the cost of capital calculation. To derive both the ratio $\frac{RW_{SA}^L}{RW_{SA}^H}$ and the expected capital relief we rely on the table published by the regulator comparison risk weights between SA and IRB, as shown in Table 1.

RW_{SA}^L is equal to 35%. To calculate RW_{SA}^H we simply take the average of the SA risk weights for the four LTV bands above 60%, which results in an average risk weight of 37.25% and a ratio of 0.94.[28]

Regarding the expected capital relief, we rely on an indication provided by the regulator in its 2018 Annual Competition Report that "on average, we anticipate these [banks]' minimum capital requirements will reduce by 10%–15%."[29] Assuming a Total Capital Requirement of 10% and a risk-weighted assets density of 36.5%,[30] the expected capital relief is 0.36%-0.55% of total assets, which is directly comparable with the cost of prepositioning, also expressed as a % figure out of total assets.

For illustrative purposes, we assume that a "Bank A" has the following return on assets $r_H = 3.6\%$ and $r_L = 3.1\%$. Its expected capital relief is 0.50% and its degree of prepositioning is 12%. This would yield a lower bound of the cost of capital r_E of 6.8%:

$$r_E \geq \frac{12\% * \left(3.6\% * \frac{35\%}{37.25\%} - 3.1\%\right)}{0.50\%} = 6.8\%$$

Estimates of bank-specific lower bound of capital cost

We then estimate the bank-specific cost of capital for the subset of banks with SREP 2019 that were eligible. To do so, we estimate multiple regressions by comparing the degree of prepositioning bank-by-bank relative to all banks in the control group. We use the 60% LTV threshold given that this LTV band combines both a wide IRB vs SA gap (i.e., expected benefits) and the largest differential in interest rates (i.e., profit sacrifice). We observe that the degree of prepositioning ranges from 10% to

[27] This approach rest on the underlying simplifying assumption that banks are monoline mortgage banks, i.e., they only invest in mortgage loans.

[28] We ignore the residual band with $LTV \geq 100\%$ due to a low number of mortgages in the sample period.

[29] See PRA, 2018 Annual Competition Report, June 2018, p. 33, available at https://www.bankofengland.co.uk/-/media/boe/files/annual-report/2018/pra-2018.pdf?la=en&hash=929BC2A486101460E1A371FF96F0DC73B424BF0F.

[30] This figure is the average of the SA risk weights across the 6 LTV bands as shown in Table 9. This approach is in line with the assumption that the relevant banks are monoline mortgage banks.

21%, being 15% on average.[31] Similarly, we obtain bank-specific estimates of capital reliefs from internal policy impact assessments ahead of the publication of the policy statement. They range from 0% of total assets to 0.9% of total assets. To proxy the return on high LTV and low LTV mortgages, we use the average rates of 2-year fixed mortgages in the year 2016 below LTV 60% and at least 60%. We find that these shadow costs of capital differ across banks ranging from 7% to 16% being 11% on average. It is worth noting that this estimate is only marginally above the estimates for the cost of capital for large banks.[32]

7. Conclusions

We study a salient change in policy which creates an incentive for banks to change their asset composition in order to benefit from a reduction of their capital requirements. We examine whether banks react to anticipated reliefs of capital requirements and to which of the announcements in the policy lifecycle they react.

Using a novel dataset of the population of all residential mortgages and supervisory risk scores, we demonstrate that banks likely to receive capital reliefs increase their benefit by investing into low-risk assets (i.e., low LTV mortgages) following the publication of the policy. In addition, using unique data on the frequency of bank-supervisor interaction, we then show that likely eligible banks that have a higher number of supervisory interactions reacted earlier in response to the publication of the consultation paper. We interpret this as indicative evidence that the bilateral communication between regulated banks and their supervisors allowed the former to better gauge whether they were likely to be in scope of, and thus benefit from, the policy in question.

From a policy evaluation perspective, we find that not only the initial response of eligible banks, increasing their exposure to lower risk assets, goes in the direction intended by the policy, but also that the response persists beyond its implementation. Such persistence rules out opportunistic gaming that would have been problematic from a prudential perspective. However, we detect the opposite effect for ineligible banks, that is, reducing their exposure to lower risk assets. Similarly, we find that eligible banks with more time to change their asset composition failed to invest in low-risk assets, once those in the previous cohort had already prepositioned.

[31] We exclude two outliers with no prepositioning at all.

[32] For example, the latest survey by the European Banking Authority estimates banks' cost of equity to be in the range of 8%-10%: see European Banking Authority, Risk Assessment Questionnaire – Summary of the Results, June 2019, available at https://eba.europa.eu/sites/default/documents/files/documents/10180/2854739/916f8c4b-7099-4aba-ac1f-882cfd4c3583/RAQ%20Booklet%20Spring%202019.pdf.

References

Abbassi, P., R. Iyer, J.L. Peydro, and P. Soto (2018), "Dressing up for the regulators: Evidence from the largest-ever supervisory review", *Working Paper*.

Andrade, P., G. Gaballo, E. Mengus, and B. Mojon (2019), "Forward guidance and heterogeneous beliefs", *American Economic Journal: Macroeconomics* 11 (3), 1–29.

Acharya, V.V., Schnabl, P. and Suarez, G. (2013), "Securitization without risk transfer", *Journal of Financial economics* 107 (3), 515-536.

Begley, T.A., A. Purnanandam and K. Zheng (2017), "The strategic under-reporting of bank risk", *Review of Financial Studies* 30 (10).

Behn, M, R. Haselman and V. Vig (2014), "The limits of model-based regulation", ECB Working Paper No. 1928, available at https://www.ecb.europa.eu/pub/pdf/scpwps/ecbwp1928.en.pdf.

Benetton, M., P. Eckley, N. Garbarino, L. Kirwin and G. Latsi (2021), "Capital requirement and mortgage pricing: Evidence from Basel II", *Journal of Financial Intermediation* 48.

Bholat, D., J. Brookes, C. Cai, K. Grundy and J. Lund (2017), "Sending firm messages: text mining letters from PRA supervisors to banks and building societies they regulate", Bank of England Staff Working Paper No. 688, available at https://www.bankofengland.co.uk/-/media/boe/files/working-paper/2017/sending-firm-messages-text-mining-letters-from-pra-supervisors-to-banks-and-building-societies.pdf?la=en&hash=A7246EBC75A6836A1EB7662930F913EA8D34DB6F.

Bruno, B., E. Onali and K. Schaeck (2018), "Market reaction to bank liquidity regulation", *Journal of Financial and Quantitative Analysis* 53 (2).

Buch, C., M. Buchholz and L. Tonzer (2015), "Uncertainty, bank lending, and bank-level heterogeneity*", IMF Economic Review*, 63 (4).

Cloyne, J., K. Huber, E. Ilzetzki, and H. Kleven (2019), "The effect of house prices on household borrowing: A new approach", *American Economic Review* 109 (6).

Chavaz, M. and D. Elliott (2020), "Separating retail and investment banking: Evidence from the UK", Bank of England Staff Working Paper No. 892.

Eckley, P., W. Francis and A. Mathur (2021), "In the dangerzone! Regulatory uncertainty and voluntary bank capital surpluses", mimeo.

Fraisse, H., M. Lé and D. Thesmar (2019), "The real effects of bank capital requirements", *Management Science* 66 (1).

Gissler, S., Oldfather, J. and D. Ruffino (2016), "Lending on hold: Regulatory uncertainty and bank lending standards", *Journal of Monetary Economics* 81, 89–101.

Gropp, R., Mosk, T., Ongena, S. and C. Wix (2019), "Bank response to higher capital requirements: Evidence from a quasi-natural experiment", *Review of Financial Studies* 32 (1), 266–299.

Gropp, R., Mosk, T., Ongena, S. I. Simak, and C. Wix (2021), "Supranational Rules, National Discretion: Increasing versus Inflating Regulatory Bank Capital?", *Working Paper.*

Jokipii T. and A. Milne (2008), "The cyclical behaviour of European bank capital buffers", *Journal of Banking & Finance*, 32 (8).

Kara G. and Y. Yook (2019), "Policy uncertainty and bank mortgage credit", *BIS Working Papers* 820, Bank for International Settlements.

Kisin, R., and A. Manela (2016), "The shadow cost of bank capital requirements", *Review of Financial Studies* 29 (7).

McKay, A., E. Nakamura, and J. Steinsson (2016), "The power of forward guidance revisited", *American Economic Review* 106 (10), 3133-58.

Rodnyansky, A. and O. M. Darmouni (2017), "The effects of quantitative easing on bank lending behavior", *Review of Financial Studies* 30 (11), 3858–3887.

Schäfer, A., I. Schnabel, and B.W. di Mauro (2017), "Bail-in expectations for European banks: Actions speak louder than words", CEPR Discussion Paper No. 11061, available at https://cepr.org/active/publications/discussion_papers/dp.php?dpno=11061.

Soto P.E. (2020), "Breaking the word bank: Effects of verbal uncertainty on bank behavior", *Journal of Financial Services Research* (1-2).

Stolz S. and M. Wedow (2011), "Banks' regulatory capital buffer and the business cycle: Evidence for Germany", *Journal of Financial Stability*, 7 (2).

Valencia F. (2016), "Bank capital and uncertainty", *Journal of Banking & Finance*, 69 (S1-S9), 51–59.

Annex

Table A1. Examples of wording in supervisory review letters

Low risk
• It would be helpful in future iterations of its ICAAP if the bank explained how this figure, and the calibration of the trigger for action, were arrived at. • We encourage the bank to consider how the risk function will develop to provide proactive challenge and take full ownership of the bank's risk framework. • The bank's credit risk appetite should be better articulated.
Medium risk
• Further evolution of MI is however required, with appropriate commentary to facilitate Board discussion. • Progress has been made on the development of the Risk Management Framework (RMF). (…) The bank recognised that while the new RMF is materially embedded, it cannot be fully so until all the new executive hires are in place and the ongoing cultural changes embedded. • Whilst the continued commitment of the NEDs has been critical in achieving progress, we believe that this arrangement is likely to be unsustainable in the medium to longer term and that it may – if continued – compromise their independence. • We ask that the scope of their remit is widened to include a review of bank's pricing model, in addition to other financial models too in line with good practice and governance.
High risk
• The focus of our supervisory strategy for the next twelve months will therefore continue to be the bank's development of a long term strategy to accrete capital resources and the ongoing management of the risks of its loan book. • We would therefore ask you to review your approach to hedging FX risk as a matter of urgency and provide us with the output of your analysis by the end of October.

Swiss Finance Institute

Swiss Finance Institute (SFI) is the national center for fundamental research, doctoral training, knowledge exchange, and continuing education in the fields of banking and finance. SFI's mission is to grow knowledge capital for the Swiss financial marketplace. Created in 2006 as a public–private partnership, SFI is a common initiative of the Swiss finance industry, leading Swiss universities, and the Swiss Confederation.

swiss:finance:institute

c/o University of Geneva, Bd. Du Pont d'Arve 42, CH-1211 Geneva 4
T +41 22 379 84 71, rps@sfi.ch, www.sfi.ch