# In the dangerzone! Regulatory uncertainty and voluntary bank capital surpluses

Peter Eckley*, William Francis†, and Aakriti Mathur‡§

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**Abstract**

Banks voluntarily hold substantially more capital than required by regulators. Understanding why is important for forecasting the extent to which banks would use this surplus to support lending in a crisis, and therefore for calibrating macroprudential policy. This paper examines the role that uncertainty about regulatory capital requirements plays in banks' choice of voluntary capital surpluses. We use two new measures of regulatory uncertainty based on bank-level confidential regulatory data and news-media text. A one standard deviation increase in regulatory uncertainty increases banks' voluntary capital surpluses by 0.8 to 2 percentage points on average. This is economically significant compared to a Basel minimum capital requirement of 8%. And this effect is stronger when banks operate closer to their regulatory minima, i.e. in the "dangerzone".

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*Bank of England. Email: Peter.Eckley@bankofengland.co.uk
†Bank of England. Email: Bill.Francis@bankofengland.co.uk
‡Corresponding author. Bank of England. Email: Aakriti.Mathur@bankofengland.co.uk
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# 1 Introduction

Capital regulation features prominently in the oversight of the banking sector and requires that banks support their activities with minimum amounts of capital. By forcing banks to internalize the costs that their behaviours can impose on the economy, capital regulation aims to affect bank behaviour and reduce the likelihood of disruption to payment and lending services, which are vital to a healthy economy. As a result, understanding the efficacy of capital regulation in that role continues to be of interest to policymakers and academics alike.

The impact of minimum capital requirements on banks' choice of capital ratios (or voluntary surpluses), in particular, has received considerable attention in the banking literature. Studies on this issue generally document a positive relationship between capital ratios (or surpluses) and capital requirements (Ediz *et al.*, 1998; Alfon *et al.*, 2004; Francis and Osborne, 2010; Gropp *et al.*, 2019; Imbierowicz *et al.*, 2018; De Jonghe *et al.*, 2020), indicating that banks increase capital ratios (surpluses) in response to higher capital requirements. They also find that this behaviour is evident even when requirements are not technically binding. This result is consistent with there being a precautionary motive underlying banks' capital management practices, which drives banks to choose capital ratios (surpluses) to self-insure against the risk of costly non-compliance.[1]

But banks make this choice in an environment where policymakers constantly make decisions that alter the nature, timing and impact of capital requirements, as well as the penalties associated with non-compliance.[2] Banks therefore face significant uncertainty about the underlying requirements that is likely to affect their capital management decisions. Indeed, in recent years, banks have begun to consider regulatory uncertainty and complexity around the Basel III international capital standards as two of their most important challenges (Hancock and Ruffino, 2017; BCBS, 2018).

Understanding the impact of uncertainty about capital requirements is important, since, if it affects precautionary behaviour, it could have consequences for banks' willingness to deploy capital to support lending to the broader economy. Questions about the effect of such precautionary behavior have risen to the fore considering the Covid-19 pandemic, which has heightened uncertainty about the economy and future losses more generally. Offering some insights, Valencia (2016) shows that uncertainty about factors affecting capital resources also increases banks' voluntary surpluses because of the self-insurance motive. The analysis, however, assumes that capital requirements are either fixed (or certain) or known well in advance. We contend that this self-insurance motive may also derive from another source of uncertainty around the "rules of the game". To the best of our knowledge, the effect of uncertainty regarding capital regulation and requirements on bank behaviour has not yet been studied empirically.

We address this gap by empirically investigating the effect of policy-related uncertainty regarding capital rules and requirements on banks' choice of voluntary capital surpluses.

[1]Banks face considerable costs if they breach (or as they approach) minimum requirements. These include costs related to increased supervisory oversight and market discipline, as well as transaction, signalling and agency costs associated with need to raise capital. In the extreme, a bank can be closed and lose its valuable charter.

[2]See Barth and Miller (2017) and Herring (2018) for good overviews of just how extensive the policy debates have been around the Basel international capital standards over the past several decades.

We focus on the United Kingdom between 1989 and 2013. Our focus on the UK is motivated by the nature of its domestic regulatory regime, which, discussed below, offers a unique source of uncertainty with which to investigate this issue.

Identifying a suitable proxy of regulatory capital uncertainty is central to our analysis. We approach this task in two ways. First, in the spirit of Baker *et al.* (2016) and Eckley (2015), we construct a measure of policy-related uncertainty using textual analysis of press articles. It is an index of uncertainty based on a filtering algorithm designed to pick up keywords specifically related to banking policy uncertainty. We use this as a systematic measure of capital policy uncertainty common to the UK banking sector. We interpret it as uncertainty about the underlying rules and the penalties associated with breaching such rules.

Second, we use a proprietary data set of confidential, bank-specific capital requirements to develop a complementary measure of uncertainty. Set as part of the UK regulator's long-standing practice (since the late 1980s), these bank-specific capital requirements, known as 'trigger' ratios, reflect add-ons to the 8% minimum requirement designed to capture risks not considered in the international standards. Several features of these data make their use appropriate as a novel measure of uncertainty in our study. First, the add-ons are based on supervisors' judgements about, among other things, weakness in a bank's systems, governance and controls (Ediz *et al.*, 1998; Francis and Osborne, 2009, 2012; Aiyar *et al.*, 2014b). Second, they are confidential and not known by the market. Third, the supervisory process for establishing bank-specific requirements involved consideration of the add-ons assigned to peer institutions. In this regard, the process was highly discretionary and not known to (or observable by) banks in the UK. Finally, trigger ratios were updated every 18-36 months; however, the exact timing of such updates was not known with certainty. For these reasons, banks faced an additional source of uncertainty about the extent and timing of capital requirements under the UK's capital regime. We exploit the variation in bank-specific requirements to develop a second, complementary measure of uncertainty, the mean-absolute deviation of individual requirements for each bank. We interpret this measure as an idiosyncratic measure of uncertainty.[3]

To identify the effect of uncertainty, we set up a partial adjustment model where the main dependent variable is the capital surplus as a percentage of its risk-weighted assets, and the key explanatory variables are (alternatively) the two measures of uncertainty. The key advantage of the model is that it allows us to separate the long-run equilibrium relationship between banks' capital resources and explanatory variables, which we interpret as banks' capital targets, from the short-run adjustment dynamics, for which we have no theory priors. Consequently, we focus on the long-run relationships in our analysis. Our specification also contains a parameter for the pace of adjustment towards the bank's capital target.

We find evidence of a persistent positive association regulatory capital uncertainty (under either measure) and capital surplus, consistent with precautionary behaviour. In our preferred model, we find that a one standard deviation increase in uncertainty about regulatory capital requirements (by either measure) is linked to an increase in banks'

[3]Under Basel III, supervisory discretion is built into the capital requirement via 'Pillar 2', which allows supervisors to impose additional confidential, bank-specific capital requirements for risks not captured as part of the minimum 'Pillar 1' requirement.

capital targets by 0.8 to 2 percentage points of risk-weighted assets.[4] These results are economically significant as well, as they represent 10% to 25% of the Basel minimum capital requirement of 8%.

Our results also provide support to existing evidence that shows that banks prefer to build their capital surpluses using either retained profits, or through deleveraging (see, for example, Gropp *et al.*, 2019 and Cohen and Scatigna, 2016). The main implication of this finding is that if the time-varying capital requirement regime is perceived to be sufficiently uncertain or discretionary, especially during a downturn or a negative shock such as that from the Covid-19 pandemic, banks would be unlikely to use their surpluses to support lending, preferring instead to self-insure by building additional capital surpluses or headrooms. This would be counter-productive to the policy makers' objective.

To identify possible mechanisms through which uncertainty propagates in banks' capital management practices, we investigate whether the positive effect of regulatory capital uncertainty on capital surplus exhibits heterogeneity in the cross section. In particular, we focus on banks that operate closer to their capital requirements âĂŞ i.e. those that are in the "dangerzone". These banks should respond even more strongly to any perceived increase in uncertainty around requirements. The mechanism relies on the assumption that any adjustment or non-compliance costs are likely to be steeper for "dangerzone" banks that need to build their capital surpluses quickly, than comparable banks at safe distance-to-requirement. If that is the case, then the impact of uncertainty shocks may likely to be more pronounced at such firms. To test this hypothesis, we use several different measures of proximity to minimum requirements and, under each, find that the effect of uncertainty on capital surplus is more pronounced at "dangerzone" banks. More specifically, in line with our hypothesis, we find that the effect of uncertainty is on average three times stronger for these "dangerzone" banks, irrespective of how they are defined.

The results hold under a battery of robustness checks, including using alternate proxies of control variables, sub-sampling by period and bank size and ownership class, using different treatments of outliers, controlling for sample composition changes and profit volatility, and using different estimation techniques. Crucially, we show that our results are not an artefact of crisis adjustments, or a peculiar feature of the post-crisis period. Additionally, although the way in which the UK's domestic capital regime worked mitigates endogeneity concerns around the use of the bank-specific uncertainty measure, we pursue an additional exercise to examine this issue. We first regress bank-specific capital requirements on a set of bank and time fixed effects, similar to Buch *et al.* (2015), and then use the dispersion of residuals to construct a bank-specific measure of uncertainty. We obtain qualitatively similar results when using this alternative measure of uncertainty.

Our work has important implications for policy discussions around regulatory buffer usability. Several new "regulatory buffers" were introduced after the global financial crisis, such as the capital conservation buffer (CCoB). In this new regime, additional costs are imposed on banks in normal times if they are in breach of their combined Basel III regulatory buffers, including having restrictions placed on dividend distributions. However, the objective of these buffers is to encourage banks to use them in supporting lending when economic conditions deteriorate and certainty fades, such as that being faced during the Covid-19 pandemic. The issue is that these new regulatory buffers have

[4] A one standard deviation increase in uncertainty is observed, for example, when capital regulation was moved from the Bank of England to the Financial Services Authority (FSA) in 2001.

not been tested since their introduction, raising concerns around their usability (see, for example, BCBS, 2019; FSB, 2020; BOE, 2020; Federal Reserve, 2020).

For banks operating at or close to their Basel III regulatory buffers, there are three sources of uncertainty. The first is around the supervisor's precise response function during adverse states of the world, for example, in the use of discretion, and in any return to normality. The second source of uncertainty stems from any additional costs or penalties that might be imposed on the bank, for example, in terms of additional scrutiny, and whether these costs may be made steeper or conditional on the extent or duration of buffer use or even market conditions. The third, and equally important, source of uncertainty stems from market discipline. In particular, banks may not want to be seen moving first to use their regulatory buffers if their peers are not doing so.

While a key focus of our paper is on understanding how uncertainty may affect banks' precautionary capital management behaviour, our empirical results may be informative for the debate around "buffer usability" more broadly. That is, the empirical results can be qualitatively generalised to any kind of uncertainty surrounding capital requirements, even if the details of the regime change over time. This is because uncertainty in this scenario operates through a common precautionary channel: an asymmetric and monotonically increasing cost function for any bank that approaches or breaches its minimum requirements. If the new regulatory buffers are considered as de facto minimum requirements, then our results indicate that banks are likely to be quite hesitant to dip into them in an effort to support lending activity. In this scenario, buffer usability could be improved through a combination of improved communication and constrained discretion. These tools are already being considered as further policy options by central banks during the Covid-19 pandemic.

The remainder of the paper is organised as follows. In section 2, we explore the relevant literature and how it applies to our work. In section 3, we discuss the evolution of capital regulation in the UK, and provide details on construction of our uncertainty measures in section 4. The empirical specification with a detailed discussion of various variables is in sections 5.1 and 5.2. Section 6 onwards presents the results and section 7 concludes.

# 2 Linking uncertainty, capital surpluses, and danger-zone banks

Our paper relates closely to existing work on how uncertainty affects economic agents. In this section, we focus on this strand of the literature to demonstrate the analytical link between uncertainty and capital surpluses. We also contribute to two other strands in the literature, specifically empirical measurement of uncertainty (discussed in greater detail in section 4.1), and the theoretical and empirical determinants of surpluses (section 5.2).

The Knightian concept of uncertainty relates to the inability to accurately forecast the likelihood of occurrence of certain events. This implies that future shocks have an unknown probability distribution.[5] Most existing evidence points to the fact that economic

[5]To that extent, it is distinct from risk, which involves a known probability distribution over a set of events (Bloom, 2014).

agents dislike high uncertainty. They tend to re-weight probabilities towards unfavourable future events, confounding "certain" for good and "uncertain" for bad, and taking up a wait-and-see approach (Biljanovska *et al.*, 2017).[6]

The theoretical background for the wait-and-see effects of uncertainty lies in real options theory (Bernanke, 1983; Brennan and Schwartz, 1985; Dixit and Pindyck, 1994), which relies on the fact that corporate investment has (at least partial) irreversibility and high adjustment costs – the latter, in particular, being a feature that is extendable to bank capital.

The main link between capital surpluses and regulatory uncertainty comes from the fact that in the presence of financial frictions, the most important reason why banks hold capital surpluses is to avoid accidentally breaching the minimum requirement (Lindquist, 2004; Jokipii and Milne, 2008; Stolz and Wedow, 2011). Alfon *et al.* (2004) surveyed 13 large and medium-sized banks in the UK in 2003, and found that avoiding the consequences of a potential breach was regarded as "very important" by all of them. In the theoretical model by Peura and Keppo (2006) where raising capital is costly and takes time, uncertainty around a possible "breach" takes the form of a regulator that randomly checks in to see whether the bank is complying with the minimum requirement. The bank therefore has an incentive to hold surpluses to prevent being shut down when it is audited.

In the real options literature, it is costlier for the firm to invest and then have a worse state of the world materialize. This makes them cautious. In a similar vein, for a bank specifically considering uncertainty around their capital requirements (or any decisions which can effect their resources, like lending), it is costlier to be caught holding less than the minimum. As a result, the bank always prefers to hold precautionary surpluses. As policy uncertainty increases, the value of the option to build surpluses increases.[7]

Our paper fits directly with a smaller set of work at the intersection of uncertainty and bank behaviour. The paper most closely related to ours is Valencia (2016). Using a model of bank capital in the presence of financial frictions, the author shows that forward-looking banks have an incentive to self-insure by holding more capital when uncertainty around loan return realisations increases. This is because an increase in uncertainty increases funding costs and hurts profitability. The empirical results show that uncertainty as measured by the relative equivalent precautionary premium (REPP) explains nearly 50% of US banks' regulatory capital surpluses.[8] Our paper complements this analysis by looking at a different source of uncertainty, namely that surrounding the bank's capital resources and minimum requirements.

There is consensus that bank lending decreases when there is a general increase in uncertainty (see, for example, Cheng *et al.*, 2019; Bordo *et al.*, 2016; Kara and Yook, 2019).

[6] Agents can display ambiguity aversion (Ilut and Schneider, 2014) when they have pessimistic beliefs and act as if only the worst outcomes will occur. In that case, as the range of possible outcomes or uncertainty expands, they may aggressively cut back on investment decisions. Additionally, as Bloom (2014) points out, good events are not usually associated with uncertainty, either because good news develops slowly over time, therefore allowing for adequate time to change beliefs more smoothly, or because bad news by itself generates uncertainty.

[7] The concept of precautionary surpluses also links to the literature that shows uncertainty increases precautionary savings by consumers (Bansal and Yaron, 2004; Bloom, 2014).

[8] Analytically, REPP is defined as the certain increase in capital for bank $i$ in the absense of uncertainty, which is set as equal to the capital (net of dividends) that is yielded with uncertainty.

Soto (2020) uses machine learning techniques to construct a bank-specific measure of uncertainty, reflecting the bank's perception of the various uncertainities facing it, and finds that higher uncertainty in general is associated with lower lending. Our work complements this strand of the literature by narrowing down the source of uncertainty and looking at its implications for capital behaviour. Buch *et al.* (2015) measure country-wise banking sector uncertainty as the cross-sectional dispersion in bank-level variables. Using this measure, the authors find that higher uncertainty reduces lending; however, this relationship is weaker in banks that are better capitalised and hold higher liquidity buffers. For us, this implies that better capitalised banks should be less affected by uncertainty.

Therefore, next we shift our focus to *dangerzone* banks, that is, banks that are operating closer to their minimum requirements as compared to the sector in any given quarter. Our push along this direction is also grounded in the literature that shows that a bank that approaches its minimum requirement faces increasing regulatory costs.[9] In Furfine (2001), the costs of approaching the minimum are assumed to be continuous, so a bank that currently meets its requirement may not be completely unaffected by them. These costs can take various forms, for example, a poorly capitalised bank may have restrictions imposed on its activities, may be required to submit future capitalisation plans, or may have to reduce flow and size of dividends. In the extreme case, the bank can fail.

Ediz *et al.* (1998) find that banks who are close to their minima (measured as one standard deviation above the triggers) in the last period tend to build up capital more aggressively than their "safer" counterparts. This finding is similar to Rime (2001), who finds that Swiss banks that approach their minimum requirements build their capital ratios more aggressively to avoid penalties imposed due to a breach by the regulator. In Heid *et al.* (2004), the authors find that the relationship between bank capital and risk is also dependent on the amount of capital banks hold in excess of the regulatory minimum.

## 3 Capital regulation in the UK

There have been two components of minimum capital requirements in the UK between 1989-2013. The first comprised of internationally-agreed rules such as through Basel I which set a "hard floor" for the requirements. On top of that, there was a confidential and discretionary add-on imposed by the UK banking regulator that was both bank and time specific.

$$\text{Total minimum requirement} = \overbrace{\underbrace{\text{Basel I 8\%}}_{Publicly-known} + \underbrace{\text{Discretionary add-on}}_{Confidential}}^{Confidential}$$

There have been three international capital reporting regimes in the UK (de Ramon *et al.*, 2017). The first regime until 1997 Q1 corresponded to the 1988 Basel Accord (Basel I), when risk-sensitive capital requirements were introduced for the first time (Francis and

[9]These costs are built into the way capital rules are designed – as argued in Goodhardt (1995), the arbitrary nature of capital requirements means that supervisors need to pre-commit themselves to a series of graduated responses to any transgressions to avoid time inconsistency and forbearance.

Osborne, 2010). Consequently, UK banks were expected to hold a minimum 8% of risk-weighted assets as capital.

Over the period 1997 Q2 to 2007 Q4, Basel I was amended to reflect, among other things, risks on trading activities. Between 2008 Q1 and 2013 Q4, UK moved to Basel II and II.5, when revisions were made to increase the sensitivity of capital requirements to credit risk and higher requirements were introduced on securitisation positions, off-balance sheet vehicles, and trading book exposures (de Ramon *et al.*, 2017). Work on implementing Basel III in the UK had already started by 2010 (Basel Committee on Banking Supervision, 2010).

The second component was a discretionary domestic policy of imposing additional capital surcharges, also called "trigger ratios", on top of the Basel 8% minimum. The overall minimum requirement for each bank was therefore a sum of the Basel 8% and the trigger ratio or add-on. A breach of these overall requirements would "trigger" a regulatory intervention by the banking regulator, Bank of England between 1988–1998 and the Financial Services Authority from 1998 till 2013. We draw on four features of these capital add-ons for for identification.

First, the add-ons were both bank and time-varying, unlike most countries in the world which had a flat 8% requirement between 1988 and 2013. This variation in requirements is captured in our data. Between 1989 and 2013, the overall minimum requirement, i.e. the sum of the Basel 8% and the add-on, had an interquartile range of 9.5% to 14%, and averaged 12.3% (figure 2). Second, the add-ons, and therefore the overall requirements, were confidential. Each bank's add-on was known only to itself and was not made public. Therefore, banks were unaware of the requirements of their peer groups, although supervisors could use information regarding peers' requirements in their decision-making process (FSA, 2008).

Third, the add-ons were imposed in order to address several recognized shortfalls in the Basel regime, which did not explicitly consider the potential for bank losses emanating from interest rate, legal, reputational, and organisational risks (Francis and Osborne, 2010). Regulators would base their decisions on firm-specific reviews and judgements around organization structures, systems, and reporting procedures, rather than, for example, credit risk factors (Aiyar *et al.*, 2014a; Ediz *et al.*, 1998). In his review of the pre-crisis regulatory architecture, Turner (2009) found that neither did the FSA's add-ons adequately consider business model risks and sustainability nor did they rely on a developed financial analysis (FSA, 2008). Echoing this "light-touch" regulatory philosophy, one senior official said in 2006 (Huertas, 2006):

> *In our supervisory work we make an estimate of the degree to which we can rely on the firm's own governance and control systems to identify, assess, manage and control risk. (...)*
> *If we conclude that we can rely on the firm's own governance and controls, we do just that. We employ what we perceive to be a lighter regulatory touch, and review the work of internal control departments such as internal audit and risk management (...)*

Anecdotal and empirical evidence also supports the view that capital requirement changes were exogenous with respect to balance sheet variables (De Marco and Wieladek, 2015). Aiyar *et al.* (2014b), for instance, find that changes in capital ratio requirements were not associated with past or future changes in the credit risk of loans, and that bank balance sheet variables in general could not predict quarterly time variation in bank-specific capital requirements. We also replicate a similar analysis of regressing quarterly trigger ratios on balance sheet observables, and a full set of bank and time fixed effects. None of the included variables are significant across a host of different specifications and variable transformations.

Finally, the timing of supervisory reviews varied significantly in practice although in principle, trigger ratios were to be reviewed at least once or twice every one and half to three years. These timings were also not uniform across the cross-section of banks. There was also the possibility of variation in the composition of supervisory teams and assessment panels, as documented thoroughly in (FSA, 2008).

# 4 Regulatory uncertainty

The total policy uncertainty affecting bank $i$'s capital ratio at time $t$ can be defined as a function of two components:

$$F(\underbrace{\eta_t}_{\text{sector-level}}, \underbrace{\zeta_{i,t}}_{\text{bank-specific}})$$

The first parameter $\eta_t$ includes all aspects of policy uncertainty that affect banks' decisions of how much capital resources to hold. We define this measure at the banking sector level to allow for any common component to policy uncertainty, for example arising through international arrangements like Basel I.

Bank-specific uncertainty ($\zeta_{i,t}$) is uncertainty surrounding the bank's minimum capital requirement. As discussed in section 3, this measure relies on the fact that between 1989 and 2013, UK banks were subject to a bank and time-varying supervisory add-on or trigger. We use rolling dispersion of the bank-specific add-on to construct this second measure of uncertainty, interpreting it as supervisory discretion.

Existing work on empirical measurement of uncertainty relies on four types of conceptual proxies: volatility of a data series, text-based measures, dispersion in forecasts, and dispersion of firms' productivity shocks.[10] Our measures fall in the first two categories, and are complementary to each other as they tackle different aspects of uncertainty surrounding bank capital (resources vs. requirements). In the remainder of the section, we first discuss the text-based measure, and then the bank-specific measure.

## 4.1 Textual measures of banking sector uncertainty

Our textual measures of policy uncertainty are based on the methodology by Baker *et al.* (2016) and Eckley (2015). Baker *et al.* (2016) construct economic policy uncertainty measures (henceforth EPU) based on newspaper articles for several countries. The measure is based on monthly counts of articles that contain words relating to uncertainty,

[10] For a more detailed discussion, refer to Bloom (2014).

economy, and policy, scaled by the total number of articles. Their main finding is that policy uncertainty is associated with greater stock price volatility and reduced investment and employment in policy-sensitive sectors.[11] Our measure is constructed similarly, but is narrow in scope. Eckley (2015) discusses the theoretical properties and empirical considerations of constructing news-based uncertainty measures.

To construct our main text-based measure on banking sector policy uncertainty, we use articles published in four general audience UK newspapers - The Guardian, The Times, The Independent, and The Daily Telegraph - accessed using Lexis Nexis.[12] Next, we count the number of articles in these newspapers that mention UK banking or banking policy at a quarterly frequency between 1989 and 2013 (see appendix A.1 for more details on keyword selection). This gives us a total of $90,881$ articles, or roughly 920 articles per quarter.

We then count the subset of articles that in addition to being about banking or banking policy, also contain uncertainty and related words (see Sandile, 2016 and appendix A.1). Filtering based on these key word searches produces a smaller sample of $26,338$ articles, that is, 272 articles per quarter, that are more finely focused on the intersection of banking, banking policy, and uncertainty. Therefore, on average, uncertainty is mentioned in a third of the articles relating to banking policy in the UK each quarter.

In a third step, and as is standard in the literature, we scale the smaller set of uncertainty-related articles by all banking and banking policy related articles. This is because raw counts can be misleading – there may be differences in coverage volumes across newspapers for example, or fluctuations in the popularity of specific topics. For each newspaper, $p$, in each quarter, $t$, we obtain the share $UncRatio_{p,t}$:

$$UncRatio_{p,t} = \frac{\text{Articles on banking policy in UK which mention uncertainty or related words}_{p,t}}{\text{All articles on banking policy in the UK}_{p,t}}$$

Following Husted *et al.* (2017), we standardize the time series $UncRatio_{p,t}$ to have standard deviation equal to one. We then sum the resulting series across the four newspapers, and scale the sum to have mean 100. This final series represents our text-based measure of banking regulatory uncertainty or *BRU:Narrow*, and is the main proxy for policy uncertainty in our empirical analysis of banks' choice of capital buffers.

For comparison, we complement the narrow measure with a broader version of the indicator, based on articles from a more finance oriented newspaper, the Financial Times (FT), accessed using Factiva. To construct this index using information from the FT, we follow the same approach as before, but remove any mentions of the word "policy" from our keywords, as described in appendix A.2. This index therefore refers to a much broader set of uncertainties in the banking sector that stem not only from policy, but can still affect resources.

[11] Alexopoulos and Cohen (2015) similarly construct a general economic uncertainty index using the New York Times and find that uncertainty depresses the level of economic activity, increases stock market volatility, and decreases market returns.

[12] These papers are also used by Husted *et al.* (2017) to construct their measure of UK monetary policy uncertainty index.

The universe of all FT articles on the UK banking sector (roughly 1 million articles) forms the denominator of this variable. The numerator consists the subset of articles that additionally contain mentions of uncertainty or related words (roughly $28,000$ articles).[13] We then scale the counts of numerator articles by denominator articles, to get the percent of uncertainty related FT articles as a share of total banking sector related articles, which we label as *BRU:Broad*.[14]

### Discussion

Figure 3 reports the 2-quarter rolling average of our banking regulatory uncertainty (BRU) measures: broad, *BRU:Broad*, and narrow, *BRU:Narrow*. The two measures are significantly positively correlated (0.45) at the 1% significance level.

Both measures are elevated – the narrow measure more than the broad one – during the early-to-mid 90's, reflecting uncertainty caused by the small banks crisis, when banking losses in the UK were over three times as high as those in the GFC (Balluck *et al.*, 2016).[15] Increases in both measures also coincide with uncertainty around how capital regulation would change once the Financial Services Authority (FSA) was set up after 2001. This is evident from, for example, IMF (2003):

> *"External observers suggested that there continues to be significant* ***uncertainty*** *in the financial community about the process used by the FSA to manage the various objectives assigned to it. (....)*
> *It believes that time will help generate practical experience and knowledge. Nonetheless, the continuing* ***uncertainty*** *suggests the need for further efforts to help regulated institutions and the general public improve their understanding of the new regulatory framework."* (page 171, emphasis ours)

Finally, as expected, both uncertainty measures increase substantially around the global financial crisis (GFC) although the broad measure shows a relatively steeper increase after 2008. This difference is potentially driven by the way the broad measure is constructed, which reflects other uncertainties to a larger degree as compared to the narrow measure, such as those surrounding the macroeconomy, monetary policy, and the reaction of supervisors to the crisis. Due to the same reason, by the end of the sample (2013 Q2),

[13] Note that double negation of the word "uncertainty" is relatively rare and Eckley (2015) finds that "not uncertain" appears only in 12 of two million articles in his sample of FT articles. Similarly, an earlier version Baker *et al.* (2016) conducted a human audit of 5000 articles on economic policy uncertainty, and found that only 1.8% of those articles mentioned low or declining uncertainty. The result indicates that newspapers tend to publish articles about uncertainty only when it is high or rising.

[14] We also construct other variants of these indices, such as one on capital regulation uncertainty that is based on a larger, more specialised, set of keywords (eg. *CRD IV* or *Basel I/II/III* or *capital requirements*, etc). This reduces the total number of article counts to 7800 (denominator), with the uncertainty-related counts to 700 (numerator). However, coverage gaps in the initial part of the sample due to the extensive keywords leads to sharp spikes in this measure, rendering it less useful for any further analysis.

[15] The *small banks crisis* in the UK started in July 1991 with the failure of Bank of Credit and Commerce International (BCCI), precipitated by the recession in the early 90s. Over a course of four years, roughly 25 small banks failed (Balluck *et al.*, 2016). There was a flight of deposits from these small banks, as interbank liquidity dried up. Though the banks were not by themselves systemically important, their failures increased uncertainty and fear in wholesale markets, as a result of which the Bank of England had to step in to provide liquidity support (Logan, 2001).

once the broad set of rules around Basel III were finalised, the narrow measure shows a sharp decline, while the broad measure stays elevated. In appendix A.3, we provide additional sanity checks for the narrow uncertainty measure (*BRU:Narrow*) since it is our main variable of interest.

Next, we check how our textual measures are correlated with other well-known and widely used measures of uncertainty, such as general policy uncertainty in the UK (EPU from Baker *et al.*, 2016), realised market volatility (calculated using data from the FTSE), and macroeconomic uncertainty (dispersion of GDP growth forecast, and the Bank of England's overall macroeconomic uncertainty indicator).[16] It is clear that these are measures of *macroeconomic* or *market* uncertainty and to that extent capture different information than what we are interested in.[17]

However, as shown in table 1, all the measures are quite highly and significantly correlated with one another. Our main measure, *BRU:Narrow*, is positively and significantly correlated at the 1% confidence level with EPU (0.35) and macroeconomic uncertainty (0.49), and negatively correlated with GDP growth (−0.40). This is in line with intuition since uncertainty is known to be counter-cyclical, that is, it increases when the macroeconomic situation is worsening. From table 1, we can see that the broader measure, *BRU:Broad*, is less correlated with macroeconomic uncertainty and GDP growth, but more correlated with EPU – indicating also that it is a more general measure of uncertainty for the banking sector than *BRU:Narrow*.

It is also interesting to see how our two text-based measures of uncertainty have evolved from one capital regime to another. Using capital reporting regime dates from de Ramon *et al.* (2017), we plot the densities of both the uncertainty measures for each regime in figures 4 and 5. For both measures, we see that there is a shift of the distribution to the right (indicating increases in uncertainty) for the last capital regime in the post-crisis period. However, this rightward shift is more pronounced for the broad measure than the narrow measure, implying that general uncertainty in the banking sector as captured by our measures has increased by far more than uncertainty only around banking policy.

## 4.2 Bank-specific measure of uncertainty

We use dispersion in the bank's supervisory add-ons or triggers to construct the bank-specific measure of uncertainty. Specifically, we calculate the mean absolute deviation of the add-on for each bank over the last eight or twelve quarters. The construction reflects the idea that a volatile series is harder to forecast (Bloom, 2014) and can affect the accuracy of agents' expectations. The time periods are chosen since triggers had to be reviewed by supervisors atleast once or twice every one and a half to three years (Francis and Osborne, 2010). The measure is shown below (equation 1) for a trigger $t$,

[16] The Bank of England's macroeconomic uncertainty index is the first principal component of seven series that capture different facets of uncertainty in the UK. These series are: the FTSE implied market volatility, Sterling option-implied volatility, dispersion of company earnings forecasts, dispersion of annual GDP growth forecasts, unemployment expectations balance, "demand uncertainty limiting investment" score, and total number of press articles citing economic uncertainty (Haddow *et al.*, 2013).

[17] A similar observation is made by Baker *et al.* (2016), who highlight the distinction between different measures of uncertainty – in their case, VIX and EPU – which are measured differently and relate to uncertainty about different aspects of the economy.

and $q = 8, 12$ quarters:

$$\text{Bank-specific uncertainty, } MADTRIG_{it}^{q} = \frac{\sum |\text{trigger}_{it} - \overline{trigger}_{i,t-1:t-q}|}{q} \quad (1)$$

The main advantage of this measure is that it is easy to calculate and has an intuitive interpretation. An increase in the measure reflects an increase in supervisory uncertainty with respect to each individual bank's capital requirement or "add on". Because of the way that triggers were set (see section 3), it can be interpreted as an increase in supervisory discretion. Indeed, this indicator is similar to measure on intensity of regulatory oversight or scrutiny used by, for example, Lindquist (2004) and Peura and Keppo (2006), which also considers the likelihood that requirements will be increased in the future at short notice.

At time $t$, the bank must decide how much capital to hold for the next time period $t+1$, when the new capital requirement will be communicated. Using information over the preceding eight to twelve quarters, the bank observes that the distribution of its add-ons has widened. This increase in capital requirement uncertainty makes it cautious, making it more likely that it will prefer to build up its capital surpluses between $t$ and $t+1$ to avoid any accidental breach of the minima. The construction of the indicator over a rolling window means that any increase in the dispersion dissipates slowly over four to five quarters. However, this gradual reversion to zero (i.e. no uncertainty) after a one-off change in the requirement is not unreasonable given the presence of significant financial frictions in capital accumulation and asymmetric non-compliance costs of breaching the minima.

Figure 6 plots the average $MADTRIG_{it}$ for all banks in the sample every quarter (constructed over $q = 8$ *or* 12), along with the *BRU:Narrow* index. We find a significant positive correlation between bank-specific uncertainty and both measures of banking sector policy uncertainty (narrow and broad). For instance, the correlation of $MADTRIG_{it}^{q=12}$ with the broad BRU is 0.37 and with the narrow BRU is 0.12 in the panel (both significant at the 1% level). In the early part of the sample, there were few changes in individual capital requirements, which means that the average *MADTRIG* measure in the early part of our estimation period is close to zero, but uncertainty about individual capital requirements appears to heighten starting around 2001 when supervision of banks and building societies was transferred to the UK FSA and individual capital requirements were changed more frequently (figure C.1). The sharp uptick in mean absolute deviation of triggers is in 2008 Q1.[18]

Although this measure represents a step forward in obtaining a bank level proxy for capital requirement uncertainty, it comes with two caveats.[19] The first is that while true

[18]Between 2008 Q2 and 2010 Q4, 48% of trigger changes in our sample were decreases, the rest increases.

[19]In an ideal world, a cleaner measure of bank-specific uncertainty could be constructed using letters sent by supervisors communicating the trigger decision. However, we could not find a systematic record of FSA letters to banks that would cover a sufficiently long time period or sample of banks. An analysis of supervisor communication in the UK has only been done in Bholat *et al.* (2017), who restrict their sample to whatever FSA letters they could access for the pre-crisis period, and all letters under the new PRA in 2014 and 2015.

uncertainty is forward looking, the *MADTRIG* measure is by construction backward looking as it relies on past changes in the trigger. However, in the absence of survey evidence with a sufficient coverage of years and banks, which might speak to the forward-looking element of capital requirement uncertainty, this measure is still an improvement. The second caveat relates to the measure's symmetry, since it does not distinguish between increases and decreases in the trigger, but is merely based on the absolute changes. This type of measurement is standard in the literature, since it closely relates to the concept of Knightian uncertainty. Symmetric treatment of uncertainty may be an issue if agents are able to forecast accurately and disentangle between good and bad uncertainty (decreases and increases in triggers respectively) and take decisions accordingly, but evidence so far does not indicate that that is the case (Biljanovska *et al.*, 2017).

# 5 Econometric analysis

We use confidential bank balance sheet and capital requirements data from the *Historical Banking Regulatory Database* (HBRD) at the Bank of England. It covers the full banking system between 1989–2013.[20] In our analysis, we focus on solo-consolidated banks.

The main dependent variable is *surplus*. It is defined throughout as the actual capital holdings less the overall minimum requirement, as a percentage of risk weighted assets for each bank in each quarter (similar to Valencia, 2016; Shim, 2013). Figure 1 shows the evolution of *surplus* over the sample. It varies perceptibly by the capital regulatory regime, with the post-2007 period not on average very different from the preceding regimes. Surplus is also consistently right-skewed, implying that a few banks – building societies and other small banks – hold much higher surpluses than average (see also figure C.2).

## 5.1 Empirical specification

Following previous work (Flannery and Rangan, 2006; Francis and Osborne, 2010; de Ramon *et al.*, 2016), our specification is derived from a partial adjustment model of capital. The bank's target surplus is determined by its balance sheet characteristics, and in each period, it adjusts gradually towards that target with a view to minimize adjustment costs. We can write it out as the following autoregressive distributed lag model:

$$s_{i,t} = \beta_1 s_{it-1} + \beta_2 x_{i,t} + \beta_3 x_{it-1} + \epsilon_{i,t} \tag{2}$$

$$\implies s_{i,t} - s_{it-1} + s_{it-1} = \beta_1 s_{it-1} + \beta_2 x_{i,t} + \beta_3 x_{it-1} + \epsilon_{i,t}$$

$$\implies \Delta s_{i,t} = \theta[s_{it-1} - \gamma x_{it-1}] + \beta_2 \Delta x_{i,t} + \epsilon_{i,t} \tag{3}$$

where, $s_{it}$ is the surplus for bank $i$ at time $t$, and $x_{it}$ are the balance sheet variables that proxy the bank's internal capital surplus target (discussed in detail below). The model

[20] For a detailed discussion, refer to de Ramon *et al.* (2017).

parameters can be re-written as:

$$\text{Rate of convergence to equilibrium} : \theta = \beta_1 - 1$$
$$\textbf{Long-run rates of adjustment} : \gamma = \frac{\beta_2 + \beta_3}{1 - \beta_1}$$
$$\text{Impulse responses} : \phi = \beta_2$$

In the interest of space, we report $\theta$ and $\gamma$ for all specifications. There are two main advantages of using this model. First, we are interested in how balance sheet variables ($x_{it}$) affect the long-run adjustment of surplus capital, which might be quite different from the short-run mechanisms, for which we have no theory priors. Second, we can extract average *speeds of adjustment* of capital surpluses from the parameter $\theta$.

We expect $\theta$ to be between $[-1, 0)$ and significantly different from zero. If $\theta$ is close to $-1$ then the speed of adjustment towards the long-run surplus is quite fast, but if it is closer to 0, then the bank's adjustment is slow. A priori, we expect slow adjustment of bank capital surpluses on average, unless they are operating closer to their minimum requirements (i.e. in the "dangerzone"). We define the half-life of surplus capital as the number of years required for a unit shock to dissipate by one-half (Kim *et al.*, 2007).

## 5.2 Data and explanatory variables

We use an unbalanced sample of 239 banks, of which foreign subsidiary assets account for an average of 26% over the entire sample.[21] Appendix B contains more information on the data processing, and table B.1 provides variable definitions and their sources. Our main hypotheses can be written down as follows:

**Hypothesis 1 (H1):** *An increase in uncertainty is associated with an increase in surplus capital, holding all else equal.*

**Hypothesis 2 (H2):** *On average, speed of adjustment of surplus capital is slow; but it is much faster for those closer to their minimum requirement ("dangerzone" banks).*

**Hypothesis 3 (H3):** *The effect of uncertainty is higher for "dangerzone" banks.*

Regulatory uncertainty that affects bank capital resources and requirements is our main variable of interest. We expect the coefficient on it to be positive. When there is an increase in regulatory uncertainty, the bank's next period minimum becomes a moving target (as the probability distribution of possible outcomes widens). It therefore becomes less certain about whether it will be able to meet its minimum requirement in the next period.[22] The bank then, holding all else equal, is likely to minimize the expected cost of an accidental breach in the next period by building precautionary capital surpluses – in essence using the intervening time as a transition period.

[21] The results are robust to the exclusion of foreign subsidiaries. For one set of robustness checks, see table D.10; others are available on request.

[22] As long as the bank is not *certain* that it will face a decrease in the requirement next period, there exists a non-zero probability of facing an increase.

Bank's may adjust their surplus capital based on peer effects of the kind discussed in Lindquist (2004) - that is, banks holding excess capital to serve as an instrument in the competition for unsecured deposits and money market funding (Tabak *et al.*, 2011). In that case, banks would care about their buffers only in relation to their peers. In our analysis, we do not look at peer effects of this kind between different types of banks. Instead, we focus on the **distance to requirement** for a bank, defining it in a way that incorporates elements of peer effects.

The probability of facing a costly breach of the minimum is higher for a bank that is operating closer to its requirement than a bank who is farther away.[23] Therefore, increases in regulatory uncertainty - which increases the probability of being subject to these costs - should effect these "dangerzone" banks more than it does "safe" banks. We use three dummy variables as measures of *dangerzone* banks (similar to Ediz *et al.*, 1998; Rime, 2001; Stolz and Wedow, 2011; Brei and Gambacorta, 2016).

The first two are specified as being in the bottom tercile or below median in the overall surplus capital distribution that period. In a sense therefore, these capture the overall "peer" effect. A third definition is the bottom tercile from the *publicly-observable* minimum requirement of 8%. This is because in the UK, each individual bank's triggers, and therefore surpluses, are private information and consequently unobservable to the other banks or the market. Also, even though each individual bank can choose the amount of surplus capital it holds, it cannot influence its designation as a "dangerzone" bank based on our definitions. This is because the designation is based on the cross-sectional distribution of surplus for the banking sector each quarter, which can be considered more exogenous to the individual bank.

A priori, we expect the effects of uncertainty to be the strongest for these *dangerzone* banks. However, in the end it is an empirical question whether it is the distance from the private or public minimum that matters more - and this relationship is likely to be bank and time varying.

### Controls

Based on the assumption that the bank is cost-minimising (Francis and Osborne, 2010; Ayuso *et al.*, 2004), there are several other variables that have been traditionally used to explain variation in surplus capital and to proxy for banks' internal capital targets.

Adjustment costs are particularly important, measured as the coefficient on the lagged dependent variable, $surplus_{i,t-1}$. Banks generally find it costly to adjust their capital ratios - and therefore surpluses - very quickly because of a host of non-negligible stock and flow costs (Kashyap *et al.*, 2010; Ayuso *et al.*, 2004). Therefore, the sign on this should be positive. The second variable is cost of funding, which we define as return on equity. The expected sign on this is negative: the higher the cost of remunerating excess capital, the lower the surplus the bank is likely to hold (Ayuso *et al.*, 2004; Stolz and Wedow, 2011; Jokipii and Milne, 2008).[24]

[23] These costs may be continuous, as in Furfine (2001), and decreasing in the distance-to-requirement.

[24] In some cases, the coefficient on ROE can also be positive, reflecting a profitability interpretation, that is, higher the profits, higher the surplus held by the bank.

High adjustment costs mean that banks facing adverse shocks to their capital may prefer to build surpluses using retained profits or by cutting lending activity rather than issuing new public equity that might be interpreted as a negative signal (Kashyap *et al.*, 2010; Berger *et al.*, 1995).[25] Therefore, we expect that the coefficient on retained profits should be positive, while the one on loan growth should be negative. To the extent that capital requirements - the potential credit supply constraints - are hardly ever binding in our sample on average, loan growth proxies for credit demand (Ayuso *et al.*, 2004).[26]

The third variable is cost of failure, measured as ratio of provisions to total assets, which has an ambiguous sign. A positive coefficient would imply that banks act prudently, that is when their riskiness based on regulatory or internal assessments increases, they hold more surpluses to cover for any potential losses. A negative sign could be a sign of moral hazard induced by deposit insurance or too-big-to-fail subsidies. The negative sign could also imply that riskier banks have better risk management policies (Francis and Osborne, 2010).

Another important determinant of surplus capital is market discipline or signalling. Market discipline, stemming from bank stakeholders like uninsured depositors, might affect bank funding costs as well and force banks to hold higher surpluses to reduce leverage and therefore likelihood of failures (Francis and Osborne, 2010). Additionally, banks may also hold higher surpluses to signal soundness to the market and rating agencies (Jokipii and Milne, 2008). We measure market discipline by subordinated debt to total assets.[27]

Size is also an important indicator of a bank's surplus capital. Larger banks have greater portfolio diversification, benefit from too-big-to-fail subsidies, advantages in the access to capital (Aiyar *et al.*, 2014b; Berger *et al.*, 2008), and economies of scale in screening and monitoring of borrowers (Francis and Osborne, 2010; Tabak *et al.*, 2011). Therefore, they usually hold much smaller surpluses than smaller banks (Elizalde and Rafael, 2007; D'Erasmo, 2018). In table 2, we show that this is true for the UK as well – the median small bank (defined as a bank with less than 1% share of total banking sector assets) holds 14.4% surplus capital, whilst a median large bank (those with share greater than 1% in total banking sector) holds 2.9%.[28] In our analysis, we will use time demeaned size ($\text{tds}_{i,t} = log\ \text{assets}_{i,t} - \overline{log\ \text{assets}_t}$), and we expect the coefficient on it will be significantly negative.

The business cycle or state of the economy is an important macroeconomic control, the sign on which is ambiguous, and likely state-dependent. For example, Estrella (2004) argues that banks increase capital ratios in anticipation of loan losses, because of the presence of adjustment costs. Since loan losses lag the business cycle, this could mean that actual buffers increase in downturns. This negative relationship could also be evidence of myopic bank behaviour, in that banks fail to fully internalise risks during the upturn, leading to a fall in their capital ratios. On the other hand, papers such as Borio *et al.*

[25] Cohen and Scatigna (2016) find after the global financial crisis, large global banks built up their capital ratios through retained earnings.

[26] However, Aiyar *et al.* (2014b) argue that binding capital requirements are perfectly compatible with non-zero capital surpluses, as long as banks capital ratios change in response to requirements.

[27] Subordinated debt holders are typically the first to bear losses in the event of bank failure, but unlike shareholders do not participate in the upside of the bank's risky investments. Therefore, holders of subordinated debt, which are rated, have an incentive to require a higher risk premium, as well as stronger incentive to monitor the bank's behaviour.

[28] These results are robust to other definitions of "large" and "small" banks and also of surplus capital.

(2001) argue that risks that materialise in a downturn build up during the preceding boom. Under this explanation, rational banks will build up buffers during good times.

Finally, as we discussed earlier, the textual measure may contain references to macroeconomic or monetary policy uncertainty in the context of the banking sector, but these are not particularly interesting for us. Therefore, we control for these in every specification. We measure macroeconomic uncertainty in two ways – the dispersion of GDP growth forecasts and the Bank of England principle component measure discussed in section 4.1 – and monetary policy uncertainty by the Husted *et al.* (2017) textual index.

# 6 Results

Our main specification is therefore:

$$\begin{aligned} \text{surplus}_{i,t} = \beta_1 \text{surplus}_{it-1} + \boldsymbol{\phi_1} \text{uncertainty}_{it/t} + \boldsymbol{\phi_2} \text{uncertainty}_{it-1/t-1} \\ + \beta_2 X_{i,t} + \beta_3 X_{it-1} + \alpha_{i,capreg} + \zeta_q + \epsilon_{i,t} \end{aligned} \tag{4}$$

for bank $i$ in quarter-year $t$, and where $\phi$ is our coefficient of interest on banking regulatory $\text{uncertainty}_t$ or capital requirement $\text{uncertainty}_{it}$ (alternatively). $X_{it}$ and $X_{it-1}$ contain the relevant explanatory variables that proxy for the bank's internal capital target: return on equity, provisions, subordinated debt, time demeaned size, trigger, retained profits, loan growth, GDP growth, and macro and monetary policy uncertainties. The baseline specification contains *bank* $\times$ *capital regulation regime* and quarter fixed effects ($\alpha_{i,capreg}$ and $\zeta_q$ respectively) since our main variable of interest is only time varying. The former in particular is a more flexible way of controlling for any confounding bank unobservables by capital reporting regime when a full set of time fixed effects is not feasible. When we switch to bank-specific measure of uncertainty ($MADTRIG_{it}$), we will be able to control for bank and time unobservables that may affect capital surpluses. Standard errors are clustered at the bank and time level, using the Cameron *et al.* (2011) adjustment.

The main results are presented in table 5. Columns (1)-(4) contain a full set of bank and time fixed effects; from column (5) onwards we add the bank-invariant macro variables, and therefore replace these with *bank* $\times$ *capital reporting regime* fixed effects. The main results are in column (6). We can see that the narrow measure of banking regulatory uncertainty, *BRU:Narrow* has a positive and significant effect on bank surplus, confirming our initial hypothesis. A one standard deviation increase in banking regulation uncertainty – which happened for example during the move of capital regulation from the Bank of England to the Financial Services Authority – is consistent with a long-run increase in surplus of about 0.08 standard deviations or 2.1 percentage points. This represents a quarter of the Basel minimum capital requirement of 8%, and is therefore economically meaningful as well. For comparison, we replace this with the broad measure of banking sector uncertainty in column (7), which also has a positive and significant sign. The coefficient on the broad measure is larger because it is scaled differently as compared to the narrow measure (as simply a share of all articles rather than an index); however, it translates to a similar effect in terms of magnitude, roughly 2.6pp.

The rest of the coefficients have signs as expected. As in the rest of the literature, we find that bank size (*time demeaned size*) and profits (*retained profits*) are consistently important determinants of surplus. Larger banks holds on average lower surpluses, and banks with higher retained profits hold higher surpluses. The coefficient on *provisions* is positive and significant, indicating prudent behaviour by banks on average: when there is a positive shock to the bank's internal assessment of its own risk (that is, it holds higher provisions against general losses), the surplus adjusts to be higher on average as well in the long-run.

In table 5, the $\theta$ $(= \beta_1 - 1)$ in the first row is negative and significant for all specifications, indicating that there is partial adjustment of surplus capital, and that the model is therefore correctly specified. The interpretation of this coefficient (column 6), is that it takes approximately 4.3 quarters for a unit shock to surplus capital to dissipate by half.[29] In column (4) where we are able to control more flexibly for time shocks, the speed of adjustment of surplus is slower and translates to 9.55 quarters.

It may be that a large part of the observed relationship between regulatory uncertainty and *surplus* is driven by the post-2007 period, which was characterised by a financial crisis that precipitated large-scale increases in regulatory uncertainty as well as other structural changes. To ensure that our results are not confounded by the crisis period and its aftermath, we re-run the model on sub-samples. In table 6, we report the full sample results with the narrow uncertainty measure, *BRU:N*, in column (1) (which is the same as column (6) from table 5), and also split the sample into three: excluding the crisis period (2007 Q3- 2009 Q2) in column (2), pre-2007 Q2 in column (3)–(4) and post-2007 Q2 in column (5)–(6). In columns (4) and (6), we replace our narrow measure with the broad uncertainty measure, *BRU:B*.

The key takeaway is that the results are not being driven by the crisis period. In column (3), the coefficient on *BRU* indicates similar magnitudes as before: a 1 standard deviation increase in banking regulation uncertainty in the pre-2007 period was associated with a 0.1 standard deviation increase in surplus capital. Both measures of uncertainty are insignificant in the post-crisis period. This does not necessarily imply that the link between uncertainty and surpluses has disappeared after the crisis for at least two reasons. One is that our dataset in the post-crisis period is relatively shorter (less than thirty quarters), which may make extracting the longer-run relationships more difficult on average. The second reason is that we still find a positive link between uncertainty and surpluses in the post-crisis period when we dig deeper into certain sub-samples of banks. For example, as we show below, the average results for banks belonging to groups and building societies are driven primarily by the post-crisis period. The $\theta$ coefficients are negative and significant for all specifications, indicating the appropriateness of the model. The speeds of adjustment are roughly similar.[30]

[29] Half-life is calculated as $(0.25 \times \frac{ln(0.5)}{ln(1-0.10)})$. We multiply by 0.25 to get the half-life calculation in years.

[30] Specifically, a unit shock to surplus capital dissipates by half in 1.07 years in the sample excluding the crisis, and 1 year in the pre-crisis sample.

## Robustness

To further ensure that our main results are not driven by the post-crisis period, we run a few more robustness checks. In columns (1) and (2) of table D.3, we interact our narrow and broad uncertainty measures, respectively, with a dummy *d.Post2007* that takes value 0 between 1989 Q1 - 2007 Q2, and 1 for the time period between 2007 Q3 - 2013 Q4. To be consistent with previous results, at least the baseline coefficient, which reflects the pre-crisis period, should be positive and significantly different from 0. We find that is the case, however, the interaction term is negative and significant as well. Therefore, the overall coefficient on banking regulation uncertainty (*BRU:N*) is positive, but smaller than before, translating to roughly 0.83pp. We consider this more conservative estimate as our baseline effect. In columns (3) and (4), we run a fully nested model, interacting all our explanatory variables with the $d.Post2007$ dummy. We do this to allow for a structural break during the crisis, that affects all aspects of the banks in our sample. Our main conclusions hold.

Given that the results are similar between our two measures of uncertainty, from here on we report only the results for the narrow measure - which is a conceptually cleaner signal of banking policy uncertainty.[31] We do a few robustness checks at this point to ensure that the baseline results are not driven by the way surplus is defined or the sample composition. First, we use two alternate definitions of the dependent variable - surplus as share of the capital resources of the bank, and surplus as a share of the bank specific minimum requirement - and use those as the dependent variable in table D.4. Second, we restrict the sample to those 136 banks that have existed in the sample between 1995 and 2013, representing on average 65% of total banking sector assets. We find that the results are not sensitive to either.

Finally, although we have taken care to exclude banks with very specialised business models, the extreme values of surplus might still be driving the results. Therefore, we truncate the dependent variable, *surplus* at various cut-offs in table D.8 and show that the results are not sensitive to the distribution of *surplus*.[32]

## Heterogeneity in business model

Next, we investigate whether the results are sensitive to the bank's business model, which is likely to determine the extent to which financial frictions, that is, the costs of raising external capital quickly, are binding. It could, for instance, be that banks which are part of groups do not have the same relationship between surpluses and uncertainty as banks that are not. This may be because banks that are part of a group have access to intra-group capital markets during times of stress and therefore external financial frictions are

[31] All results reported henceforth also hold qualitatively with the alternate broad measure, but the magnitudes are slightly larger.

[32] None of the other results change if we truncate the surplus by using the maximum values that would have existed in the sample if we had winsorized at 2.5% or 5% level in each tail. However, wherever business category is available, we can see that it is mostly business societies holding higher surpluses. Therefore, we use the full sample of data here; and do not report the other results in the interest of space.

not as binding for them.[33]

Therefore, in table D.5 we restrict the sample to only groups in column (1), excluding groups in column (2), and after dropping the "extreme" banks, that is, those that are too large or too small in column (3).[34] Our sample contains 68 groups, which are static identifiers based on one year of data. We find that the results are robust to these sample cuts. Similarly in table D.7, we find that the results hold also for building societies, despite the fact that they already hold much higher surpluses than other banks on average. Although the relationship holds for the entire sample, it is mostly driven by the post-crisis period.

## 6.1 Dangerzone banks

We now test our hypotheses on *distance to requirement.* We have three measures of *dangerzone* banks. The first two are straightforwardly defined as whether the bank is in the bottom tercile of the surplus capital distribution ($DZ^t_{it}$) or below the median ($DZ^m_{it}$). The third criterion is based on the fact that triggers set by the regulatory in the UK are confidential, and therefore, actually the publicly observable minimum is 8% throughout the period. Therefore, the final criterion is whether the bank is below median of the *publicly observed* surplus distribution, that is, from 8% ($DZ^p_{it}$). Note that these dummies are calculated each quarter, therefore, they are both bank and time varying. They are always included in each regression but not reported.

There are significant differences in the average surplus capital holdings of safe and *dangerzone* banks by all three definitions (panel A, table D.1). The average *dangerzone* bank holds between $2-3$pp surplus capital, which is significantly smaller than those held by "safe" banks. We also find that *dangerzone* banks are on average larger, have higher returns on equity, have higher share of risk weighted assets, significantly lower provisions and minimum requirements, and lesser reliance on market funding (table D.2).

We interact our text-based uncertainty measure with a dummy variable for whether the bank is in the "dangerzone" or not, that is, BRU:N$_t \times DZ^{t,m,p}_{it}$, where $t, m, p$ are the three measures. The main advantage of doing this is that we can then include time fixed effects and have more robust identification. However, the downside is that we cannot identify the base effect on $BRU$ – which is collinear to the time fixed effects – and we can no longer say anything about the speed of adjustment towards equilibrium for *safe* and *dangerzone* banks separately.

The results are presented in table 7. With all three measures of *dangerzone* banks, we find that the coefficient on the interaction is positive and significant. Therefore, there is an additional positive effect of banking regulation uncertainty on surplus capital for banks who are operating closer to their minimum requirements. The effect seems to be strongest for those below median surplus capital, calculated from trigger (column 2) or the publicly observable 8% minimum (column 3). In terms of magnitude, we find that a

[33]Banks that are part of groups in our sample hold significantly lesser capital surpluses than banks who are not part of groups, providing some indication that they face lower external financing constraints.

[34] *Very large* banks are those in the top 10% of the size distribution overall; similarly *very small* banks are those in the bottom 10%.

one-standard deviation increase in regulatory uncertainty has an additional effect of 2-4 percentage points for banks in the danger zone.

## 6.2 Bank-specific measure of uncertainty

We now check whether our hypothesis of a positive relationship between uncertainty and surplus capital holds when we use our measure of bank-specific uncertainty, $MADTRIG_{it}^{q=12}$. The main advantage of doing this is that we can now include a full set of bank and time ($quarter - year$) fixed effects. Table D.1 demonstrates that safe banks have significantly higher $MADTRIG_{it}^{q=12}$ on average.[35]

The results are shown in table 8. The bank-specific measure of uncertainty, $MADTRIG_{it}^{q=12}$, has the incorrect sign but is insignificant for the entire sample of banks in column (1) and the sub-sample of safe zone banks in column (2). However, it is positive and significant for the danger zone banks in columns (3)-(5). We find that the relationship is actually strongest for the third measure of danger zone banks, which ranks them according to their publicly observable surplus from the Basel I minimum of 8%. There is additionally some evidence to show that dangerzone banks do not act prudently: an increase in *provisions* is met with a reduction in *surplus*. Finally, the half-life adjustment, after controlling for time effects, is much slower for safe banks, roughly 9.55 quarters, than for danger zone banks, which ranges between one to two months.

Rather than splitting the samples, we can also interact our measure of bank specific uncertainty $MADTRIG$ with the dummies identifying $dangerzone$ banks. In table 10, we see that the interaction terms are all positive but significant only for dangerzone banks that are below median surpluses. The magnitude is similar to before, translating to approximately 1.87pp. For the other two, the coefficients are just insignificant at ten percent confidence level (the $p$-values are 0.11 and 0.13 for columns (1) and (3)). There is evidence that these results are actually being driven by extreme values in the $MADTRIG$.[36]

We do some additional checks for various cuts in the data in table 9, such as using only the consistent sample of banks in columns (1)-(3), excluding building societies in column (4), and excluding very large or very small banks in column (5). Although the design of domestic capital regulation reduces concerns around endogeneity, we examine this issue using a different methodology. We first regress bank triggers on lagged triggers and a full set of (bank and time) fixed effects. The alternate measure of uncertainty is then calculated using a similar 12-quarter rolling dispersion of the residuals for each bank.[37] They key message does not change, that is, an increase in bank-specific uncertainty is associated with a long-run increase in surplus capital, but only for those banks that are operating closer to their minimum requirements.

[35] This is consistent with "safe" banks having higher minimum requirements on average, as shown earlier.

[36] When we winsorize $MADTRIG_{it}^{q=12}$ at 5% level on the right tail, we find similar results in terms of magnitude, but stronger in terms of significance (available on request).

[37] Results are not reported here for brevity but are available on request.

### 6.3 Market discipline

The literature has argued that the main reason for banks to hold surpluses is fear of accidental breach of the minimum and the costly regulatory repercussions, but there is ample evidence to show that market discipline can be important as well. Banks that are more reliant on market funding may be wary of letting their capital surpluses fall below a certain level, get too close to their minimum requirements, or fall too far below what their peers hold. So what is the dominant force - regulatory pressure or market discipline - that causes *dangerzone* banks to build up their surpluses and move back into the safe zone? There is no way to run a horse race between the two forces directly, since we have no way of observing the regulatory cost imposed on danger zone banks. However, we can test whether banks' response to regulatory uncertainty is higher when they face more market pressure. To do this, we use an interaction term *market discipline* × *uncertainty*. We proxy market discipline by the share of subordinated debt to total assets on the bank's balance sheet as we have done throughout the paper, and use our two measures of uncertainty: $BRU$ and $MADTRIG^{q=12}$. Our hypothesis is that:

**Hypothesis 4 (H4):** *In the presence of regulatory uncertainty, additional market discipline pressure forces dangerzone banks to hold higher surpluses.*

In table 11, all columns are on dangerzone banks but columns (1)-(3) use the narrow uncertainty measure and columns (4)-(6) use bank-specific uncertainty. In columns (1)-(3), the interaction term *market discipline* × $BRU$ has the opposite sign than expected, but it is very imprecisely estimated. On the other hand, in columns (4)-(6), the interaction of bank-specific uncertainty with market discipline has the expected positive sign, that is, for a given level of regulatory uncertainty, a *dangerzone* bank with higher exposure to market discipline will hold higher surpluses. However, intuitively, it is only significant for the banks that are identified as being in the dangerzone from the publicly observable minimum. That is, market discipline seems to work strongest when a bank approaches its Basel I 8% minimum requirement, since that is what is observable by the market.

## 7 Policy implications and conclusions

In this paper, we study the impact of regulatory uncertainty on bank capital surpluses in the UK over 1989-2013. We use two new measures of regulatory uncertainty based on bank-level confidential regulatory data and news-media text. We find evidence that higher regulatory uncertainty is associated with higher bank capital surpluses. More precisely, one standard deviation increase in regulatory uncertainty is linked to higher capital surpluses to the tune of 0.8-2pp. We find that this relationship is not driven by the spike in regulatory uncertainty after the 2008 global financial crisis, and that it is robust to a battery of checks.

We find that the relationship between surpluses and uncertainty is even stronger for *dangerzone* banks, that is, banks that are at the bottom of the cross-sectional surplus distribution. We find some evidence that *dangerzone* banks are not prudent in holding more surplus capital in response to higher risk-taking. *Dangerzone* banks do not consistently respond by more in the presence of higher uncertainty when they are also more exposed to market discipline, indicating that regulatory pressure is stronger. Other important determinants of capital surpluses are bank size, retained profits, and loan growth. Shocks to capital surpluses are slow to dissipate in general, but they are quite fast for *dangerzone* banks.

Existing work, while acknowledging the precautionary motive for banks to hold voluntary capital surpluses, assumes that capital requirements are known a priori. However, banks choose their capital resources in a world where policymakers constantly make decisions that alter the nature, timing and impact of capital requirements, as well as the penalties associated with non-compliance. Therefore, there is an additional source of uncertainty stemming from the "rules of the game" which can amplify any self-insurance motive. Our empirical results support this hypothesis. Our work is closely related to existing work on the impact of uncertainty on banks' decisions and the determinants of banks' capital ratios. We also draw on, and contribute to, the work on measuring uncertainty.

Our empirical results provide a meaningful lens through which to view buffer usability discussions in the context of the Covid-19 pandemic. The focus in this paper has been on management buffer usability. Nevertheless, the empirical results can be qualitatively generalised to any kind of uncertainty surrounding capital requirements, even if the details of the regime change over time, as long as any bank that approaches or breaches its minimum requirement faces an asymmetric and monotonically increasing cost function. If we consider the new regulatory buffers as de facto minimum requirements, then our results indicate that banks are likely to be quite hesistant fall into them in an effort to support lending activity. Uncertainty around these requirements during a shock is likely to only amplify the self-insurance motive. The margin of adjustment is likely to be via the denominator (risk-weighted assets) rather than through retained earnings. Future research on the effects on lending of uncertainty around capital resources and requirements can speak to this more clearly.

# Bibliography


Aiyar S, Calomiris C, Hooley J, Korniyenko Y, 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 CW, Wieladek T (2014b). "Does macro-prudential regulation leak? Evidence from a UK policy experiment." *Journal of Money, Credit and Banking*, **46**(1), 181–214.

Alexopoulos M, Cohen J (2015). "The power of print." *International Review of Economics and Finance*, **40**(2015), 8–28.

Alfon I, Argimon I, Bascuñana-Ambrós P (2004). "What determines how much capital is held by UK banks and building societies?" *Occasional Paper Series No. 22*, Financial Services Authority.

Ayuso J, Pérez D, Saurina J (2004). "Are capital buffers pro-cyclical? Evidence from Spanish panel data." *Journal of Financial Intermediation*, **13**(2004), 249–264.

Baker SR, Bloom N, Davis SJ (2016). "Measuring economic policy uncertainty." *Quarterly Journal of Economics*, **131(4)**, 1593–1636.

Balluck K, Galiay A, Ferrara G, Hogarth G (2016). "The small bank failures of the early 1990s: Another story of boom and bust." *Bank of England Quarterly Bulletin*, **56**(1), 41–51.

Bansal R, Yaron A (2004). "Risks for the long run: A potential resolution of asset pricing puzzles." *The Journal of Finance*, **LIX**(4), 1481–1509.

Barth JR, Miller SM (2017). "A primer on the evolution and complexity of bank regulatory capital standards." *Mercatus Working Paper 2017*, Mercatus Center.

Basel Committee on Banking Supervision (2010). "Basel III: A global regulatory framework for more resilient banks and banking systems." *Technical report*, Bank for International Settlements.

BCBS (1998a). "Framework for evaluation of internal control systems." *Consultative document*, Basel Committee on Banking Supervision. URL https://www.bis.org/publ/bcbs33.htm.

BCBS (1998b). "Framework for internal control systems in banking organisations." *Guidelines*, Basel Committee on Banking Supervision. URL https://www.bis.org/publ/bcbs40.htm.

BCBS (2008a). "Guidelines for computing capital for incremental risk in the trading book." *Consultative document*, Basel Committee on Banking Supervision. URL https://www.bis.org/publ/bcbs141.pdf.

BCBS (2008b). "Proposed revisions to the Basel II market risk framework." *Consultative document*, Basel Committee on Banking Supervision. URL https://www.bis.org/publ/bcbs140.htm.

BCBS (2009a). "Enhancements to the Basel II framework." *Standards*, Basel Committee on Banking Supervision. URL https://www.bis.org/publ/bcbs157.htm.

BCBS (2009b). "Proposed enhancements to the Basel II framework." *Consultative document*, Basel Committee on Banking Supervision. URL https://www.bis.org/publ/bcbs150.htm.

BCBS (2009c). "Strengthening the resilience of the banking sector." *Consultative document*, Basel Committee on Banking Supervision. URL https://www.bis.org/publ/bcbs164.htm.

BCBS (2018). "Survey on the interaction of regulatory instruments: Results and analysis." *Working Paper 33*, Basel Committee on Banking Supervision.

BCBS (2019). "Newsletter on buffer usability." *Technical report*, Basel Committee for Banking Supervision, Bank for International Settlements. URL https://www.bis.org/publ/bcbs_nl22.htm.

Berger A, DeYoung R, Flannery M, Lee D, ÃŰztekin Ã (2008). "How do large banking organizations manage their capital ratios?" *Journal of Financial Services Research*, **34**(2), 123–149.

Berger AN, Herring RJ, Szego GP (1995). "The role of capital in financial institutions." *Journal of Banking & Finance*, **19**(3-4), 393–430.

Bernanke B (1983). "Irreversibility, uncertainty, and cyclical investment." *Quarterly Journal of Economics*, **97**(1), 85–106.

Bholat D, Brookes J, Cai C, Grundy K, Lund J (2017). "Sending firm messages: Text mining letters from PRA supervisors to banks and building societies they regulate." *Working Paper No. 688*, Bank of England.

Biljanovska N, Grigoli F, Hengge M (2017). "Fear thy neighbor: Spillovers from economic policy uncertainty." *IMF Working Papers 17/240*, International Monetary Fund.

Bloom N (2014). "Fluctuations in uncertainty." *Journal of Economic Perspectives*, **28**(2), 153–176.

BOE (2020). "Q&A on the use of liquidity and capital buffers." *Technical report*, Bank of England. Released by the Prudential Regulatory Authority originally on 20 April, 2020 and updated on 06 July, 2020.

Bordo MD, Duca J, Koch C (2016). "Economic policy uncertainty and the credit channel: Aggregate and bank level U.S. evidence over several decades." *Journal of Financial Stability*, **26**(C), 90–106.

Borio C, Furfine C, Lowe P (2001). "Procyclicality of the financial system and financial stability: Issues and policy options." In Bank for International Settlements (ed.), "Marrying the macro- and micro-prudential dimensions of financial stability," volume 01, pp. 1–57. Bank for International Settlements.

Brei M, Gambacorta L (2016). "Are bank capital ratios pro-cyclical? New evidence and perspectives." *Economic Policy*, **31**(86), 357–403.

Brennan MJ, Schwartz ES (1985). "Evaluating natural resource investments." *The Journal of Business*, **58**(2), 135–157.

Buch C, Buchholz M, Tonzer L (2015). "Uncertainty, bank lending, and bank-level heterogeneity." *IMF Economic Review*, **63**(4), 919–954.

Cameron CA, Gelbach JB, Miller DL (2011). "Robust inference with multiway clustering." *Journal of Business and Economics Statistics*, **29**, 283–249.

Cheng H, Gawande K, Ongena S, Qi S (2019). "The role of political connections in mitigating the adverse effect of policy uncertainty on banks." *Working paper*, SSRN. URL https://ssrn.com/abstract=3003476.

Coffinet J, Coudert V, Pop A, Pouvelle C (2012). "Two-way interplays between capital buffers and credit growth: Evidence from French banks." *Journal of International Financial Markets, Institutions & Money*, **22**(2012), 1110–1125.

Cohen BH, Scatigna M (2016). "Banks and capital requirements: Channels of adjustment." *Journal of Banking & Finance*, **69**(S1), 56–69.

De Jonghe O, Dewachter H, Ongena S (2020). "Bank capital (requirements) and credit supply: Evidence from pillar 2 decisions." *Journal of Corporate Finance*, **60**(C), 1–28.

De Marco F, Wieladek T (2015). "The real effects of capital requirements and monetary policy: Evidence from the United Kingdom." *Staff working paper no. 573*, Bank of England.

de Ramon SJA, Francis WB, Harris Q (2016). "Bank capital requirements and balance sheet management policies: Has the relationship changed after the crisis?" *Staff working paper no. 635*, Bank of England.

de Ramon SJA, Francis WB, Milonas K (2017). "An overview of the UK banking sector since the Basel Accord: Insights from a new regulatory database." *Staff working paper no. 652*, Bank of England.

de Ramon SJA, Francis WB, Straughan M (2018). "Bank competition and stability in the United Kingdom." *Staff working paper no. 748*, Bank of England.

D'Erasmo P (2018). "Are higher capital requirements worth it?" *Technical report 2018 Q2*, Federal Reserve Bank of Philadelphia Research Department.

Dixit AK, Pindyck RS (1994). *Investment under uncertainty*. Princeton University Press, 1 edition.

Eckley P (2015). "Measuring economic uncertainty using news-media textual data." *MPRA Paper No. 64874*, MPRA.

Ediz T, Michael I, Perraudin W (1998). "The impact of capital requirements on UK bank behaviour." *FRBNY Economic Policy Review*, **1998**, 15–22.

Elizalde A, Rafael R (2007). "Economic and regulatory capital in banking: What is the difference?" *International Journal of Central Banking*, **3**(3), 87–118.

Estrella A (2004). "The cyclical behaviour of optimal bank capital." *Journal of Banking and Finance*, **28**, 1469–1498.

Federal Reserve (2020). "Q&A on statement regarding the use of capital and liquidity buffers." *Technical report*, Board of Governors of the Federal Reserve System. URL https://bit.ly/2ZZ2RyV.

Flannery M, Rangan KP (2006). "Partial adjustment toward target capital structures." *Journal of Financial Economics*, **79**(3), 469–506.

Fonseca RA, Gonzállez 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**(2010), 892–902.

Francis W, Osborne M (2009). "Bank regulation, capital, and credit supply: Measuring the impact of prudential standards." *Occasional Papers in Financial Regulation Series No. 36*, The Financial Services Authority. URL https://goo.gl/r2ohGf.

Francis W, 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.

Francis WB, Osborne M (2010). "On the behavior and determinants of risk-based capital ratios: Revisiting the evidence from UK banking institutions." *International Review of Finance*, **10:4**(2010), 485–518.

FSA (2008). "The supervision of Northern Rock: A lessons learned review."

FSB (2020). "COVID-19 pandemic: Financial stability implications and policy measures taken." *Technical report*, Financial Stability Board. Report submitted to the G20 Finance Ministers and Governors.

Furfine C (2001). "Bank portfolio allocation: The impact of capital requirements, regulatory monitoring, and economic conditions." *Journal of Financial Services Research*, **20**(1), 33–56.

Goodhardt C (1995). "Some regulatory concerns." *Special paper 79, Financial Markets Group*, London School of Economics.

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

Haddow A, Hare C, Hooley J, Shakir T (2013). "Macroeconomic uncertainty: What is it, how can we measure it, and why does it matter?" *Quarterly bulletin*, Bank of England.

Hancock D, Ruffino D (2017). "Results of the survey on the interaction of regulatory instruments." *Basel III monitoring report*, Basel Committee on Banking Supervision.

Heid F, Porath D, Stolz S (2004). "Does capital regulation matter for bank behaviour? Evidence for German savings banks." *Discussion paper series 2: Banking and financial studies no. 2004,03*, Deutsche Bundesbank.

Herring RJ (2018). "The evolving complexity of capital regulation." *Journal of Financial Services Research*, **53**(2), 183–205.

Huertas T (2006). "The future of banking regulation and supervision." Speech by Dr. Thomas Huertas, Director, Wholesale Firms Division and Banking Sector Leader, FSA BBA 4th Annual Regulating Banking in Britain Conference [Accessed: 2020-12-01], URL https://bit.ly/37n189O.

Husted L, Rogers J, Sun B (2017). "Monetary policy uncertainty." *Working Paper Number 1215*, Board of Governors of the Federal Reserve System. *(Journal of Monetary Economics, forthcoming).*

Ilut CL, Schneider M (2014). "Ambiguous business cycles." *American Economic Review*, **104**(8), 2368–2399.

Imbierowicz B, Kragh J, Rangvid J (2018). "TimeâĂŘvarying capital requirements and disclosure rules: Effects on capitalization and lending decisions." *Journal of Money, Credit and Banking*, **50**(4), 573–602.

IMF (2003). "Financial Sector Assessment Program: United Kindom." *Country report*, International Monetary Fund.

Jokipii T, Milne A (2008). "The cyclical behaviour of European bank capital buffers." *Journal of Banking & Finance*, **32**(2008), 1440–1451.

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

Kashyap AK, Stein JC, Hanson S (2010). "An analysis of the impact of "substantially heightened" capital requirements on large financial institutions." *Mimeo*, University of Chicago and Harvard Business School.

Kim J, Ogaki M, Yang M (2007). "Structural error correction models: A system method for linear rational expectations models and an application to an exchange rate model." *Journal of Money, Credit, and Banking*, **39**(8), 2057–2075.

Lindquist KG (2004). "Banks' buffer capital: How important is risk." *Journal of International Money and Finance*, **23**(2004), 493–513.

Logan A (2001). "The United Kingdom's small banks' crisis of the early 1990s: What were the leading indicators of failure?" *Staff working paper no. 139*, Bank of England.

Peura S, Keppo J (2006). "Optimal bank capital with costly recapitalization." *The Journal of Business*, **79**(4), 2163–2201.

Rime B (2001). "Capital requirements and bank behaviour: Empirical evidence for Switzerland." *Journal of Banking & Finance*, **25**(4), 789–805.

Sandile H (2016). "Unpacking policy uncertainty: Evidence from European firms." *Unpublished manuscript*, URL https://bit.ly/2XL8gpQ.

Shim J (2013). "Bank capital buffer and portfolio risk: The influence of business ccycle and revenue diversification." *Journal of Banking & Finance*, **37**(2013), 761–772.

Soto PE (2020). "Breaking the word bank: Effects of verbal uncertainty on bank behavior." *Journal of Financial Services Research*, **2020**.

Stolz S, Wedow M (2011). "Banks' regulatory capital buffer and the business cycle: Evidence for Germany." *Journal of Financial Stability*, **7**(2011), 98–110.

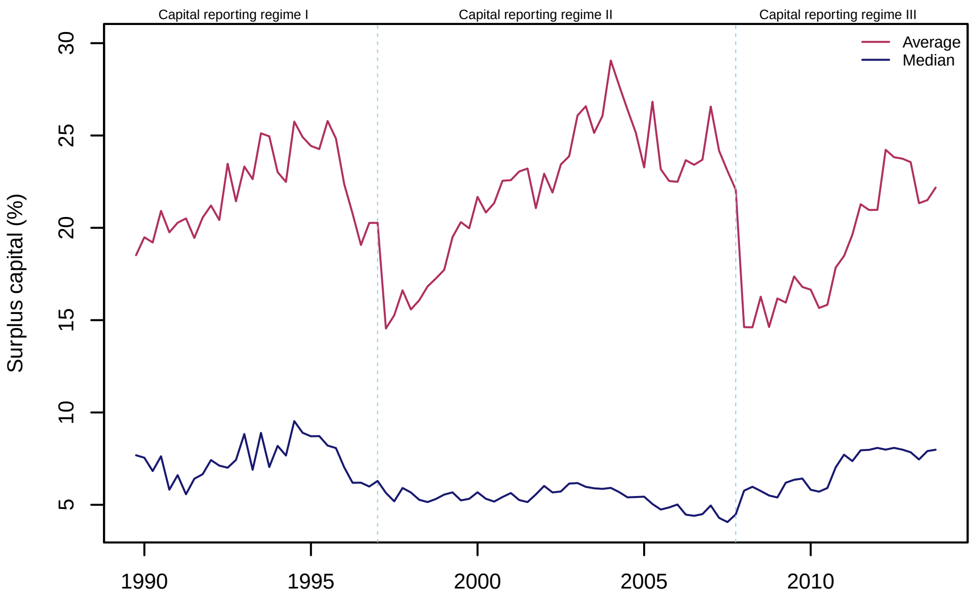
Tabak BM, Noronha AC, Cajueiro D (2011). "Bank capital buffers, lending growth and economic cycle: Empirical evidence for Brazil." *Technical report*, Bank for International Settlements. In: BIS CCA Conference on Monetary Policy, Financial Stability and the Business Cycle.

Turner A (2009). "The Turner Review: A Regulatory Response to the Global Banking Crisis."

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

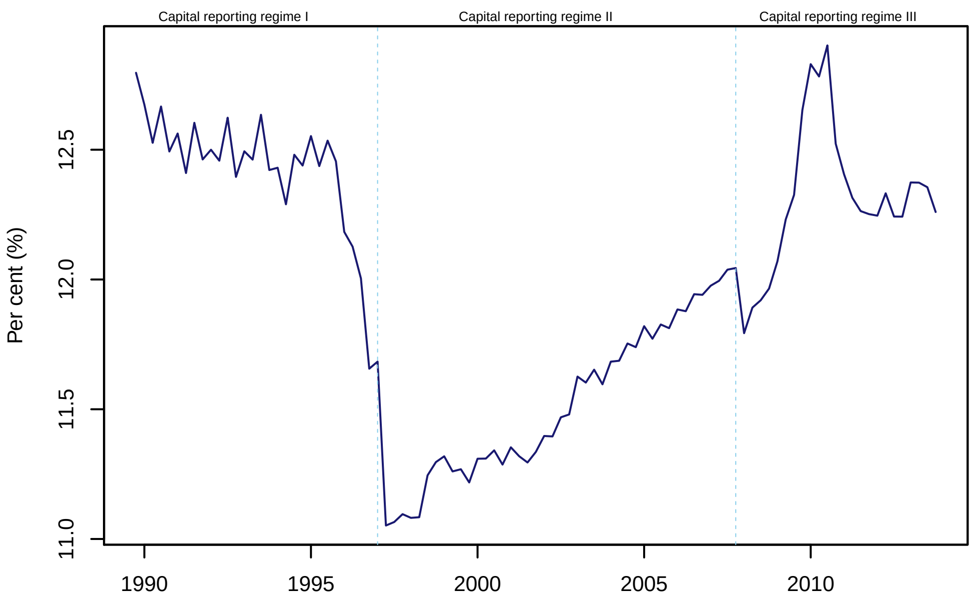
# Figures and tables

Figure 1: Time series evolution of surplus capital



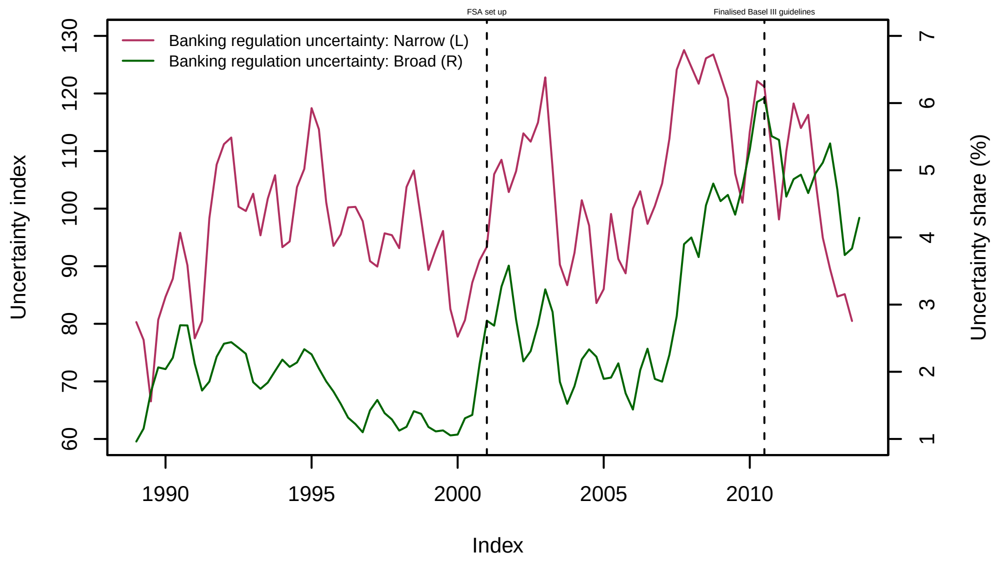

*Note:* This figure plots the average and median surplus for the overall sample of 295 banks. The data have already been winsorized at the 1% level to remove outliers. The three capital reporting regimes are based on de Ramon *et al.* (2017). These are: until 1997 Q1; from 1997 Q2 to 2007 Q4; and from 2008 Q1 to 2013 Q4.

Figure 2: Time series evolution of median minimum requirements



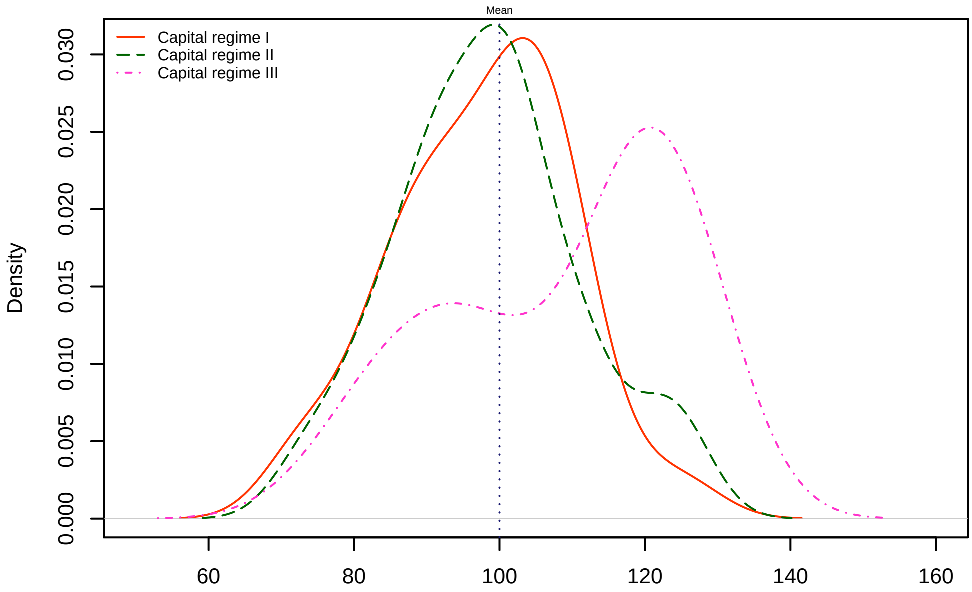

*Note:* This figure plots the median total minimum requirement for the sample of 295 banks. The three capital reporting regimes are based on de Ramon *et al.* (2017). These are: until 1997 Q1; from 1997 Q2 to 2007 Q4; and from 2008 Q1 to 2013 Q4.

Figure 3: Banking sector policy uncertainties



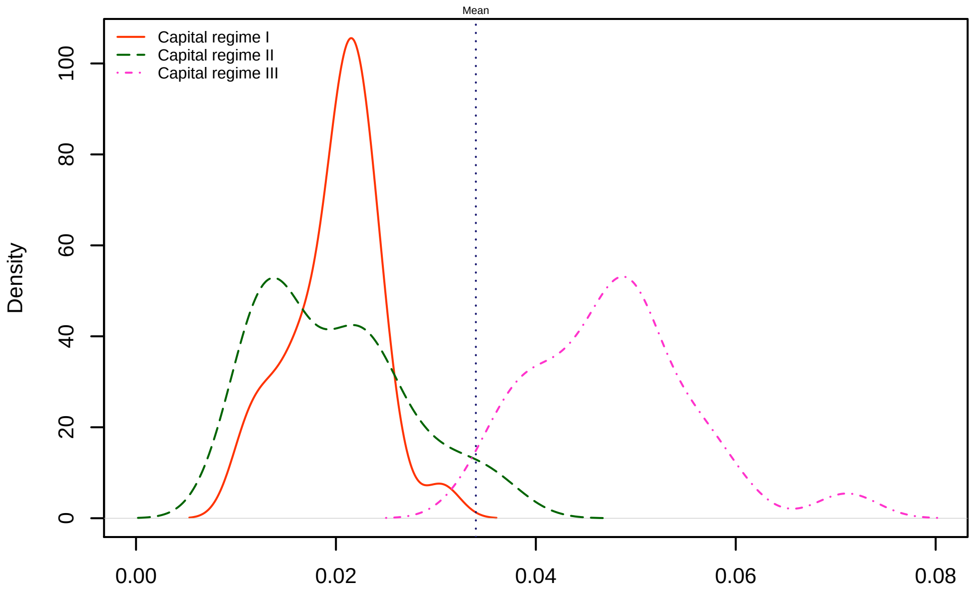

*Note:* This figure plots the 2-quarter rolling mean of the *narrow* and *broad* banking policy uncertainty measures. The two labelled dates correspond to the set up of the Financial Services Authority in 2001 Q1, and finalisation of the Basel III guidelines in 2010 Q4. Details of the keywords used to obtain article counts are in appendix A and discussion of how the measure itself is constructed is in section 4.1.

Figure 4: Density of narrow text-based measure of uncertainty across capital regimes




*Note:* This figure shows the density plot of narrow banking regulation uncertainty ($BRU{:}N$) for each of the capital regimes. The three capital reporting regimes are based on de Ramon *et al.* (2017). These are: until 1997 Q1; from 1997 Q2 to 2007 Q4; and from 2008 Q1 to 2013 Q4. The vertical line denotes the mean for the uncertainty measure, which is by construction equal to 100 for the entire sample (which increases to 116 in the third regime). More details on the construction of the measure are in section 4.1.

Figure 5: Density of broad text-based measure of uncertainty across capital regimes




*Note:* This figure shows the density plot of broad banking regulation uncertainty (*BRU:B*) for each of the capital regimes. The three capital reporting regimes are based on de Ramon *et al.* (2017). These are: until 1997 Q1; from 1997 Q2 to 2007 Q4; and from 2008 Q1 to 2013 Q4. The vertical line denotes the mean for the uncertainty measure, which is equal to 0.034 for the entire sample (which increases to 0.049 in the third regime). More details on the construction of the measure are in section 4.1.

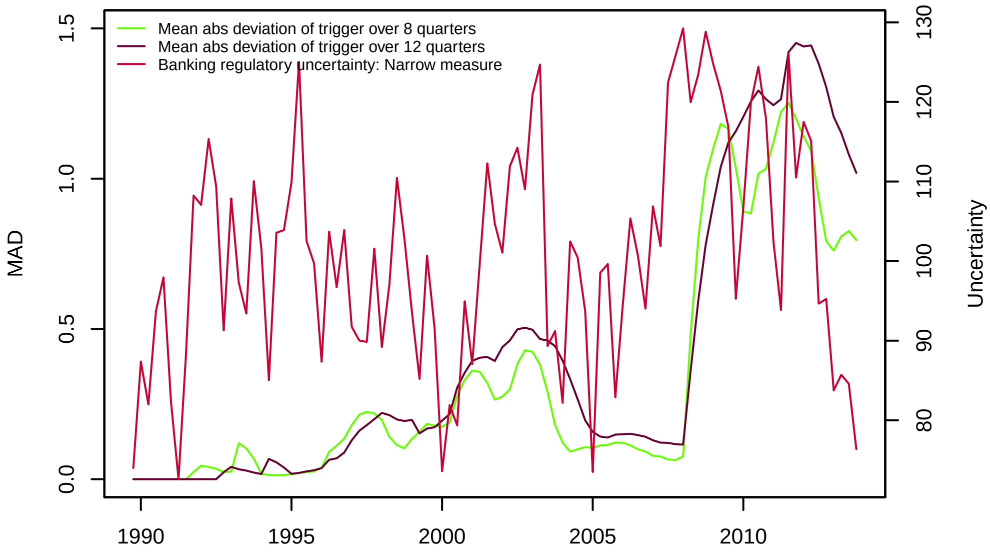
Table 1: Uncertainty variables: Correlations

| | GDP growth | Disp. of growth forecast | BoE macro uncertainty | UK EPU | Market volatility | BRU: Broad | BRU: Narrow |
|---|---|---|---|---|---|---|---|
| GDP growth | | | | | | | |
| Disp. of growth forecast | −0.21* | | | | | | |
| BoE macro uncertainty | −0.55*** | 0.53*** | | | | | |
| UK EPU | −0.19 | 0.09 | 0.40*** | | | | |
| Market volatility | −0.42*** | 0.24* | 0.51*** | −0.02 | | | |
| BRU: Broad | −0.29** | 0.17 | 0.31*** | 0.88*** | 0.06 | | |
| BRU: Narrow | −0.40*** | 0.43*** | 0.49*** | 0.35** | 0.53*** | 0.43**** | |
| UK MPU | −0.04 | 0.00 | −0.07 | 0.13 | 0.32** | 0.26** | 0.38*** |

* $p < .1$, ** $p < .05$, *** $p < .01$

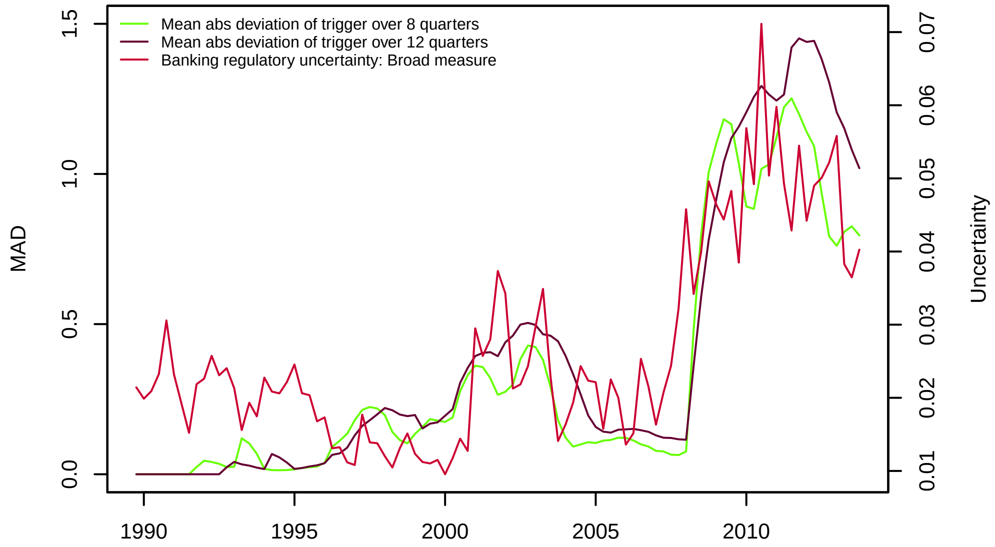
*Note: GDP growth* is the real YoY GDP growth rate in the UK. *Dispersion of growth forecasts* is the dispersion of the 1 year ahead growth forecasts. *BoE macro uncertainty* is a composite measure of overall macroeconomic uncertainty used internally within the Bank of England, which is the first principal component of 7 series that capture different facets of uncertainty in the UK. These series are: the FTSE implied market volatility, Sterling option-implied volatility, dispersion of company earnings forecasts, dispersion of annual GDP growth forecasts, unemployment expectations balance, "demand uncertainty limiting investment" score, and total number of press articles citing economic uncertainty (Haddow *et al.*, 2013). *Market volatility* is the realised market volatility of the FTSE. *UK EPU* is the UK economic policy uncertainty sourced from Baker *et al.* (2016). *UK MPU* is monetary policy uncertainty for the UK sourced from Husted *et al.* (2017). *BRU: Narrow* and *BRU: Broad* are the textual measures of uncertainty; more details are in section 4.1.

Figure 6: Bank-specific trigger uncertainty and narrow regulatory uncertainty




*Note:* This figure plots the average 8 and 12-quarter mean absolute deviation of trigger. The underlying series is the 8/12 quarter mean absolute deviation for each bank (this means over the last 8 observations). The time periods are selected based on the fact that triggers have been historically set every two to three years Francis and Osborne (2010). The sharp uptick in the mean absolute deviation of the triggers is in 2008 Q1, when 133 out of 181 changes in triggers were decreases. $MADTRIG^{q=12}$ and *BRU:N* are positively correlated in the panel (0.12), which is significant at the 1% level.

Figure 7: Bank-specific trigger uncertainty and broad regulatory uncertainty




*Note:* This figure plots the average 8 and 12-quarter mean absolute deviation of trigger. The underlying series is the 8/12 quarter mean absolute deviation for each bank (this means over the last 8 observations). The time periods are selected based on the fact that triggers have been historically set every two to three years (Francis & Osborne 2009). The sharp uptick in the mean absolute deviation of the triggers is from 2008 Q1 onwards. This coincides with the large scale *decreases* in triggers for most firms that went on from 2008 Q1 to 2010 Q4. $MADTRIG^{q=12}$ and *BRU:N* are positively correlated in the panel (0.36), which is significant at the 1% level.

Table 2: Median surplus capital of UK banks (1989–2013)

| **Category** | **N** | (1) **Surplus (%)** | (2) **Surplus/ capital (%)** | (3) **Trigger (%)** |
|---|---|---|---|---|
| All | 239 | 5.62 | 33.00 | 11.00 |
| Consistent sample | 132 | 5.65 | 33.45 | 11.00 |
| UK | 147 | 4.57 | 30.00 | 10.08 |
| Foreign | 92 | 9.33 | 41.00 | 12.52 |
| Mini | 25 | 17.21 | 52.00 | 16.99 |
| Small | 87 | 14.42 | 48.00 | 14.00 |
| BSOC | 67 | 4.41 | 28.00 | 10.00 |
| Groups | 65 | 3.29 | 25.00 | 10.00 |
| Large | 93 | 2.87 | 22.95 | 9.94 |
| Very large | 45 | 2.28 | 20.00 | 9.25 |

*Note:* This table shows the median surplus capital for UK (solo) banks between 1989-2013. Surplus capital in (1) is defined as total bank capital less the individual capital requirement, as a share of RWA. In column (2), it is $\frac{\text{Capital}_{it} - \text{minimum}_{it}}{\text{Capital}_{it}}$. The consistent sample is the banks that exist in the sample in both 1995 and 2013. UK banks are those headquartered in the UK; subsidiaries of foreign banks are considered "foreign banks". Small banks are those whose share in total banking assets is less than 1%, and large banks are those whose share is more than 1%. The overall trends hold when we use alternate definitions of small and large banks (banks in first and third quartile by share of total assets respectively): larger banks hold on average lower buffers.

Table 3: Summary statistics: Panel variables

| Variable | N | Mean | St. Dev. | Pctl(25) | Median | Pctl(75) | Pctl(95) |
|---|---|---|---|---|---|---|---|
| Capital ratio (RWA) | 15436 | 26.94 | 27.83 | 13.32 | 17.30 | 27.79 | 78.66 |
| CT1 to TT1 | 15436 | 0.99 | 0.19 | 1.00 | 1.00 | 1.00 | 1.00 |
| Minimum req. (to RWA) | 15436 | 12.13 | 4.34 | 9.50 | 11.00 | 14.00 | 19.00 |
| **Surplus (to RWA)** | 15436 | 14.80 | 26.83 | 2.83 | 5.58 | 14.21 | 62.98 |
| **MADTRIG**$^{q=12}$ | 15436 | 0.42 | 1.05 | 0.00 | 0.00 | 0.42 | 2.00 |
| Return on equity | 15420 | 7.90 | 15.43 | 2.55 | 6.09 | 11.10 | 29.18 |
| Retained profits to assets | 15436 | -0.01 | 0.42 | 0.00 | 0.00 | 0.01 | 0.02 |
| Provisions to assets | 15433 | 0.12 | 2.09 | 0.00 | 0.01 | 0.03 | 0.16 |
| Subordinated debt to assets | 15436 | 1.27 | 2.59 | 0.00 | 0.00 | 1.81 | 5.07 |
| Log assets | 15389 | 6.57 | 2.23 | 5.02 | 6.37 | 8.06 | 10.66 |
| Time demeaned size | 15436 | -0.15 | 0.76 | -0.46 | -0.03 | 0.31 | 0.76 |
| Share in total assets | 15436 | 0.42 | 1.83 | 0.01 | 0.02 | 0.12 | 1.79 |
| Loan to assets | 15436 | 50.07 | 29.36 | 23.02 | 56.27 | 74.90 | 92.05 |
| Loan growth | 15436 | 0.03 | 16.03 | -3.16 | 0.00 | 3.35 | 20.97 |
| Dangerzone$^{t}_{it}$ | 15436 | 0.33 | 0.47 | 0 | 0 | 1 | 1 |
| Dangerzone$^{m}_{it}$ | 15436 | 0.54 | 0.50 | 0 | 1 | 1 | 1 |
| Dangerzone$^{p}_{it}$ | 15436 | 0.55 | 0.50 | 0 | 1 | 1 | 1 |
| d.Mini bank | 15436 | 0.04 | 0.19 | 0 | 0 | 0 | 0 |
| d.Small bank | 15436 | 0.22 | 0.42 | 0 | 0 | 0 | 1 |
| d.Large bank | 15436 | 0.26 | 0.44 | 0 | 0 | 1 | 1 |
| d.Very large bank | 15436 | 0.10 | 0.30 | 0 | 0 | 0 | 1 |
| d.UK bank | 15436 | 0.62 | 0.48 | 0 | 1 | 1 | 1 |

*Note:* The variables which have been winsorized at 1% in both tails are: capital ratio, surplus, return on equity, and *log* assets. The dependent variable is *surplus*, which is defined as the difference between capital ratio and overall minimum requirement, as a percentage of risk-weighted assets. The key independent variable is bank-specific uncertainty, $MADTRIG^{q=12}$. The maximum value for $MADTRIG^{q=12}$ is driven by one bank whose trigger was reduced drastically from 100% of RWA to 17%. Table B.1 contains variable definitions.

Table 4: Summary statistics: Uncertainty variables and macro controls

| Variable | N | Mean | St. Dev. | Pctl(25) | Median | Pctl(75) | Pctl(95) |
|---|---|---|---|---|---|---|---|
| UK EPU | 68 | 120.94 | 77.62 | 69.84 | 82.85 | 158.75 | 273.64 |
| Market volatility | 97 | 0.01 | 0.00 | 0.01 | 0.01 | 0.01 | 0.02 |
| **Banking regulation uncertainty: Broad** | 97 | 0.03 | 0.01 | 0.02 | 0.02 | 0.04 | 0.05 |
| **Banking regulation uncertainty: Narrow** | 97 | 101.44 | 13.92 | 91.55 | 100.69 | 110.50 | 125.03 |
| Monetary policy uncertainty | 97 | 104.07 | 41.36 | 75.41 | 97.36 | 127.32 | 173.36 |
| GDP growth (quarterly YoY) | 96 | 4.43 | 2.16 | 3.77 | 4.69 | 5.71 | 7.05 |
| Dispersion of next year forecast history | 97 | 0.28 | 0.13 | 0.16 | 0.27 | 0.35 | 0.53 |
| Aggregate write-offs | 84 | 1813.07 | 1157.82 | 921.00 | 1381.00 | 2397.00 | 4507.00 |
| Annual output gap | 25 | -0.35 | 1.87 | -1.70 | 0.03 | 0.84 | 3.08 |
| Banking sector Z-Score | 20 | 9.68 | 3.55 | 6.74 | 9.97 | 11.83 | 16.55 |
| Banking crisis dummy | 19 | 0.33 | 0.42 | 0 | 0 | 0.80 | 1 |

*Note:* The table presents summary statistics for macro variables. The variable of key interest is *banking regulation uncertainty*. Details of the text-based uncertainty measures and their sources are in table 1 and section 4.1.

## Table 5: Key result I: Baseline panel results

| | Dependent variable: $\Delta Surplus_{it}$ | | | | | | |
|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
| Rate of convergence to equilibrium, $\theta$ | | | | | | | |
| $Surplus_{it-1}$ | -0.07*** | -0.07*** | -0.07*** | -0.07*** | -0.15*** | -0.15*** | -0.15*** |
| | (0.012) | (0.012) | (0.012) | (0.012) | (0.027) | (0.027) | (0.027) |
| Rate of adjustment, $\gamma$ | | | | | | | |
| Return on $equity_{it-1}$ | 0.09 | 0.08 | 0.09 | 0.09 | -0.01 | -0.01 | 0.00 |
| | (0.157) | (0.157) | (0.155) | (0.139) | (0.065) | (0.065) | (0.065) |
| $Provisions_{it-1}$ | 0.91 | 0.91 | 0.90 | 0.74 | 1.93*** | 1.94*** | 1.92*** |
| | (2.438) | (2.444) | (2.453) | (2.328) | (0.324) | (0.334) | (0.317) |
| Subordinated $debt_{it-1}$ | 1.02 | 1.02 | 1.02 | 0.76 | 0.39 | 0.38 | 0.35 |
| | (0.834) | (0.828) | (0.830) | (0.783) | (0.446) | (0.448) | (0.442) |
| Time demeaned $size_{it-1}$ | -10.13*** | -10.25*** | -10.43*** | -10.18*** | -11.92*** | -12.31*** | -12.43*** |
| | (3.687) | (3.700) | (3.738) | (3.669) | (2.925) | (2.984) | (2.989) |
| $Trigger_{it-1}$ | | -0.11 | -0.13 | 0.06 | -0.38* | -0.37* | -0.41* |
| | | (0.360) | (0.364) | (0.340) | (0.216) | (0.212) | (0.215) |
| Retained $profits_{it-1}$ | | | 4.68* | 5.53* | 3.77*** | 3.79*** | 3.82*** |
| | | | (2.499) | (3.096) | (1.307) | (1.414) | (1.404) |
| Loan $growth_{it-1}$ | | | | -1.37*** | -0.58*** | -0.58*** | -0.57*** |
| | | | | (0.346) | (0.130) | (0.129) | (0.127) |
| GDP $growth_{t-1}$ | | | | | 0.80*** | 0.81*** | 0.52* |
| | | | | | (0.227) | (0.307) | (0.275) |
| **Narrow text-based uncertainty, BRU:$N_{t-1}$** | | | | | | 0.16*** | |
| | | | | | | (0.055) | |
| **Broad text-based uncertainty, BRU:$B_{t-1}$** | | | | | | | 259.99*** |
| | | | | | | | (78.332) |
| Observations | 15,413 | 15,413 | 15,413 | 15,413 | 15,232 | 15,232 | 15,232 |
| No of banks | 239 | 239 | 239 | 239 | 239 | 239 | 239 |
| R-sq | 0.86 | 0.86 | 0.86 | 0.86 | 0.75 | 0.75 | 0.75 |
| BSOC dummy | No | No | No | No | Yes | Yes | Yes |
| Bank FE | Yes | Yes | Yes | Yes | B x d.CapReg | B x d.CapReg | B x d.CapReg |
| Time FE | Yes | Yes | Yes | Yes | No | No | No |
| Quarter FE | No | No | No | No | Yes | Yes | Yes |
| Macro uncertainty | No | No | No | No | No | Yes | Yes |
| MPU | No | No | No | No | No | Yes | Yes |

Robust standard errors in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

*Note: Surplus* is in percentage points, measured as capital ratio less bank-specific minimum capital requirement by risk-weighted assets. *d.CapRegime* is a categorical variable capturing the three different waves of capital regulation regimes in the UK: till 1997 Q2, between 1997 Q2 to 2007 Q4, and from 2008 Q1 onwards. *BRU:N* is the narrow measure of regulatory uncertainty, whereas *BRU:B* is the broad version of the textual measure. Columns (1)-(4) contain both bank and time FE, whereas columns (5)-(7) include (*bank, B* $\times$ *d.CapReg*) fixed effects to control for bank & capital regime unobserved heterogeneity, so that the beta$\beta$ is identified by comparing the same bank within each capital regime. Columns (6) & (7) additionally control for monetary policy uncertainty and macroeconomic uncertainty. Standard errors are clustered at bank-time level. Table B.1 contains definitions of all the variables.

Table 6: Key result II: *Pre* and *post* crisis, all banks

| | *Dependent variable:* $\Delta Surplus_{it}$ | | | | | |
|---|---|---|---|---|---|---|
| | (1) All | (2) All ex. crisis | (3) Pre-2007 | (4) Pre-2007 | (5) Post-2007 | (6) Post-2007 |
| Rate of convergence to equilibrium, $\theta$ | | | | | | |
| $\text{Surplus}_{it-1}$ | -0.15*** | -0.15*** | -0.17*** | -0.17*** | -0.14** | -0.14** |
| | (0.027) | (0.028) | (0.029) | (0.029) | (0.065) | (0.065) |
| Rate of adjustment, $\gamma$ | | | | | | |
| $\text{Return on equity}_{it-1}$ | -0.01 | 0.04 | 0.08 | 0.09 | -0.01 | -0.01 |
| | (0.065) | (0.097) | (0.113) | (0.114) | (0.074) | (0.080) |
| $\text{Provisions}_{it-1}$ | 1.94*** | 1.89*** | 1.95*** | 1.92*** | -0.15 | -0.15 |
| | (0.334) | (0.264) | (0.215) | (0.198) | (0.601) | (0.575) |
| $\text{Subordinated debt}_{it-1}$ | 0.38 | 0.16 | 0.17 | 0.15 | 0.44 | 0.44 |
| | (0.448) | (0.522) | (0.782) | (0.778) | (0.582) | (0.516) |
| $\text{Time demeaned size}_{it-1}$ | -12.31*** | -13.17*** | -12.49*** | -12.56*** | -16.69** | -16.66** |
| | (2.984) | (3.199) | (3.489) | (3.587) | (7.479) | (7.362) |
| $\text{Trigger}_{it-1}$ | -0.37* | -0.37 | -0.52 | -0.49 | -0.36 | -0.36 |
| | (0.212) | (0.230) | (0.390) | (0.387) | (0.298) | (0.295) |
| $\text{Retained profits}_{it-1}$ | 3.79*** | 5.71*** | 5.66*** | 5.62*** | 4.05** | 4.08** |
| | (1.414) | (1.612) | (1.891) | (1.990) | (1.753) | (1.726) |
| $\text{Loan growth}_{it-1}$ | -0.58*** | -0.66*** | -0.63*** | -0.63*** | -0.47 | -0.47 |
| | (0.129) | (0.140) | (0.136) | (0.135) | (0.288) | (0.286) |
| $\text{GDP growth}_{t-1}$ | 0.81*** | 0.87** | 0.94* | 0.74 | 1.92** | 1.40** |
| | (0.307) | (0.345) | (0.484) | (0.462) | (0.834) | (0.705) |
| **BRU:N**$_{t-1}$ | 0.16*** | 0.21*** | 0.26*** | | -0.03 | |
| | (0.055) | (0.062) | (0.081) | | (0.101) | |
| **BRU:B**$_{t-1}$ | | | | 289.35** | | 142.86 |
| | | | | (121.620) | | (128.609) |
| Observations | 15,232 | 13,754 | 10,737 | 10,737 | 4,487 | 4,487 |
| No of banks | 239 | 239 | 239 | 239 | 196 | 196 |
| R-sq | 0.75 | 0.75 | 0.74 | 0.74 | 0.78 | 0.78 |
| BSOC dummy | Yes | Yes | Yes | Yes | Yes | Yes |
| Post-2007 dummy | Yes | No | No | No | No | No |
| Bank FE | B x d.CapReg | B x d.CapReg | B x d.CapReg | B x d.CapReg | B x d.CapReg | B x d.CapReg |
| Quarter FE | Yes | Yes | Yes | Yes | Yes | Yes |
| Macro uncertainty | Yes | Yes | Yes | Yes | Yes | Yes |
| MPU | Yes | Yes | Yes | Yes | Yes | Yes |

Robust standard errors in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

*Note: Surplus* is in percentage points, measured as capital ratio less bank-specific minimum capital requirement by risk-weighted assets. *d.CapRegime* is a categorical variable capturing the three different waves of capital regulation regimes in the UK: till 1997 Q2, between 1997 Q2 to 2007 Q4, and from 2008 Q1 onwards. *All excluding crisis* is the full sample excluding 2007 Q3 - 2009 Q2; *Pre-2007* is the time period from 1989 Q1 to 2007 Q2; and *Post-2007* is from 2007 Q3 to 2013 Q4. *BRU:N* is the narrow measure on regulatory uncertainty, whereas *BRU:B* is the broad version of the textual measure. All columns include (*bank,* $B \times d.CapReg$) fixed effects to control for bank unobserved heterogeneity, so that the $\beta$ is identified by comparing the same bank within the same capital regime. Standard errors are clustered at bank-time level. Table B.1 contains definitions of all the variables.

## Table 7: Key result III: *Dangerzone* banks

| | *Dependent variable:* $\Delta Surplus_{it}$ | | |
|---|---|---|---|
| | (1) | (2) | (3) |
| Rate of convergence to equilibrium, $\theta$ | | | |
| Surplus$_{it-1}$ | -0.07*** | -0.07*** | -0.07*** |
| | (0.012) | (0.012) | (0.012) |
| Rate of adjustment, $\gamma$ | | | |
| Return on equity$_{it-1}$ | 0.09 | 0.09 | 0.09 |
| | (0.140) | (0.136) | (0.138) |
| Trigger$_{it-1}$ | -0.01 | -0.07 | -0.06 |
| | (0.341) | (0.330) | (0.333) |
| Provisions$_{it-1}$ | 0.74 | 0.73 | 0.75 |
| | (2.318) | (2.250) | (2.238) |
| Subordinated debt$_{it-1}$ | 0.72 | 0.74 | 0.72 |
| | (0.823) | (0.807) | (0.821) |
| Retained profits$_{it-1}$ | 5.33* | 5.07* | 5.05* |
| | (3.107) | (3.023) | (3.039) |
| Time demeaned size$_{it-1}$ | -9.75*** | -8.74** | -8.63** |
| | (3.770) | (3.672) | (3.681) |
| Loan growth$_{it-1}$ | -1.34*** | -1.30*** | -1.30*** |
| | (0.345) | (0.338) | (0.337) |
| **BRU:N**$_{t-1}$ $\times$ **d.Bottom tercile of surplus from trigger**$_{it-1}$ | 0.15** | | |
| | (0.066) | | |
| **BRU:N**$_{t-1}$ $\times$ **d.Below median of surplus from trigger**$_{it-1}$ | | 0.31*** | |
| | | (0.094) | |
| **BRU:N**$_{t-1}$ $\times$ **d.Bottom tercile from Basel I 8%**$_{it-1}$ | | | 0.29*** |
| | | | (0.095) |
| Observations | 15,413 | 15,413 | 15,413 |
| No of banks | 239 | 239 | 239 |
| R-sq | 0.86 | 0.86 | 0.86 |
| Bank FE | Yes | Yes | Yes |
| Time FE | Yes | Yes | Yes |

Robust standard errors in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

*Note: Surplus* is in percentage points, measured as capital ratio less bank-specific minimum capital requirement by risk-weighted assets. *d.Bottom tercile of surplus from trigger* ($DZ_{it}^{t}$) is a dummy variable that takes value 1 if the bank is in the bottom tercile of surpluses (defined from the trigger) for that quarter. *d.Below median of surplus from trigger* ($DZ_{it}^{m}$) is a dummy that takes value 1 if the bank is below median of the cross-sectional surplus distribution. Finally, the dummy *d.Bottom tercile of surplus from Basel I minimum of 8%* ($DZ_{it}^{p}$) takes value 1 if the bank is in the bottom tercile of cross-sectional surplus distribution, but where surplus is calculated as the distance from the publicly observable Basel I minimum of 8%. All dummies are included by themselves in addition to the interaction. All columns have both bank and time fixed effects, and standard errors are clustered at bank-time level. Table B.1 contains definitions of all the variables.

Table 8: Key result IV: Bank specific measure of uncertainty, $MADTRIG_{it}^{q}$

| | Dependent variable: $\Delta Surplus_{it}$ | | | | |
|---|---|---|---|---|---|
| | (1) All | (2) Safe banks | (3) $DZ_{it}^{t}$ | (4) $DZ_{it}^{m}$ | (5) $DZ_{it}^{p}$ |
| Rate of convergence to equilibrium, $\theta$ | | | | | |
| $\text{Surplus}_{it-1}$ | -0.07*** | -0.07*** | -0.87*** | -0.68*** | -0.68*** |
| | (0.012) | (0.013) | (0.058) | (0.082) | (0.086) |
| Rate of adjustment, $\gamma$ | | | | | |
| $\text{Return on equity}_{it-1}$ | 0.10 | 0.02 | 0.01*** | 0.01 | 0.00 |
| | (0.139) | (0.189) | (0.003) | (0.006) | (0.005) |
| $\text{Trigger}_{it-1}$ | 0.18 | 0.10 | -0.03* | -0.05 | -0.06* |
| | (0.351) | (0.323) | (0.019) | (0.034) | (0.034) |
| $\text{Provisions}_{it-1}$ | 0.72 | 0.65 | -1.05*** | -0.43* | -0.20 |
| | (2.332) | (2.214) | (0.214) | (0.246) | (0.176) |
| $\text{Subordinated debt}_{it-1}$ | 0.80 | 0.53 | -0.02 | 0.06 | 0.06 |
| | (0.777) | (0.836) | (0.038) | (0.049) | (0.050) |
| $\text{Retained profits}_{it-1}$ | 5.55* | 4.91 | 4.94** | 6.85 | 8.92* |
| | (3.128) | (3.225) | (2.254) | (5.012) | (4.635) |
| $\text{Time demeaned size}_{it-1}$ | -10.28*** | -11.41*** | -0.17* | -0.33* | -0.30* |
| | (3.704) | (4.318) | (0.102) | (0.180) | (0.163) |
| $\text{Loan growth}_{it-1}$ | -1.36*** | -1.42*** | -0.00 | -0.01 | -0.01*** |
| | (0.345) | (0.364) | (0.003) | (0.005) | (0.004) |
| **Mean abs deviation of trigger**$_{it-1}^{q=12}$ | -1.18 | -1.40 | 0.12* | 0.23** | 0.29*** |
| | (1.379) | (1.514) | (0.072) | (0.098) | (0.102) |
| Observations | 15,413 | 10,324 | 5,079 | 8,372 | 8,491 |
| No of banks | 239 | 233 | 191 | 211 | 213 |
| R-sq | 0.86 | 0.86 | 0.11 | 0.26 | 0.27 |
| Bank FE | Yes | Yes | Yes | Yes | Yes |
| Time FE | Yes | Yes | Yes | Yes | Yes |

Robust standard errors in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

*Note: Surplus* is in percentage points, measured as capital ratio less bank-specific minimum capital requirement by risk-weighted assets. *d.Bottom tercile of surplus from trigger* ($DZ_{it}^{t}$) is a dummy variable that takes value 1 if the bank is in the bottom tercile of surpluses (defined from the trigger) for that quarter. *d.Below median of surplus from trigger* ($DZ_{it}^{m}$) is a dummy that takes value 1 if the bank is below median of the cross-sectional surplus distribution. Finally, the dummy *d.Bottom tercile of surplus from Basel I minimum of 8%* ($DZ_{it}^{p}$) takes value 1 if the bank is in the bottom tercile of cross-sectional surplus distribution, but where surplus is calculated as the distance from the publicly observable Basel I minimum of 8%. $MADTRIG^{q=12}$ is the mean absolute deviation of bank *i*'s trigger in the past 12 quarters. All columns have both bank and time fixed effects, and standard errors are clustered at bank and time level. Table B.1 contains definitions of all the variables.

## Table 9: $MADTRIG^q_{it}$: Additional checks

| | Dependent variable: $\Delta Surplus_{it}$ | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | (1) Consistent $DZ^t_{it}$ | (2) Consistent $DZ^m_{it}$ | (3) Consistent $DZ^p_{it}$ | (4) Exc. BSOC $DZ^t_{it}$ | (5) Exc. BSOC $DZ^m_{it}$ | (6) Exc. BSOC $DZ^p_{it}$ | (7) Only (10-90th pc.) $DZ^m_{it}$ | (8) Only (10-90th pc.) $DZ^p_{it}$ |
| Rate of convergence to equilibrium, $\theta$ | | | | | | | | |
| $\text{Surplus}_{it-1}$ | -0.76*** | -0.54*** | -0.54*** | -0.90*** | -0.70*** | -0.70*** | -0.62*** | -0.63*** |
| | (0.044) | (0.044) | (0.043) | (0.051) | (0.084) | (0.084) | (0.038) | (0.038) |
| Rate of adjustment, $\gamma$ | | | | | | | | |
| $\text{Return on equity}_{it-1}$ | 0.01* | 0.00 | 0.00 | 0.01*** | 0.00 | 0.00 | 0.00 | 0.00 |
| | (0.005) | (0.009) | (0.008) | (0.003) | (0.005) | (0.005) | (0.006) | (0.006) |
| $\text{Trigger}_{it-1}$ | -0.04 | 0.06 | 0.07 | -0.03 | -0.03 | -0.03 | -0.03 | -0.03 |
| | (0.036) | (0.049) | (0.050) | (0.027) | (0.042) | (0.041) | (0.036) | (0.036) |
| $\text{Provisions}_{it-1}$ | -0.78*** | 0.47 | 0.20 | -0.97*** | -0.38* | -0.38* | -0.42 | -0.41 |
| | (0.265) | (1.644) | (1.424) | (0.195) | (0.220) | (0.218) | (0.266) | (0.256) |
| $\text{Market}_{it-1}$ | -0.03 | 0.08 | 0.10 | -0.02 | 0.01 | 0.01 | 0.09* | 0.09* |
| | (0.056) | (0.078) | (0.077) | (0.039) | (0.049) | (0.052) | (0.052) | (0.051) |
| $\text{Retained profits}_{it-1}$ | 4.15* | 0.93 | 3.73 | 3.89* | 6.46 | 6.33 | 8.78* | 8.77* |
| | (2.437) | (6.726) | (5.972) | (2.051) | (4.745) | (4.740) | (4.985) | (4.943) |
| $\text{Time-demeaned size}_{it-1}$ | -0.10 | -0.06 | -0.09 | -0.15 | -0.33* | -0.31* | -0.34** | -0.34** |
| | (0.138) | (0.231) | (0.228) | (0.113) | (0.173) | (0.170) | (0.155) | (0.154) |
| $\text{Loan growth}_{it-1}$ | -0.00 | -0.01* | -0.01* | -0.00 | -0.01** | -0.01** | -0.01* | -0.01 |
| | (0.003) | (0.007) | (0.007) | (0.003) | (0.005) | (0.004) | (0.007) | (0.007) |
| $MADTRIG^{q=12}_{it-1}$ | 0.08 | 0.03 | 0.08 | 0.12 | 0.26*** | 0.26*** | 0.17* | 0.17* |
| | (0.089) | (0.153) | (0.149) | (0.075) | (0.095) | (0.095) | (0.105) | (0.105) |
| Observations | 3,075 | 5,126 | 5,107 | 3,504 | 5,827 | 5,810 | 6,670 | 6,643 |
| No of banks | 109 | 121 | 121 | 140 | 158 | 157 | 189 | 189 |
| R-sq | 0.19 | 0.40 | 0.40 | 0.10 | 0.25 | 0.25 | 0.32 | 0.31 |
| Bank FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Time FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |

Robust standard errors in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

*Note: Surplus* is in percentage points, measured as capital ratio less bank-specific minimum capital requirement by risk-weighted assets. *d.Bottom tercile of surplus from trigger* ($DZ^t_{it}$) is a dummy variable that takes value 1 if the bank is in the bottom tercile of surpluses (defined from the trigger) for that quarter. *d.Below median of surplus from trigger* ($DZ^m_{it}$) is a dummy that takes value 1 if the bank is below median of the cross-sectional surplus distribution. Finally, the dummy *d.Bottom tercile of surplus from Basel I minimum of 8%* ($DZ^p_{it}$) takes value 1 if the bank is in the bottom tercile of cross-sectional surplus distribution, but where surplus is calculated as the distance from the publicly observable Basel I minimum of 8%. For this table, these dummies are re-calculated for each cut of the data. $MADTRIG^{q=12}_{it}$ is the mean absolute deviation of bank $i$'s trigger in the past 12 quarters. All columns are on various cuts of the *dangerzone* sample: columns (1)-(3) restrict the sample to the consistent set of banks, columns (4)-(6) contain *dangerzone* banks excluding building societies, and columns (7)-(8) omit the very large ($> 90^{th}$ percentile) and very small ($< 10^{th}$ percentile) banks. All columns have both bank and time fixed effects, and standard errors are clustered at bank and time level. Table B.1 contains definitions of all the variables.

Table 10: Key result V: *Dangerzone* banks and $MADTRIG^{q}_{it}$

| | *Dependent variable:* $\Delta Surplus_{it}$ | | |
|---|---|---|---|
| | (1) | (2) | (3) |
| Rate of convergence to equilibrium, $\theta$ | | | |
| Surplus$_{it-1}$ | -0.07*** | -0.07*** | -0.07*** |
| | (0.012) | (0.013) | (0.013) |
| Rate of adjustment, $\gamma$ | | | |
| Return on equity$_{it-1}$ | 0.10 | 0.10 | 0.09 |
| | (0.137) | (0.133) | (0.133) |
| Trigger$_{it-1}$ | 0.09 | 0.03 | 0.06 |
| | (0.337) | (0.313) | (0.321) |
| Provisions$_{it-1}$ | 0.67 | 0.64 | 0.65 |
| | (2.312) | (2.227) | (2.214) |
| Subordinated debt$_{it-1}$ | 0.73 | 0.73 | 0.70 |
| | (0.761) | (0.741) | (0.753) |
| Retained profits$_{it-1}$ | 5.27* | 4.98* | 4.96* |
| | (3.095) | (2.959) | (2.971) |
| Time demeaned size$_{it-1}$ | -8.93** | -7.12** | -7.04* |
| | (3.680) | (3.594) | (3.613) |
| Loan growth$_{it-1}$ | -1.32*** | -1.26*** | -1.26*** |
| | (0.341) | (0.331) | (0.329) |
| MADTRIG$^{q=12}$ | -1.57 | -1.64 | -1.54 |
| | (1.393) | (1.356) | (1.370) |
| **MADTRIG$^{q=12}_{it-1}$ × d.Bottom tercile of surplus from trigger$_{it-1}$** | 2.79 | | |
| | (1.789) | | |
| **MADTRIG$^{q=12}_{it-1}$ × d.Below median of surplus from trigger$_{it-1}$** | | 3.02* | |
| | | (1.673) | |
| **MADTRIG$^{q=12}_{it-1}$ × d.Bottom tercile from Basel I 8%$_{it-1}$** | | | 2.48 |
| | | | (1.655) |
| Observations | 15,413 | 15,413 | 15,413 |
| No of banks | 239 | 239 | 239 |
| R-sq | 0.86 | 0.86 | 0.86 |
| Bank FE | Yes | Yes | Yes |
| Time FE | Yes | Yes | Yes |

Robust standard errors in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

*Note: Surplus* is measured as capital ratio less bank-specific minimum capital requirement, as a percent of risk-weighted assets. *d.Bottom tercile of surplus from trigger* ($DZ^{t}_{it}$) is a dummy variable that takes value 1 if the bank is in the bottom tercile of surpluses (defined from the trigger) for that quarter. We consider two more alternate definitions. The first is *d.Below median of surplus from trigger* ($DZ^{m}_{it}$) which takes value 1 if the bank is below median of the cross-sectional surplus distribution. The second is *d.Bottom tercile of surplus from Basel I minimum of 8%* ($DZ^{p}_{it}$) takes value 1 if the bank is in the bottom tercile of cross-sectional surplus distribution, defined as the distance from the Basel I minimum of 8%. All columns have both bank and time fixed effects, and standard errors are clustered at bank and time level. Table B.1 contains definitions of all the variables.

## Table 11: Key result VI: Market discipline

| | Dependent variable: $\Delta Surplus_{it}$ | | | | | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| | $DZ^t_{it}$ | $DZ^m_{it}$ | $DZ^p_{it}$ | $DZ^t_{it}$ | $DZ^m_{it}$ | $DZ^p_{it}$ |
| Rate of convergence to equilibrium, $\theta$ | | | | | | |
| Surplus$_{it-1}$ | -0.87*** | -0.68*** | -0.68*** | -0.87*** | -0.68*** | -0.68*** |
| | (0.059) | (0.082) | (0.086) | (0.058) | (0.082) | (0.086) |
| Rate of adjustment, $\gamma$ | | | | | | |
| Return on equity$_{it-1}$ | 0.01*** | 0.01 | 0.00 | 0.01*** | 0.01 | 0.00 |
| | (0.003) | (0.006) | (0.005) | (0.003) | (0.006) | (0.005) |
| Trigger$_{it-1}$ | -0.02 | -0.03 | -0.04 | -0.03 | -0.05 | -0.06* |
| | (0.020) | (0.029) | (0.029) | (0.019) | (0.034) | (0.034) |
| Provisions$_{it-1}$ | -1.09*** | -0.44* | -0.21 | -1.04*** | -0.43* | -0.21 |
| | (0.207) | (0.252) | (0.183) | (0.212) | (0.251) | (0.179) |
| Subordinated debt$_{it-1}$ | 0.07 | 0.30* | 0.25 | -0.02 | 0.03 | 0.03 |
| | (0.115) | (0.164) | (0.169) | (0.044) | (0.059) | (0.060) |
| Retained profits$_{it-1}$ | 5.16** | 7.21 | 9.31** | 4.97** | 6.89 | 8.93* |
| | (2.257) | (5.092) | (4.718) | (2.251) | (5.049) | (4.660) |
| Time demeaned size$_{it-1}$ | -0.18* | -0.35* | -0.34** | -0.17* | -0.33* | -0.31* |
| | (0.102) | (0.183) | (0.166) | (0.102) | (0.180) | (0.162) |
| Loan growth$_{it-1}$ | -0.00 | -0.01* | -0.01*** | -0.00* | -0.01 | -0.01*** |
| | (0.003) | (0.005) | (0.004) | (0.003) | (0.005) | (0.004) |
| **BRU:N$_{t-1}$ × Subordinated debt$_{it-1}$** | -0.00 | -0.00 | -0.00 | | | |
| | (0.001) | (0.001) | (0.002) | | | |
| **MADTRIG$^{r=12}_{it-1}$** | | | | 0.11* | 0.15* | 0.20** |
| | | | | (0.058) | (0.091) | (0.094) |
| **MADTRIG$^{r=12}_{it-1}$ × Subordinated debt$_{it-1}$** | | | | 0.01 | 0.06 | 0.06* |
| | | | | (0.038) | (0.037) | (0.029) |
| Observations | 5,079 | 8,372 | 8,491 | 5,079 | 8,372 | 8,491 |
| No of banks | 193 | 211 | 213 | 191 | 211 | 213 |
| R-sq | 0.11 | 0.26 | 0.26 | 0.11 | 0.26 | 0.26 |
| Bank FE | Yes | Yes | Yes | Yes | Yes | Yes |
| Time FE | Yes | Yes | Yes | Yes | Yes | Yes |

Robust standard errors in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

*Note: Surplus* is measured as capital ratio less bank-specific minimum capital requirement, as a percent of risk-weighted assets. Market discipline is measured by share of *subordinated debt*. *d.Bottom tercile of surplus from trigger* ($DZ^t_{it}$) is a dummy variable that takes value 1 if the bank is in the bottom tercile of surpluses (defined from the trigger) for that quarter. *d.Below median of surplus from trigger* ($DZ^m_{it}$) is a dummy that takes value 1 if the bank is below median of the cross-sectional surplus distribution. Finally, the dummy *d.Bottom tercile of surplus from Basel I minimum of 8%* ($DZ^p_{it}$) takes value 1 if the bank is in the bottom tercile of cross-sectional surplus distribution, but where surplus is calculated as the distance from the publicly observable Basel I minimum of 8%. $MADTRIG^{q=12}$ is the mean absolute deviation of bank-specific trigger calculated over 12 quarters. All columns have both bank and time fixed effects, and standard errors are clustered at bank and time level. Table B.1 contains definitions of all the variables.

# Appendices

## A Construction of uncertainty measures

### A.1 Keywords: Narrow banking regulation uncertainty measure

**Denominator of all banking policy related articles**: (bank* or bankingor "building societ*" or lender or boe or BOE or "Bank of England") near50 (brit* or UK) AND (policy or policies or rules or regulation or regulatory or requirement* or capital* or "Basel") AND wc>99 AND re=UK

**Numerator of subsample of uncertainty in banking policy related articles**: ((bank* or banking! or "building societ*" or lender or boe or BOE or "Bank of England") near50 (brit* or UK) AND (policy or policies or rules or regulation or regulatory or requirement* or capital* or "Basel")) AND (uncert* or ambiguous or dubious or precarious or unpredictable or undecided or undetermined or unresolved or unsettled or concern or worr* or anxiet* or unclear) AND wc>99 AND re=UK

**Near50** requires that brit* or UK be within 50 words of the banking related words (changing this changes the results only marginally).

**wcc>99** requires that the size of the article be at least 99 words.

**re=UK** sets the region to the UK to further make sure that the articles are UK related.

**Sensitivity**: We also tried adding words like "Basle" or "supervisor*" for a couple of random quarters for The Guardian but do not capture significantly more number of articles. In a separate version of the indicator, we also require uncertainty related words to be in the same paragraph as banking and policy related words, but the variation obtained then is quite low. For example, we get only 323 articles in The Guardian over 1989-2017 and in some quarters where the keyword searches pick up only 1 or 2 articles, none of them are actually about banking.

### A.2 Keywords: Broad banking sector uncertainty measure

**Denominator of all banking policy related articles**: (bank* OR "building societ*" OR banking! OR lender* OR boe OR "Bank of England") AND (brit* OR UK)

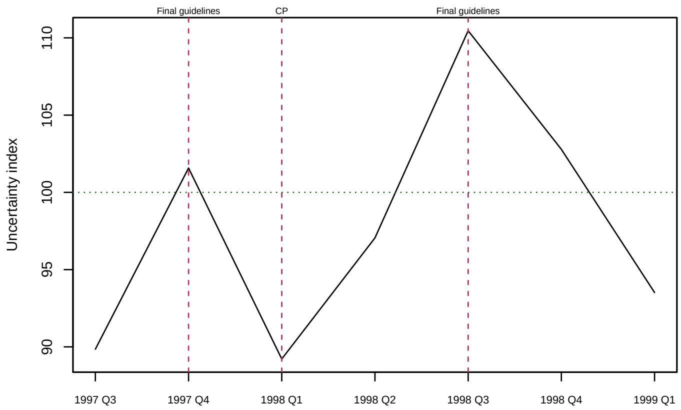
**Numeratore of subsample of uncertainty in banking policy related articles**: (bank* OR "building societ*" OR banking! OR lender* OR boe OR "Bank of England") AND (brit* OR UK) AND (uncert*)

### A.3 Sensitivity checks: Narrow measure

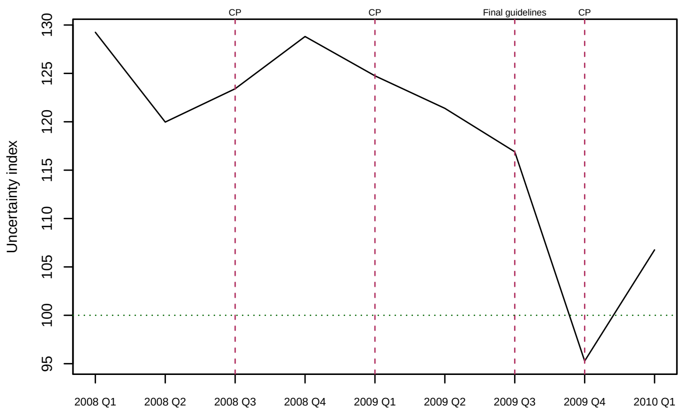
We conduct a few sanity checks for our measure of narrow banking regulatory uncertainty, since that is our main variable of interest. The first is to check what happens to the measure around the time of major Basel publications, especially consultation papers where proposals are put out for public comments for a stipulated period of time. In order for the measure to be considered reasonable, we should expect that publications of these consultation papers should lead to a spike in uncertainty, but a document that finalises the agreed rules might imply a resolution of regulatory uncertainty, in which case we would hope to observe a downturn in our text-based measure. Importantly, we do not draw causal links here; instead, we only expect that the measure show reasonable movement around the key dates selected.

We choose two events, a decade apart, for our sensitivity checks. The first is the changes to the Basel I Market Risk Amendment in 1997 Q4.[38] This was followed by a consultation paper on internal control systems in 1998 Q1 (BCBS, 1998a), with final guidelines in 1998 Q3 (BCBS, 1998b). The second is a set of documents released in the aftermath of the crisis. The consultation papers issued to enhance Basel II in 2008 Q3 and 2009 Q1 (BCBS, 2008b,a, 2009b), the ensuing final guidelines in 2009 Q3 (BCBS, 2009a), and release of another CP on Basel III in 2009 Q4 (BCBS, 2009c).[39] In figure A.1, we plot our narrow uncertainty measure, zooming in on the time period around these releases, and find the expected relationship.

Figure A.1: Narrow measure of uncertainty and Basel announcements




(a) Basel I-II announcements




(b) Basel II-III announcements

*Note:* This figure plots behaviour of narrow banking sector policy uncertainty (*BRU:N*) with some key dates when Basel announcements were made. In panel A, the dates are 1997 Q4 (when Basel II when changes in the market risk amendment were announced), 1998 Q1 (when the Basel II consultation paper on internal control systems was released) and 1998 Q3 (when the internal control systems guidelines were finalised). In panel B, the dates are as follows: 2008 Q3 (proposed improvements to the capital regime for trading book positions and market risk framework), 2009 Q1 (more trading book proposals and strengthening of the capital framework), 2009 Q2 (final guidelines on the trading book and capital assessment), and 2009 Q4 (consultation document on strengthening capital and liquidity regulations).

[38]See: https://www.bis.org/press/p970918a.htm.

[39]For a complete post-crisis timeline, see: https://www.bis.org/publ/bcbsca.htm.

We also eyeball those quarters where uncertainty is high, that is, those quarters where the uncertainty measure shows an upswing greater than one standard deviation about its mean (which is by construction equal to 100). This identified 19 quarters (5 before 2007 Q2, the remainder after the crisis). We undertook a closer review of articles for a couple of randomly selected quarters from this subset by reading the articles. For example, in 1992 Q1, most of the articles were related to merger policy, competition regulation, changes to Basel requirements, fragmented financial service industry regulation, regulation of building societies given their relationship with insurance sector. Several of these were also in context of stock market or general banking performance, for example, discussing their capitalisation or uncertainty in response to a property price shock or bad outcome in the elections.

This confirms our earlier intuition that macroeconomic uncertainty, as well as monetary policy uncertainty might also find mentions in the articles. For example, there may be uncertainty on how the economy will do and how that will translate to bank performance, or uncertainty around how the regulator will respond (like through interest rates) to changing circumstances. To the extent that these uncertainties effect the bank's forecast capital resources, we do not purge them out by narrowing the keyword searches further. However, we will control for them explicitly in the regressions.

# B Data processing

We winsorize the following variables at 1% in both tails: capital ratio, minimum requirements, surplus capital, return on equity and assets. We drop those observations where loans are equal to zero or where there are changes in capital which greater than 100 percentage points in either direction as these may be driven by changes in risk weights, or large changes in loan growth (in most observations this is the case). Therefore, we additionally drop changes in quarterly loans that are greater than 150 percentage points (in either direction), as these reflect particular changes in the balance sheet that may be driven by special circumstances. We also drop banks which have unknown origins. Further, our sample contains a small set of specialised banks like those that engage in wealth management or investment banking, who might be holding high surplus capital because of significant differences in their business models. Therefore, in order to restrict attention to only commercial banks, we follow de Ramon *et al.* (2018) and drop 18 banks that have an average loan-to-asset ratios of less than 10% and a deposit-to-asset ratio of less than 20% over the entire sample, as well as foreign subsidiaries with unknown business models which hold very large surpluses. To allow for proper clustering of standard errors, we use only those banks where there are at least 30 quarters of continuous data. Importantly, we check that our results are not being driven by data processing: using the raw dataset gives us the same significant relationship between uncertainty and bank capital surpluses, but with significantly larger magnitudes. We also cross-check our results using a different dataset on banking groups, and find evidence in support of our hypothesis.

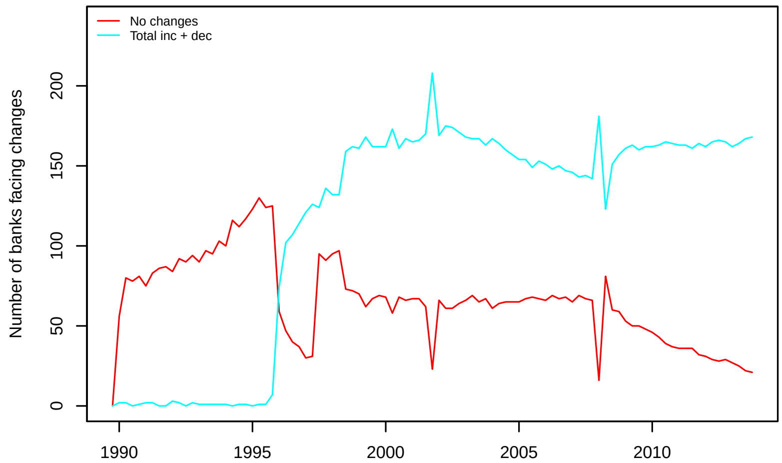
Table B.1: Variable definitions and data sources

| **Variable** | **Calculation** | **Unit** | **Source** |
|---|---|---|---|
| $\text{Surplus}_{it}$ | Total (Tier 1+Tier 2) capital less the minimum, as % of total RWAs: $100 \times \frac{\text{Capital}_{it} - \text{Overall minimum}_{it}}{\text{RWA}_{it}}$ | % | HBRD |
| $\text{Return on equity}_{it}$ | $100 \times \frac{\text{Current year profit loss (SA)}_{it}}{\text{CT1}_{it}}$ | % | HBRD |
| $\text{Provisions}_{it}$ | Ratio of total provisions to loans: $\frac{\text{Provisions}_{it}}{\text{Loans}_{it}}$ | % | HBRD |
| $\text{Market}_{it}$ | $100 \times \frac{\text{Subordinated debt}_{it}}{\text{Assets}_{it}}$ | % | HBRD |
| $\text{Retained profits}_{it}$ | $\frac{\text{Retained profits}_{it}}{\text{Assets}_{it}}$ | % | HBRD |
| $\text{Size}_{it}$ | $log\ (\text{assets})_{it} - log\ (\mu_{\text{assets}})_i$ | GBP | HBRD |
| $\text{Loan growth}_{it}$ | QoQ growth of loan to assets: $100 \times \Delta(log(\frac{\text{Loan}_{it}}{\text{Assets}_{it}}))$ | % | HBRD |
| $\text{MADTRIG}^q_{it}$ | Mean absolute deviation of $trigger_{it}$ over $q$ previous quarters, where $q = 8, 12$ | % | HBRD |
| $\text{BSOC}_{it}$ | Identifier for building societies | Dummy | HBRD |
| $\text{Dangerzone}^t_{it}$ | Bottom tercile of cross-sectional surplus capital distribution (from $\text{trigger}_{it}$) | Dummy | HBRD |
| $\text{Dangerzone}^m_{it}$ | Below median of cross-sectional surplus capital distribution (from $\text{trigger}_{it}$) | Dummy | HBRD |
| $\text{Dangerzone}^p_{it}$ | Bottom tercile of cross-sectional surplus capital distribution (from Basel I 8%) | Dummy | HBRD |
| $\text{Macro uncertainty}_t$ | Principal component of 6 component series | Number | BoE |
| $\text{GDP growth}_t$ | Quarterly YoY GDP growth | % | FRED |
| $\text{Output gap}_t$ | Output gap | % | OECD |
| $\text{Banking sector z-score}_t$ | Captures probability of default of a country's banking system. Median $\frac{\text{ROA}+(\text{equity/assets})}{\sigma(\text{ROA})}$ | Number | GFD, WDI |
| $\text{Banking crisis dummy}_t$ | Dummy variable for the presence of banking crisis (1=banking crisis, 0=none) | Dummy | GFD, WDI |

*Note:* This table contains variable definitions and their sources.

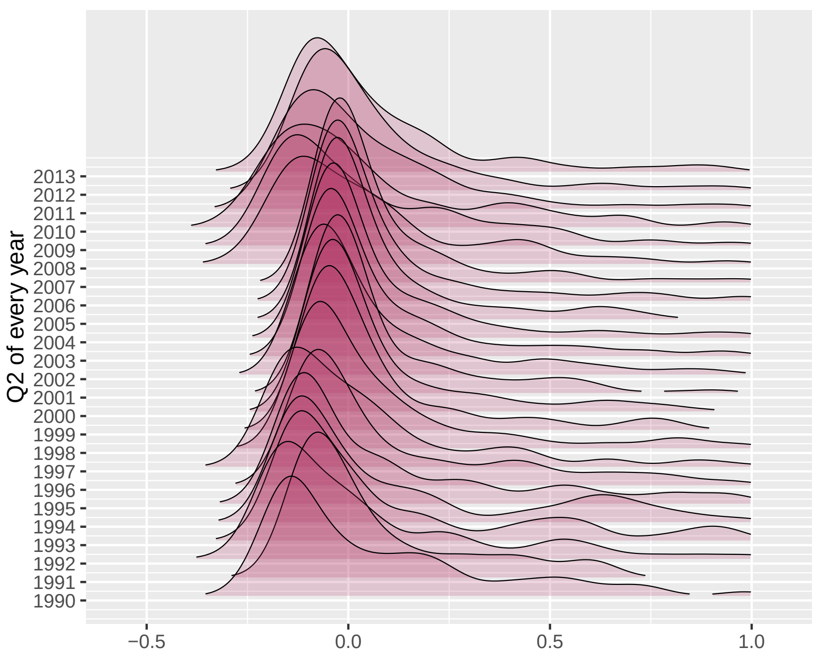
# C Additional figures

Figure C.1: Median minimum requirements: Overall changes




*Note:* This figure plots the number of banks facing *changes* (increases or decreases) in their minimum capital requirements in every quarter vs. those facing no changes.

Figure C.2: Cross-sectional distribution of surplus




*Note:* This figure plots the cross-sectional distribution of surplus, scaled by per-quarter median, for the all banks in the sample. The data have been winsorized at the 1% level to remove extreme values and banks with unknown origins or less than 20 quarters of data have been dropped. For presentation purposes, the graph limits are specified as $(-0.5, 1)$.

# D Additional tables

Table D.1: Surpluses and bank-specific uncertainty: Safe vs. *dangerzone* banks

| **Panel A: Surplus** | | | |
|---|---|---|---|
| Sample | Observations | Mean | *ttest* of differences in means |
| Safe | 10345 | 21.03 | |
| $DZ_{it}^t$ | 5091 | 2.12 | 18.90*** |
| Safe | 7050 | 28.59 | |
| $DZ_{it}^m$ | 8386 | 3.20 | 25.39*** |
| Safe | 6934 | 29.83 | |
| $DZ_{it}^p$ | 8502 | 3.23 | 25.75*** |

| **Panel B:** $MADTRIG^{q=12}$ | | | |
|---|---|---|---|
| Sample | Observations | Mean | *ttest* of differences in means |
| Safe | 10345 | 0.48 | |
| $DZ_{it}^t$ | 5091 | 0.30 | 0.18*** |
| Safe | 7050 | 0.55 | |
| $DZ_{it}^m$ | 8386 | 0.31 | 0.24*** |
| Safe | 6934 | 0.54 | |
| $DZ_{it}^p$ | 8502 | 0.33 | 0.21*** |

*** p<0.01, ** p<0.05, * p<0.1

*Note:* The table shows differences in *surplus* and $MADTRIG^{q=12}$ for safe and *dangerzone* banks in the sample. *d.Bottom tercile of surplus from trigger* ($DZ_{it}^t$) is a dummy variable that takes value 1 if the bank is in the bottom tercile of surpluses (defined from the trigger) for that quarter. *d.Below median of surplus from trigger* ($DZ_{it}^m$) is a dummy that takes value 1 if the bank is below median of the cross-sectional surplus distribution. Finally, the dummy *d.Bottom tercile of surplus from Basel I minimum of 8%* ($DZ_{it}^p$) takes value 1 if the bank is in the bottom tercile of cross-sectional surplus distribution, but where surplus is calculated as the distance from the publicly observable Basel I minimum of 8%. $MADTRIG^{q=12}$ is the mean absolute deviation of bank-specific trigger calculated over 12 quarters, and *surplus* is capital less minimum requirement by RWAs.

Table D.2: Differences between safe and *dangerzone* banks

| Variable | Safe banks, $\mu$ | $DZ_{it}^t$ banks, $\mu$ | *ttest* of differences in means |
|---|---|---|---|
| Log assets | 5.61 | 7.37 | −1.75*** |
| RWA/TA | 51.29 | 55.85 | −4.55*** |
| Insured deposits/TA | 50.24 | 64.66 | −14.42*** |
| Loans/TA | 38.70 | 59.62 | −20.92*** |
| Sub-debt/TA | 1.39 | 1.16 | 0.23*** |
| Return on equity | 7.13 | 8.53 | −1.40*** |
| Provisions | 0.22 | 0.04 | 0.18*** |
| Minimum req. (% of RWAs) | 13.45 | 11.01 | 2.44*** |
| Retained profits | −0.01 | 0.002 | −0.01** |
| Loan growth | −0.05 | 0.11 | −0.16 |

*** p<0.01, ** p<0.05, * p<0.1

*Note:* This table shows the key balance sheet differences between safe and *dangerzone* ($DZ_{it}^t$) banks, with the latter being those banks which are in the bottom tercile of surpluses (defined from the trigger) for that quarter. The trends remain the same if we use other definitions of *dangerzone* banks. $TA$ is total assets.

Table D.3: Robustness I: Interaction with *post-2007* dummy and fully nested model

| | Dependent variable: $\Delta Surplus_{it}$ | | | |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| Rate of convergence to equilibrium, $\theta$ | | | | |
| $\text{Surplus}_{it-1}$ | -0.15*** | -0.15*** | -0.15*** | -0.15*** |
| | (0.027) | (0.027) | (0.027) | (0.027) |
| Rate of adjustment, $\gamma$ | | | | |
| $\text{ROE}_{it-1}$ | -0.01 | 0.00 | 0.01 | 0.01 |
| | (0.067) | (0.065) | (0.151) | (0.151) |
| $\text{ROE}_{it-1} \times$ d.Post07 | | | -0.03 | -0.02 |
| | | | (0.238) | (0.237) |
| $\text{Provisions}_{it-1}$ | 1.94*** | 1.92*** | 2.15*** | 2.11*** |
| | (0.337) | (0.325) | (0.271) | (0.265) |
| $\text{Provisions}_{it-1} \times$ d.Post07 | | | -2.33*** | -2.29*** |
| | | | (0.666) | (0.648) |
| $\text{Subordinated debt}_{it-1}$ | 0.38 | 0.35 | 0.09 | 0.05 |
| | (0.448) | (0.441) | (0.709) | (0.695) |
| $\text{Subordinated debt}_{it-1} \times$ d.Post07 | | | 0.60 | 0.61 |
| | | | (0.902) | (0.893) |
| $\text{Retained profits}_{it-1}$ | 3.78*** | 3.82** | 5.31** | 5.32** |
| | (1.358) | (1.542) | (2.101) | (2.153) |
| $\text{Retained profits}_{it-1} \times$ d.Post07 | | | -1.49 | -1.32 |
| | | | (2.444) | (2.367) |
| $\text{Time demeaned size}_{it-1}$ | -12.34*** | -12.48*** | -12.22*** | -12.45*** |
| | (2.980) | (3.006) | (3.480) | (3.574) |
| $\text{Time demeaned size}_{it-1} \times$ d.Post07 | | | -2.61 | -2.35 |
| | | | (5.920) | (5.965) |
| $\text{Trigger}_{it-1}$ | -0.37* | -0.40* | -0.54 | -0.61* |
| | (0.217) | (0.216) | (0.359) | (0.328) |
| $\text{Trigger}_{it-1} \times$ d.Post07 | | | 0.30 | 0.38 |
| | | | (0.387) | (0.367) |
| $\text{Loan growth}_{it-1}$ | -0.58*** | -0.57*** | -0.68*** | -0.68*** |
| | (0.127) | (0.127) | (0.151) | (0.151) |
| $\text{Loan growth}_{it-1} \times$ d.Post07 | | | 0.23 | 0.24 |
| | | | (0.171) | (0.172) |
| $\text{GDP growth}_{it-1}$ | 0.74** | 0.57** | 0.63 | 0.60 |
| | (0.341) | (0.288) | (0.497) | (0.469) |
| $\text{GDP growth}_{it-1} \times$ d.Post07 | | | 0.22 | -0.58 |
| | | | (0.929) | (0.792) |
| $\text{BRU:N}_{it-1}$ | 0.22*** | | 0.17** | |
| | (0.058) | | (0.077) | |
| $\text{BRU:N}_{it-1} \times$ d.Post07 | -0.16** | | -0.14 | |
| | (0.066) | | (0.125) | |
| $\text{BRU:B}_{it-1}$ | | 285.90*** | | 271.60** |
| | | (89.700) | | (120.113) |
| $\text{BRU:B}_{it-1} \times$ d.Post07 | | -84.40 | | 63.91 |
| | | (130.158) | | (223.194) |
| Observations | 15,232 | 15,232 | 15,232 | 15,232 |
| No of banks | 239 | 239 | 239 | 239 |
| R-sq | 0.75 | 0.75 | 0.75 | 0.75 |
| BSOC dummy | Yes | Yes | Yes | Yes |
| Bank FE | B x d.CapReg | B x d.CapReg | B x d.CapReg | B x d.CapReg |
| Quarter FE | Yes | Yes | Yes | Yes |
| Macro uncertainty | Yes | Yes | Yes | Yes |
| MPU | Yes | Yes | Yes | Yes |

Robust standard errors in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

*Note: Surplus* is in percentage points, measured as capital ratio less bank-specific minimum capital requirement by risk-weighted assets. *d.CapReg* is a categorical variable capturing the three different waves of capital regulation regimes in the UK: till 1997 Q2, between 1997 Q2 to 2007 Q4, and from 2008 Q1 onwards. *d.Post07* is a dummy variable for the period from 2007 Q3 to 2013 Q4. *BRU:N* is the narrow measure on regulatory uncertainty, whereas *BRU:B* is the broad version of the textual measure. All columns include (*bank, B* $\times$ *d.CapReg*) fixed effects to control for bank unobserved heterogeneity, so that the beta is identified by comparing the same bank within the same capital regime. Columns (1) and (2) contain an interaction of our uncertainty measures with the *d.Post*07 dummy and columns (3) and (4) contain the fully nested model. Standard errors are clustered at bank-time level. Table B.1 contains definitions of all the variables.

Table D.4: Robustness II: Using alternate measures of *surplus*

| | Dependent variable: | | | | | |
|---|---|---|---|---|---|---|
| | $\Delta Surplus/Capital_{it}$ | | | $\Delta Surplus/Trigger_{it}$ | | |
| | (1) All | (2) Pre-crisis | (3) Post-crisis | (4) All | (5) Pre-crisis | (6) Post-crisis |
| Rate of convergence to equilibrium, $\theta$ | | | | | | |
| Relative surplus$_{it-1}$ | -0.25*** | -0.24*** | -0.33*** | -0.88*** | -0.65*** | -0.95*** |
| | (0.015) | (0.016) | (0.031) | (0.090) | (0.199) | (0.051) |
| Rate of adjustment, $\gamma$ | | | | | | |
| Return on equity$_{it-1}$ | -0.03 | 0.02 | -0.07 | -0.00 | 0.00 | -0.01* |
| | (0.038) | (0.050) | (0.046) | (0.003) | (0.007) | (0.004) |
| Provisions$_{it-1}$ | 0.23*** | 0.28*** | 0.05 | 0.07*** | 0.08*** | 0.01 |
| | (0.051) | (0.050) | (0.251) | (0.011) | (0.009) | (0.032) |
| Subordinated debt$_{it-1}$ | 0.64** | 1.07** | 0.36 | 0.03 | 0.03 | 0.02 |
| | (0.283) | (0.478) | (0.286) | (0.030) | (0.052) | (0.036) |
| Time demeaned size$_{it-1}$ | -9.54*** | -9.64*** | -8.95*** | -0.99*** | -1.05*** | -1.18*** |
| | (1.039) | (1.337) | (1.928) | (0.200) | (0.259) | (0.453) |
| Trigger$_{it-1}$ | -0.87** | -1.11*** | -1.06** | -0.10*** | -0.14*** | -0.10*** |
| | (0.411) | (0.269) | (0.437) | (0.024) | (0.047) | (0.029) |
| Retained profits$_{it-1}$ | 1.44 | 3.23*** | 0.05 | 0.11** | 0.15* | 0.17*** |
| | (0.904) | (1.005) | (0.288) | (0.051) | (0.078) | (0.035) |
| Loan growth$_{it-1}$ | -0.21*** | -0.24*** | -0.15*** | -0.01*** | -0.01*** | -0.01** |
| | (0.040) | (0.045) | (0.058) | (0.002) | (0.005) | (0.004) |
| GDP growth$_{t-1}$ | 0.70*** | 0.28 | 1.89*** | 0.04* | 0.08** | 0.09** |
| | (0.225) | (0.281) | (0.494) | (0.021) | (0.035) | (0.036) |
| BRU:N$_{t-1}$ | 0.13*** | 0.17*** | 0.10 | 0.01** | 0.02*** | -0.01 |
| | (0.044) | (0.048) | (0.118) | (0.004) | (0.007) | (0.006) |
| Observations | 15,232 | 10,737 | 4,487 | 15,228 | 10,733 | 4,487 |
| No of banks | 239 | 239 | 198 | 239 | 238 | 198 |
| R-sq | 0.66 | 0.68 | 0.58 | 0.14 | 0.21 | 0.19 |
| Post-2007 dummy | Yes | Yes | Yes | Yes | No | No |
| Bank FE | B x d.CapReg | B x d.CapReg | Bank x d.CapReg | B x d.CapReg | B x d.CapReg | B x d.CapReg |
| Quarter FE | Yes | Yes | Yes | Yes | Yes | Yes |
| Macro uncertainty | Yes | Yes | Yes | Yes | Yes | Yes |
| MPU | Yes | Yes | Yes | Yes | Yes | Yes |

Robust standard errors in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

*Note:* This table conducts robustness checks with two alternate measures of surplus capital. In columns (1)-(3), *surplus* is defined as share of *capital* resources, that is, $100 \times \frac{capital-minimum}{capital}$; whereas in columns (4)-(6), it is defined as share of *trigger*, that is, $\frac{capital-trigger}{trigger}$, as in Ayuso *et al.* (2004); Coffinet *et al.* (2012); Fonseca and Gonzállez (2010). *d.CapRegime* is a categorical variable capturing the three different waves of capital regulation regimes in the UK: till 1997 Q2, between 1997 Q2 to 2007 Q4, and from 2008 Q1 onwards. We also always include quarter fixed effects to control for seasonality, as is standard in the literature, since we cannot include a full set of time fixed effects (*quarter-time*) at this stage as our parameter of interest is on the variable *banking regulation uncertainty*, which is only time varying. The standard errors are robust and clustered at firm-time level. Table B.1 contains definitions of all the variables.

Table D.5: Robustness III: Banks in *groups*, restricting sample to *10-90th percentile* of banks

| | *Dependent variable:* $\Delta Surplus_{it}$ | | |
|---|---|---|---|
| | (1) Only banks in groups | (2) Banks not in groups | (3) All ex. very small & very large |
| Rate of convergence to equilibrium, $\theta$ | | | |
| $Surplus_{it-1}$ | -0.25*** | -0.12*** | -0.18*** |
| | (0.043) | (0.026) | (0.027) |
| Rate of adjustment, $\gamma$ | | | |
| Return on $equity_{it-1}$ | -0.05 | 0.06 | 0.00 |
| | (0.085) | (0.097) | (0.065) |
| $Trigger_{it-1}$ | -0.07 | -0.70** | -0.27 |
| | (0.412) | (0.280) | (0.261) |
| $Provisions_{it-1}$ | 15.35*** | 2.10*** | 1.74*** |
| | (4.163) | (0.500) | (0.291) |
| Subordinated $debt_{it-1}$ | -0.24 | 0.74 | 0.37 |
| | (0.460) | (0.665) | (0.409) |
| Retained $profits_{it-1}$ | 0.32 | 4.21** | 3.31** |
| | (0.613) | (1.761) | (1.294) |
| Time demeaned $size_{it-1}$ | -5.44*** | -17.29*** | -11.48*** |
| | (1.038) | (4.959) | (2.431) |
| Loan $growth_{it-1}$ | -0.14** | -1.00*** | -0.52*** |
| | (0.054) | (0.232) | (0.102) |
| GDP $growth_{t-1}$ | 0.30 | 1.21*** | 0.72*** |
| | (0.225) | (0.429) | (0.279) |
| $BRU{:}N_{t-1}$ | 0.15*** | 0.15* | 0.16*** |
| | (0.057) | (0.087) | (0.049) |
| Observations | 4,219 | 11,013 | 13,117 |
| No of banks | 68 | 173 | 222 |
| R-sq | 0.66 | 0.79 | 0.71 |
| BSOC dummy | Yes | Yes | Yes |
| Post-2007 dummy | Yes | Yes | Yes |
| Bank FE | B x d.CapReg | B x d.CapReg | B x d.CapReg |
| Time FE | No | No | No |
| Quarter FE | Yes | Yes | Yes |
| Macro uncertainty | Yes | Yes | Yes |
| Monetary policy uncertainty | Yes | Yes | Yes |

Robust standard errors in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

*Note:* $Post-2007$ is a dummy that takes value 0 between 1989 Q1 - 2007 Q2, and 1 for the time period between 2007 Q2 - 2013 Q4. All columns include (firm $\times$ d.capital regimes) fixed effects to control for firm-capital regime unobserved heterogeneity. We also always include quarter fixed effects to control for seasonality, as is standard in the literature, since we cannot include a full set of time fixed effects (*quarter-time*) at this stage as our parameter of interest is on the variable *banking regulation uncertainty* which is only time varying. BRU:N is the narrow measure of uncertainty as defined in section 4.1. Column (1) restricts the sample to those banks which belong to groups, and column (2) restricts to those which do not belong in groups. Column (3) drops banks which are in the top and bottom 10% of the size distribution. The standard errors are robust and clustered at firm-time level.

Table D.6: Robustness IV: *Consistent* sample of banks

| | | *Dependent variable:* $\Delta Surplus_{it}$ | |
|---|---|---|---|
| | (1) | (2) | (3) |
| | Consistent | Consistent, pre-2007 | Consistent, post-2007 |
| Rate of convergence to equilibrium, $\theta$ | | | |
| $\text{Surplus}_{it-1}$ | -0.17*** | -0.18*** | -0.21** |
| | (0.036) | (0.039) | (0.094) |
| Rate of adjustment, $\gamma$ | | | |
| $\text{Return on equity}_{it-1}$ | 0.07 | 0.25** | -0.00 |
| | (0.071) | (0.119) | (0.059) |
| $\text{Trigger}_{it-1}$ | -0.54* | -0.55 | -0.66 |
| | (0.316) | (0.383) | (0.453) |
| $\text{Provisions}_{it-1}$ | 1.80*** | 1.84*** | -0.24 |
| | (0.361) | (0.207) | (0.385) |
| $\text{Subordinated debt}_{it-1}$ | 0.23 | -0.24 | 0.51 |
| | (0.454) | (0.630) | (0.795) |
| $\text{Retained profits}_{it-1}$ | 3.24** | -2.34 | 3.41*** |
| | (1.269) | (6.135) | (0.985) |
| $\text{Time demeaned size}_{it-1}$ | -8.73*** | -9.56*** | -10.41** |
| | (2.500) | (2.822) | (5.277) |
| $\text{Loan growth}_{it-1}$ | -0.55*** | -0.56*** | -0.29 |
| | (0.127) | (0.143) | (0.192) |
| $\text{GDP growth}_{t-1}$ | 0.78** | 0.73 | 1.19* |
| | (0.355) | (0.625) | (0.611) |
| $\text{BRU:N}_{t-1}$ | 0.11*** | 0.19*** | 0.01 |
| | (0.042) | (0.073) | (0.062) |
| Observations | 10,124 | 6,793 | 3,328 |
| No of banks | 132 | 132 | 132 |
| R-sq | 0.72 | 0.71 | 0.68 |
| BSOC dummy | Yes | Yes | Yes |
| Post-2007 dummy | Yes | No | No |
| Bank FE | B x d.CapReg | B x d.CapReg | B x d.CapReg |
| Quarter FE | Yes | Yes | Yes |
| Macro uncertainty | Yes | Yes | Yes |
| Monetary policy uncertainty | Yes | Yes | Yes |

Robust standard errors in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

*Note:* $Post-2007$ is a dummy that takes value 0 between 1989 Q1 - 2007 Q2, and 1 for the time period between 2007 Q2 - 2013 Q4. All columns include (firm × d.capital regimes) fixed effects to control for firm-capital regime unobserved heterogeneity. We also always include quarter fixed effects to control for seasonality, as is standard in the literature, since we cannot include a full set of time fixed effects (*quarter-time*) at this stage as our parameter of interest is on the variable *banking regulation uncertainty* which is only time varying. BRU:N is the narrow measure of uncertainty as defined in section 4.1. *Consistent* set of firms are those 134 firms that have existed within the sample between 1995 and 2013. This sub-sampling is done to avoid compositional changes from affecting the overall results, but the data may still be unbalanced.

Table D.7: Robustness V: Based on business model, BSOCs vs others

| | *Dependent variable:* $\Delta Surplus_{it}$ | | |
|---|---|---|---|
| | (1) All | (2) Pre-2007 | (3) Post-2007 |
| Rate of convergence to equilibrium, $\theta$ | | | |
| Surplus$_{it-1}$ | -0.07*** | -0.09*** | -0.13*** |
| | (0.012) | (0.019) | (0.047) |
| Rate of adjustment, $\gamma$ | | | |
| Return on equity$_{it-1}$ | 0.09 | 0.27 | 0.12 |
| | (0.138) | (0.287) | (0.104) |
| Trigger$_{it-1}$ | -0.01 | -0.51 | -0.64 |
| | (0.341) | (0.429) | (0.452) |
| Provisions$_{it-1}$ | 0.74 | 2.74*** | -2.26*** |
| | (2.308) | (0.427) | (0.833) |
| Subordinated debt$_{it-1}$ | 0.79 | 0.12 | 0.80 |
| | (0.787) | (0.948) | (0.659) |
| Retained profits$_{it-1}$ | 5.44* | 10.94*** | 3.07** |
| | (3.204) | (4.211) | (1.534) |
| Time demeaned size$_{it-1}$ | -10.15*** | -13.63*** | -15.72** |
| | (3.673) | (4.261) | (6.279) |
| Loan growth$_{it-1}$ | -1.36*** | -1.14*** | -0.42* |
| | (0.344) | (0.302) | (0.234) |
| BRU:N$_{t-1}$ $\times$ d.BSOC$_i$ | 0.29* | 0.13 | 0.30* |
| | (0.167) | (0.098) | (0.155) |
| Observations | 15,413 | 10,739 | 4,667 |
| No of banks | 239 | 239 | 198 |
| R-sq | 0.86 | 0.82 | 0.81 |
| Sample | All | Pre-crisis | Post-crisis |
| Bank FE | Yes | Yes | Yes |
| Time FE | Yes | Yes | Yes |

Standard errors in parentheses, clustered at bank-time level.
*** p<0.01, ** p<0.05, * p<0.1

*Note:* $BSOC_{it}$ is a dummy that takes value 1 if the bank is identified as a building society. All columns include bank and time fixed effects. This implies that we cannot identify the base effect of *banking regulation uncertainty* since it is only time varying. BRU:N is the narrow measure of uncertainty as defined in section 4.1. Column (1) reports the results for the full sample, (2) for the pre-crisis period and column (3) for post-crisis period. The standard errors are robust and clustered at firm-time level.

Table D.8: Robustness VI: Using truncated definition of surplus

| | *Dependent variable:* $\Delta Surplus_{it}$ | | | | |
|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) |
| Rate of convergence to equilibrium, $\theta$ | | | | | |
| $\text{Surplus}_{it-1}$ | -0.15*** | -0.17*** | -0.21*** | -0.29*** | -0.33*** |
| | (0.027) | (0.028) | (0.030) | (0.027) | (0.029) |
| Rate of adjustment, $\gamma$ | | | | | |
| $\text{Return on equity}_{it-1}$ | -0.01 | -0.06 | -0.06 | -0.05* | -0.04** |
| | (0.065) | (0.059) | (0.049) | (0.028) | (0.019) |
| $\text{Provisions}_{it-1}$ | 1.94*** | 1.84*** | 1.08 | 0.51 | 0.48 |
| | (0.334) | (0.312) | (1.131) | (0.601) | (0.482) |
| $\text{Subordinated debt}_{it-1}$ | 0.38 | 0.42 | 0.62* | 0.70** | 0.54*** |
| | (0.448) | (0.405) | (0.361) | (0.299) | (0.209) |
| $\text{Time demeaned size}_{it-1}$ | -12.31*** | -10.30*** | -8.86*** | -7.03*** | -6.29*** |
| | (2.984) | (1.940) | (1.514) | (0.902) | (0.670) |
| $\text{Trigger}_{it-1}$ | -0.37* | -0.31 | -0.35 | -0.29 | -0.14 |
| | (0.212) | (0.209) | (0.225) | (0.183) | (0.146) |
| $\text{Retained profits}_{it-1}$ | 3.79*** | 3.14** | 1.53 | 0.67 | 0.28 |
| | (1.414) | (1.283) | (0.947) | (0.611) | (0.502) |
| $\text{Loan growth}_{it-1}$ | -0.58*** | -0.49*** | -0.41*** | -0.21*** | -0.14*** |
| | (0.129) | (0.107) | (0.081) | (0.045) | (0.030) |
| $\text{GDP growth}_{t-1}$ | 0.81*** | 0.68** | 0.45** | 0.43*** | 0.31** |
| | (0.307) | (0.266) | (0.202) | (0.158) | (0.127) |
| $\text{BRU:N}_{t-1}$ | 0.16*** | 0.11** | 0.10** | 0.10*** | 0.08*** |
| | (0.055) | (0.047) | (0.041) | (0.029) | (0.023) |
| Truncation | None | $\leq 200$ | $\leq 150$ | $\leq 100$ | $\leq 75$ |
| Observations | 15,232 | 15,135 | 15,073 | 14,890 | 14,623 |
| No of banks | 239 | 239 | 239 | 239 | 239 |
| R-sq | 0.75 | 0.72 | 0.70 | 0.65 | 0.63 |
| BSOC dummy | Yes | Yes | Yes | Yes | Yes |
| Bank FE | B x d.CapReg | B x d.CapReg | B x d.CapReg | B x d.CapReg | B x d.CapReg |
| Time FE | No | No | No | No | No |
| Quarter FE | Yes | Yes | Yes | Yes | Yes |
| Macro uncertainty | Yes | Yes | Yes | Yes | Yes |
| MPU | Yes | Yes | Yes | Yes | Yes |

Standard errors in parentheses are clustered at bank-time level.
*** p<0.01, ** p<0.05, * p<0.1

*Note:* This specification is a robustness check to table 6. We defined *surplus* as usual (capital ratio less the minimum, as share of risk weighted assets), but truncate it to be between various cut-offs to show that the results are not being driven by the right-skewness of the surplus distribution. 200 is the approximate value at which surplus would have been truncated at if we had winsorized at 2.5%, and 100 is approximate level for a 5% winsorization. Finally, 75 is the approximate value of $\mu_{surplus} + (1.5 \times \sigma_{surplus})$. $d.CapRegime$ is a categorical variable capturing the three different waves of capital regulation regimes in the UK: till 1997 Q2, between 1997 Q2 to 2007 Q4, and from 2008 Q1 onwards. All columns include (*bank* $\times$ *d.capital regimes*) fixed effects. We also always include quarter fixed effects to control for seasonality. The standard errors are robust and clustered at firm-time level. Table B.1 contains definitions of all the variables.

Table D.9: Robustness VII: Using alternate measure of macro performance

| | *Dependent variable:* $\Delta Surplus_{it}$ | | | |
|---|---|---|---|---|
| | (1) All | (2) All ex. crisis | (3) Pre-2007 | (4) Post-2007 |
| Rate of convergence to equilibrium, $\theta$ | | | | |
| $\text{Surplus}_{it-1}$ | -0.15*** | -0.15*** | -0.17*** | -0.14** |
| | (0.027) | (0.028) | (0.029) | (0.065) |
| Rate of adjustment, $\gamma$ | | | | |
| $\text{Return on equity}_{it-1}$ | -0.02 | 0.04 | 0.09 | -0.01 |
| | (0.064) | (0.097) | (0.114) | (0.074) |
| $\text{Trigger}_{it-1}$ | -0.36* | -0.35 | -0.51 | -0.37 |
| | (0.215) | (0.225) | (0.390) | (0.291) |
| $\text{Provisions}_{it-1}$ | 1.93*** | 1.88*** | 1.94*** | -0.16 |
| | (0.330) | (0.262) | (0.213) | (0.640) |
| $\text{Subordinated debt}_{it-1}$ | 0.39 | 0.13 | 0.13 | 0.43 |
| | (0.453) | (0.521) | (0.782) | (0.559) |
| $\text{Retained profits}_{it-1}$ | 3.73*** | 5.69*** | 5.68*** | 4.11** |
| | (1.367) | (1.650) | (2.000) | (1.869) |
| $\text{Time demeaned size}_{it-1}$ | -12.23*** | -13.49*** | -12.78*** | -16.80** |
| | (2.997) | (3.382) | (3.687) | (7.445) |
| $\text{Loan growth}_{it-1}$ | -0.58*** | -0.66*** | -0.62*** | -0.47 |
| | (0.130) | (0.141) | (0.136) | (0.287) |
| $\text{Output gap}_{t-1}$ | 0.01 | 0.96* | 1.10* | -0.83 |
| | (0.365) | (0.580) | (0.654) | (0.580) |
| $\text{BRU:N}_{t-1}$ | 0.11** | 0.20*** | 0.25*** | 0.04 |
| | (0.047) | (0.069) | (0.082) | (0.152) |
| Observations | 15,232 | 13,754 | 10,737 | 4,487 |
| No of banks | 239 | 239 | 239 | 198 |
| R-sq | 0.75 | 0.75 | 0.74 | 0.78 |
| BSOC dummy | Yes | Yes | Yes | Yes |
| Bank FE | B x d.CapReg | B x d.CapReg | B x d.CapReg | B x d.CapReg |
| Quarter FE | Yes | Yes | Yes | Yes |
| Macro uncertainty | Yes | Yes | Yes | Yes |
| Monetary policy uncertainty | Yes | Yes | Yes | Yes |

Robust standard errors in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

*Note: Surplus* is measured as capital ratio less bank-specific minimum capital requirement, as a percent of risk-weighted assets. All variables are as before, except GDP growth is replaced by output gap to show the results are not sensitive to how business cycle is measured. *All excluding crisis* is the full sample excluding 2007 Q3 - 2009 Q2; *Pre-2007* is the time period from 1989 Q1 to 2007 Q2; and *Post-2007* is from 2007 Q3 to 2013 Q4. All columns have both bank-capital regime ($B \times CapReg$) and quarter fixed effects, and standard errors are clustered at bank and time level. Table B.1 contains definitions of all the variables.

## Table D.10: Robustness VIII: Excluding foreign subsidiaries

| | Dependent variable: $\Delta Surplus_{it}$ | | | |
|---|---|---|---|---|
| | (1) All | (2) Exc. crisis | (3) Pre-2007 | (4) Post-2007 |
| Rate of convergence to equilibrium, $\theta$ | | | | |
| $\text{Surplus}_{it-1}$ | -0.15*** | -0.16*** | -0.20*** | -0.09 |
| | (0.050) | (0.050) | (0.049) | (0.076) |
| Rate of adjustment, $\gamma$ | | | | |
| $\text{BRU:N}_{t-1}$ | 0.14** | 0.17** | 0.19* | 0.22 |
| | (0.059) | (0.076) | (0.097) | (0.253) |
| Observations | 9,486 | 8,570 | 6,767 | 2,714 |
| No of banks | 147 | 147 | 147 | 121 |
| R-sq | 0.75 | 0.74 | 0.70 | 0.87 |
| Bank FE | Bank x d.CapRegime | Bank x d.CapRegime | Bank x d.CapRegime | Bank x d.CapRegime |
| Quarter FE | Yes | Yes | Yes | Yes |

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

*Note:* This table shows a robustness check that demonstrates that the results are not driven by foreign subsidiaries in the sample. The dependent variable is as before, *surplus*, measured as capital ratio less bank-specific minimum capital requirement, as a percent of risk-weighted assets. Controls are included in all the columns, but excluded for brevity in presentation. *All excluding crisis* is the full sample excluding 2007 Q3 - 2009 Q2; *Pre-2007* is the time period from 1989 Q1 to 2007 Q2; and *Post-2007* is from 2007 Q3 to 2013 Q4. All columns have both bank-capital regime ($B \times CapReg$) and quarter fixed effects, and standard errors are clustered at bank and time level. Table B.1 contains definitions of all the variables.

## Table D.11: Robustness IX: Controlling for resource uncertainty

| | Dependent variable: $Surplus_{it}$ | | | |
|---|---|---|---|---|
| | (1) All | (2) $\text{DZ}^t_{it}$ | (3) $\text{DZ}^m_{it}$ | (4) $\text{DZ}^p_{it}$ |
| Rate of convergence to equilibrium, $\theta$ | | | | |
| $\text{Surplus}_{it-1}$ | -0.15*** | -0.87*** | -0.69*** | -0.68*** |
| | (0.028) | (0.058) | (0.082) | (0.085) |
| Rate of adjustment, $\gamma$ | | | | |
| $\sigma$ (retained profits)$_{it-1}$ | 0.39* | 0.08*** | 0.16*** | 0.14*** |
| | (0.228) | (0.026) | (0.040) | (0.042) |
| $\text{BRU:N}_{t-1}$ | 0.14** | | | |
| | (0.061) | | | |
| $\text{MADTRIG}^{q=12}_{it-1}$ | | 0.12* | 0.25*** | 0.30*** |
| | | (0.073) | (0.095) | (0.100) |
| Observations | 15,030 | 5,025 | 8,281 | 8,402 |
| No of banks | 236 | 188 | 208 | 210 |
| R-sq | 0.75 | 0.12 | 0.27 | 0.27 |
| BSOC dummy | Yes | No | No | No |
| Crisis dummy | Yes | No | No | No |
| Bank FE | Bank x d.CapRegime | Yes | Yes | Yes |
| Quarter FE | Yes | No | No | No |
| Time FE | No | Yes | Yes | Yes |

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

*Note:* This table shows a robustness check that demonstrates that explicitly controlling for resource uncertainty – proxied here as the four-quarter variance of retained profits – does not change the baseline results, neither does using variance of return on assets. The dependent variable is as before, *surplus*, measured as capital ratio less bank-specific minimum capital requirement, as a percent of risk-weighted assets. Controls are included in all the columns, but excluded for brevity in presentation. Column (1) has both bank-capital regime ($B \times CapReg$) and quarter fixed effects, column (2) onwards contains full set of time and bank fixed effects. Standard errors are clustered at bank and time level. Table B.1 contains definitions of all the variables.