In the dangerzone!
Regulatory uncertainty and voluntary bank capital surpluses

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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' 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, and this effect is stronger when banks operate closer to their regulatory minima, i.e. in the "dangerzone". Given a Basel I minimum capital requirement of 8%, our results are economically meaningful.

JEL Classification: G21; G28; G32

Keywords: Bank capital; buffer usability; regulatory capital requirements; capital surpluses; regulatory uncertainty.

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1 Introduction

Given its critical role in supporting the real economy, the banking industry remains one of the most heavily regulated industries overall. Capital regulation, in particular, features prominently in the oversight of this sector and requires that banks support their activities with minimum amounts of capital to reduce the likelihood of failure and disruption of payment and lending services vital to a healthy economy.

The 2007-09 financial crisis prompted several reforms to banking regulation aimed at reducing the likelihood and severity of similar episodes in the future. Changes to the international capital standards, under Basel III, increase both the quantity and quality of capital requirements. In addition, the new rules introduce a series of mandatory capital buffers designed to help stem losses associated with individual bank failures and moderate economic cycles. Some of these new buffers are state dependent (e.g., the countercyclical capital buffer), increasing in upturns and decreasing in downturns to help shape lending capacity, while others act as shock absorbers (e.g., bank-specific buffer for stress, or the Pillar 2B buffer) and are potentially usable in periods of more trying conditions as a way to bolster banks' lending capacity and temper economic downturns.[1]

The benefits of this second set of buffers depend on whether banks will, in fact, choose to dip into them to support lending when economic conditions deteriorate and certainty fades, such as that faced during the coronavirus shock. Using these buffers, however, involves regulatory and market costs, e.g., in the form of heightened supervisory scrutiny and restrictions on market distribution allowances (MDAs) that potentially impact funding costs. Such costs depend on how much of the buffer is used as well as the length of time it takes to restore the buffer to its required level. This means that banks face a cost-benefit trade-off when deciding whether to dip into these buffers. The prospect of such behaviour, however, is an open question that remains firmly on the agenda of policymakers around the world. The intended macroeconomic benefits of such regulatory buffers are further clouded by research suggesting that banks hold voluntary surpluses (excess of current capital over required minima) for a number of reasons, including a desire to avoid costs related to supervisory intervention and market discipline if they approach or fall below the required minimum capital ratio (see, for example, Furfine, 2001; Ayuso *et al.*, 2004; Lindquist, 2004; Alfon *et al.*, 2004).[2]

Since the tail end of the crisis and the announcement of Basel III in 2009, banks' capital ratios and voluntary surpluses around the world have continued to climb (e.g., Cohen and Scatigna, 2016). This has been particularly evident in the UK where the median voluntary surplus has increased from 6% (of risk-weighted assets) in 2009 to 8% in 2013 (figure 1).[3] However, at the same time that banks have built up these surpluses, concerns around economic and regulatory policy uncertainty have intensified. With respect to policy uncertainty, two surveys by the Basel Committee on Banking Supervision (BCBS) in 2017 and 2018 indicated that banks considered regulatory uncertainty and complexity

[1] For more details on post-crisis capital requirements in the UK, see, for example, FPC (2015).

[2] See, for example, Jackson *et al.* (1999) for a good overview.

[3] Banks' holdings of surplus capital is not unique to the UK, or to the post-crisis period. Banks operate with excess capital on average in Germany (Stolz and Wedow, 2011), Portugal (Montagnoli *et al.*, 2018), Spain (Ayuso *et al.*, 2004), Norway (Lindquist, 2004), Canada (Guidara *et al.*, 2013), Brazil (Tabak *et al.*, 2011), EU (Jokipii and Milne, 2008), and US (Flannery and Rangan, 2008; Shim, 2013; D'Erasmo, 2018).

around Basel III as two of their most important challenges (Hancock and Ruffino, 2017; BCBS, 2018).

Meanwhile, a burgeoning literature on the side-effects of uncertainty has shown that an increase in uncertainty can make economic agents more conservative, which can have potentially negative effects on investment activity and the real economy more widely (Dibiasi *et al.*, 2018; Baker *et al.*, 2016; Gulen and Ion, 2016, among others), and negatively affect real outcomes.

This background raises the question of whether and how uncertainty about regulation plays a role in banks' capital management practices and, in particular, creates incentives for them to hold *precautionary surpluses*. The basic intuition underlying this question is that uncertainty around regulatory policies, including capital standards or the criteria used by regulators to apply and enforce these standards, can affect a bank's ability to estimate the policy rule with which it must comply. In these cases, the expected cost of non-compliance is affected, potentially influencing the trade-offs banks make when deciding how much additional capital to hold to avoid costly breaches.

Our paper aims to develop a better understanding of how such surpluses are determined and how they vary with risk and across banks, conditional on macroeconomic conditions, economic policy uncertainty and regulatory uncertainty, as a way to help understand the factors that might limit or promote the benefits of reforms under the new capital standards.

We construct two separate and distinct measures of regulatory policy uncertainty and use each to investigate their incremental effects on UK banks' capital buffer decisions during the period 1989 to 2013. The first, derived from textual analysis of press articles in the spirit of Baker *et al.* (2016) and Eckley (2015), reflects a systematic measure of regulatory policy uncertainty that is common to the UK banking sector overall. We interpret this measure as uncertainty around *sector-wide changes in rules or regulations.*

The second, based on the long-standing supervisory practice in the UK of assigning individual capital requirements (i.e., that vary across banks and over time), reflects an idiosyncratic measure of regulatory policy uncertainty that is unique to each bank within the system. This bank-specific measure captures uncertainty related to the minimum capital requirement that a bank must maintain, or face costly regulatory and market scrutiny.

To construct this bank-specific measure, we use the realised volatility of add-ons imposed by UK supervisors on top of the Basel I minimum requirement of 8%. These bank and time-varying top-ups, which were confidential and discretionary, were intended to address risks that were not covered by international regulations, and were based on supervisory judgements around weaknesses in the bank's systems, governance, and controls (Francis and Osborne, 2009; Aiyar *et al.*, 2014; Ediz *et al.*, 1998). The exact dates of the changes were not based on a pre-set schedule, and the decision function of the regulator was more subjective than rules-based, and therefore uncertain from the point of view of the bank.

Even though our sample period ends in 2013, our results are still meaningful for the post-crisis period, since these add-ons were qualitatively similar to several features of the Basel III reforms, such as pillar 2 and stress test based capital requirements. The uncertainty measure is therefore interpretable as an indicator of *supervisory discretion.*

We set up a partial adjustment model where the main dependent variable is the actual capital surplus held by the bank 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. It can help shed light on the heterogeneity in adjustment mechanisms of different banks, which is of key interest to policy-makers.

We find that a one standard deviation increase in uncertainty about regulatory capital requirements (by either measure) is linked to an increase in banks' capital targets by 0.8 to 2 percentage points of risk-weighted assets.[4] Given a minimum capital requirement of 8% as per Basel I, our results are economically substantial as well. The main finding complements the work of Valencia (2016) which shows that uncertainty about factors affecting capital resources also increases banks' capital targets.

Our results provide support to existing evidence, such as by Cohen and Scatigna (2016), that shows that banks prefer to build their capital surpluses using either retained profits, or through deleveraging. 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 coronavirus pandemic, banks would be unlikely to use their surpluses to support lending, preferring instead to self-insure by building additional capital buffers or headroom. This would be counterproductive to the policy makers' objective.

Digging deeper, we zoom in on banks that operate closer to their capital requirements – i.e. those that are in the "dangerzone". These banks should respond even more strongly to any perceived increase in uncertainty around requirements. This mechanism relies on two pre-conditions that have been shown to be quite important in the literature. First, there should be non-trivial adjustment costs (Berger *et al.*, 1995; Heid *et al.*, 2004; Kleff and Weber, 2008), and second, it should be costlier for a bank to breach its minimum requirement than to hold a surplus of similar magnitude (as shown in Peura and Keppo (2006); Stolz and Wedow (2011); Aiyar *et al.* (2015), among others). All else equal, these costs are further likely to be steeper for "dangerzone" banks that need to build their capital surpluses quickly.

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. There is some evidence that "dangerzone" banks are in general less prudent than safe ones. The pace of adjustment towards equilibrium, expressed as a half-life, is between one and two years on average, but increases in the dangerzone, with half-life falling to one to two months.

Our results hold for a battery of robustness checks, including using alternate proxies of control variables, sub-sampling by period and type of bank, different treatments of outliers, controlling for sample composition changes, and using different estimation tech-

[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.

niques. Crucially, we show that our results are not an artefact of crisis adjustments, or a peculiar feature of the post-crisis period.

The contributions of our paper are along several dimensions. First, existing work looks at the implications of uncertainty stemming from ex-ante unknown asset value distributions or funding sources on capital levels. These papers, such as (Valencia, 2016), argue that banks will hold excess capital resources as self-insurance against the risk of breaching minimums and incurring the ensuing supervisory costs. However, they assume that capital requirements are either fixed/certain or known well in advance. We contend that, actually, banks face a similar uncertainty from another source: the "rules of the game", which are not known with certainty. This added source of uncertainty, has a similar effect and actually *amplifies* banks' precautionary incentives to hold excess capital. This uncertainty can stem from both banking sector level policies, such as those around the composition of Tier 1 capital, as well as from bank specific policies, especially those that involve supervisory discretion. To the best of our knowledge, this effect of uncertainty around capital regulation and requirements has not yet been studied empirically, despite theory and survey evidence pointing to its importance.

Second, we add to the literature on measurement of regulatory uncertainty by proposing two measures of banking sector regulatory uncertainty: one that is an application of existing methodologies to a new question, and another that is unique to the UK. Our empirical measures aim to capture two distinct but complementary sources of uncertainty – one about capital rules and regulations and another around supervisory discretion. To that extent, we complement the literature on measuring and disentangling the effects of supervision, such as Hirtle *et al.* (2020) for the US.

The acyclical component of uncertainty is relevant for the calibration of acyclical components of capital requirements, such as the minimum capital requirement and supervisory add-ons. If uncertainty about capital requirements changes over time, for example declining as agents learn about a new policy regime, this can affect the relationship between capital resources and requirements, and thus the optimal calibration of requirements.

The cyclical component of uncertainty could affect the usability of regulatory capital buffers to support lending during downturns, by causing cyclicality in banks' own capital targets. These buffers are a novel structural feature of reformed capital requirements, and are yet to be substantially tested. Their usability is an open question that remains firmly on the agenda of policymakers around the world, especially in light of the coronavirus pandemic (see, for example, BCBS, 2019; FSB, 2020; BOE, 2020; Federal Reserve, 2020). If regulators could find ways to reduce procyclical uncertainty about capital requirements, for example through improved communication or constrained discretion – both of which are being experiments with as policy tools by major central banks during the 2020 pandemic – this may enhance the buffer usability. We are able to exploit the unique nature of our data and pre-2013 regulation in the UK to contribute to this discussion.

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 agents dislike high uncertainty. They tend to re-weight probabilities towards unfavourable future events, in essence confounding "certain" for good and "uncertain" for bad, and therefore, end up taking 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.[7] 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 then, 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 requirements, like lending), it is costlier to be caught holding less than the minimum. As a result, the bank always prefers to hold precautionary surpluses.

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

[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] For the interviews, the authors chose banks that would provide a reasonable coverage of the sector (Alfon *et al.*, 2004).

As policy uncertainty increases, the value of the option to build surpluses increases.[8]

There is a small but highly relevant set of papers at the intersection of uncertainty and bank behaviour. The paper most closely related to ours is Valencia (2016). He presents a model of bank capital in the presence of financial frictions, and shows that when uncertainty (here thought of as uncertainty around realisations of loan returns) increases, it causes a forward looking bank to self-insure by holding more capital. This is because an increase in uncertainty, increases funding costs and hurts profitability. His main results show that banks exposed to more uncertain returns hold more capital resources. He finds that uncertainty as measured by the "relative equivalent precautionary premium" (REPP) explains nearly 50% of banks' regulatory capital surpluses for the US.[9] Our paper complements his analysis by looking at a different sources of uncertainty, namely those surrounding the bank's capital resources and minimum requirements.

Another paper that is closely related to ours is by Soto (2019). Applying machine learning tools on bank conference call transcripts, he creates a bank-specific measure of uncertainty that reflects the bank's perceptions around all the different uncertainties facing it. He finds that higher uncertainty in general is associated with lower lending in general.[10] Our paper differs significantly, since we care about a specific type of uncertainty – that around capital requirements – and how that affects capital building 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 but that this negative 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.[11] 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 dependent on the amount of capital banks hold in excess of the regulatory minimum. They find that

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

[9] 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.

[10] Similar conclusions are reached by Cheng *et al.* (2019), Bordo *et al.* (2016), Kara and Yook (2019).

[11] 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.

banks with low capital buffers try to rebuild capital by raising capital whilst simultaneously reducing risk. On the other hand, banks with large capital buffers seek to maintain their buffer by increasing risk only when capital increases.

3 Capital regulation in the UK

There have been two key components of minimum capital requirements in the UK between 1989-2013. International agreements, particularly Basel I, set a "hard floor" for the requirements, which was topped off by a confidential and discretionary add-on imposed by the UK banking regulator.

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

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

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 included 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).[12]

The second component of minimum requirements has been a discretionary domestic policy imposed by the banking regulator (Bank of England till 1998, and the Financial Services Authority (FSA) afterwards). Additional capital charges – on top of the Basel I 8% minimum – were imposed on all banks.[13] The aim of these additional requirements, called "trigger ratios", was to account for risks that were not covered by Basel I, for example, reputational, operational, legal, and interest rate related risks (Francis and Osborne, 2010). They were reviewed every 1.5-3 years based on firm-specific reviews and judgements about evolving market conditions and quality of risk management and banks' systems, governance, and controls (Ediz *et al.*, 1998; Francis and Osborne, 2010). These triggers were imposed at both the individual bank as well as group levels.[14] Two

[12] It is not unreasonable, therefore, that part of the capital hoarding behaviour we observe in the data is driven by anticipatory effects of this change, which we will investigate formally.

[13] To that extent, our sample period, while not covering the full post-crisis period, provides an advantage because these "add-ons" are similar qualitatively to Pillar 2 requirements under Basel II onwards (see, for example, BCBS, 2006), and in particular the PRA Buffer under Basel III.

[14] It was intended to address the shortcoming that the parent bank may not have adequate resources or incentives to inject capital into a standalone bank in times of stress (Francis and Osborne, 2010). Historically, there have also been separate requirements on the banking and the trading books, but in this paper, we focus on the combined minimum.

important features in the way these triggers were set matter for our analysis. First, they could be changed at any point by the regulator, and second, the decision function of the regulator was more subjective than rules-based, and was therefore uncertain from the point of view of the bank.

Anecdotal evidence supports the view that capital requirement changes were exogenous with respect to balance sheet variables (De Marco and Wieladek, 2015). For example, In his review of the pre-crisis regulatory architecture, Turner (2009) finds that the FSA's add-ons focused primarily on the bank's organization structures, systems, and reporting procedures and did not rely on a developed financial analysis (FSA, 2008).

Aiyar *et al.* (2014) find that changes in capital ratio requirements have not been 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. High-frequency changes in bank's balance sheet characteristics were therefore not instrumental in determining minimum requirements. We also replicate a similar analysis of quarterly trigger ratios on balance sheet observables, and a full set of bank and time fixed effects, using different specifications. None of the included variables are significant.

Therefore, the overall minimum requirement for each bank is the sum of the Basel I 8% plus a supervisory add-on. There is substantial variation in the *overall* minimum requirements – defined as % of risk weighted assets – over our sample. The average minimum has been roughly 12.3%, with an interquartile range of 9.5% to 14.0%.[15] Figure 2 plots the median minimum for the overall sample of banks. There is substantial cross-sectional heterogeneity – requirements have historically been higher for smaller banks (figure C.1) than larger ones, and for foreign subsidiaries (figure C.2) rather than UK banks.

4 Regulatory uncertainty

The focus in this paper is on **policy** or **regulatory** uncertainty. Total policy uncertainty for bank b at time t is a function of two components:

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

We use the evolution of capital requirements in the UK to inform measurement of the two uncertainties. The first parameter η_t includes all aspects of policy uncertainty that effect a bank's decision of how much *capital resources to hold*. By definition, this uncertainty measure encompasses many different uncertainties that affect the whole banking sector. Therefore, it includes uncertainty not only around capital regulation, but also around monetary policy, supervisory preferences, and the macroeconomy. Broadly speaking, this uncertainty then comprises aspects of the regulatory order which are applicable to all banks or broad classes of banks (for example, commercial versus building societies). It is calculated as a text-based, aggregate measure (explained in detail below).

[15]This means that the interquartile range for the add-ons is between 1.5% to 6%.

Bank-specific uncertainty $u_{b,t}$ on the other hand can be interpreted as uncertainty surrounding the *trigger*. As discussed in section 3, banks in the UK have been subject to minimum requirements with two components between 1989 and 2013: a fixed Basel I 8% minimum, and the trigger, which is a bank and time varying supervisory "add on". Our dataset allows us to exploit this bank-specific variation in the minimum capital requirements. We think of this bank specific uncertainty as reflecting the uncertainty surrounding the supervisor: specifically, their understanding of the risks facing the bank and interpretation and application of rules to the bank. For example, the supervisor may be concerned about the weaknesses in the bank's systems of control or management competence (Ediz *et al.*, 1998). To construct this measure, we use dispersion of the bank specific minimum requirement.

The literature on empirical measurement of uncertainty has grown significantly in recent years. Researchers tend to rely on proxies that are based on four general categories conceptually: volatility of a data series, text-based measures, forecast dispersion based, and dispersion of productivity shocks to firms.[16] 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. requirement). In the remainder of the section, we first discuss the two text-based measures, and then the bank-specific measure.

4.1 Textual measures of banking sector uncertainty

Our textual measures of uncertainty are based on the methodology by Baker *et al.* (2016) and Eckley (2015). Baker *et al.* (2016) construct newspaper based policy-related economic uncertainty measures (henceforth EPU) for various countries. To do this for the US, they use 10 leading newspapers, and obtain monthly counts of articles that contain words relating to uncertainty, economy, and policy (these include, for example, "Congress", "Federal Reserve", "deficit", etc.). They find that policy uncertainty is associated with greater stock price volatility and reduced investment and employment in policy-sensitive sectors. Policy uncertainty also foreshadows declines in investment, output, and employment in the United States.[17] Our measure is constructed similarly; the only difference being the newspaper coverage (since we focus on the UK) and the keywords (since we are interested in uncertainty relating to the banking sector and capital regulation). 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.[18] We proceed in the following steps. First, we count the number of articles that discuss UK banking or banking policy published in each of these newspapers between the years 1989 and 2013.[19] This gives us a total of $90,881$ articles, which is 920 articles per quarter.

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

[17] 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, significantly increases stock market volatility and decreases market returns.

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

[19] See appendix A.1 for more details on keyword selection.

We then count the number of articles that in addition to being about banking or banking policy, also contain the word "uncertainty", or words related to uncertainty (based on Sandile, 2016). 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, about a third of the articles relating to banking policy in the UK each quarter had some mention of uncertainty.

Raw counts of articles may be misleading because different newspapers may have different coverage volumes of news stories, or some topics may simply be more popular during certain periods of time. Therefore, in a third step, and as is standard in the literature, we calculate the share of all banking and banking policy related articles that contain mentions of uncertainty for each newspaper, p, in each quarter, t. This gives us $UncRatio_{p,t}$:

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

Following Husted *et al.* (2017), we standardize the time series $UncRatio_{p,t}$ to have standard deviation equal to 1. 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 *narrow banking regulatory uncertainty*, *BRU:Narrow*, and is the main proxy for policy uncertainty in our empirical analysis of banks' choice of capital buffers.

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.

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 contain mentions of banking and uncertainty or related words (roughly 28,000 articles).[20] 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.

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.

[20]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.

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).[21] 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), 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, which 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 macro uncertainty measure).[22] 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.[23]

However, as shown in table 1, all the measures are quite highly and significantly correlated with one another. Our narrow measure, *BRU:Narrow*, is positively and significantly correlated at the 1% confidence level with EPU (0.35) and the Bank of England measure

[21] The *small banks crisis* in the UK was precipitated by the recession in the early 90s, and started in July 1991 with the failure of Bank of Credit and Commerce International (BCCI). 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 stepped in to provide liquidity support (Logan, 2001).

[22] This 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).

[23] 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.

of macro uncertainty (0.49), and negatively correlated with GDP growth (-0.40). This is intuitive 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.

It is also interesting to see how our two 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

The most common and widespread measurement of uncertainty relies on dispersion of a time series, usually stock market or GDP growth. Our bank-specific uncertainty measure is related to this literature. Volatility of a time series is used as a measure of uncertainty because when a data series becomes more volatile, it is harder to forecast (Bloom, 2014), therefore preventing agents from forming accurate expectations.

We use variation in the bank's time-varying minimum requirements to construct a measure of uncertainty around bank-specific *capital requirements*. More specifically, we calculate the mean absolute deviation of the minimum requirement for each bank over the last 8 or 12 quarters. The time periods are chosen since triggers were reviewed every 1.5-3 years by the UK supervisor (Francis and Osborne, 2010). The measure is shown in equation 1, for a trigger t, and $q = 8, 12$ quarters:

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

This indicator 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 "add on". It can reflect the supervisors' preferences, risk-aversion, or interpretation of the rules.

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 example, 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.3). The sharp uptick in mean absolute deviation of triggers is in 2008 Q1, when 133 out of 181 changes in triggers were decreases.[24]

This measure comes with two caveats.[25] The first is that while true uncertainty is forward looking, the *MADTRIG* measure is by construction backward looking as it relies on past changes in the trigger. 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 (see, for example, Biljanovska *et al.*, 2017). Therefore, despite these drawbacks, our measure represents a step forward in obtaining a bank level proxy for capital requirement uncertainty.

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.[26] In our analysis, we focus on solo-consolidated banks.

The main dependent variable is *surplus*. It is consistently defined as the actual capital holdings less the overall minimum requirement, as a percentage of risk weighted assets for each bank in each quarter.[27] 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 periods. 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.5).

5.1 Empirical specification

Following previous work (Flannery and Rangan, 2006; Francis and Osborne, 2010; de Ramon *et al.*, 2016), our model 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.

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

[25] 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.

[26] The database pulls information from 14 regulatory reports over 5 different regulatory regimes. For a detailed discussion, refer to de Ramon *et al.* (2017).

[27] This definition is commonly used, for example, by Valencia (2016); Shim (2013).

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 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 θ and γ 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, which are of particular interest to regulators.

We expect θ to be between $[-1, 0)$ and significantly different from zero. Speeds of adjustment can be inferred from θ: if θ is close to -1 then the 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), which is calculated as $0.25 \times ln(0.5)/ln(\widehat{\beta}_1)$ years.

5.2 Data and explanatory variables

We use an unbalanced sample of roughly 239 banks, of which foreign subsidiary assets account for an average of 26% over the entire sample.[28] 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.*

[28]The results are robust to the exclusion of foreign subsidiaries. For the baseline results, see table D.10; others are available on request.

Regulatory uncertainty is our main variable of interest.[29] It is motivated by the fact that the most important reason why banks hold surpluses is as insurance to avoid the **costs of accidentally breaching the minimum requirement** (Stolz and Wedow, 2011; Jokipii and Milne, 2008; Lindquist, 2004).

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.[30] 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.

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.[31] 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 by 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 specific 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.

[29]Our focus on "regulatory uncertainty" is similar to the measures on "intensity of regulatory oversight or scrutiny" used by, for example, Lindquist (2004) and Peura and Keppo (2006), which also measures the likelihood that requirements will be increased in the future at short notice.

[30]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.

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

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.

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).[32]

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).[33] 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).[34]

The third variable is **cost of failure**, measured as ratio of *provisions* to total assets, 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 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.[35]

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.*, 2014; Berger *et al.*, 2008), and economies of scale in screening and monitoring of borrowers (Francis and Osborne, 2010; Tabak *et al.*, 2011). Therefore,

[32] 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.

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

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

[35] 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.

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%.[36] 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 that 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.* (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 measure discussed in section 4.1 – and monetary policy uncertainty by the Husted *et al.* (2017) measure.

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 ϕ is our coefficient of interest on banking regulatory uncertainty and X contains the relevant explanatory variables: 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 ζ_q respectively) since our main variable of interest is only time varying. When we switch to bank-specific measure of uncertainty ($MADTRIG$), we will replace these with a full set of bank and time fixed effects. 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 regime* fixed effects. The main results are in column (6). We can see that the narrow measure of banking regulatory uncertainty,

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

BRU:Narrow has a positive and significant effect on bank surplus. A 1 standard deviation increase in banking regulation uncertainty is consistent with a long-run increase in surplus of about 0.08 standard deviations, which translates to 2.1 percentage points. 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 θ ($= \beta_1 - 1$) 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.[37] In column (4) we control for all 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 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 θ coefficients are negative and significant for all specifications, indicating the appropriateness of the model. The speeds of adjustment are roughly similar.[38] 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

[37]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.

[38]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.

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.

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.[39] 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 only the consistent set of banks. These are a set of 136 banks that have existed in the sample over 1995-2013, representing on average 65% of total banking sector assets (figure C.4). 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*.[40]

Heterogeneity in business model

Next, we investigate whether the results are sensitive to the bank's business model. This is because the extent of financial frictions, that is, the cost of raising capital quickly, is likely to be linked to it. It could, for instance, be that banks which are part of groups

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

[40] 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.

do not have the same relationship with 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 not as binding for them.[41]

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).[42] 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. In results not reported here, we find evidence that the result for the groups is being driven by the post-crisis period as opposed to most of the other results where the main variation comes from the pre-crisis period.

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_{it}^{t}) or below the median (DZ_{it}^{m}). 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_{it}^{p}). [43]

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$_t \times DZ_{it}^{t,m,p}$, 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 gets eaten up by 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

[41]This is supported by the fact that banks that are part of groups hold significantly lesser capital surpluses than banks who are not part of groups.

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

[43]Note that these dummies are calculated each quarter, therefore, they are both bank and time varying. The dummies are always included in each regression but not reported.

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 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.[44]

The results are shown in table 8. The first thing to point out is that 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. 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*.

Rather than splitting the samples, we can also interact our measure of bank specific uncertainty ($MADTRIG$) with the dummies identifying *dangerzone* banks. 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 $MADTRIG$.[45]

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). We also calculate bank-specific uncertainty differently, by first regressing bank triggers on lagged triggers and a full set of (bank and time) fixed effects. The alternate measure of uncertainty is calculated using a similar 12-quarter rolling dispersion of the residuals for each bank.[46] They key message does not change, that is, an increase in bank-specific uncertainty is associated

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

[45]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).

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

with a long-run increase in surplus capital, but only for those banks that are operating closer to their minimum requirements.

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* $\times$ *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* $\times$ 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

This paper studies the impact of regulatory uncertainty on bank capital surpluses in the UK over 1989-2013. We find evidence that higher regulatory uncertainty is associated with higher bank capital surpluses. A 1 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 post-2007 sample, and that it stands up to a host of robustness checks. We find that the relationship is more robust for *dangerzone* banks, that is, banks that are below median 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 respond more to 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.

Our work contributes to the literature linking uncertainty and behaviour of economic agents. In particular, though there exists significant work on how uncertainty effects firms or consumers, there is not enough information on how it effects banks.

Two things should be kept in mind while reading our results. First, since our overall sample ends in 2013, we cannot say much about how the relationship between regulatory uncertainty and bank surpluses may have evolved after 2013 in response to Basel III. However, capital regulation in the UK over our sample contains flavours of the Basel III regime – in particular Pillar 1 and 2 – and therefore is a good benchmark for comparison.

Second, in our work we have focused quite narrowly upon regulatory uncertainty that makes future minimum capital requirements a moving target – in the presence of financial frictions, this provides a channel for a bank to hold precautionary capital surpluses. However, it is entirely plausible that regulatory uncertainty around other aspects of the bank's balance sheet could exhibit a different relationship. One can imagine that the bank evaluates the costs and benefits of all its various options – taking a wait-and-see approach or adjusting immediately to a proposed regulation. The latter may allow it to take advantage of a longer transition period but it could find that by the time it adjusts, the regulation itself has morphed again. Therefore, the relationship we have described may look different for other variables.

Nevertheless, our results have significant relevance for policy. We also shed some light on the unintended consequences of regulation. In particular, the paper aims to add to regulators' understanding of bank capital decisions, apart from contributing to the literature that shows how uncertainty in general may cause agents to behave differently. As regulators move to strengthen bank regulation internationally, the often multiple moving parts, coordinating agencies, and information asymmetry can create significant policy uncertainty and lead banks to adjust their balance sheets in different ways.

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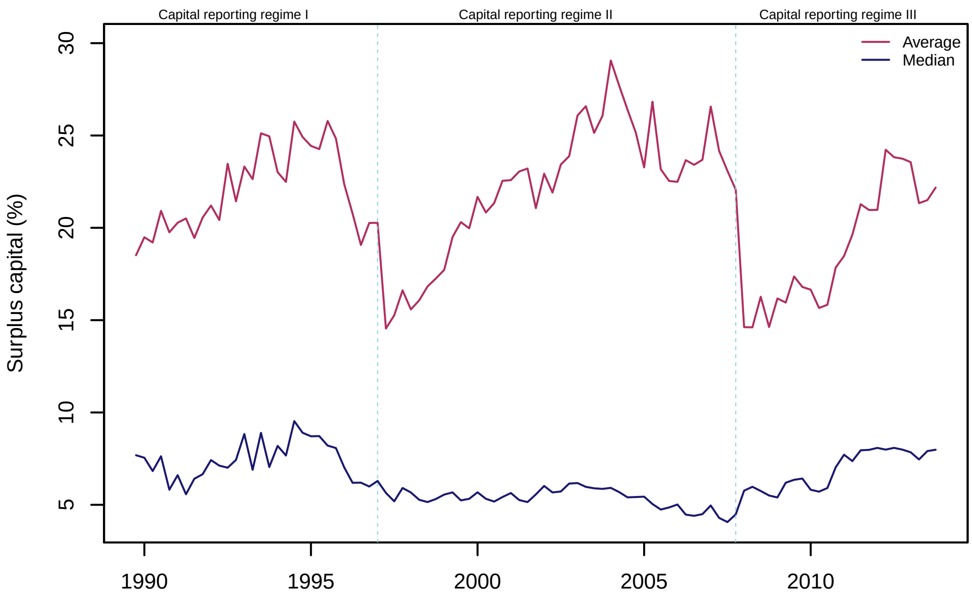
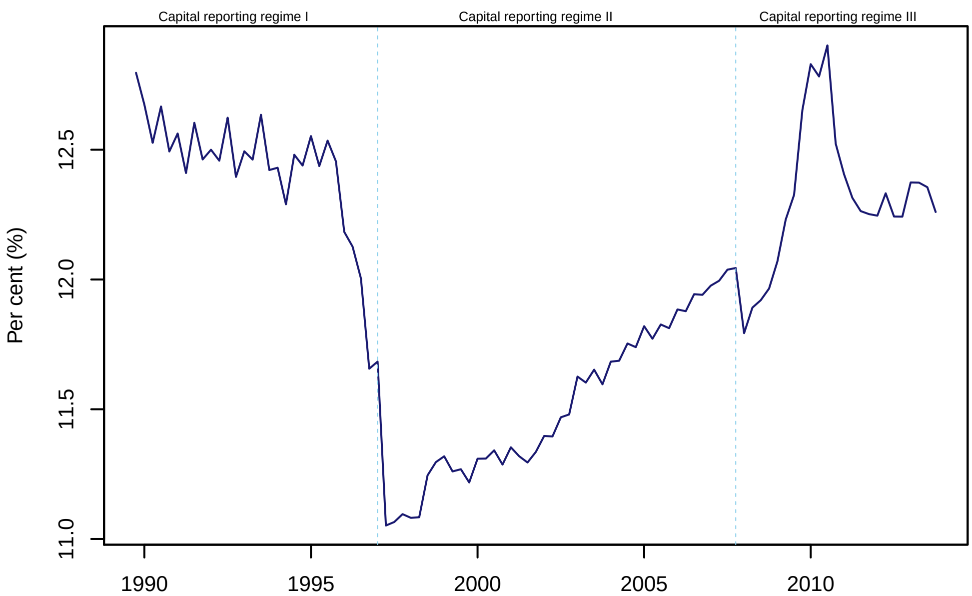
Figures and tables

Figure 1: Time series evolution of surplus capital



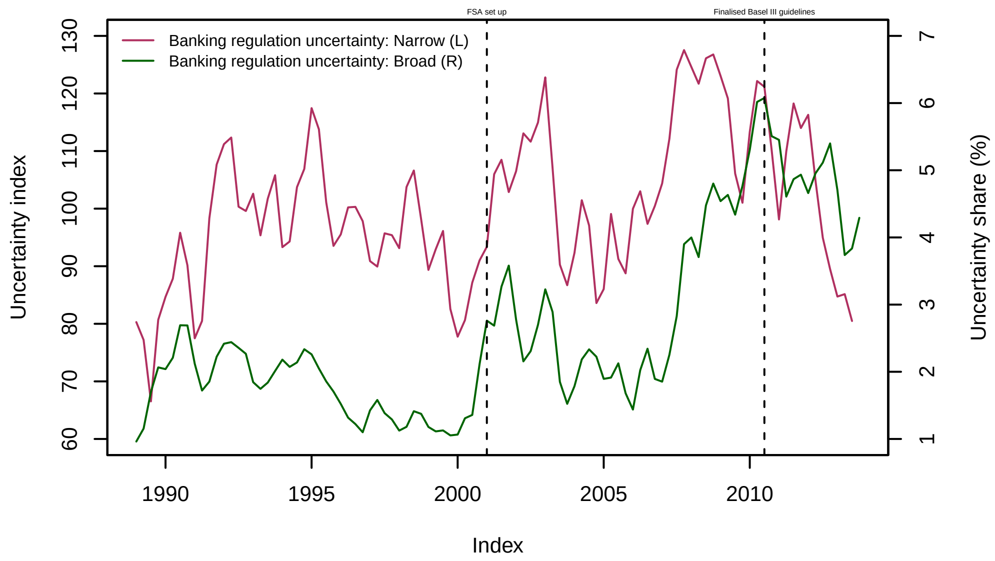
Note: This figure plots the average and median surplus for the overall sample of 295 banks. The data have already been winsorized at the 1% level to remove outliers. The three capital reporting regimes are based on de Ramon *et al.* (2017). These are: until 1997 Q1; from 1997 Q2 to 2007 Q4; and from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

Figure 2: Time series evolution of median minimum requirements



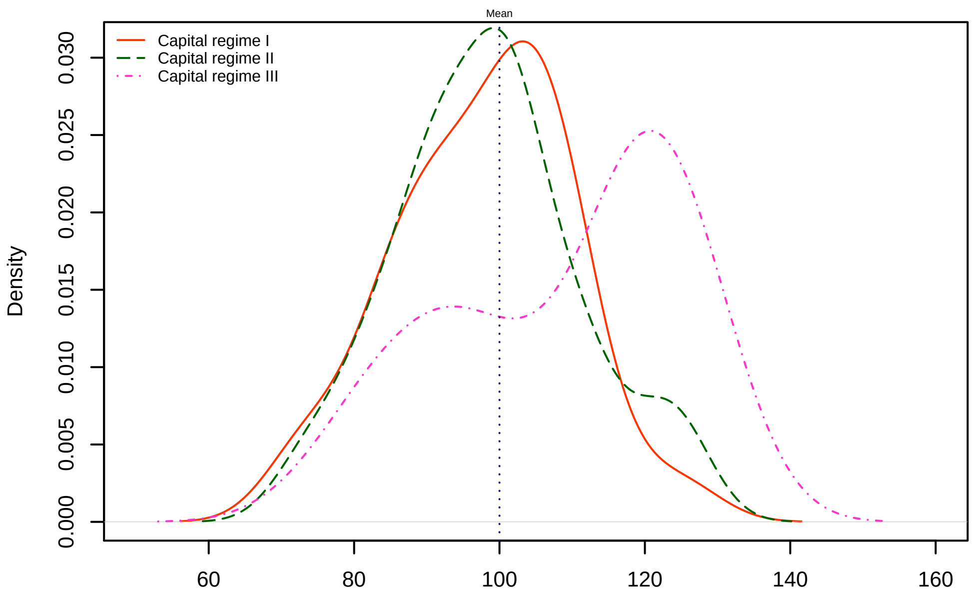
Note: This figure plots the median total minimum requirement for the sample of 295 banks. The three capital reporting regimes are based on de Ramon *et al.* (2017). These are: until 1997 Q1; from 1997 Q2 to 2007 Q4; and from 2008 Q1 to 2013 Q4.

Figure 3: Banking sector policy uncertainties



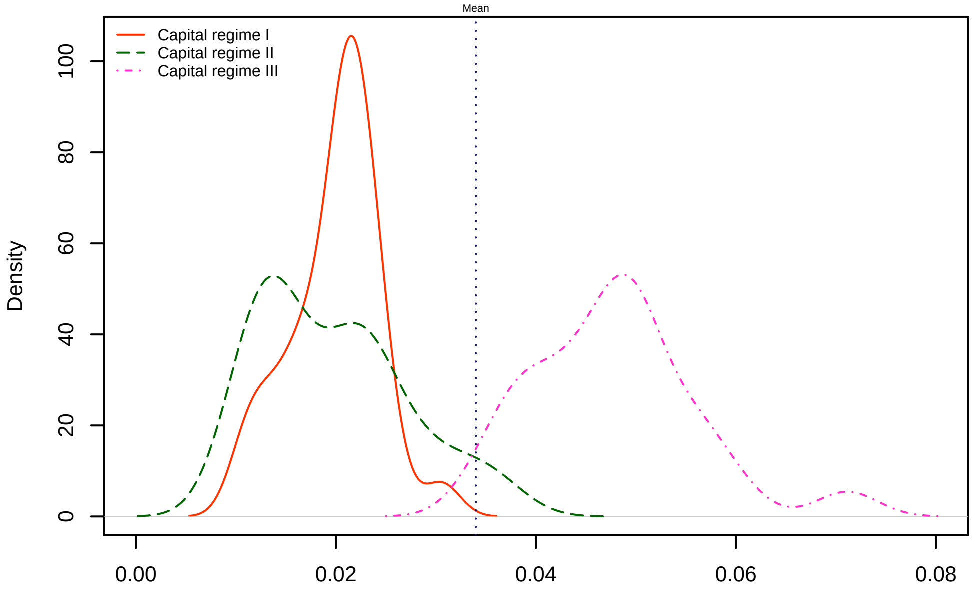
Note: This figure plots the 2-quarter rolling mean of the *narrow* and *broad* banking policy uncertainty measures. The two labelled dates correspond to the set up of the Financial Services Authority in 2001 Q1, and finalisation of the Basel III guidelines in 2010 Q4. Details of the keywords used to 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.

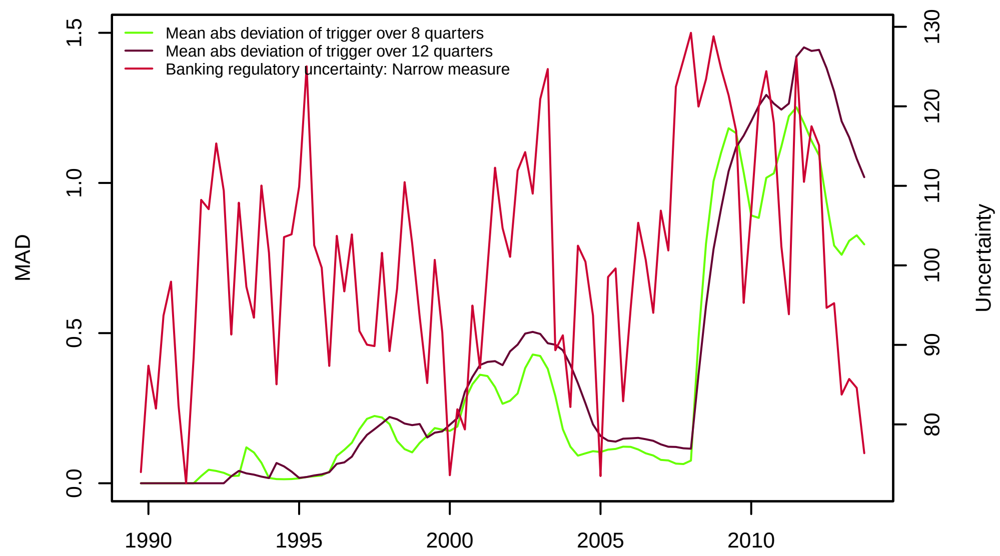
Table 1: Uncertainty variables: Correlations

	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^{***}

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

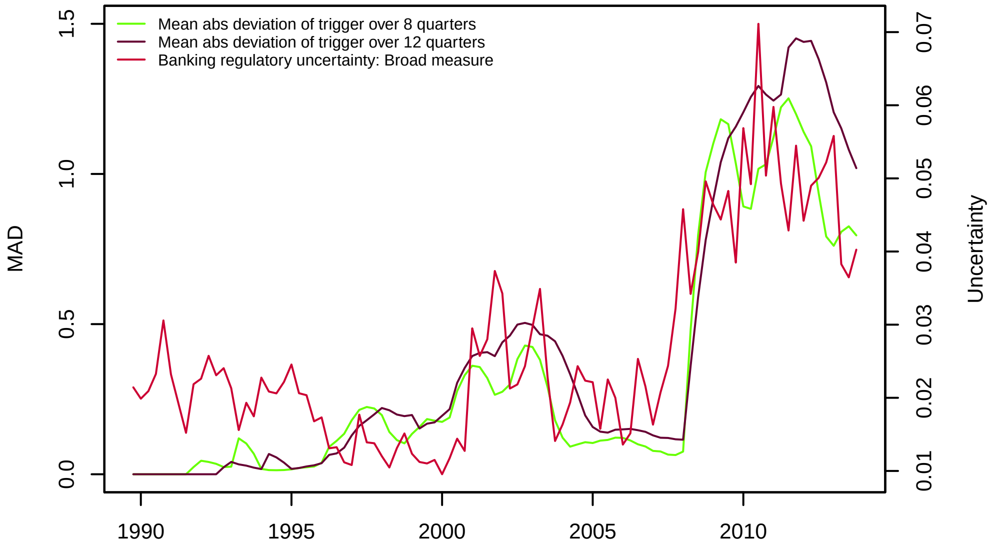
Note: GDP growth is the real YoY GDP growth rate in the UK. *Dispersion of growth forecasts* is the dispersion of the 1 year ahead growth forecasts. *BoE macro uncertainty* is a composite measure of overall macroeconomic uncertainty used internally within the Bank of England, which is the first principal 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, θ							
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, γ							
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 betaβ 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, θ						
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, γ						
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)
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)
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)
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)
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)
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)
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)
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 β 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, θ			
Surplus$_{it-1}$	-0.07***	-0.07***	-0.07***
	(0.012)	(0.012)	(0.012)
Rate of adjustment, γ			
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$_{t-1}$ × d.Bottom tercile of surplus from trigger$_{it-1}$	0.15**		
	(0.066)		
BRU:N$_{t-1}$ × d.Below median of surplus from trigger$_{it-1}$		0.31***	
		(0.094)	
BRU:N$_{t-1}$ × 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, $MADTRIG^{q}_{it}$

	Dependent variable: $\Delta Surplus_{it}$				
	(1) All	(2) Safe banks	(3) DZ^{t}_{it}	(4) DZ^{m}_{it}	(5) DZ^{p}_{it}
Rate of convergence to equilibrium, θ					
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, γ					
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)
Trigger$_{it-1}$	0.18	0.10	-0.03*	-0.05	-0.06*
	(0.351)	(0.323)	(0.019)	(0.034)	(0.034)
Provisions$_{it-1}$	0.72	0.65	-1.05***	-0.43*	-0.20
	(2.332)	(2.214)	(0.214)	(0.246)	(0.176)
Subordinated debt$_{it-1}$	0.80	0.53	-0.02	0.06	0.06
	(0.777)	(0.836)	(0.038)	(0.049)	(0.050)
Retained profits$_{it-1}$	5.55*	4.91	4.94**	6.85	8.92*
	(3.128)	(3.225)	(2.254)	(5.012)	(4.635)
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)
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$^{q=12}_{it-1}$	-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^{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 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, θ								
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, γ								
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)
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)
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)
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)
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)
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)
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, θ			
Surplus$_{it-1}$	-0.07***	-0.07***	-0.07***
	(0.012)	(0.013)	(0.013)
Rate of adjustment, γ			
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, θ						
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, γ						
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)

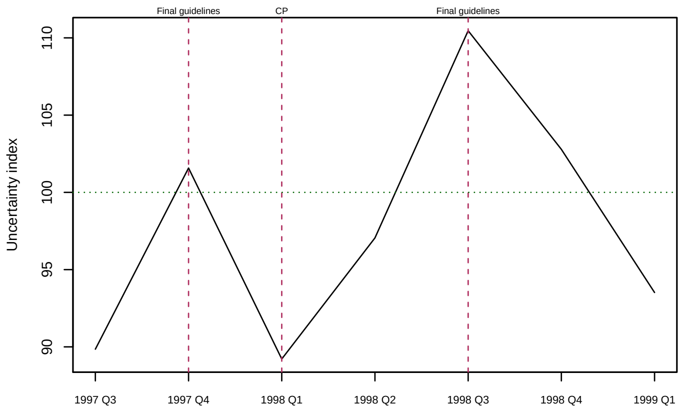
Numeratore of subsample of uncertainty in banking policy related articles: (bank* OR "building societ*" OR banking! OR lender* OR boe OR "Bank of England") AND (brit* OR UK) AND (uncert*)

A.3 Sensitivity checks: Narrow measure

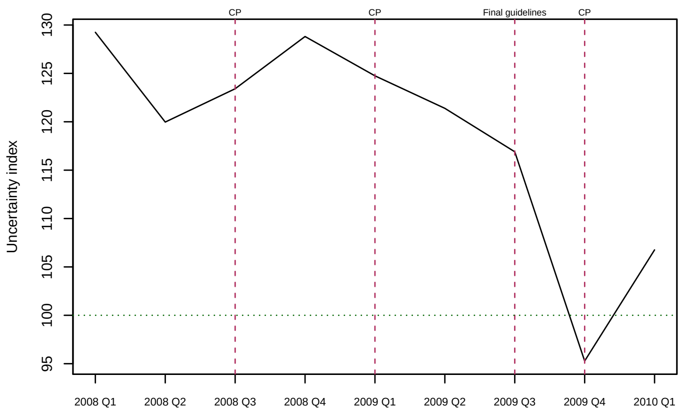
We conduct a few sanity checks for our measure of narrow banking regulatory uncertainty, since that is our main variable of interest. The first is to check what happens to the measure around the time of major Basel publications, especially consultation papers where proposals are put out for public comments 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.[47] 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).[48] 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).

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

[48]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 1 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.

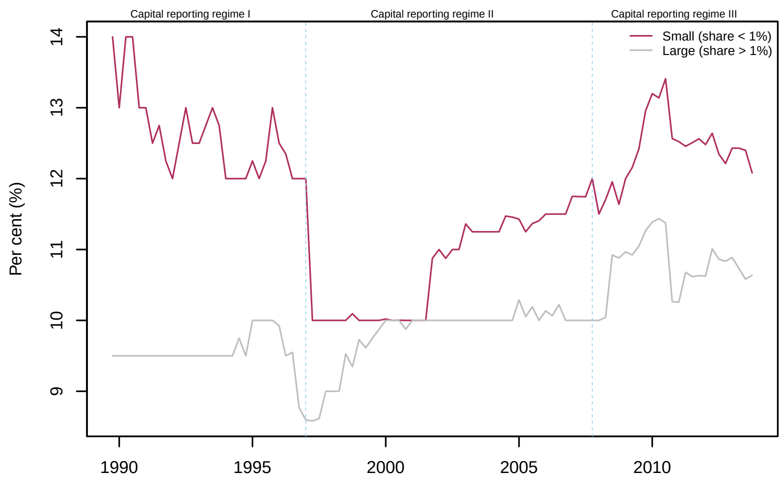
Table B.1: Variable definitions and data sources

Variable	**Calculation**	**Unit**	**Source**
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
Return on equity$_{it}$	$100 \times \frac{\text{Current year profit loss (SA)}_{it}}{\text{CT1}_{it}}$	%	HBRD
Provisions$_{it}$	Ratio of total provisions to loans: $\frac{\text{Provisions}_{it}}{\text{Loans}_{it}}$	%	HBRD
Market$_{it}$	$100 \times \frac{\text{Subordinated debt}_{it}}{\text{Assets}_{it}}$	%	HBRD
Retained profits$_{it}$	$\frac{\text{Retained profits}_{it}}{\text{Assets}_{it}}$	%	HBRD
Size$_{it}$	$log\ (\text{assets})_{it} - log\ (\mu_{\text{assets}})_i$	GBP	HBRD
Loan growth$_{it}$	QoQ growth of loan to assets: $100 \times \Delta(log(\frac{\text{Loan}_{it}}{\text{Assets}_{it}}))$	%	HBRD
MADTRIG$^q_{it}$	Mean absolute deviation of $trigger_{it}$ over q previous quarters, where $q = 8, 12$	%	HBRD
BSOC$_{it}$	Identifier for building societies	Dummy	HBRD
Dangerzone$^t_{it}$	Bottom tercile of cross-sectional surplus capital distribution (from trigger$_{it}$)	Dummy	HBRD
Dangerzone$^m_{it}$	Below median of cross-sectional surplus capital distribution (from trigger$_{it}$)	Dummy	HBRD
Dangerzone$^p_{it}$	Bottom tercile of cross-sectional surplus capital distribution (from Basel I 8%)	Dummy	HBRD
Macro uncertainty$_t$	Principal component of 6 component series	Number	BoE
GDP growth$_t$	Quarterly YoY GDP growth	%	FRED
Output gap$_t$	Output gap	%	OECD
Banking sector z-score$_t$	Captures probability of default of a country's banking system. Median $\frac{\text{ROA+(equity/assets)}}{\sigma\text{(ROA)}}$	Number	GFD, WDI
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.

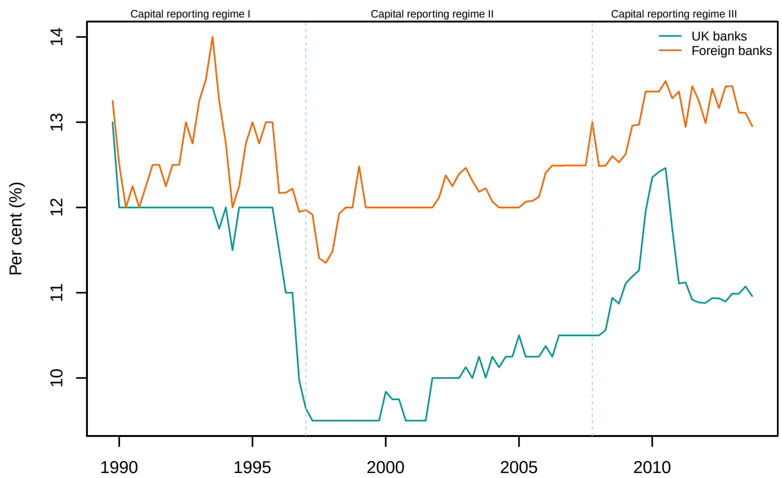
C Additional figures

Figure C.1: Median minimum requirements by bank size



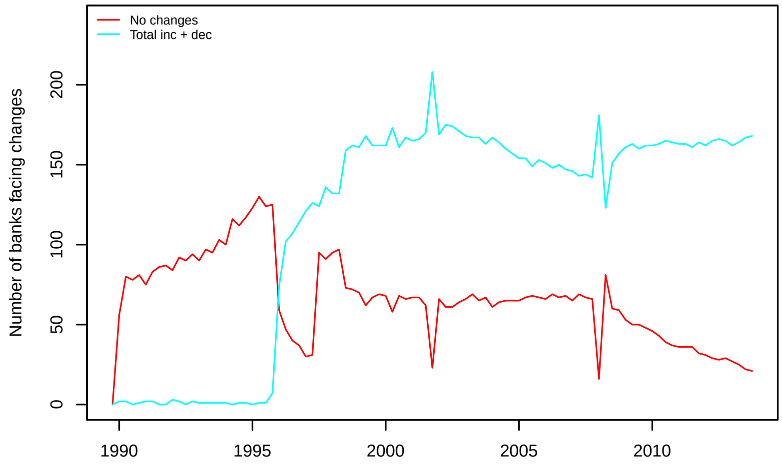
Note: This figure plots the median minimum requirement for the sample of small and large banks and shows that requirements have been higher for smaller banks. Small banks are defined as those with share in total banking assets of less than or equal to 1% in any quarter; large banks are those with shares greater than 1%. This means that the same bank can over time switch between the two categories. 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 C.2: Median minimum requirements by bank origin



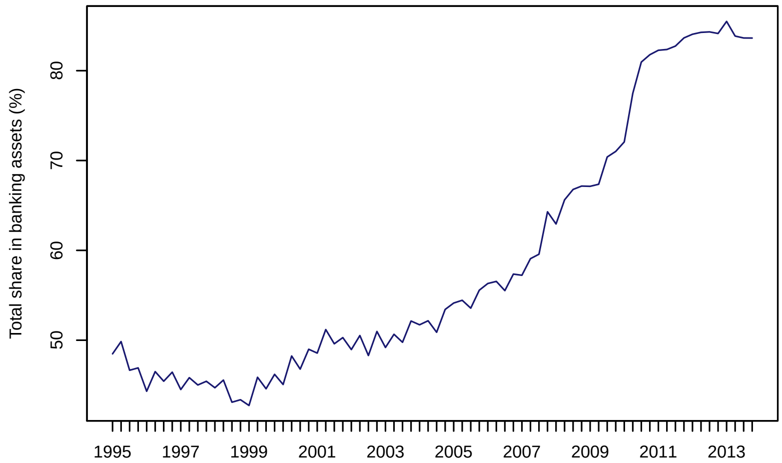
Note: This figure plots the median minimum requirements for the sample of UK and foreign banks. UK banks are those headquartered in the UK and foreign banks are UK subsidiaries of foreign banking groups. The three capital reporting regimes are based on de Ramon *et al.* (2017). These are: until 1997 Q1; from 1997 Q2 to 2007 Q4; and from 2008 Q1 to 2013 Q4.

Figure C.3: Median minimum requirements: Overall changes



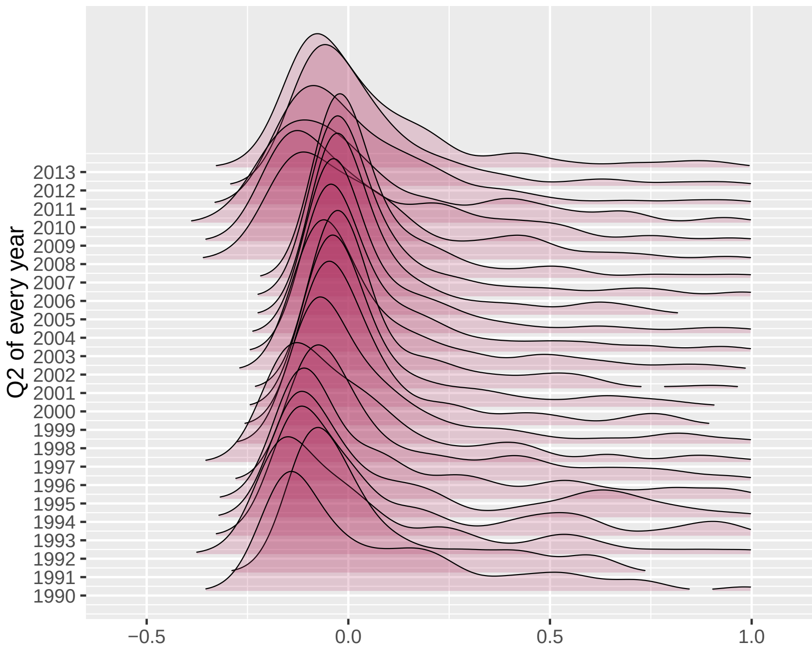
Note: This figure plots the number of banks facing *changes* (increases or decreases) in their minimum capital requirements in every quarter vs. those facing no changes.

Figure C.4: Share of consistent sample of banks in total banking assets



Note: This figure plots the share of the consistent sample of 136 firms in total banking assets every quarter.

Figure C.5: 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^t_{it}	5091	2.12	18.90***
Safe	7050	28.59	
DZ^m_{it}	8386	3.20	25.39***
Safe	6934	29.83	
DZ^p_{it}	8502	3.23	25.75***

Panel B: $MADTRIG^{q=12}$

Sample	Observations	Mean	*ttest* of differences in means
Safe	10345	0.48	
DZ^t_{it}	5091	0.30	0.18***
Safe	7050	0.55	
DZ^m_{it}	8386	0.31	0.24***
Safe	6934	0.54	
DZ^p_{it}	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^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, and *surplus* is capital less minimum requirement by RWAs.

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

Variable	Safe banks, μ	DZ^t_{it} banks, μ	*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^t_{it}) 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, θ				
Surplus_{it-1}	-0.15***	-0.15***	-0.15***	-0.15***
	(0.027)	(0.027)	(0.027)	(0.027)
Rate of adjustment, γ				
ROE_{it-1}	-0.01	0.00	0.01	0.01
	(0.067)	(0.065)	(0.151)	(0.151)
ROE_{it-1} × d.Post07			-0.03	-0.02
			(0.238)	(0.237)
Provisions_{it-1}	1.94***	1.92***	2.15***	2.11***
	(0.337)	(0.325)	(0.271)	(0.265)
Provisions_{it-1} × d.Post07			-2.33***	-2.29***
			(0.666)	(0.648)
Subordinated debt_{it-1}	0.38	0.35	0.09	0.05
	(0.448)	(0.441)	(0.709)	(0.695)
Subordinated debt_{it-1} × d.Post07			0.60	0.61
			(0.902)	(0.893)
Retained profits_{it-1}	3.78***	3.82**	5.31**	5.32**
	(1.358)	(1.542)	(2.101)	(2.153)
Retained profits_{it-1} × d.Post07			-1.49	-1.32
			(2.444)	(2.367)
Time demeaned size_{it-1}	-12.34***	-12.48***	-12.22***	-12.45***
	(2.980)	(3.006)	(3.480)	(3.574)
Time demeaned size_{it-1} × d.Post07			-2.61	-2.35
			(5.920)	(5.965)
Trigger_{it-1}	-0.37*	-0.40*	-0.54	-0.61*
	(0.217)	(0.216)	(0.359)	(0.328)
Trigger_{it-1} × d.Post07			0.30	0.38
			(0.387)	(0.367)
Loan growth_{it-1}	-0.58***	-0.57***	-0.68***	-0.68***
	(0.127)	(0.127)	(0.151)	(0.151)
Loan growth_{it-1} × d.Post07			0.23	0.24
			(0.171)	(0.172)
GDP growth_{it-1}	0.74**	0.57**	0.63	0.60
	(0.341)	(0.288)	(0.497)	(0.469)
GDP growth_{it-1} × d.Post07			0.22	-0.58
			(0.929)	(0.792)
BRU:N_{it-1}	0.22***		0.17**	
	(0.058)		(0.077)	
BRU:N_{it-1} × d.Post07	-0.16**		-0.14	
	(0.066)		(0.125)	
BRU:B_{it-1}		285.90***		271.60**
		(89.700)		(120.113)
BRU:B_{it-1} × 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* × *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, θ						
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, γ						
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, θ			
Surplus$_{it-1}$	-0.25***	-0.12***	-0.18***
	(0.043)	(0.026)	(0.027)
Rate of adjustment, γ			
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) Consistent	(2) Consistent, pre-2007	(3) Consistent, post-2007
Rate of convergence to equilibrium, θ			
Surplus$_{it-1}$	-0.17***	-0.18***	-0.21**
	(0.036)	(0.039)	(0.094)
Rate of adjustment, γ			
Return on equity$_{it-1}$	0.07	0.25**	-0.00
	(0.071)	(0.119)	(0.059)
Trigger$_{it-1}$	-0.54*	-0.55	-0.66
	(0.316)	(0.383)	(0.453)
Provisions$_{it-1}$	1.80***	1.84***	-0.24
	(0.361)	(0.207)	(0.385)
Subordinated debt$_{it-1}$	0.23	-0.24	0.51
	(0.454)	(0.630)	(0.795)
Retained profits$_{it-1}$	3.24**	-2.34	3.41***
	(1.269)	(6.135)	(0.985)
Time demeaned size$_{it-1}$	-8.73***	-9.56***	-10.41**
	(2.500)	(2.822)	(5.277)
Loan growth$_{it-1}$	-0.55***	-0.56***	-0.29
	(0.127)	(0.143)	(0.192)
GDP growth$_{t-1}$	0.78**	0.73	1.19*
	(0.355)	(0.625)	(0.611)
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, θ			
Surplus$_{it-1}$	-0.07***	-0.09***	-0.13***
	(0.012)	(0.019)	(0.047)
Rate of adjustment, γ			
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, θ					
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, γ					
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)
Provisions$_{it-1}$	1.94***	1.84***	1.08	0.51	0.48
	(0.334)	(0.312)	(1.131)	(0.601)	(0.482)
Subordinated debt$_{it-1}$	0.38	0.42	0.62*	0.70**	0.54***
	(0.448)	(0.405)	(0.361)	(0.299)	(0.209)
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)
Trigger$_{it-1}$	-0.37*	-0.31	-0.35	-0.29	-0.14
	(0.212)	(0.209)	(0.225)	(0.183)	(0.146)
Retained profits$_{it-1}$	3.79***	3.14**	1.53	0.67	0.28
	(1.414)	(1.283)	(0.947)	(0.611)	(0.502)
Loan growth$_{it-1}$	-0.58***	-0.49***	-0.41***	-0.21***	-0.14***
	(0.129)	(0.107)	(0.081)	(0.045)	(0.030)
GDP growth$_{t-1}$	0.81***	0.68**	0.45**	0.43***	0.31**
	(0.307)	(0.266)	(0.202)	(0.158)	(0.127)
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	≤ 200	≤ 150	≤ 100	≤ 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, θ				
Surplus$_{it-1}$	-0.15***	-0.15***	-0.17***	-0.14**
	(0.027)	(0.028)	(0.029)	(0.065)
Rate of adjustment, γ				
Return on equity$_{it-1}$	-0.02	0.04	0.09	-0.01
	(0.064)	(0.097)	(0.114)	(0.074)
Trigger$_{it-1}$	-0.36*	-0.35	-0.51	-0.37
	(0.215)	(0.225)	(0.390)	(0.291)
Provisions$_{it-1}$	1.93***	1.88***	1.94***	-0.16
	(0.330)	(0.262)	(0.213)	(0.640)
Subordinated debt$_{it-1}$	0.39	0.13	0.13	0.43
	(0.453)	(0.521)	(0.782)	(0.559)
Retained profits$_{it-1}$	3.73***	5.69***	5.68***	4.11**
	(1.367)	(1.650)	(2.000)	(1.869)
Time demeaned size$_{it-1}$	-12.23***	-13.49***	-12.78***	-16.80**
	(2.997)	(3.382)	(3.687)	(7.445)
Loan growth$_{it-1}$	-0.58***	-0.66***	-0.62***	-0.47
	(0.130)	(0.141)	(0.136)	(0.287)
Output gap$_{t-1}$	0.01	0.96*	1.10*	-0.83
	(0.365)	(0.580)	(0.654)	(0.580)
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

	(1) All	(2) Exc. crisis	(3) Pre-2007	(4) Post-2007
	Dependent variable: $\Delta Surplus_{it}$			
Rate of convergence to equilibrium, θ				
Surplus_{it-1}	-0.15***	-0.16***	-0.20***	-0.09
	(0.050)	(0.050)	(0.049)	(0.076)
Rate of adjustment, γ				
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

	(1) All	(2) DZ^t_{it}	(3) DZ^m_{it}	(4) DZ^p_{it}
	Dependent variable: $Surplus_{it}$			
Rate of convergence to equilibrium, θ				
Surplus_{it-1}	-0.15***	-0.87***	-0.69***	-0.68***
	(0.028)	(0.058)	(0.082)	(0.085)
Rate of adjustment, γ				
σ (retained profits)$_{it-1}$	0.39*	0.08***	0.16***	0.14***
	(0.228)	(0.026)	(0.040)	(0.042)
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.