Pro or Counter cyclical Buffers of Quality Capital: US bank holding companies

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Abstract: An optimal regulatory system results in banks accumulating capital reserves pro-cyclically. We document that bank holdings of Tier 1 capital above regulatory minimums are pro-cyclical only for large listed banks. Bank equity issues are counter cyclical to the business cycle but pro-cyclical to systemic risk. We reconcile cyclical capital buffer quality with counter-cyclical equity issues by considering retentions from profits and preference share issues. The Orderly Liquidation Authority of 2010 increased equity issues and larger capital buffers by banks most at risk of bail-in. However, the 2014 capital reforms saw reduced equity issues and reduced buffers of quality capital.

(abstract 99 words)

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1. Introduction.

The importance of banks having a safety net of surplus capital is a frequent lesson of financial crises. Both the financial crisis of 2008 and the more recent banking crisis of 2023 re-iterated the importance of banks being able to absorb balance sheet shocks.[2] The increased attention paid to questions associated with bank capital also re-invigorated the question of bank capital cyclicality. Under an optimally designed regulatory regime, banks would increase capital holdings during periods of credit expansions to create a buffer against future losses during negative credit cycles. As credit expansions predict subsequent credit downturns, (Greenwood*, et al.*, 2022; Schularick and Taylor, 2012), the optimal bank capital cycle is to pro-cyclically increase capital buffers. However, Baron (2020), finds that bank equity issues and equity retentions decline during credit expansion cycles. He demonstrates that this sub-optimal cycle is due to the impact of deposit guarantees. We extend Baron (2020) to consider the cyclicity of bank buffers of quality capital by closing the loop between equity issues, buffers of quality capital, preference share issues, retentions from profits and credit risk density. We consider the theme of bank capital buffer cyclicality against the backdrop of the regulatory reforms that followed the financial crisis of 2008, and the degree to which these diverse factors impacted upon a large sample of both listed and unlisted banks, thus extending both Baron (2020) and Berger*, et al.* (2022). We argue that improving and extending our understanding of bank buffers of quality capital is valuable due to the diverse stakeholder clientele of banks. As bank capital buffers reduce the likelihood of taxpayer funded bailouts, while also speeding recovery from economic crises (Thakor, 2014), increased understanding of the factors that underly holdings of quality capital have importance to both academic and policy audiences.

Banks' holdings of capital in excess of regulatory minimums is well documented (Jokipii and Milne, 2012; 2011), Valencia and Bolanos (2018) and Bui*, et al.*,2017)). However, the financial crisis of 2007 – 2008 (GFC, hereafter) revealed a preference by regulators to monitor bank capital quantity rather than quality. Despite having an established hierarchy of capital represented as higher quality capital (Tier 1) and lower quality capital (Tier 2), we have little evidence of how banks adjust their buffers of quality (Tier 1) capital over time. Furthermore, the revisions to the Capital Adequacy accord following the GFC, brought the issue of capital quality back to the forefront of bank regulatory

[2] Thakor (2014) refers to bank capital as braking distance, providing additional space between the bank and failure while also allowing time for bank managers to see and respond to impending crises.

policy. This motivates our research agenda to address the key question: "What factors determine bank buffers of quality capital?"

We find that bank buffers of quality capital are pro-cyclical for larger listed banks and we confirm that the economic countercyclicality of equity issues found by Baron (2020) also holds for a larger sample of listed and unlisted banks. We then extend this result across several dimensions by establishing that bank preference share issues are pro-cyclical, with large listed banks displaying marginal counter-cyclicality. We find that large banks are also pro-cyclical in employing retentions from profits to increase buffers of quality capital during positive economic cycles. Thus, bank buffers of quality capital are funded according to pecking order theory with retentions and preference shares used to increase buffers of quality capital during economic upswings. Only when alternative sources of capital increase in relative expense, while reducing in relative availability (during economic down turns) do banks increase equity issues. Consistent with this perspective, we find that worsening loan quality is an important determinant of increased equity issues. Furthermore, we establish that bank equity issues are proactive to increased bank systemic risk (CATFIN) (for both listed and unlisted banks across all size classifications) , via pro-cyclicality with respect to CATFIN (Allen*, et al.*, 2012). We thus extend our understanding of bank capital economic cyclicality to the dimension of systemic cyclicality. Our results have important implications for the policy debate surrounding not only bank capital cyclicality, but also for the issue of granularity of prudential policy settings. Additionally, we find no evidence that banks manipulate the denominator used when calculating regulatory capital ratios (credit risk density) in response to changes in economic cycles.

The process of regulatory reforms that followed the GFC resulted in a series of amendments focused on increasing bank capital quality and reducing potential imposts on taxpayers due to bank failure. The Orderly Liquidation Authority (OLA) introduced in 2010 as part of the Dodd-Frank Act saw the focus of regulatory intervention into distressed financial institutions shift from regulatory sponsored bail-outs via equity injections to bail-in via equity write off and junior debt holdings converted to equity (Berger*, et al.*, 2022). We consider the impact of both the OLA and the post financial crisis revisions to the capital regulations. We conclude that the OLA stimulated increased bank buffers of quality capital and bank equity issues and saw some reductions in bank preference share issues. However, the revisions to capital regulations that were implemented in 2014 had the opposite impact to that intended, seeing a reduction in bank buffers of quality capital and reduced issues of bank equity and preferred stock. Thus, we also document that bank buffers of quality capital have declined over our study period despite the increased regulatory attention paid to incentivising banks to hold more capital of high quality (see Figure 1).

FIGURE 1 about here.

Both Berger*, et al.* (2022) and Baron (2020) considered listed banks only. Berger*, et al.* (2022) tested their model upon a sample of the 50 largest listed U.S bank holding companies. Baron (2020) tested his model on sample of large listed US commercial banks but did not consider unlisted banks. Hence, the economic significance of combining a large sample of listed banks with a large sample of unlisted banks it is still unknown. We argue that considering an enhanced sample of both larger and smaller (but still economically important) banks, as well as comparing listed with unlisted banks offers several benefits to the literature. While large banks individually can be an important source of financial contagion, the collective actions of smaller and unlisted banks can also be a source of a banking crisis. The Savings and Loan Crisis of the late 1980s (Walter, 2019) and the Spanish Savings Banking Crisis following the Global Financial Crisis of 2008 (Blanco-Oliver, 2021) are two examples of national financial crises sourced from the small bank sector. The recent banking crisis of 2023 was also sourced from banks in the second tier of size. Furthermore, we find no evidence in the literature of implementation of a dynamic bank-level approach to bank capital holdings, allowing for time variation in capital regulations and variable bank-level capital requirements such as those imposed on systemically important banks. This approach will address the impact of economic cycles upon bank-level holdings of high-quality (Tier 1) capital in excess of the regulatory minimum, as well as the cyclicality of issues of bank equity and other regulatory compliant capital.

Bank holdings of quality (Tier 1) capital are important from a number of perspectives and to a number of stakeholders. The general consensus of theories of bank capital such as Merton (1977) and Repullo (2004) emphasise the importance of bank capital as a buffer against managerial risk seeking and unexpected losses. Increased bank capital has the beneficial property of increasing bank survival probability (Berger and Bouwman, 2013). However, higher levels of bank capital has also been argued to be associated with increased bank risk seeking (Calem and Rob, 1999; Koehn and Santomero, 1980). After the financial crisis of 2008, the regulatory response has emphasised banks holding increased amounts of higher quality bank capital (Anginer*, et al.*, 2021). Empirical studies have shown that bank capital, especially higher quality capital, is associated with reduced likelihood of bank failure (Berger and Bouwman, 2013), higher stock returns (Demirguc-Kunt*, et al.*, 2013), improved market share (Berger and Bouwman, 2013), stable bank lending during financial shocks (Schwert, 2018), the payment mechanism for bank mergers (Grullon*, et al.*, 1997), as well as the impact of monetary policy (Gambacorta and Shin, 2018). Furthermore, the introduction of the OLA increased the importance of bank Tier 1 capital to holders of subordinated (junior) debt (Berger*, et* *al.*, 2022). Despite the relevance of bank capital quality to a wide variety of stakeholders we find no previous studies that have addressed the question of the cyclicality of buffers of bank quality capital above the regulatory minimums.

Our paper extends our understanding of bank holding of excess capital in several dimensions. First, we scrutinize buffers of quality capital (Tier 1 capital above the regulatory minimum) of BHCs and we allow for heterogeneity across time and banks[3]. Second, we consider if bank buffers of quality capital are pro or counter cyclical, this extends the work of Baron (2020) into the domain of regulatory capital ratios. Third, we consider heterogeneity among US BHCs with particular emphasis on size and listed status, this extends the work of both Baron (2020) [listed banks] and Berger*, et al.* (2022) [large listed banks]. The experience of the GFC has seen a focus upon listed and large banks from the perspective of both academic studies and regulatory attention (Eisenbach*, et al.*, 2022). We argue, consistent with Eisenbach*, et al.* (2022), that this focus does not necessarily fully capture all the relevant dimensions of banking system risk. Fourth, we compute capital buffer adjustment speeds for banks with 'extreme' capitalisation levels (*i.e.,* poorly capitalised or well capitalised). As discussed in Berger*, et al.* (2022) speed of adjustment toward the unobserved optimal capital buffer is an important element of banks responses to regulatory changes. Further, in the spirit of Berger*, et al.* (2022) we consider the impact of the introduction of the OLA across a large sample of both listed and unlisted banks while also considering the implications of the introduction of the Troubled Asset Relief Program, as well as the possible impact of the size based accounting issues raised by Gong*, et al.* (2018). Additionally, we extend the research agenda considering economic cyclicality of bank capital to the question of systemic risk cyclicality, to establish that banks issue new equity as a response to increased aggregate systemic risk.

The rest of this paper is structured as follows, the next section discusses the relevant theories and provides a selected review of the relevant literature. The third section discusses the nature of our sample and presents our empirical setup. In the fourth section we present our results and robustness tests. The final section provides our conclusions and discusses the policy implications of our results.

2. Theory and literature review

[3] Baron (2020) adopted a simplifying assumption that the benchmark for bank capital holdings is the book equity to assets ratio, with banks viewed as undercapitalized if they fall below five percent equity to asset ratios. We apply the risk weighted regulatory Tier 1 capital ratios and allow for time variations in these regulations, as well as bank specific capital ratios such as those imposed upon Global Systemically Important Banks.

The use of actual or implied guarantees in the banking system (including the perception that some banks are too big to fail), creates risk-seeking incentives for shareholders of these banks. Merton (1977) demonstrated that these risk-seeking incentives can be reduced by requiring banks to hold more capital. Bank risk-seeking transfers increased risk to the underwriters of deposit insurance, effectively the taxpayers, while also increasing the likelihood of contagious financial distress, leading to potentially large-scale economic costs. The beneficiary of any upside from this risk seeking are bank shareholders. The Basle Capital Adequacy Accords are aimed at creating a global benchmark best practice for determining the appropriate risk adjusted levels of capital for banks to offset these risk-seeking incentives, while continuing to allow a profitable and efficient banking system. Prior to the Capital Adequacy process each nation pursued individual regulatory agendas, in many nations the insights of Merton (1977) generated nation-specific bank capital regulations.

Under the Basle Capital Adequacy Framework, bank capital is graded into two categories; Tier 1 and Tier 2.[4] Tier 1 capital – largely composed of shareholder funds and retained earnings as well as some types of preference shares – is recognised as superior in terms of its loss-absorbent characteristics (BCBS, 2011).[5] On the other hand, Tier 2 capital (complying subordinated debt instruments and general provisions) has inferior loss-absorbent qualities but is less costly.[6] Therefore, a bank, in designing its optimal mix of Tier 1 and Tier 2 capital, may trade-off cost with loss-absorbency.

Regulators face the challenging task of stipulating that a bank set aside an 'appropriate' capital base. On the one hand, they must protect against systemic vulnerabilities by requiring that banks hold higher levels of quality capital, and minimise the costs of bank failures. On the other hand, they must balance the interests of bank shareholders (and other stakeholders), who desire that banks avoid holding high levels of costly capital, while also ensuring banks continue to exist as profitable going concerns, and fostering the important economic functions that banks provide. Striking a balance

[4] Under Basel II framework, at the discretion of national authorities, banks could issue a third category of regulatory capital, Tier 3 capital. Tier 3 capital consisted of short-term subordinated debt and was limited to 250% of a bank's Tier 1 capital required for market risk. Tier 3 was intended to play a secondary role (to Tier 1 capital) in covering market risk. Tier 3 capital instruments have been gradually phased out under Basel III.

[5] Basel III introduces two further sub-categories of Tier 1 regulatory capital. Common Equity Tier 1 consists largely of ordinary shares and retained earnings. It is regarded as the highest quality regulatory capital available to absorb losses (BCBS, 2011). Additional Tier 1 capital is composed of unsecured perpetual instruments that are subordinated in seniority to bank creditors (BCBS, 2011, p 16) and certain preferred shares. Common Equity Tier 1 is more expensive to raise in capital markets but commensurately more loss-absorbent.

[6] Tier 2 capital is subordinated to depositors and general creditors and any complying debt-like security must have an original maturity of at least five years (BCBS, 2011).

between cost considerations (in which case Tier 2 capital is superior) and loss-absorbency qualities (in which case Tier 1 capital is preferred) has proven difficult for both regulators and bank managers.

2.1 Bank Capital Buffers

The Capital Adequacy process has become both a global benchmark for calculating bank capital holdings as well as the accepted minimum capital levels for a bank. Banks hold buffers in excess of the regulatory minimum set by the relevant national authority (Jokipii and Milne, 2008).[7] The resulting capital buffer enables a bank to absorb unexpected losses (FDIC, 2016), signals its financial health (Berger*, et al.*, 1995), offers flexibility to exploit growth opportunities (Berger*, et al.*, 2008), shields against supervisory intervention, and reduces costly market disciplinary pressures (Berger*, et al.*, 1995; Jokipii and Milne, 2008). Furthermore, bank capital buffers reduce the probability of taxpayer-funded bailouts (Jokipii and Milne, 2008).[8]

Bank capital buffers reflect the difficulty in raising capital cheaply when needed, especially given the likely negative signalling impact of a capital raising (Myers and Majluf, 1984). There is also evidence of a negative association between capital buffers and the economic cycle, such that a bank grows its buffer during economic downswings, and depletes its buffer during upswings (Ayuso*, et al.*, 2004; Baron, 2020; Francis and Osborne, 2010; Jokipii and Milne, 2008; Lindquist, 2004). Basel II introduced the possibility of bank regulators requiring banks to increase capital buffers during business cycle upswings. Basel III introduced two business cycle-dependent capital buffer requirements, which are intended to induce procyclicality in capital holdings by banks.[9]

Banks also consider the costs to shareholders of loss of its 'franchise value' or 'charter value'.[10] A bank with high franchise value may desire larger capital buffers to absorb losses and avoid insolvency (Demsetz*, et al.*, 1996). Likewise, a bank exposed to market discipline is incentivised to signal its

[7] Each nation is free to accept, reject or modify the Capital Adequacy process (Hohl*, et al.*, 2018).
[8] Banks holding capital buffers reflects capital market imperfections. If equity markets are perfect, a bank's optimal buffer would be zero, given the opportunity cost of holding idle capital (García-Suaza, et al. (2012). Banks may have an internal capital target that is above the regulatory capital ratio (Jokipii and Milne (2008). Regulators have the option of requiring a bank to hold capital above the usual regulatory minimum.
[9] These two buffers are intended to (1) address procyclicality in capital positions of banks, and (2) mitigate the damage caused by the accumulation of systemic risks (BCBS, 2013). The phasing in of the first of these buffers, the Capital Conservation Buffer, began in 2016. This gradually increased to 2.5% through to 2019. US regulators also have the discretion to mandate that Advanced Approaches BHCs set aside an additional buffer of up to 2.5% composed of CET1, at times when systemic vulnerabilities are unacceptably high. This buffer is known as the Counter-Cyclical Capital Buffer (CCyB), and is currently set at 0% in the US.
[10] Franchise value is the value of the bank's future profits that would be lost if it were to be insolvent (Demsetz*, et al.*, 1996; Jokipii and Milne, 2011).

ongoing soundness by holding larger buffers (Jackson, *et al.*, 1999; Jokipii and Milne, 2008). Furthermore, bank capital buffers provide insurance against the possibility of violating capital regulations (Jokipii and Milne, 2008; Marcus, 1983) , as well as enabling banks to take advantage of asset growth and funding opportunities as they present themselves (Jokipii and Milne, 2008).

2.2 Bank Capital Cyclicality

Concerns with respect to bank capital cyclicality predate the GFC (Ayuso, *et al.*, 2004; Estrella, 2004; Heid, 2007). Ideally bank capital holdings should vary pro-cyclically with the economic cycle. As the credit expansion cycle predicts economic downturns and worsening credit quality (Greenwood, *et al.*, 2022; Schularick and Taylor, 2012), pro-cyclical accumulation of capital buffers during economic upswings would protect banks and the wider economy from the negative impact of cyclical economic downturns. Baron (2020) presents, and empirically tests, a model which demonstrates that deposit insurance removes incentives for banks to issue new equity pro-cyclically. It is demonstrated that despite equity issuance being cheaper during positive economic cycles (Baron and Xiong, 2017), banks issue equity during economic downturns when it is more expensive (and generates negative signals) due to the impact of deposit insurance. As deposit insurance results in bank deposits being priced close to the risk-free rate, bank equity issues do not result in a lower overall cost of capital. Furthermore, for a sample of listed banks, Baron (2020) demonstrates a pronounced size effect, in which counter-cyclicality of equity issues is dominated by large banks. The cyclicality of bank capital buffers is less clear-cut. Jokipii and Milne (2008) and Ayuso, *et al.* (2004) both find evidence to support bank capital buffers are counter-cyclical, while Valencia and Bolanos (2018) find pro-cyclicality. However, in each case the measure of capital holdings is based on total regulatory capital (Tier 1 and Tier 2) capital.

The importance of pro-cyclicality in capital holdings has been acknowledged by the post-GFC amendment to the Capital Adequacy Framework, with the introduction of Counter-Cyclical Buffer (CCyB) requirement at the discretion of the national regulator. While equity is a key component of bank capital buffers and of quality (Tier 1) capital, it is not the only component of bank regulatory capital. Thus, it is possible that bank capital buffers are pro-cyclical while net equity issues are counter cyclical. Furthermore, as previously discussed, our sample has a wider variation in size than that of Baron (2020), and our sample includes listed as well as unlisted banks. Additionally, Berger, *et al.* (2022) demonstrate that the change in regulatory policy toward bail-in after the introduction of the Orderly Liquidation Authority (OLA) has seen the largest listed US banks increase their equity holdings. Accordingly, we do not hypothesise a direction for the relationship between economic cycles and buffers of quality capital.

2.3 Capital buffer quality

The GFC revealed that the regulatory attention toward bank capital was, to that point in time, myopic (Chor and Manova, 2012; Fratzscher, 2012). Basel III addresses some of the regulatory shortcomings exposed during the GFC by raising not only the quantity of required regulatory capital but also its quality.[11] Supporting this emphasis upon quality, Demirguc-Kunt*, et al.* (2013) find that differences across individual banks' capital quality did not materially impact stock returns before the crisis. During the GFC, variations in Tier 1 capital became associated with the outperformance of individual banks, especially larger banks. Thus, the market increasingly recognised the importance of the quality of bank capital rather than the quantity of capital

Market frictions (such as information asymmetries and issuance costs) also explain why Tier 1 capital is more expensive to raise than Tier 2 capital (Myers and Majluf, 1984). Thus, a bank must trade-off the quality and quantity of its capital buffers. The existing literature indicates that a bank actively manages, not only the size, but also the quality of its buffer (see, Acharya*, et al.*, 2022) and Martín-Oliver, 2012)).[12] The risk is that a bank, driven by moral hazard, favours cheaper financing, such as complying subordinated debt (i.e. Tier 2 capital) and complying preference shares, before raising shareholder funds (i.e. Tier 1 capital) (Dinger and Vallascsas, 2016) Thus, judging a bank's financial health based purely on the size of its overall (Tier 1 and Tier 2) capital buffer has proven inadequate.

2.4 Control Variables

We expect larger banks to have less of the more expensive Tier 1 capital, (with its superior loss absorbing characteristics) in their capital buffers. This is because larger banks are typically covered by implicit state safety nets such as TBTF (Hannan and Hanweck, 1988), have greater market access and flexibility in issuing equity and hybrid securities (Jayaratne and Morgan, 2000), and possess superior economies of scale in the monitoring of risky borrowers. Berger and Bouwman (2013) observe that higher aggregate capital benefits small banks always (i.e. during crises and normal times). However, larger banks only benefit (in terms of survival and market share growth) from

[11] Basel III emphasises the importance of CET1 (i.e. shareholder equity) as part of a bank's total capitalisation. Under Basel III the common equity Tier 1 capital to total risk-weighted assets increases from 2 to 4.5%. Banks must also hold Tier 1 capital to total-risk weighted assets ratio of 6%. Total capital to total risk-weighted assets ratio remains 8%. A new capital measure is a countercyclical buffer of 0-2.5% imposed at the regulator's discretion. A bank-specific 'capital conservation' buffer of 2.5% of common equity was also phased in between 2014 and 2019.

[12] Both these studies indicate that during the pre-GFC period banks favoured the issuance of Tier 2 capital instruments, such as hybrids over Tier 1 (common equity capital). Additionally, banks continued paying out substantial dividends. The net impact was that the quality of banks' capital holdings fell when it was most required to absorb losses.

stronger capitalisation during banking crises.[13] Thus, the first control variable in our model is bank size. We would expect that larger banks would hold smaller buffers of quality capital.

Hirtle and Stiroh (2007) defines retail intensity as including '*deposit-taking, lending and other financial services provided to consumers and small businesses through all delivery channels…*' (p.1107). Understanding the composition of capital buffers for retail banks is complicated by opposing forces. On the one hand, greater retail exposure (deposit mobilisation) as a component of total liabilities increases the value of deposit insurance (Berger*, et al.*, 2008; Berger*, et al.*, 1995). If moral hazards drive that bank, then one would anticipate a smaller capital buffer (Dinger and Vallascsas, 2016). However, as is found by Berger*, et al.* (2008) retail banks hold larger capital buffers (quantity) as compared with their wholesale peers. It is argued that retail banks, reliant on depositor funding, have greater charter values (Jokipii and Milne, 2008). To protect its charter value, a retail bank holds additional Tier 1 as a component of its capital buffers. Thus, we include retail intensity in our model as our second control variable and expect banks with higher levels of retail intensity to hold larger buffers of quality capital.

The operational complexity and opacity of a bank may influence the overall composition of its capital buffer. Regulatory reforms in the US, especially the Gramm-Leach-Bliley Act (1999), [14] permitted bank holding companies to engage in previously restricted financial services. Agency conflicts are more likely within complex institutions, where scrutiny of management by outsiders is hampered by information asymmetries (Jensen and Meckling, 1976). Laeven and Levine (2007) find that markets ascribe a "diversification discount" to complex financial institutions. The authors attribute this lower value to agency problems associated with monitoring complex banks. Many banks have diversified revenues through off-balance sheet exposures. The growth in off-balance sheet exposures is closely related to increasing firm opacity and information asymmetry (Laeven and Levine, 2007; Williams and Rajaguru, 2013). These banks may prioritise reliance upon retained earnings to finance their activities (Gropp and Heider, 2010). Greater information asymmetry for complex banks results in alternative sources of finance such as equity raising will be costlier (Myers and Majluf, 1984). Operational complexity is found to be associated with uninformed funding sources (due to greater information asymmetry) and this uncertainty can result in sudden and unpredictable funding withdrawals (Huang and Ratnovski, 2011). To mitigate this potential instability, complex banks may hold more Tier 1 capital in their buffers. Thus, we include operational complexity measures as

[13] See also Laeven*, et al.* (2016) whom similarly suggest that greater capitalisation benefits larger banks mainly during crises.
[14] Furlong (2000) offers a detailed overview of the Gramm-Leach-Bliley Act (1999).

controls in our model, expecting that more operationally complex banks will hold larger buffers of quality capital.

There is evidence of a pronounced negative relationship between overall capital buffer size (Tier 1 and Tier 2 capital) and credit risk for less capitalised banks (Jokipii and Milne, 2011). This may be consistent with two scenarios. On the one hand, a bank operating near regulatory minimums has an incentive to re-establish its target capital buffer by decreasing loan portfolio risk, while simultaneously increasing capital (Heid*, et al.*, 2004). This would indicate that banks are attuned to the high regulatory costs associated with falling below the regulatory minimum.[15] On the other hand, a poorly-capitalised bank may finance riskier projects or borrowers (increasing credit risk), while depleting its buffer. This gamble is justified by the potential for higher returns that, if earned, would mitigate the likelihood of breaching the regulatory minimum (Calem and Rob, 1999; Jokipii and Milne, 2011). The moral hazard encouraged by the presence of the state safety net would, theoretically, only intensify this risk-seeking behaviour. It is observed by Jokipii and Milne (2011) and Williams (2014) that the overall relationship between bank risk and capital is U-shaped.[16] Williams (2014) finds that the intensity of risk-seeking lessens as bank capitalisation levels improve, but only to a certain point of capitalisation. After this point is reached, well-capitalised banks maintain their buffer by increasing (decreasing) credit risk when capital increases (decreases). As credit risk increases, so too does the need to signal ongoing viability, assuming that charter values influence bank manager decision-making (Jokipii and Milne, 2011). It follows that banks should signal their viability in the composition of their capital buffers. If this is the case, then a bank with high credit risk will compensate for this by growing the quality of its capital buffers.

Studies such as Koehn and Santomero (1980) and Blum (1999) have found increasing bank capital is associated with increased bank risk. A U-shaped relationship between bank capital and bank risk has been demonstrated by Calem and Rob (1999) and Williams (2013 and 2014). Thus we will include in our model a control for non-linearity in credit risk An important element in this non-linear relationship is the degree of regulatory intensity (Brimmer and Dahl, 1975; Calem and Rob, 1999; Shrieves and Dahl, 1992), with lower regulatory intensity being accompanied by increased bank risk seeking in the presence of capital regulations. Eisenbach*, et al.* (2022) find that the allocation of United States supervisory resources is biased toward bank size and not bank risk, and as such may not prevent morally hazardous bank risk increases underwritten by deposit insurance safety nets. Given our sample is drawn from a single nation with a relatively homogenous regulatory structure,

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[15] Buser*, et al.* (1981) provides a detailed discussion on the implicit costs of falling below the regulatory minimum.
[16] A similar U-shaped relationship is observed by Jokipii and Milne (2011) for a sample of US BHCs.

the differences in regulatory intensity will largely be captured by our existing measures particularly size (Eisenbach*, et al.*, 2002).

Jokipii and Milne (2011) argue that greater investments in liquid assets reduce the need for insurance against falling below the minimum capital requirements. This is consistent with the precautionary motive for holding liquid assets. In contrast, a positive association is found between capital ratios and liquid assets by Ahmad*, et al.* (2008). It is suggested, consistent with Angbazo (1997), that the liquidity premium on the required rate of return on equity falls with greater liquid assets. This makes equity financing cheaper and thus it is more desirable for firms to issue capital as liquid asset holdings increase. The evidence to date finds that a bank with high liquidity targets lower capital buffers (Berger*, et al.*, 2008; Jokipii and Milne, 2011). This may be through risk minimization, as suggested by Jokipii and Milne (2011) or higher liquid assets being indicative of market access restrictions (Bates*, et al.*, 2009). We include bank holdings of liquid assets in our model, expecting a negative relationship with bank buffers of quality capital.

3. Sample and empirical framework

3.1 Sample

Our sample is an unbalanced panel of US Bank Holding Companies (BHC), Financial Holding Companies (FHC), and Savings and Loan Holding Companies (SLHC) (collectively referred to as BHCs). Our data covers the quarterly periods from 2001 to 2019.[17] All BHC data are obtained from the holding company regulatory reports filed quarterly to the Federal Reserve, FR Y-9C and published by the Federal Reserve Bank of Chicago. We focus on BHCs, as opposed to individual commercial banks (which are in turn owned by BHCs). This approach is based upon the regulator's "source of strength" doctrine, which requires a BHCs to be financially responsible for their subsidiary banks.[18] It is also consistent with capital adequacy requirements being assessed on a consolidated basis. In turn, bank managers are expected to execute their financial strategy with the overall corporate group in mind. Thus, capital management is best investigated at the BHC level.

The US banking system also features cross-ownership interests across some BHCs. To eliminate double counting, only top-tiered BHCs are included in the sample (Shim, 2013; Stiroh and Rumble,

[17] We thus end our sample before the introduction of stress-test based capital buffers.
[18] The 'source of strength' doctrine is prescribed in Sec 38A Federal Deposit Insurance Corporation Improvement Act of 1991.

2006). Top-tiered BHCs must either file a FR Y-9C report or FR Y-9SP report with the regulator. BHCs with total consolidated assets exceeding $1 billion are automatically required to file the quarterly FR Y-9C report.[19] BHCs that do not meet this threshold must file the *bi-annual* FR Y-9SP report. The data required for this study, especially, the required components of regulatory capital are only captured by the FR Y-9C filings.

We eliminate all BHCs which are noted as subsidiaries of another BHC. This yield an initial sample of 87,860 bank-quarter observations.[20] The requirement that large BHCs deduct investments in nonconsolidated affiliates (from their regulatory capital) only commenced from Quarter 1 2001. This has been recognised by Gong*, et al.* (2018) as a potential source of capital arbitrage. Thus, we commence the sample period from the date from which large BHCs were required to make these deductions – Quarter 1 2001. Including only those BHCs subject to the same capitalisation rules relating to subsidiaries avoids the capitalisation trap examined by Gong*, et al.* (2018), where capitalisation ratios of small BHCs were found to be overstated. All BHCs in our sample are required to comply with the same regulatory standards with respect to the deductibility of minority interests held in banking affiliates.

As bank mergers may be endogenous to economic cycles we eliminate all target banks for the last reporting quarter prior to the merger event as well as the three quarters prior to the last reporting quarter. We also eliminate all acquiring banks for quarter of the merger event as well as the three quarters prior to, and following, the merger event. Targets and acquirers are treated as unique observations for as long as the data are reported separately. We use the BHC regulatory code (known as the "RSSD ID") as the unique identifier. Changes in the BHC RSSD ID are regarded as a new institution, to reflect that these reorganisations are associated with major structural changes to the institution. Following Kashyap, et al. (2002) this approach reduces potential sample-selection bias. Furthermore, we include in our sample only those banks reporting at least eight consecutive quarters of data, consistent with Kashyap*, et al.* (2002). Over our sample period, the structure of the FR Y-9C reports has been revised several times. We have identified situations where two data codes used over time, with identical titles, but capture different, albeit overlapping information points. We have taken care to verify that the codes applied to construct our variables are time consistent.

[19] The reporting threshold for FR Y-9C reports was set at a minimum of $1 billion in total consolidated assets in March 2015. Before that, it was $500 million from March 2006. Before March 2006, it was $150 million.
[20] We use the code RSSD9364 to identify all BHCs which are a subsidiary of another BHC.

3.2 Empirical framework

We utilise a partial adjustment model, consistent with prior studies on bank capital buffers (Ayuso*, et al.*, 2004; Jokipii and Milne, 2008). Our approach assumes that banks (1) have a pre-determined optimal capital buffer target, and (2) adjust their capital holding towards this target through time. Thus, an observed change in a bank's capital buffer can be classified into components, (1) the discretionary adjustment towards a target capital buffer, and (2) the adjustment resulting from exogenous circumstances:

$$\Delta BUF_{i,t} = \Delta^d BUF_{i,t} + E_{i,t} , \qquad (1)$$

where, the subscripts *i*, and *t* denote individual banks and time horizons, ΔBUF is the observed change in the capital buffer, $\Delta^d BUF$ denotes the desired discretionary change in the capital buffer, and *E* is an exogenously determined random shock term (Brewer*, et al.*, 2008). However, transaction costs mean a bank cannot make instantaneous adjustments to their desired target capital buffer. Thus, the buffer adjustment, ΔBUF is not instantaneous, instead banks partially adjust toward their target buffer (BUF^*) between $t - 1$ and *t* (Jokipii and Milne, 2008). This speed of adjustment toward the target buffer is denoted by an adjustment term, θ. Thus,

$$\Delta BUF_{i,t} = \theta(BUF^*_{i,t} - BUF_{i,t-1}) + \varepsilon_{i,t} \qquad (2)$$

or,

$$BUF_{i,t} = (1 - \theta)BUF_{i,t-1} + \theta BUF^*_{i,t} + \varepsilon_{i,t} , \qquad (3)$$

where, θ is the speed of adjustment, and ε is a stochastic error term. The speed of adjustment term, θ, should lie between 0 and 1. As the transaction costs of adjustment to BUF^* reduces, θ should approach 1 (instantaneous adjustment). Our model assumes that exogenous circumstances will continuously impact upon the ability of a bank to reach BUF^*. These stochastic processes ($\varepsilon_{i,t}$) will result in the bank either moving closer to or further away from BUF^* (Jokipii and Milne, 2011). Thus, equation (2) implies that a bank will continuously adjust their observed capital buffer in order to approach or return to BUF^*. Our sample banks are also subject to Prompt Corrective Action (PCA), which involves regulatory intervention into the bank's capital and dividend decisions as the capital buffer falls below zero (Aggarwal and Jacques, 2001). This intervention removes the stochastic element that is part of our empirical model, and as such all BHCs without a positive observed capital buffer will be excluded from our estimations.

However, because the target capital buffer BUF^* is not observable, it is approximated by a set of ***N*** explanatory variables:

$$BUF^*_{i,t} = \sum_{n=1}^{N} \theta\delta_n X_{ni,t}, \tag{4}$$

where, X is a vector of N explanatory variables and δ is a vector of parameters. Our empirical estimation thus takes the form:

$$\begin{aligned} BUF_{i,t} = (1-\theta)BUF_{i,t-1} &+ \alpha_1 SIZE_{i,t-2} + \alpha_2 RETAIL\ INTENSITY_{i,t-2} \\ &+ \alpha_3 COMPLEXITY_{i,t-2} + \alpha_4 CREDIT\ RISK_{i,t-2} \\ &+ \alpha_5 LIQUIDITY_{i,t-2} + \alpha_6 CREDIT\ CYCLE_{t-2} + \beta_1 ROE_{i,t-2} \\ &+ \beta_2 MKTDISCIPLINE_{i,t-2} + \varepsilon_{i,t} \end{aligned} \tag{5}$$

In Table 1 we present the definitions and data sources to construct our dependent variable, observed capital buffers. As we found observed capital buffers to have some potentially influential extreme values, we winsorised our dependent variables at the one and ninety-nine percent levels. Table 2 has the descriptive statistics of our dependent variables. Table 3 provides the definitions and for our independent variables. As shown in equation (5) we include two additional controls into our model; return on equity (ROE) and market discipline (MKTDISCIPLINE)

3.2.1 Dependent variables

Buffer size is defined as the amount of total capital held (quarterly) in excess to the regulatory minimum (Fonseca and González, 2010; Jokipii and Milne, 2011).[21] The introduction of the first Basel Capital Accord (often called BIS1) and its adoption by the United States in 1992 set the benchmark for bank capital holdings for the period up to and just after the Global Financial Crisis of 2008. Under this approach banks were required to hold a ratio of capital to Risk Weighted Assets (RWA) of eight percent. Banks were required under this first (and second) version of the capital accord to hold a ratio of Tier 1 capital to RWA of at least four percent.[22] Tier 1 capital is defined as common equity and retained earnings (the main component) as well as some perpetual preferred stock and defined minority interests. Tier 2 Capital included a specified amount of bank loan losses, some additional preferred stock and specified debt instruments such as unsecured perpetual debt. The next iteration of the Capital Accord (BISII), developed the calculation of RWA, but did not change the

[21] Prior to Basel III, BHCs were permitted to hold Tier 3 regulatory capital (for market risk). However, no BHCs in the sample reported Tier 3 capital.
[22] Walter (2019) provides a valuable history of US bank capital regulations.

requirement for banks to hold a Tier 1 capital to RWA ratio of four percent and total complying capital (Tier 1 plus Tier 2) to RWA ratio of eight percent.

The third main iteration of the Capital Acord (BISIII) responded to the lessons of the GFC and overhauled both the numerator and denominator of bank's required capital holdings. The definition of complying capital and the calculation of RWA were revised. Furthermore, the previous ratios of four and eight percent were changed to require banks to hold more capital, especially Tier 1 capital. Additionally, a new definition of high-quality capital was introduced, Core Equity Tier 1 capital (CET1), which is a sub component of Tier 1 capital, mainly consisting of common stock and retained earnings, with other components of Tier 1 capital, such as specified preferred stock, now also referred to as Additional Tier 1 capital (AT1)

Under BISIII, the Tier 1 risk-based capital ratio lifted in a series of steps from four percent prior to 2013 to six percent after 2015. Although the total risk-based capital ratio minimum remains at eight percent under BISIII, these Tier 1 ratio requirements requires a greater proportion of Tier 1 capital. BISIII also introduced additional capital buffer obligations. These are intended to both address the less than desired cyclicality of bank capital holdings and protect against the accumulation of systemic risks over time (BCBS, 2013). The first of these, the Capital Conservation Buffer (CCB), was effective in 2016 with an additional 0.625% Common Equity Tier 1 (CET1) required to be set aside. This gradually increased to 2.5% through to 2019. These changes are summarised in Table 1. The descriptive statistics of our dependent variables are shown in Table 2.

<u>Tables 1 and 2 about here.</u>

These changes generated some issues in constructing our time consistent measure of buffer quality. The regulations identify CET1 as the necessary instrument to compose the CCB. However, the measure of buffer of quality capital used in our study is based upon the broader Tier 1 capital (and therefore treats CET1 and Additional Tier 1 capital indifferently) vs Tier 2 capital. Prior to Basel III's adoption in 2016, FR Y-9C reports were not structured in a manner that either stated CET1 or provided the necessary reporting details to accurately calculate it for previous periods. Furthermore, the changes in reporting that accompanied these changes means that calculating a pre-2014 CET1 ratio requires a number of assumptions which introduce potential bias into our results. Because much of the sample period is set prior to Basel III, use of a broader measure of buffers of quality capital is a necessity.

A second buffer measure introduced in BISIII is the Counter-Cyclical Capital Buffer (CCyB). US regulators have the discretion to mandate that Advanced Approaches BHCs set aside an additional buffer of up to 2.5% CET1 at times when systemic vulnerabilities are unacceptably high.[23] Over our sample period the Federal Reserve Board has left the CCyB at 0%.[24]

While introducing a wider set of system-wide bank capital ratios, BISIII also introduced an additional set of capital requirements that are applied only to specified banks, rather than to all banks. The concern that large and systemically important banks may be the source of system-wide crises has resulted in BISIII implementing a set of additional capital requirement for those banks identified as Globally Systemically Important. Under this process the Financial Stability Board produces an annual list of Globally Systemically Important Banks (G-SIBS), in which a small group of internationally important banks are allocated into five risk buckets (1 to 5) requiring additional capital buffers of between 1% for bucket 1 to 3.5% for bucket 5 (currently bucket 5 is empty).[25] The allocation of banks to their risk buckets can change each year. We match each bank nominated as a G-SIB to its nominated annual capital surcharge. BISIII also allowed the national regulator to nominate a group of domestically important as Domestic Systemically Important Banks (D-SIBs), resulting in an additional capital requirement of 1% of Tier 1 capital. This option has not been formally adopted and announced in the US, and the Financial Stability Oversight Council has not produced a list of D-SIBs. However, the Dodd-Frank Act does allow the imposition of additional supervision standards on any large bank (over $50 billion in assets). Following the testimony presented at the Committee of Financial Services,[26] we will treat those US banks subject to the annual stress test process as D-SIBs and as such subject to a 1% Tier 1 capital surcharge.

3.2.2 Independent variables

The details of our independent variables are available in Table 3 with the associated descriptive statistics in Table 4. Our credit cycle measure follows Baron (2020), and is drawn from the Bank for

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[23] Under Basel II, approved banks can use internal models to calculate the capital requirements for operational risk. These banks operate under the 'advanced measurement approach' (AMA). Basel II also allows approved banks to rely upon their internal models for credit risk purposes under the internal ratings-based (IRB) systems for credit risk. This avoids a bank using the risk-weight pools prescribed under the Basel Accords BCBS (2006). These alternative methodologies are followed in Basel III too. Banks who use both the AMA and IRB are known as Advanced Approaches Banks.

[24] https://www.federalreserve.gov/newsevents/pressreleases/bcreg20161024a.htm. However, as noted by the Bank for International Settlements, some other national jurisdictions have chosen to implement a counter cyclical capital buffer; https://www.bis.org/bcbs/ccyb/, accessed 22 June 2022.

[25] See https://www.fsb.org/wp-content/uploads/P231121.pdf

[26] "Who is too big to fail? GAO's assessment of the financial stability oversight council and the Office of Financial Research" (http://www.gpo.gov/fdsys/pkg/CHRG-113hhrg80873/pdf/CHRG-113hhrg80873.pdf) (PDF). U.S. Government. 14 March 2013

International Settlements. In order to benchmark our results with those of Baron (2020), our measure is likewise the annual change in the ratio of bank credit to GDP (Δ(bank credit / GDP), drawn from the BIS long series of bank credit data. To measure the impact of size upon observed capital buffers we use log of total assets. Retail intensity can be measured using several different measures. We use the alternatives of (i) employees scaled by total assets, as retail focussed institutions are likely to require more employees to service retail customers (ii) two alternative measure of retail non-interest income, (iii) retail distribution investments, (iv) retail loan intensity, and, (v) retail deposit intensity.[27] Bank complexity can also be measured using a variety of dimensions; we employ (i) the FRY9C measure of complexity, which is scaled from 1 to 9, with 9 being the highest level of complexity, (ii) audit and consulting expenses (both individually and added together), (iii) general expenses including marketing expenses, directors fees, legal expenses and federal insurance premiums, (iv) Legal expenses orthogonalized to loan quality[28], (v) unconsolidated subsidiaries, (vi) non-interest income (vii) revenue concentration. Credit risk can likewise have several alternative measures, we employ (i) credit risk density (risk weighted assets divided by totals assets), (ii) loan losses scaled by loans (iii) commercial and industrial loans as a percent of the total loan portfolio (iv) high credit risk assets (100% credit risk weighted assets under the Capital Adequacy process) as a percent of total loans (v) loans past due, (vi) loans at risk (loans not covered by credit risk sharing agreement with the FDIC).[29] We employ several different measures of bank liquidity; (i) cash and liquid deposits, (ii) cash, deposits and assets for sale, (iii) cash and all U.S Treasury securities.

Our sample period is complicated by the Capital Purchase Program (CPP) (usually known as the Troubled Asset Relief Program, TARP) providing banks with additional capital in the wake of the GFC (Duchin and Sosyura, 2012). Injections of new capital under TARP commenced in the last quarter of 2008 (Berger and Roman, 2015) , accordingly we include a dummy variable for all TARP banks and a further dummy variable for all TARP banks in the last quarter of 2008. However, not all TARP funds were dispersed in the last quarter of 2008, thus, we also include a dummy variable for all TARP banks in 2009. By 2011 over eighty-five percent of all TARP funds by value had been fully repaid. Thus, we also include in our model two additional dummy variables representing the repayment phase of TARP operating throughout 2010 and 2011.

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[27] As we have several alternatives for a number of our independent variables we select those that reduce likelihood of collinearity between our explanatory variables. For example, the correlation between Log Total Assets and Complexity is 0.087 and the correlation between Log Total Assets and Cash and Treasury Assets is -0.1046

[28] As legal expanses may also be a function of credit quality and therefore bankruptcy cost, we orthogonalize legal expenses with respect to credit quality to remove the impact of loan related costs on legal expenses.

[29] To control for the non-linearities proposed by Calem and Rob (1999) and demonstrated by Jokipii and Milne (2008) and Williams (2014) we employ Commercial and Industrial Loans Squared. Testing the alternative of Credit Risk Density Squared resulted in Hansen tests rejecting the null of correct model specification. However, including credit risk density without a nonlinear transformation in our model did not result in significant Hansen test statistic.

Table 3 about here

We introduced several further control variables into our model, (i) return on assets and (ii) market discipline. As retained earnings are an important source of bank equity, and following pecking order theory, (Myers and Majluf, 1984), a cheaper source of capitalisation, we would expect that banks would rather use retentions than equity issues to improve a bank's capital buffer. That being said Baron (2020) demonstrates that the fifty largest listed banks in the US had countercyclical retained earnings policies. As discussed in Dinger and Vallascsas (2016), market forces can create incentives for banks, particularly those with lower levels of capitalisation to increase their observed capital buffers. This view was confirmed by Berger*, et al.* (2022), who established that those banks most exposed to the bail in provisions of the OLA were more likely to issue additional equity. This post-OLA equity issue was attributed to the market pressure from subordinated debt holders who had the most to lose if a regulatory bail in was enforced on those (larger) banks most likely to be subject to the OLA provisions.

Table 4 about here.

3.2.1 Empirical Model

As our data is an unbalanced panel and our model includes a lagged dependent variable, we employ the GMM model of Arellano and Bond (1991), Arellano and Bover (1995) and Blundell and Bond (1998). In order to ensure that the number of instruments are econometrically viable (Arellano and Bond, 1991; Holtz-Eakin*, et al.*, 1988), we follow Roodman (2009) to collapse the number of instruments. We estimate our model using the two-step GMM estimator, with the Windmeijer (2005) finite sample correction to the covariance matrix. In order to validate the endogeneity of our instruments we will report both the Hansen test of overidentifying restrictions as well as the Arellano and Bond (1991) autocorrelation tests of residuals for both AR(1) and AR(2). As the fixed effects estimator ignores the correlation between the lagged dependent variable and the error term, dynamic GMM estimators are the most appropriate to address our research question. In addition, our model will include two additional controls for the capital buffers of well capitalised banks (top 25% of capital buffers) and poorly capitalised banks (bottom 25% of capital buffers). It is expected that the observed speed of adjustment will be higher for poorly capitalised banks and lower for well capitalised banks. In order to further reduce the possibility of endogeneity between our independent variable and observed capital buffers we will follow Kiviet (1995) and lag all independent variables (other than the lagged dependent variable) by two periods.

One contribution of this study is to consider the impact of listed bank status upon observed capital buffers.[30] We include two measures of the impact of listed bank status, a dummy variable representing listed bank status as well as an interaction measure: listed * log (total assets). This will determine if any size-based differences between listed and unlisted bank capital buffers are apparent. It is not a priori clear which direction this effect on capital buffer will have, as on the one hand listed banks have easier and more immediate access to the capital markets (Dinger and Vallascsas, 2016) to make seasoned equity issues as well as other Capital Adequacy compliant security issues, such as complying preference shares. Such ease of access reduces the need to hold costly equity or complying capital on the balance sheet until needed in a crisis (Dahl and Shrieves, 1990), reducing observed capital buffers. Furthermore, listed banks are, on average, larger, and the public profile associated with their listed status increases the perception they are too big to fail (Kaufman, 2014), and as such more likely to be bailed out in time of financial distress (Hannan and Hanweck, 1988). This would further reduce the incentives for listed banks to hold larger capital buffers. On the other hand, listed banks are subject to more scrutiny and enhanced public disclosure regimes, (Dinger and Vallascsas, 2016) as compared to unlisted banks and as such, this market discipline may result in listed banks holding higher levels of observed capital buffers than unlisted banks. Thus, we cannot, a priori, hypothesise the marginal impact of listed versus unlisted bank status upon capital buffers.

4 Results.

The results of our regressions are shown in Table 5. The Hansen tests do not reject the null hypothesis of instrument validity, while the absence of second-order serial correlation is also confirmed. The coefficient on the lagged value of Tier 1 Capital Buffer lies within the expected value of 0 and 1, thus our model does not demonstrate any signs of misspecification concerns.

<u>Table 5 about here</u>

In contrast to the Baron (2020) finding that bank equity issues are counter cyclical, we find that bank buffers of quality capital have no cyclical element, once we control for interactions between listed bank status, listed bank size and economic cycles. To determine if listed versus unlisted banks status

[30] We use the CRSP/COMPUSTAT link provided by the New York Federal Reserve Bank to identify those listed banks reporting via the FRY9C forms.

impact on bank capital cyclicality, we include in our model a measure listed * economic cycle. We find pro-cyclicality of bank buffers of quality capital is significant only for listed banks. (see column (3) of Table 5). As size effects are also possible for this procyclicality, we further consider a three-way interaction measure (economic cycle * listed * log of assets). As shown in column (4) the collinearity between the interaction variables results in all three interaction measures being insignificant. Thus, in column (5) we re-estimate our model without the interaction variable reflecting listed bank status interacting with our economic cycle measure. We find that cyclicality of bank buffers of quality capital is largely confined to capital adjustments by larger listed banks. Thus, we argue that policy conclusions regarding the cyclicality of bank capital holdings that are drawn from studies of large (or the largest) listed banks are not necessarily generalisable to a wider population of banks, especially unlisted banks and smaller listed banks.

As we are estimating a partial adjustment model, our estimated coefficient is $(1 - \theta)$ where θ is the speed of adjustment. We find that banks narrow the gap between their unobserved target and actual capital buffer by about 20% per quarter. Furthermore, the banks with smaller buffers of quality capital (lowest 25%) have a faster overall speed of convergence, while banks with larger buffers of quality capital (top 25%) have a slower speed of convergence towards their target buffer size.

Our first control variable is bank size. It is expected that larger banks hold smaller buffers of quality capital due to combination of a higher expected probability of bailout (too big to fail) as well as ease of access to capital markets, even during crisis periods. Our results do not confirm this hypothesis and thus we do not find the too big to fail and market access effects apply to the higher cost and higher quality Tier 1 capital, once we control for all other factors, particularly the relationship between economic cycles and bank size.

We find no evidence that bank-level retail focus has any impact on bank holdings of quality capital. As shown in Table 3, we considered several alternative measures of retail activity, but for simplicities sake we shown only those for number of employees scaled by total assets.[31] Our third control variable considered complexity, again, as shown in Table 3, we considered a number of alternative measures of bank complexity, and we show the results for the Federal Reserve Bank's own measure of bank

[31] Our choice between alternative independent variables was largely driven by identifying those variables with the lowest in sample correlation with the other independent variables.

complexity, which consistently has no significant relationship with bank buffers of quality capital. With respect to credit risk we again considered several alternative measures. We found that risky lending activity has a U-shaped relationship with bank buffers of quality capital, consistent with previous evidence. As discussed above bank capital has a U shaped relationship with bank risk (Calem and Rob, 1999), with banks with both low and high levels of capital engaging in risk seeking activities, with different motivations for each group of banks.[32]

Bank buffers of quality capital are found to have no relationship with bank holdings of liquid assets. Likewise, we find that listed bank status or listed bank size have no impact upon bank buffers of quality capital.

Endogeneity of listed bank status.

As one motivation of banks choosing listed status is to obtain access to a larger pool of market capital, it is possible that listed banks status is endogenous to the capital raising decision. We employ several controls for this possibility. The first was our use of the GMM dynamic panel approach of Holtz-Eakin*, et al.* (1988), Arellano and Bond (1991) and Arellano and Bover (1995) which remove endogeneity by internally transforming the data (Roodman, 2009). Our Hansen J test does not reject our choice of instruments. Further, we test the endogeneity of listed bank status via a two stage GLS estimation, as shown in Table 6. As listed banks are subject to the compliance costs of both prudential regulators as well as the relevant stock exchanges and the Securities and Exchange Commission, we argue that audit expenses are a relevant instrument for listed bank status. In column 1 of Table 6 we evaluate the exclusion condition for audit expenses and demonstrate that audit expenses have no significant relationship with bank buffers of Tier 1 capital. In column 2 of Table 6 we provide the results for the first stage regressions of the two stage GLS estimation and demonstrate the audit expenses are a valid instrument for listed bank status and that listed banks have higher audit expenses. In column three of Table 6 we provide the results for our second stage GLS estimation and find results consistent with those in Table 5 with some caveats. As 2SGLS does explicitly deal with the difficulties associated with dynamic panel estimation we had to apply the contemporaneous value of our economic cycle variable, rather than the second lag. Furthermore, the 2SGLS model finds that listed banks hold larger buffers of quality capital, unlike the GMM which found no difference

[32] In a separate regression we confirm the argument of Calem and Rob (1999)of a non-linear relationship between credit risk density (RWA Total Assets) and bank buffers of quality capital. Banks with lower capital buffer have, on average higher credit risk portfolios, due to the adverse impact of deposit insurance (Baron, 2020). Banks with high capital buffers likewise have high credit risk density portfolios due to the need to increase revenues to offset the higher cost of capital. Our results confirm those of Eisenbach*, et al.* (2022) that size-based supervisory attention does not necessarily focus upon those banks with riskier portfolios.

between listed banks and unlisted bank in terms of quality capital buffers, except via the channel of the economic cycle impacting upon larger listed banks.

Table 6 about here.

As is it possible that our results are biased by the size effect of listed banks being larger, we re-estimated our model from Table 5 using a size limited sample. In Table 7 we show that listed banks are, on average, larger than unlisted banks. However, as also shown in Table 7, the smallest listed banks are smaller than the smallest unlisted banks. Accordingly, we re-estimated our model, restricting the sample to those banks the same size or smaller than the largest unlisted bank, but no smaller than the smallest unlisted banks. In this way we excluded the extreme values, in terms of size, from our listed bank sub-sample. The results for this size limited sample are shown in Table 8, and support our results in Table 5. Thus, our result that bank buffers of quality capital are procyclical only for larger listed banks remains supported and is not the outcome of size biases resulting from listed bank status.

Tables 7 and 8 about here.

Equity and Preference Share issues.

At first glance our results are contradictory with those of Baron (2020), in that he finds bank equity issues are counter-cyclical, while we find bank quality capital buffers are cyclical. In this section we will provide empirical evidence that reconciles this apparent disparity. Baron (2020, p 4197) measured equity issue as "..*new equity issuance minus share repurchases minus dividends*..", the reporting format in the FRY9C reports does not allow an exact replication of this variable, instead we will use the nearest available variables, gross sales of common stock plus conversion or retirement of common stock minus cash dividends declared on common stock. Again following Baron (2020), we normalise this net new equity issue by the book value of equity. Similarly to Baron (2020) we find that over our study period banks paid out more in dividends and stock retirements than they raised in new equity (see Table 9, Panel A). However, when we decompose our data into listed versus unlisted banks (see Table 9, Panels B and C), we find that on average *unlisted* banks paid out more in dividends and stock repurchases than they raised in new equity, while listed banks, on average raised slightly more in new equity than they paid out. Further, we divided our sample by the dimensions of both listed status as well as the top twenty-five percentile by total assets. We find that banks in top quartile by size (both listed and unlisted) engaged in net equity retirement over our sample period, with larger unlisted banks retiring more equity, on average, than listed banks. (Table 9, Panels D and E) However, banks in the lower three quartiles of size differ in net equity raising (on average) according to listed status. Listed banks in the lowest three quartiles by size engaged in net positive equity raisings over our sample period (Table 9, Panel F), while unlisted banks in the lower three quartiles continued the theme of negative net new equity raisings on average (Table 9, Panel G). This again verifies the point that listed and unlisted banks have different equity management strategies which are driven by bank size as well as listed status.

Table 9 about here.

We re-estimate our model in equation (5), replacing Tier1 capital buffers as a dependent variable with our net new equity issue variable. As our model no longer includes a lagged dependent variable, we do not use a Dynamic Panel approach, instead we estimate our model with random effects panel regressions (as our model incudes a dummy variable for listed status, we cannot use a fixed effect Least Squares Dummy Variable estimator). These results are shown in Table 10.

Table 10 about here.

We find that economic cycles have a counter -cyclical impact on equity issues for all banks in our sample. This demonstrates the consistency of our sample with with that of Baron (2020). Allowing for the impact of bank size on the cyclical behaviour of bank equity issues shows that larger listed banks have a marginally higher counter cyclical tendency as compared to other listed banks. We argue that while larger listed banks are subject to more monitoring from both prudential regulators (Eisenbach*, et al.*, 2022) as well as market participants, the moral hazards induced by deposit insurance (Baron, 2020) and too-big to fail-status (Kaufman, 2014) result in relatively lower levels of new equity issue by larger listed banks during positive economic cycles.

Berger*, et al.* (2022), argue that the passing of the OLA placed increased pressure on larger banks to increase equity holdings to therby reduce the likelihood of forcible bail-ins being imposed upon holders of subordinated debt. This point is reinforced by our results for our market discipline measure, which reflects the percent of liabilities funded by subordinated debt. While our market discipline measure had no relationship with bank capital buffers, we find a positive and significant relationship between equity issues and proportionate subordinated debt on issue, consistent with Berger*, et al.* (2022). Furthermore, we find that TARP banks increased equity issues from 2009 onwards, which helps explains why eighty-five percent of TARP funds were repaid by 2011. Rapid repayment of TARP funds were no doubt stimulated by the conditions associated with TARP participation such as restrictions on tax benefits for managerial compensation, bonus claw backs and, later, managerial compensation ceilings (Berger and Roman, 2015). As the TARP program predates the introduction of bail-in by the OLA, in a later section we will consider if OLA resulted in a continuation of increased bank equity issues, once we control for TARP effects.[33]

Our other results indicate that those banks in the top 25% of observed capital buffers make larger issues of equity. The signalling of financial stability by holding larger buffers of quality capital is reinforced by the impact of holding liquid and high-quality assets, which is also associated with larger equity issues. Furthermore, consistent with pecking order theory, (Myers and Majluf, 1984), more profitable banks have smaller equity issues. The positive coefficient for our squared loan quality term indicates that an important motivation factor for equity issues is declining asset quality (consistent with Baron, 2020), again with non-linearity present in our credit risk measure. We also find that larger banks make proportionately smaller equity issues.

In order to reconcile our results of cyclical capital buffers and counter-cyclical equity issues, we consider bank issues of preference shares. While not all categories of preference shares are allowed to be included in Tier 1 equity, disclosure in FRY9C does not allow us to make this distinction over our entire sample period. Instead we use overall issue of preference shares as our best available consistent proxy. A large proportion of TARP funds were provided as preference shares; thus, we continue to control for the impact of TARP on the pattern of preference share issues. Again, our model no longer includes a lagged dependent variable, so we estimate the model in Table 11 using random effects regressions.[34]

Table 11 about here.

We find that banks issue preference shares pro-cyclically, choosing to use lower cost sources of Tier 1 capital to increase buffers of regulatory compliant quality capital during economic upswings. This result is consistent with both pecking order theory (Myers and Majluf, 1984) and the results of

[33] We also extend Baron (2020) by considering the impact of Treasury Stock, including redemptions, with similar results to those discussed above.

[34] We estimated the models presented in Table 11 with dummy variables for 2008 and 2009 to control for the impact of the TARP program on preference share issues.

Acharya*, et al.* (2022) and Dinger and Vallascsas (2016). Also consistent with pecking order theory, is the result that more profitable banks make smaller issues of preference shares. While listed banks make larger preference share issues, consistent with the market access arguments, larger listed banks make proportionately smaller issues. Furthermore, economic cycles interact with listed bank status to increase preference share issues, while larger listed banks make marginally larger issues of preference shares during economic upswings. In contrast to our results for equity issues, market discipline, as represented by previous issues of subordinated debt has no impact upon preference share issuance. This result supports the arguments presented by Berger*, et al.* (2022) that subordinated debt holders coerce bank management into issuing high quality equity to reduce their exposure to forcible bail-ins. In a later section we will explore if this effect predated the introduction of the OLA, due to the impact of the TARP program on preference share issues.

We also find that loan quality does not motivate preference share issues. This result is consistent with the regulatory perspective that shareholders should bear the costs of poorer loan quality. Further, larger banks make proportionately larger issues of preference shares. The signalling of financial strength associated with holdings of liquid assets has no impact on preference share funding, indicating that this signal is most valued by investors in straight equity.[35]

While we find that banks have pro-cyclical buffers of quality capital, banks have alternative sources of increased regulatory capital outside of equity. In order to further establish the source of increased buffers of quality capital, we consider the relationship between capital buffers, economic cycles and each of bank profits and bank credit risk density. When increasing buffers of quality capital, banks can choose to increase retained earnings (consistent with pecking order theory, Myers and Majluf, 1984) or reduce credit risk density. It is possible that banks choose to engage in regulatory arbitrage by reclassifying new or existing credit risks into lower risk categories during strong economic conditions. This would have the benefit of allowing banks to increase their lending portfolio while also maintaining or increasing their reported capital level above the regulatory minimums. We consider each of these possibilities, with our results shown in Table 12.

[35] As an additional test we also applied our model to the issue of subordinated debt. Our main result is that subordinated debt issues have a negative relationship with previous subordinated debt issues and no relationship with economic cycles. As subordinated debt is not considered high quality capital, consideration of this source of bank funding sits outside of the scope of this study.

Table 12 about here.

We find no evidence of economic cycles interacting with bank credit risk density to impact upon buffers of quality capital (Table 12, columns (3) and (4)). We do, however, find that bank profits (return on assets) (columns (1) and (2)) interact with economic cycles (for larger listed banks only) to increase buffers of quality capital during positive economic cycles. This result is consistent with our previous results to indicate that pecking order considerations determine the choice of funding for increased capital buffers during economic upturns, with retentions from profits being the preferred source of increased capital. While the co-efficient for this measure is small, it reflects the impact of multiple interaction effects. A one standard deviation increase in economic activity accompanied by a one standard increased in both profits and size for listed banks will result in an increase in buffers of quality capital of 0.38 percent. This reflects the increase in bank profits and bank size that would accompany an economic boom. This increase is both statistically and economically significant. However, this increase is isolated to listed banks, especially larger listed banks. Thus, while this pro-cyclicality of bank buffers of quality capital is in line with the preferences of prudential regulators, the limitation is that this effect only holds for larger listed banks. Overall, our results indicate that further regulatory work is needed for widespread bank capital pro-cyclicality for higher quality capital.

The impacts of the 2010 Orderly Liquidation Authority and the 2014 Regulatory reforms.

As previously discussed, our sample period encompasses several major regulatory events which impacted upon bank capital after the GFC. The first was the TARP program, then followed by the introduction of the Orderly Liquidation Authority in 2010 as part of the Dodd-Frank Reforms. The OLA saw a switch in emphasis toward regulatory enforced bail-ins as compared to the taxpayer funded bail-out that characterised the GFC, such as TARP (Berger*, et al.*, 2022). The possibility of regulatory enforced bail-ins under OLA raised the likelihood of subordinated (junior) debt holders being forcibly converted to equity holders and previous equity and preference share investments being written off. As discussed by Berger*, et al.* (2022), this raised the likelihood of holders of subordinated debt coercing[36] bank management to raise additional equity to insulate the subordinated debt holders from the likelihood of mandatory conversion into equity holders.

[36] This coercion could include soft coercion such as lobbying and harder coercion such as demands for higher returns during subordinated debt rollover negotiations.

We follow the arguments presented in Berger, *et al.* (2022) and assume that the G-SIBs are collectively most likely to be subject to regulatory intervention during a financial crisis.[37] This logic is supported by the prominent role the G-SIBS played during the TARP program during the GFC with seven of the eight U.S. G-SIBS comprising the initial involuntary participants in TARP (Berger, *et al.*, 2022). Given this evidence, combined with the categorisation of the G-SIBs as Globally Systemically Important, it is reasonable to assume that the G-SIBS as a group collectively make capital structure decisions under the assumption that they are too big to fail and so most likely to be bailed out during financial crisis. Thus, following Berger, *et al.* (2022), these banks would be those most likely to be subject to bail-ins under the OLA regime. Accordingly, holders of G-SIB subordinated debt would feel themselves to be the most exposed to regulatory bail-ins and according lobby or coerce managers of G-SIBs to issue more equity to provide larger buffers against forced bail-ins.

It is worth noting that the model developed by Berger, *et al.* (2022) applies a difference in difference model allowing for both bank and time fixed effects. Our empirical approach is based upon a dynamic panel adjustment approach and as such fixed effect estimation is inappropriate (Holtz-Eakin, *et al.*, 1988; Nickell, 1981). In Table 13 we present the results for the interaction variables representing the impact of OLA and the 2014 accounting change upon G-SIBs, Systemic Banks, Large Banks, and those banks with the highest proportion of subordinated debts funding their liabilities. As noted by Duchin and Sosyura (2012) and Berger, *et al.* (2022) the Troubled Asset Relief Program (TARP), resulted in seven of the eight GSIBs being required to accept government capital injections during the GFC period.

It is notable that the 2014 introduction of the third review of the Capital Adequacy Framework (often call BISIII), and the accompanying size-based accounting change, results in a reduction in reported buffers of quality capital by all of the categories of banks that we argue are most exposed to the impact of OLA. Thus, failure to control for this dual regulatory and accounting change in our sample, (which includes a larger sample of banks than Berger, *et al.* (2022), with a larger variation in bank size), would result in the counterintuitive result that bank capital buffers fell subsequent to the introduction of OLA. Once we control for the impact of the 2014 structural changes, we find, however, that OLA

[37] This line of argument is also consistent with Eisenbach, *et al.* (2022).

resulted in increased G-SIB capital buffers, consistent with Berger*, et al.* (2022). Additionally, we find that TARP banks continued to hold higher buffers of quality capital, over and above the impact of OLA.

<u>Table 13 about here.</u>

After G-SIBs, the next groups of banks most likely to be subject to the bail-in provisions of the OLA are those large U.S. BHCs subject to the annual bank stress testing process. Once we control for the impact of the 2014 structural changes we find that the introduction of the OLA resulted increased buffers of quality capital held by both G-SIBS and stress test banks. This result aligns with those of Berger*, et al.* (2022). Given the possibility that larger banks view themselves as more likely to be bailed out due to the impact of the too big to fail effect, we considered the impact of OLA on the largest twenty five percent of our sample banks by total assets. Again, our results confirm those of Berger*, et al.* (2022), and we find that larger banks increased their capital buffers after the OLA, but their reported buffers of quality capital declined after the 2014 regulatory changes.

As listed banks are subject to higher levels of monitoring and disclosure as compared to unlisted banks, it is possible that listed banks also reacted more strongly to the impact of OLA as compared to unlisted banks. Similar to our results for large banks, our results for listed banks align with those of Berger*, et al.* (2022). Thus, the introduction of the OLA regime in 2010 resulted in listed banks increasing their Tier 1 capital buffers to reduce the bail in risk of subordinated debt holders. Again, we observe that the post 2014 regulatory changes saw a reduction of reported capital buffers for listed banks.

As the OLA regime resulted in some banks increasing their capital buffers in response to lobbying or coercion by holders of subordinated debt, we investigate the possibility that those banks with higher than average proportionate holdings of subordinated debts we also subject to this pressure to increase their buffers of quality capital, irrespective of their relative size or systemic risk status. We investigate this possibility by re-estimating our model with a set of two interaction variables representing those banks in the top five percent of subordinated debt holdings relative to total liabilities. We argue that those banks with higher relative holdings of subordinated debt are more exposed to the costs of OLA bail-in as compared to banks with lower relative levels of subordinated debt. Our results confirm that the introduction of the OLA resulted in those banks with the highest proportionate bail-in risk responded to this risk by increasing their holdings of high-quality regulatory capital. We argue that this result provides empirical support for the argument that the impact of OLA to hold additional quality capital was via the coercion or lobbying of subordinated debt holders.

The significant post-2014 decline in buffers of quality capital is of concern to both regulators and other stakeholder such as providers of deposit insurance and taxpayers. A key focus of the regulatory reforms initiated since the GFC of 2008 has been to increase the level and quality of capital held by regulated banks (BCBS, 2013). Our results indicate that while the required levels of quality capital have increased, the excess (or braking distance, Thakor, 2014)) above the regulatory minimum has declined. Bank capital regulations exist as the socially optimal level of bank capital lies above the shareholder wealth maximising level of capital (Plantin, 2015).[38] This has raised the question of what an optional level of bank capital is. This question has raised a large and complex literature seeking to quality the costs and benefits of capital regulations.[39] Depending upon model assumptions and techniques, recent estimates of optimal Tier 1 capital ratios range from six percent (Elenev*, et al.*, 2021) to sixteen percent (Begenau and Landvoight, 2022). We argue our results represent regulatory satiation, (Williams, 2014) in that bank management are viewing that the risk reducing impact of increasing capital, while increasing social welfare, is reducing returns to bank shareholders. Thus, bank management are choosing to hold, on average, lower buffers of quality capital above the regulatory minimum. As, noted above our sample ends before the introduction of stress-test based capital requirements, thus further consideration of the impact of stress-test based capital requirements upon bank capital holdings in the context of socially optimal capital holdings would be a worthwhile extension of our results.

Issuing Equity and Preference shares, OLA and the 2014 Regulatory changes.

In this section we examine the impact of the 2010 OLA and the 2014 regulatory changes on bank issues of equity and preference shares. We argue that if the subordinated debt channel we have documented above is effective, we will see increased bank issues of Tier 1 capital, especially equity but also preference shares after the introduction of OLA. However, we would not expect the 2014 introduction of the BISIII regulations and the associated accounting changes to have any impact on the marginal propensity of banks to issue additional preferences shares, while increased equity issues

[38] Absent bank capital regulations, banks would a lower level of capital and transfer the cost of bank financial distress to other stakeholders.
[39] Recent examples include Begenau and Landvoight (2022), Begenau (2020) and Elenev*, et al.* (2021).

are likely. Again, this model does not include a lagged dependent variable and as such we apply random effects estimations to address this issue. Our results are shown in Table 14.[40] With the exception of G-SIBS alone, we find that systematically important banks, larger banks and listed banks all increased the size of their equity issues after the introduction of OLA in 2010. For all of these banks, the likelihood of their being subject to a forcible bail-in is higher post OLA. Accordingly, we argue that the holders of the subordinated debts of these banks have coerced or lobbied the relevant bank to issue more equity to increase their buffers against the possible of forcible bail-in converting subordinated debt into equity (with the exception of G-SIBs). We also consider this perspective by considering those banks with proportionately higher levels of subordinated debt on issue and find the introduction of OLA had no impact.

Our results for equity issues by G-SIB is something of an anomaly as compared to the other categories of large systemic banks that we have examined in Table 14. We consider two possibilities that mitigated against OLA pressuring G-SIBs to issue more equity after 2010. The first is that seven of the eight G-SIBS in the United States were required to accept TARP funding (Berger*, et al.*, 2022; Duchin and Sosyura, 2012). It is possible that this public bailout has been interpreted to attach too - big fail-status to G-SIBs, even in the post OLA period. The other possibility is that the Collins Amendment (Herring, 2018) to the Dodd-Frank Act acted to offset the OLA incentives to issue increased equity to reduce bail-in risk for holders of subordinated debt. The Collins Amendment placed a floor on the capital requirement that banks could move below. This placed a limit on the capital benefits large complex banks (such as the GSIBs) could achieve from adopting the advanced approach to measuring risk weighted assets.[41] Such a limit could have acted to inhibit the incentives of G-SIBs to issue increased equity post OLA.

<u>Table 14 about here.</u>

Our previous results indicated that bank security issues of complying Tier 1 capital have a cyclical component, with equity more likely to be issued during economic downturns, while preference share issues and retentions from profits favoured during economic upturns. We argue that this result is consistent with the pecking order approach of Myers and Majluf (1984). The 2010 introduction of OLA continues the post-GFC theme of increased regulatory emphasis upon banks holding increased

[40] We also estimated our model with dummy variables for 2008 and 2009 to control for the impact of TARP on equity issues, with the results the same as discussed.

[41] See Herring (2018), especially page 194.

quantities of equity capital in their capital buffers, as opposed to other complying Tier 1 capital such as certain preference shares. If holders of subordinated debt are fully cognisant of the quality distinction between equity and preference shares we would expect to see the increased equity issues documented in the previous section accompanied by reduced or no change to preference share use. However, subordinated debt holders may not be concerned about the quality issues associated with the components of Tier 1 capital, and instead simply focus on increased Tier 1 buffers to reduce their bail-in risk. If the first possibility holds we would expect to see reduced preference share issues by banks most subject to bail in risk. If the second possibility holds we would expect to see preference share issues to increase following the introduction of OLA as banks seek to minimise their cost of capital following the pecking order approach to capital structure (Myers and Majluf, 1984). We test these alternatives, using the same interaction variables used previously, with the results shown in Table 15.[42]

Table 15 about here.

We find no evidence that GSIBs changed their pattern of preference share issues after the introduction of OLA. However, we find that the broader category of systemically important banks did increase their preference share issues after introduction of OLA, as did listed banks. In the case of the largest twenty five percent of banks by assets we find that the 2014 introduction of BISIII saw decreased preference share issues. We argue that these observed effects represent on overall increased regulatory and market-based pressure for banks to hold more equity capital as opposed to other forms of Tier 1 capital. This resulted in an ongoing process of larger banks (subject to higher levels of regulatory and market surveillance) substituting reduced preference share issues with increased equity issues. However, some systemically important banks (most likely large banks subject to the stress test process, but not the GSIBs), did increase their issue of preference shares post OLA. Our results indicate that some large listed, systemic bank chose increased their reported levels of Tier 1 capital immediately after the passing of OLA via issuing preference shares. Given our mixed results above, we argue that the OLA generally provided a stimulus to new equity issues, which has been accompanied with increased use of preference shares by some but not all categories of banks most subject to the bail-in impact of OLA.

[42] We also estimated our model with dummy variables for 2008 and 2009 to control for the impact of TARP on preference share issues, with the results the same as discussed.

Robustness Tests: TARP

As the TARP process has a number of dimensions we exploited these dimensions to evaluate the robustness of our results to different TARP related shocks. Following Duchin and Sosyura (2012) and Duchin and Sosyura (2014) we considered the dimension of political connections.[43] We found no evidence that political connection of banks impacted upon the cyclicality of banks capital. We also considered additional dimensions of the TARP program, including speed of repayment, the nature of security used to provide the TARP funding, the relative impact of the TARP funding in terms of TARP funding as a percent of Tier 1 capital the quarter before TARP funding was received, and the proportion of overall TARP funding received by each bank. In no case did we find that these different TARP dimensions impacted upon our findings of economic cyclicality.

Robustness Tests: CATFIN.

As bank capital may respond to the level of systemic risk within the banking system rather than the economic cycle, we conducted a further series of robustness test in which we replaced our economic cycle measure of bank credit to GDP with the aggregate systemic risk measure of Allen*, et al.* (2012), CATFIN.[44] The CATFIN provides a measure of aggregate forward looking systemic risk (Allen*, et al.* (2012). As it is a system wide measure, it can be applied to both the listed and the unlisted banks that are a feature of our study. Allen*, et al.* (2012) demonstrate that CATFIN can forecast macroeconomic downturns six months in advance and as such, this measure provides a valuable robustness test for our business cycle results. In general, our results with respect to economic cyclicality are robust to this alternative measure of systemic cyclicality. However, we find one important point of departure, as shown in Table 16. Firstly, we find that bank capital issue is pro-cyclical with respect to CATFIN. This result is not limited to listed banks only, but encompasses all banks. From a policy perspective this is an important result. As Allen*, et al.* (2012) established that increases in CATFIN pre-empt down turns in economic activity, (by approximately six months) our results establish that bank equity issues are pro-cyclical with respect to systemic risk, which is a desirable outcome for prudential regulators. Thus, instead of being reactive to the economic cycle, bank equity issue is responsive to the systemic risk cycle. Consistent with the results in Table 10 for economic cycles, listed bank equity issues are strongly counter-cyclical with respect to CATFIN. Thus, listed banks continue their counter-cyclicality of equity issues, as shown by Baron (2020), but instead with respect to forward looking bank system wide risk. This counter cyclicality for listed

[43] We are grateful to Denis Sosyura for his generous assistance with this data.
[44] We are grateful to Linda Allen for her assistance with providing this data.

banks is of a magnitude to offset the general pro-cyclicality of equity issue across all banks. While large listed banks do display some marginal pro-cyclicality of equity issues, the outcome is to offset, in the case of listed banks, the regulatory preferred outcome of pro-cyclical equity issues.

Table 16 about here.

Conclusions and policy implications.

The importance of the quality of bank capital, especially equity, has been a feature of bank capital regulations since before the introduction of the first iteration of the Capital Adequacy framework. The experience of the GFC as well as the Silicon Valley banking crisis of 2023 has re-confirmed this importance. By studying a large sample of both listed and unlisted banks we are able to offer a number of contributions to the existing literature considering bank capital. Previous studies have emphasised large and / or listed banks. However, not all financial crises originate from large or listed banks. Further, regulatory policies based on studies of large listed banks may not necessarily be extendable to a wider sample of different banks. Our wider sample allows us to identify which aspects of previous studies of bank capital are extendable to a wider population of banks. Accordingly, we are also able to identify under which circumstances regulatory policy stances may have to be more nuanced and under which circumstances a wider-ranging uniform policy can be implemented.

The question the cyclicality of quality bank capital is an important one. Under an ideally devised regulatory regime banks would accumulate reserves of quality (Tier 1 and equity) capital during economic booms to have increased reserves against the loan losses that will occur during the inevitable economic downturn that follows (Greenwood*, et al.*, 2022). We establish that bank buffers of quality capital are pro-cyclical with respect to the economic cycle for large listed banks only. Once we control for the impact of economic cycles on buffers of quality (Tier 1) capital of large listed banks we find no evidence of economic cyclicality in quality capital holdings for other banks. Thus, any regulatory policies aimed in increasing the pro-cyclicality of all banks need to account for differences in both bank size and listed status. We conduct a variety of robustness tests to establish that our results are not affected by the endogeneity of either listed bank status or the endogeneity effect of bank size interacting with listed status. The results of Eisenbach*, et al.* (2022), finding that regulatory attention is disproportionately weighted towards larger banks, reinforce the importance of this point.

Baron (2020) demonstrated that bank equity issues are counter-cyclical, which stands in contrast to our finding that bank buffers of quality (Tier 1) capital are pro-cyclical for large listed banks. We are able to reconcile these results by considering the cyclicality of different elements of bank capital. We find that bank preference share issues are pro-cyclical and bank equity issues are counter-cyclical. By studying a wider sample of banks as compared to Baron's (2020) focus upon listed banks, we are able to develop several extensions of Baron's (2020) results. We establish that bank equity counter-cyclicality applies to wide sample of listed and unlisted bank, with larger listed banks showing some signs of marginal pro-cyclicality in equity issues. As we would expect that listed banks have superior ability to issue equity as compared to unlisted banks, polices aimed in increasing pro-cyclicality of unlisted bank capital quality will need to incentivise increased earnings retention. We also establish that retentions from profits to increase buffers of quality capital are likewise procyclical for large listed banks only. Thus, smaller and unlisted banks are not adopting the regulator's preferred outcome of quality capital cyclicality. However, we also demonstrate an important extension of Baron (2020), in that all banks are pro-cyclical in their equity issues with respect to aggregate bank systemic risk (CATFIN, Allen*, et al.*, 2012). Thus, banks are looking toward aggregate systemic risk, (which leads economic downturns by approximately six months), when timing their equity issues. However, this benefit (from regulatory perspective) is offset by the strong counter-cyclicality with respect to CATFIN of equity issues by listed banks. This is of considerable policy concern, as CATFIN provides early warning of impending contagious crises in banks, this is exactly when regulators would desire banks to improve the quality of the capital holdings. Instead we document a reduction of new equity issues by listed banks in response to increases in systemic risk.

Unlike our nuanced results for equity issues, we find preference share issues are pro-cyclical. We find that larger listed banks are marginally more pro-cyclical in their preference share issues than unlisted and smaller listed banks. We argue that this result reflects pecking order preferences in capital issues (Myers and Majluf, 1984). Even though banks are constrained by regulations as to which type of securities comply with capital quality requirements, banks follow pecking order when deciding their capital issue strategies. We find more profitable banks hold smaller buffers of quality capital and make smaller issues of both equity and preference shares, instead relying upon retained earnings as needed. Once banks choose to access the external market for complying high quality capital, preference shares are issued during economic upswings, as it is cheaper. Banks issue equity during economic downturns, when it is more expensive, but less expensive alternatives are either not available or have become prohibitively more expensive.

One benefit of our sample is that we are able to consider the differential impact of several structural breaks impacting upon bank capital that followed the GFC. The Orderly Liquidation Authority introduced in 2010 as part of the Dodd-Frank Reforms, shifted the focus of regulatory attention from bail-out to bail-in (Berger*, et al.* (2022). As discussed by Berger*, et al.* (2022) the impact of this change was that we would expect the holders of subordinated (junior) debt to lobby and or coerce bank managers to increase their holdings of quality capital (Tier 1 and equity) to increase the bank buffer against forcible conversion of subordinated debt into equity. Berger*, et al.* (2022) verified this expectation by considering a sample of fifty large listed banks. We verify that the results of Berger*, et al.* (2022) also applies to a large sample of both listed and unlisted banks, as well as to a greater variety of bank sizes. Furthermore, by considering banks with proportionately larger issues of subordinated debts, we find support for the argument that subordinated debt holders are the source of this coercion or lobbying to increase bank holdings of quality capital. We also demonstrate that the process of regulatory reform and regulatory surveillance emphasising bank equity holdings after the GFC was able to counteract the bank pecking-order based penchant for preference share issues instead of equity issues. By considering the impact of the regulatory and accounting reforms of 2014 we are also able to demonstrate that these changes acted to offset the post-TARP and post-OLA increases in observed holdings of bank high-quality capital buffers. Furthermore, the post GFC regulatory focus upon bank equity holdings resulted in a post 2014 reduction in bank preference share issues. Thus, the current focus on bank capital quality has continued to provide a longer run counterforce to bank pecking-order based capital inclinations.

Our study has several policy implications. Regulatory policies aimed in increasing bank equity holding must account for the systematic difference in market access of listed and unlisted bank. Accordingly, regulators should develop a combination of regulatory policies and regulatory suasions that result in all banks increasing their buffer of high-quality capital during economic upturns. As it has been well-documented that economic booms are followed reductions in credit quality (Greenwood*, et al.*, 2022; Schularick and Taylor, 2012)), the reduced market access of unlisted banks to new sources of equity during credit crises may result in a banking crisis sourced in the unlisted bank sector. The current set of pro-cyclical capital policies have had some of their desired impact on large listed banks but this leaves a population of smaller and unlisted banks comparatively less well prepared for the impact of credit downturns following economic booms. However, these concerns are mitigated by increased issues of equity across all bank classes in response to increased aggregate systemic risk, which precedes economic downturns. We have also demonstrated that the dimensions of bank size and market access will impact on responses to regulatory changes. While concerns with respect to the moral hazard impact of too big to fail policies remain, and have been emphasised by policy responses to the 2023 banking crises, care must also be taken that smaller and unlisted banks do not become a source of a future financial crisis.

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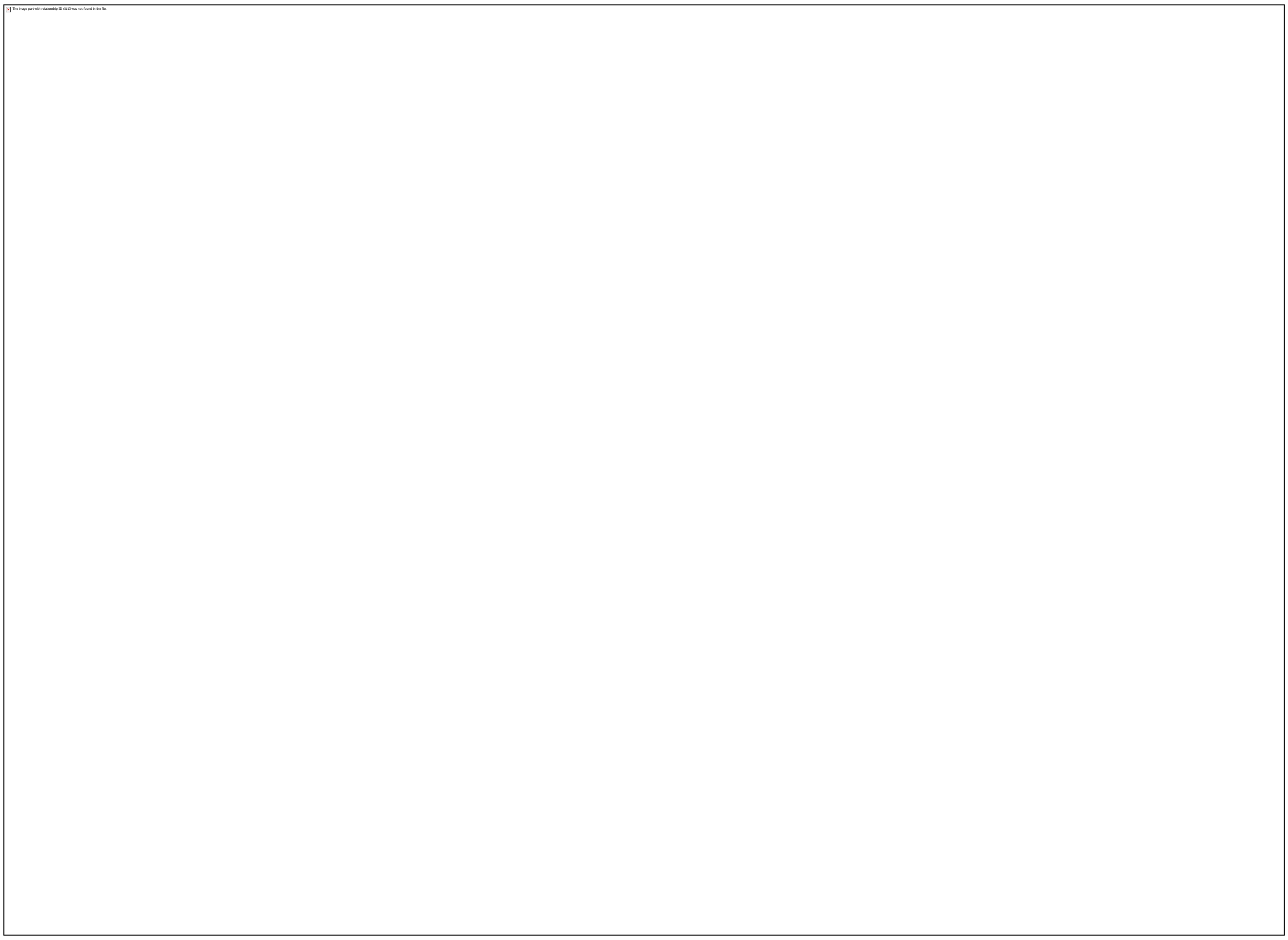
Figure 1: Bank Level holdings of Tier 1 regulatory capital in excess of regulatory minimums.



Tier 1 capital Buffer: Bank level capital holdings of Tier 1 capital in excess of regulatory minimums. All banks with less than 8 consecutive observations excluded. All subsidiary banks excluded. All Tier 1 capital buffers are calculated using both system wide and bank-specific capital requirements. Regulatory changes in required Tier 1 capital accounted for. Requirements imposed upon G-SIBs included in our calculations. Banks Subject to the US annual stress test process are treated as D-SIBs. [45] Date source: US FRY9C reports.

[45] "Who is too big to fail? GAO's assessment of the financial stability oversight council and the Office of Financial Research" (http://www.gpo.gov/fdsys/pkg/CHRG-113hhrg80873/pdf/CHRG-113hhrg80873.pdf) (PDF). U.S. Government. 14 March 2013

Table 1 dependent variable definitions.

Dependent Variables:

Variable	Definitions
Tier 1 Capital Ratio	Tier 1 capital (Core Equity Tier 1 [CET1] + Additional Tier 1)/ Risk Weighted Assets
Tier 1 buffer	Tier 1 capital ratio less 4 prior to 2013. Tier 1 capital ratio less 4.5 for 2014 Tier 1 capital ratio less 6 for 2015 Tier 1 capital ratio less 6 after 2015 GSIB buffers by adjusted by risk bucket as determined annually by the Financial Stability Board, 4 = 2.5% 2 = 2%, 2 = 1.5%, 1 = 1% 1% additional Tier 1 capital for Stress Test Banks / DSIBS. [46] Capital conservation buffer Tier 1 less 0.625 for 2016; Tier 1 less 1.25 for 2017;Tier 1 less 1.875 for 2018; Tier 1 less 2.5 for 2019 Tier 1 buffers Winsorised at 1% and 99% levels.
Core Equity Tier 1 (CET1) ratio capital buffer	CET1 less 4 for 2014 CET1 less 4.5 after 2015
Total Capital Ratio (Tier 1 and Tier 2)	Total Risk weighted capital ratio.

Table 2 Descriptive statistics: Dependent Variables

After Winsorisation. (1, 99%)

Variable	Observations	Mean	Std. dev.	Minimum	Maximum
Tier 1 Ratio	88,746	13.1663	5.182839	0	36.8794
Core Equity Tier 1 capital Ratio	10,610	13.14974	4.751749	6.4214	36.1661
Tier 1 Buffer	88,746	8.708081	5.210803	-7.25	32.8794
Core Equity Tier 1 Buffer	10,610	8.652807	4.751609	1.9214	31.6661
Total Capital Adequacy Ratio	78,177	14.58168	5.111035	1.12	38.37

[46] The Financial Stability Oversight Council (FSOC) does not provide a list of D-SIBs (Domestic Systemically Important Banks). However, the Dodd–Frank Act imposes increased supervision standards (including being subject to annual USA Stress Test) on any bank holding company with a larger than $50 billion balance sheet. Thus, those banks subject to the USA Stress Test can be considered to be D-SIBs in the US "Who is too big to fail? GAO's assessment of the financial stability oversight council and the office of financial research" (http://www.gpo.gov/fdsys/pkg/CHRG-113hhrg80873/pdf/CHRG-113hhrg80873.pdf) (PDF). U.S. Government. 14 March 2013

Table 3 Independent Variables

Variable	Definition
Credit Cycle	
Economic Cycle	The annual change in the ratio of bank credit to GDP from the BIS long data series
Size	
Size logtotalass	Log of total assets
Retail Intenstiy	
Retail intensity: Employees	Employees per total assets
Retail Intensity: Retail non-interest income 1	Retail non-interest income (excluding bank and credit card income) = Income and fees from the printing and sale of checks + Income and fees from automated teller machines + Safe deposit box rent / net income (loss)
Retail Intensity: Retail non-interest income 2	Retail non-interest income (including bank and credit card income) / net income (loss)
Retail Intensity: Product distribution	Investment in product distribution network. premises and fixed assets (including capitalized leases) / total assets
Retail Intensity: Retail loans	Retail Loans. Loans to individuals for household, family and other personal expenditures including credit cards, automobile loans, student loans, revolving credit plans other than credit cards) / Total loans
Retail intensity: Retail deposits	Non-interest-bearing domestic deposits to Total Liabilities
Operational Complexity	
Complexity	FED complexity measure, scaled from 1 to 9.
Audit and consulting expenses.	(Other non-interest expenses less data processing expenses, marketing expenses, directors fees, printing and stationary expenses, communications and post expenses, legal expense and federal insurance premium) / total non-interest expenses.
General expenses divided by non-interest expenses	Data processing expenses, marketing expenses, directors fees, printing and stationary expenses, communications and post expenses, legal expense and federal insurance premium) / total non-interest expenses
Audit Expenses	Accounting and audit expenses divided by total non-interest expenses
Consulting Expenses	Consulting and advisory expenses divided by total non-interest expenses
Complexity: Legal expenses without credit quality effects	The residuals of fixed effect regression, legal expenses regressed on loan losses scaled by non-interest expenses
Complexity: Unconsolidated subsidiaries.	Investments and unconsolidated subsidiaries and associated companies as a percent of total assets.
Complexity: Non-interest income	Noninterest income as a percent of total revenue.
Credit Risk	
Risk weighted Assets	Risk weighted assets calculated according to the Capital Adequacy process
Credit Risk Density	Risk weighted assets divided by total assets
Credit Risk: Loan losses	Loan Losses as a percent of loans and leases; net of unearned income and allowance.
Credit Risk: Commercial and Industrial loans	Commercial and Industrial loans as precent of total loans.
High Credit risk assets	100% credit risk weighted on balance sheet assets
Credit Risk: loans past due	Loans Past due
Liquid Assets	
Liquidity: Cash and deposits	Cash and balances due from banks
Liquidity: Cash, deposits and assets for sale	Cash, deposits and assets for sale

Liquidity: Cash and all U.S. treasury securities.	Cash and all U.S. treasury securities.
Pecking Order	
Return on Equity	Return on Equity
Market Discipline	
Market Discipline	Subordinated securities as a percent of liabilities.

Table 4 Descriptive Statistics: Independent Variables

Variable	Observations	Mean	Std. Dev.	Minimum	Maximum
Log Total Assets	90,914	13.80803	1.517248	5.888878	21.7302
Retail Intensity Employees	90,913	0.0297451	0.053781	0	3.115246
Retail Intensity Retail Fees	81,593	5.563922	352.9734	-25000	78700
Retail Intensity Retail Fees and Credit Card income	40,632	21.30166	909.7984	-87600	68900
Retail Intensity Product Distribution	90,914	1.853076	1.529468	0	57.74282
Retail Intensity Retail Loans	90,872	32.30884	19.5788	0	198.6839
Retail Intensity Retail Deposits	90,911	14.51598	8.996561	0	98.71102
Complexity	252,162	2.266583	1.467088	0	9
Complexity 2 Audit and consulting expenses	90,879	23.82675	8.849671	-29.36203	328.1825
Complexity 3 Audit Expenses	40,652	0.8022902	0.9493282	-4.647847	14.00793
Complexity 4 Consulting Expenses	40,646	1.110624	1.78422	-0.2071925	44.9831
Complexity 4: Legal Expenses without Credit Quality affects	81,633	9.27E-11	1.594732	-30.41675	66.26996
Complexity 5 Unconsolidated Subsidiaries	90,506	0.1207327	1.607616	-0.3097681	99.99995
Complexity 6 Non-interest income	90,388	1.630192	4.899287	-0.3553416	96.7864
Risk Weighted Assets	88,580	8108967	6.77E+07	-433299	1.70E+09
Risk Weighted Assets to total Assets	88,580	71.67446	12.37872	-1.396685	171.2885
Loan Losses scaled by loans	90,837	0.3487456	0.9098639	0	73.34107
Commercial and Industrial loans scaled by total loans	90,427	15.68653	10.45185	0	100
100% credit risk weighted on balance sheet assets	10,545	70.58161	12.84129	6.051359	106.2434
Loans Past Due	87,988	1.663581	2.659425	0	75.36899
Liquidity: Cash and bank deposits	90,328	5.019098	4.742886	0.0000554	86.35621
Liquidity Cash, bank deposits and assets for sale	90,328	23.37333	12.16745	0.0000554	95.97383
Liquidity: Cash and US Treasury	90,354	3.222733	3.323007	-1.221892	76.19727
Return on Equity	90,887	1.263141	2427.115	-696875	162019.4
Subordinated securities as a percent of liabilities.	57,885	1.416528	1.827682	0	87.05954

Table 5 Impact of Economic cycle and Listed Bank Status upon Bank Buffers of Quality Capital

Dependent Variable: Tier 1 Capital Buffer					
VARIABLES	(1)	(2)	(3)	(4)	(5)
Tier 1 Buffer t-1	0.798***	0.798***	0.798***	0.797***	0.599***
	(0.0183)	(0.0183)	(0.0183)	(0.0183)	(0.129)
Lowest 25% of Tier 1 Buffer t-1	-0.0472***	-0.0474***	-0.0478***	-0.0478***	-0.117**
	(0.0125)	(0.0125)	(0.0125)	(0.0125)	(0.0458)
Highest 25% of Tier 1 Buffer t-1	0.0598***	0.0598***	0.0601***	0.0601***	0.163**
	(0.00698)	(0.00697)	(0.00697)	(0.00696)	(0.0671)
Log Total Assets t-2	-0.0298**	-0.0399*	-0.0428*	-0.0428*	-0.0489
	(0.0150)	(0.0232)	(0.0232)	(0.0232)	(0.0341)
Return on Equity t-2	-0.000984***	-0.000985***	-0.000984***	-0.000984***	-0.000838***
	(0.000101)	(0.000100)	(0.000100)	(0.000100)	(0.000145)
Mkt Discipline Subordinated Debts t-2	-0.0248	-0.0271	-0.0283	-0.0287	-0.0770
	(0.0238)	(0.0240)	(0.0240)	(0.0241)	(0.0491)
Complexity (FED Reserve) t-2	-0.00355	-0.00317	-0.00302	-0.00301	-0.00983
	(0.00648)	(0.00646)	(0.00645)	(0.00645)	(0.0104)
Risk Weighted Assets/Total Assets t-2	-0.0200***	-0.0200***	-0.0200***	-0.0200***	-0.0277***
	(0.00234)	(0.00232)	(0.00232)	(0.00232)	(0.00566)
Retail 1 Employees t-2	3.372	3.307	3.287	3.284	4.802
	(2.102)	(2.136)	(2.137)	(2.137)	(3.344)
Liquidity: Cash and US Treasury t-2	0.00626	0.00616	0.00619	0.00620	0.0111
	(0.00397)	(0.00395)	(0.00395)	(0.00395)	(0.00679)
C&I loans /total loans t-2	-0.0137***	-0.0138***	-0.0139***	-0.0139***	-0.0188***
	(0.00301)	(0.00301)	(0.00301)	(0.00301)	(0.00516)
C&I loans /total loans t-2 squared	0.000255***	0.000257***	0.000258***	0.000259***	0.000362***
	(6.10e-05)	(6.12e-05)	(6.12e-05)	(6.13e-05)	(0.000105)
Annual Change Bank Debt to GDP t-2 (economic cycle)	0.00604**	0.00578**	0.00153	0.00156	-0.00205
	(0.00275)	(0.00272)	(0.00296)	(0.00296)	(0.00426)
Listed Bank	0.0220	-0.195	-0.270	-0.254	-0.188
	(0.0253)	(0.267)	(0.269)	(0.272)	(0.393)
Listed * Log Total Assets t-2		0.0158	0.0205	0.0195	0.0170
		(0.0200)	(0.0201)	(0.0203)	(0.0292)
Annual change in Econ Cycle * Listed t-2			0.0121**	-0.0145	
			(0.00543)	(0.0480)	
Annual change in Econ Cycle * Listed * log Total Assets t-2				0.00182	0.000949**
				(0.00332)	(0.000434)
TARP Bank	-0.138***	-0.139***	-0.137***	-0.136***	-0.163***
	(0.0229)	(0.0229)	(0.0229)	(0.0229)	(0.0362)
2014 Dummy variable	-0.266***	-0.265***	-0.261***	-0.260***	-0.227***
	(0.0366)	(0.0365)	(0.0365)	(0.0366)	(0.0433)
TARP Bank in 4thq 2008	0.979***	0.979***	0.970***	0.969***	0.991***
	(0.122)	(0.122)	(0.122)	(0.122)	(0.122)

TARP Bank in 2009	0.469***	0.469***	0.459***	0.457***	0.608***
	(0.0496)	(0.0496)	(0.0499)	(0.0501)	(0.110)
TARP Bank in 2010	0.459***	0.460***	0.451***	0.450***	0.568***
	(0.0553)	(0.0553)	(0.0555)	(0.0556)	(0.0974)
TARP Bank in 2011	0.318***	0.319***	0.308***	0.306***	0.398***
	(0.0435)	(0.0435)	(0.0441)	(0.0442)	(0.0775)
Constant	3.503***	3.638***	3.687***	3.688***	5.778***
	(0.454)	(0.545)	(0.545)	(0.545)	(1.496)
Observations	57,044	57,044	57,044	57,044	57,044
Number of banks	2,428	2,428	2,428	2,428	2,428
F Stat	53243***	50721***	48435***	46395***	24777***
No. of instruments	23	24	25	26	24
AR1 p-value	0	0	0	0	0
AR2 p-value	0.611	0.611	0.616	0.617	0.931
Hansen p-value	0.127	0.129	0.146	0.149	0.195

Dependent Variable: Tier 1 capital Buffer: Bank level capital holdings of Tier 1 capital in excess of regulatory minimums. Robust standard errors in parentheses, *** $p<0.01$, ** $p<0.05$, * $p<0.1$ All banks with capital buffers zero or below are excluded. All banks with less than 8 consecutive observations excluded. All regressions estimated with two-step dynamic panel GMM estimations (Arellano and Bond (1991), Arellano and Bover (1995) and Blundell and Bond (1998). The number of instruments are collapsed following Roodman (2009). The finite sample correction of Windmeijer (2005) is applied. All Tier 1 capital buffers are calculated using both system wide and bank-specific capital requirements.

Table 6 Instrumental variables estimation for exogeneity of Listed Bank status.

VARIABLES	(1) GMM Dependent Variable Tier 1 Capital Buffers	(2) First stage for Column 3 Dependent Variable: Licence (Dummy Variable)	(3) 2ndstage GLS Dependent Variable Tier 1 Capital Buffers
Listed Bank (predicted value from column 2 in column 3)	0.0268		0.266**
	(0.0418)		(0.133)
Tier 1 Buffer t-1	0.717***	0.0039***	0.837***
	(0.0264)	(0.0011)	(0.00399)
Lowest 25% of Tier 1 Buffer t-1	-0.150***	-0.0050***	-0.117***
	(0.0199)	(0.0013)	(0.00475)
Highest 25% of Tier 1 Buffer t-1	0.0938***	-0.0009	0.0616***
	(0.00977)	(0.0006)	(0.00251)
Log Total Assets t-2	-0.0131	0.1551***	-0.0363*
	(0.0209)	(0.00221)	(0.0201)
Return on Equity t-2	-0.000870***	-0.00002	-0.000898***
	(0.000128)	(0.00002)	(9.17e-05)
Mkt Discipline Subordinated Debts t-2	-0.0299	-0.0537***	0.0235
	(0.0438)	(0.0035)	(0.0147)
Complexity (FED Reserve) t-2	0.00623	0.0033**	0.000938
	(0.0119)	(0.0013)	(0.00462)
Risk Weighted Assets/Total Assets t-2	-0.0219***	0.0032***	-0.0103***
	(0.00365)	(0.0002)	(0.000988)
Retail 1: Employees t-2	7.895***	-0.5135**	4.382***
	(3.056)	(0.2019)	(0.751)
Liquidity: Cash and US Treasury t-2	-0.00247	-0.0099***	0.00338
	(0.00596)	(0.0009)	(0.00353)
C&I loans /total loans t-2	-0.00999**	-0.0059***	-0.00323
	(0.00463)	(0.0006)	(0.00236)
C&I loans /total loans t-2 squared	0.000195**	0.00009***	5.66e-05
	(9.53e-05)	(0.00001)	(4.25e-05)
Annual Change Bank Debt to GDP t-2 (economic cycle)	0.0121***		
	(0.00412)		
Audit Expenses t-2	0.0253	0.0707***	
	(0.0177)	(0.0026)	
Annual Change Debt to GDP		0.0042***	0.00636**
		(0.0008)	(0.00314)
TARP Bank	-0.164***	0.3070***	-0.190***
	(0.0419)	(0.0068)	(0.0478)
2014 Dummy variable	-0.257***	0.0149*	-0.268***
	(0.0382)	(0.0083)	(0.0307)
TARP Bank in 4thq 2008	0.984***	0.0216	1.202***
	(0.127)	(0.0227)	(0.0829)

TARP Bank in 2009	0.437***	0.0171	0.378***
	(0.0583)	(0.0121)	(0.0445)
TARP Bank in 2010	0.420***	0.0183	0.298***
	(0.0590)	(0.0118)	(0.0434)
TARP Bank in 2011	0.283***	0.0152	0.209***
	(0.0495)	(0.0119)	(0.0436)
Constant	3.947***	-2.1039***	2.407***
	(0.611)	(0.0402)	(0.279)
Observations	25,934	27476	27,476
Number of banks	1,209	1,231	1,231
F Stat	17709		
No. of instruments	24		
AR1 p-value	0		
AR2 p-value	0.695		
Hansen p-value	0.525		
Overall R squared			
Chi Square			0.934

Tier 1 capital Buffer: Bank level capital holdings of Tier 1 capital in excess of regulatory minimums. Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1 All banks with capital buffers zero or below are excluded. All banks with less than 8 consecutive observations excluded. Current value of debt to GDP ratio applied to allow convergence. Audit Expenses to total expenses used as instrument for Listed Bank status. Column (1) estimated to demonstrate the exclusion condition, using two-step dynamic panel GMM estimations (Arellano and Bond (1991), Arellano and Bover (1995) and Blundell and Bond (1998). The number of instruments are collapsed following Roodman (2009). The finite sample correction of Windmeijer (2005) is applied. All Tier 1 capital buffers are calculated using both system wide and bank-specific capital requirements. Column (1) demonstrates the exclusion condition for audit expenses, using Tier 1 Capital Buffers as the dependent variable. Column (2) presents the first stage of the 2 stage GLS, using the dummy variable for listed status as the dependent variable. Column (3) presents the second stage results using Tier 1 Capital Buffers as the dependent variable, and substituting the estimated value for listed status calculated from the results of the model presented in Column (2).

Table 7 Descriptive Statistics to verify size limited sample.

Panel A Restricted to Positive Tier 1 Capital Buffers: Unlisted Banks

Variable	Observations	Mean	Std. dev.	Minimum	Maximum
Tier 1 Buffer	55,713	9.302072	5.342441	0.01	32.8794
Log Total Assets	56,856	13.27901	1.103957	9.7648	20.96946
Return on Equity	56,829	6.219648	13.59404	-1101.16	591.5217
Mkt Discipline: Subordinated Debt	56,503	0.161378	0.574952	0	9.25734
Complexity	214,409	2.222127	1.339499	0	9
Risk Weighted Assets to Total Assets	55,710	70.88663	12.13483	0	134.3559
Retail Intensity: Employees	56,856	0.032361	0.065858	0	3.115246
Cash and all U.S. treasury securities	56,373	3.550146	3.723772	-1.22189	76.19727
C&I loans /total loans	56,454	15.53358	10.00757	0	100

Panel B Restricted to Positive Tier 1 Capital Buffers: Listed Banks

Variable	Observations	Mean	Std. dev.	Minimum	Maximum
Tier 1 Buffer	31,524	8.237959	4.242478	0.01	32.8794
Log Total Assets	32,549	14.69553	1.673643	5.888878	21.7302
Return on Equity	32,549	12.06479	804.874	-6352.54	100003
Mkt Discipline: Subordinated Debt	32,488	0.366587	0.906037	0	17.61438
Complexity	36,244	2.513133	2.01552	0	9
Risk Weighted Assets to Total Assets	31,558	73.41403	11.54213	16.75314	171.2885
Retail Intensity: Employees	32,548	0.02539	0.017929	0	1.554404
Cash and all U.S. treasury securities	32,475	2.672588	2.405415	0.004455	71.24352
C&I loans /total loans	32,472	15.9827	11.12112	0	100

Table 8 Size limited sample: Control for bank size effects on Bank Quality Capital Buffers

	Dependent Variable: Tier 1 Capital Buffer				
VARIABLES	(1)	(2)	(3)	(4)	(5)
Tier 1 Buffer t-1	0.802***	0.801***	0.801***	0.801***	0.599***
	(0.0182)	(0.0182)	(0.0182)	(0.0182)	(0.128)
Lowest 25% of Tier 1 Buffer t-1	-0.0446***	-0.0448***	-0.0453***	-0.0453***	-0.116**
	(0.0124)	(0.0124)	(0.0124)	(0.0124)	(0.0459)
Highest 25% of Tier 1 Buffer t-1	0.0583***	0.0583***	0.0586***	0.0585***	0.163**
	(0.00692)	(0.00691)	(0.00691)	(0.00690)	(0.0669)
Log Total Assets t-2	-0.0265*	-0.0390*	-0.0420*	-0.0420*	-0.0481
	(0.0155)	(0.0231)	(0.0232)	(0.0232)	(0.0342)
Return on Equity t-2	-0.000988***	-0.000988***	-0.000987***	-0.000987***	-0.000840***
	(0.000100)	(0.000100)	(0.000100)	(1.00e-04)	(0.000144)
Mkt Discipline Subordinated Debts t-2	-0.0245	-0.0276	-0.0287	-0.0289	-0.0783
	(0.0238)	(0.0242)	(0.0241)	(0.0242)	(0.0495)
Complexity (FED Reserve) t-2	-0.00471	-0.00430	-0.00414	-0.00414	-0.0110
	(0.00649)	(0.00646)	(0.00644)	(0.00644)	(0.0104)
Risk Weighted Assets/Total Assets t-2	-0.0200***	-0.0199***	-0.0200***	-0.0200***	-0.0278***
	(0.00234)	(0.00232)	(0.00232)	(0.00232)	(0.00566)
Retail 1 Employees t-2	3.347	3.269	3.249	3.247	4.757
	(2.101)	(2.135)	(2.135)	(2.136)	(3.351)
Liquidity: Cash and US Treasury t-2	0.00610	0.00597	0.00600	0.00600	0.0110
	(0.00395)	(0.00394)	(0.00394)	(0.00394)	(0.00679)
C&I loans /total loans t-2	-0.0134***	-0.0136***	-0.0137***	-0.0137***	-0.0186***
	(0.00300)	(0.00300)	(0.00300)	(0.00300)	(0.00515)
C&I loans /total loans t-2 squared	0.000250***	0.000253***	0.000254***	0.000254***	0.000359***
	(6.08e-05)	(6.09e-05)	(6.10e-05)	(6.10e-05)	(0.000105)
Annual Change Bank Debt to GDP t-2 (economic cycle)	0.00555**	0.00524*	0.000986	0.000998	-0.00246
	(0.00272)	(0.00270)	(0.00293)	(0.00293)	(0.00422)
Listed Bank	0.0163	-0.269	-0.347	-0.340	-0.283
	(0.0251)	(0.274)	(0.276)	(0.280)	(0.403)
Listed * Log Total Assets t-2		0.0207	0.0257	0.0252	0.0235
		(0.0205)	(0.0206)	(0.0208)	(0.0299)
Annual change in Econ Cycle * Listed t-2			0.0122**	0.000916	
			(0.00545)	(0.0529)	
Annual change in Econ Cycle * Listed * log Total Assets t-2				0.000777	0.000945**
				(0.00368)	(0.000439)
TARP Bank	-0.133***	-0.134***	-0.132***	-0.132***	-0.158***
	(0.0227)	(0.0228)	(0.0227)	(0.0227)	(0.0361)
TARP Bank in 4thq 2008	0.961***	0.961***	0.952***	0.952***	0.975***
	(0.123)	(0.123)	(0.123)	(0.123)	(0.123)
TARP Bank in 2009	0.466***	0.467***	0.457***	0.456***	0.606***
	(0.0498)	(0.0498)	(0.0501)	(0.0503)	(0.109)
TARP Bank in 2010	0.452***	0.452***	0.444***	0.443***	0.562***
	(0.0558)	(0.0558)	(0.0560)	(0.0561)	(0.0973)

TARP Bank in 2011	0.313***	0.315***	0.304***	0.303***	0.394***
	(0.0437)	(0.0437)	(0.0443)	(0.0445)	(0.0768)
2014 Dummy variable	-0.297***	-0.296***	-0.292***	-0.291***	-0.255***
	(0.0288)	(0.0287)	(0.0287)	(0.0288)	(0.0384)
Constant	3.432***	3.601***	3.651***	3.651***	5.773***
	(0.455)	(0.544)	(0.545)	(0.545)	(1.496)
Observations	56,894	56,894	56,894	56,894	56,894
Number of banks	2,427	2,427	2,427	2,427	2,427
F Stat	53623***	51052***	48745***	46683***	24704***
No. of instruments	23	24	25	26	24
AR1 p-value	0	0	0	0	0
AR2 p-value	0.614	0.614	0.620	0.620	0.939
Hansen p-value	0.0935	0.0952	0.110	0.111	0.146

No bank is bigger than the largest unlisted bank, no bank smaller than the smallest unlisted Bank. Dependent Variable: Tier 1 capital Buffer: Bank level capital holding of Tier 1 capital in excess of regulatory minimums. Robust standard errors in parentheses, *** $p<0.01$, ** $p<0.05$, * $p<0.1$ All banks with capital buffers zero or below are excluded. All banks with less than 8 consecutive observations excluded. All regressions estimated with two-step dynamic panel GMM estimations (Arellano and Bond (1991), Arellano and Bover (1995) and Blundell and Bond (1998). The number of instruments are collapsed following Roodman (2009). The finite sample correction of Windmeijer (2005) is applied. All Tier 1 capital buffers are calculated using both system-wide and bank-specific capital requirements.

Table 9 Descriptive statistics of security issues by banks.

Panel A All Banks

Variable	Observations	Mean	Std. dev.	Minimum	Maximum
Net New Equity	90,316	-0.9417839	11.58385	-723.6111	1466.276
New Preferred Stock	90,352	0.3409047	2.93631	-72.53104	139.8022
New Subordinated Debt	15,197	7.767965	545.3334	-100	63845
Net New Equity including Treasury Stock	90,298	-1.309525	11.56453	-723.6111	1466.276

We follow Baron (2020) is defining new equity issues: Net New Equity = (sale of common stock + conversion or retirement of common stock – cash dividends on common stock) / total equity capital * 100. New Preferred Stock = (gross sales of preferred stock – cash dividend paid on preferred stock) / total perpetual preferred stock * 100. New Subordinated Debt is percent changes in subordinated notes and debentures from Year t -1 to Year t. Net New Equity including Treasury stock allows for the sale and redemption of stock as well as equity issue , dividends and conversion or retirement of common stock.

Panel B Unlisted Banks

Variable	Observations	Mean	Std. dev.	Minimum	Maximum
Net New Equity	57,388	-1.492189	12.38411	-723.6111	1466.276
New Preferred Stock	57,432	0.2254226	2.508857	-72.53104	106.7605
New Subordinated Debt	7,348	11.34428	755.4373	-100	63845
Net New Equity including Treasury Stock	57,378	-1.699186	12.42706	-723.6111	1466.276

Panel C Listed Banks

Variable	Observations	Mean	Std. dev.	Minimum	Maximum
Net New Equity	32,928	0.0174809	9.965557	-86.53846	629.0977
New Preferred Stock	32,920	0.542374	3.552325	-31.59274	139.8022
New Subordinated Debt	7,849	4.419924	203.8454	-100	16666.67
Net New Equity including Treasury Stock	32,920	-0.6303639	9.846222	-373.0689	629.0977

Panel D Listed Bank in Top 25% by size

Variable	Observations	Mean	Std. dev.	Minimum	Maximum
Net New Equity	15,691	-0.2932719	8.169917	-64.15305	241.4696
New Preferred Stock	15,684	0.5861325	3.495977	-26.00916	81.67002
New Subordinated Debt	6,391	3.317264	84.73639	-100	5500
Net New Equity including Treasury Stock	15,688	-1.124534	8.50296	-182.6603	228.2642

Panel E Unlisted Bank Banks in Top 25% of sample by size

Variable	Observations	Mean	Std. dev.	Minimum	Maximum
Net New Equity	6,971	-1.713457	12.04956	-723.6111	105.77
New Preferred Stock	7,001	0.3016561	3.247861	-72.53104	106.7605
New Subordinated Debt	2,330	30.72183	1324.028	-100	63845
Net New Equity including Treasury Stock	6,971	-1.75177	11.59094	-723.6111	100

Panel F Listed Banks in lower 75% of sample by size

Variable	Observations	Mean	Std. dev.	Minimum	Maximum
Net New Equity	17,237	0.300362	11.34874	-86.53846	629.0977
New Preferred Stock	17,236	0.5025557	3.602473	-31.59274	139.8022
New Subordinated Debt	1,458	9.253327	438.5225	-100	16666.67
Net New Equity including Treasury Stock	17,232	-0.1804716	10.90725	-373.0689	629.0977

Panel G Unlisted Bank banks in lower 75% of sample by size

Variable	Observations	Mean	Std. dev.	Minimum	Maximum
Net New Equity	50,417	-1.461595	12.42946	-618.9343	1466.276
New Preferred Stock	50,431	0.2148396	2.388107	-21.57863	75.04221
New Subordinated Debt	5,018	2.346734	147.1891	-100	6250
Net New Equity including Treasury Stock	50,417	-1.461595	12.42946	-618.9343	1466.276

TABLE 10 Estimates of the Impact of economic cycles upon new equity issues.

	Dependent Variable: Net New Equity Issues				
VARIABLES	(1)	(2)	(3)	(4)	(5)
Tier 1 Buffer t-1	-0.0715***	-0.0717***	-0.0711***	-0.0724***	-0.0712***
	(0.0174)	(0.0174)	(0.0174)	(0.0174)	(0.0174)
Lowest 25% of Tier 1 Buffer t-1	-0.0429**	-0.0425**	-0.0412**	-0.0408**	-0.0416**
	(0.0180)	(0.0180)	(0.0180)	(0.0180)	(0.0180)
Highest 25% of Tier 1 Buffer t-1	0.0777***	0.0779***	0.0777***	0.0774***	0.0778***
	(0.0102)	(0.0102)	(0.0102)	(0.0102)	(0.0102)
Log Total Assets t-2	-0.601***	-0.553***	-0.508***	-0.503***	-0.519***
	(0.0642)	(0.0927)	(0.0934)	(0.0934)	(0.0934)
Return on Equity t-2	-0.00117***	-0.00117***	-0.00117**	-0.00117***	-0.00117**
	(0.000453)	(0.000453)	(0.000453)	(0.000453)	(0.000453)
Mkt Discipline Subordinated Debts t-2	0.173***	0.174***	0.187***	0.154**	0.186***
	(0.0656)	(0.0657)	(0.0657)	(0.0659)	(0.0658)
Complexity (FED Reserve) t-2	-0.0210	-0.0215	-0.0223	-0.0186	-0.0224
	(0.0253)	(0.0253)	(0.0253)	(0.0253)	(0.0253)
Risk Weighted Assets/Total Assets t-2	-0.00530	-0.00539	-0.00572	-0.00596	-0.00563
	(0.00462)	(0.00463)	(0.00463)	(0.00462)	(0.00463)
Loan Losses / Total Assets t-2	0.965***	0.964***	0.961***	0.951***	0.963***
	(0.0424)	(0.0424)	(0.0424)	(0.0424)	(0.0424)
Retail 1 Employees t-2	-35.65***	-35.30***	-34.90***	-35.14***	-34.98***
	(3.797)	(3.829)	(3.830)	(3.829)	(3.831)
Liquidity: Cash and US Treasury t-2	0.0759***	0.0755***	0.0757***	0.0768***	0.0756***
	(0.00837)	(0.00839)	(0.00839)	(0.00839)	(0.00839)
Annual Change Bank Debt to GDP t-2 (economic cycle)	-0.0735***	-0.0733***	-0.0415***	-0.0386***	-0.0495***
	(0.0125)	(0.0125)	(0.0148)	(0.0148)	(0.0147)
Listed Bank	2.314***	3.394**	4.763***	5.490***	4.378***
	(0.213)	(1.533)	(1.570)	(1.573)	(1.566)
Listed * Log Total Assets t-2		-0.0799	-0.173	-0.220*	-0.147
		(0.112)	(0.115)	(0.115)	(0.114)
Annual change in Econ Cycle * Listed t-2			-0.0942***	-1.193***	
			(0.0234)	(0.167)	
Annual change in Econ Cycle * Listed * log Total Assets t-2				0.0751***	-0.00485***
				(0.0113)	(0.00158)
TARP Bank	0.409*	0.413*	0.403	0.406*	0.405
	(0.247)	(0.246)	(0.246)	(0.246)	(0.246)
TARP Bank in 4^{th}q 2008	-0.130	-0.131	-0.0200	-0.122	-0.0409
	(0.401)	(0.401)	(0.402)	(0.402)	(0.402)
TARP Bank in 2009	2.583***	2.584***	2.682***	2.594***	2.663***
	(0.207)	(0.207)	(0.209)	(0.209)	(0.209)
TARP Bank in 2010	3.311***	3.314***	3.381***	3.315***	3.369***
	(0.203)	(0.203)	(0.203)	(0.203)	(0.203)
TARP Bank in 2011	0.892***	0.894***	1.001***	0.912***	0.980***
	(0.209)	(0.209)	(0.211)	(0.211)	(0.211)
2014 Dummy variable	0.220	0.219	0.177	0.240*	0.183
	(0.145)	(0.145)	(0.146)	(0.146)	(0.146)

C&I loans /total loans t-2	0.0343***	0.0349***	0.0352***	0.0369***	0.0350***
	(0.0125)	(0.0125)	(0.0125)	(0.0125)	(0.0125)
C&I loans /total loans t-2 squared	-0.000744***	-0.000749***	-0.000758***	-0.000760***	-0.000756***
	(0.000236)	(0.000236)	(0.000236)	(0.000236)	(0.000236)
Constant	6.896***	6.265***	5.654***	5.588***	5.810***
	(0.976)	(1.310)	(1.319)	(1.319)	(1.319)
Observations	56,895	56,895	56,895	56,895	56,895
Number of banks	2,427	2,427	2,427	2,427	2,427
Wald Chi Squared	1686***	1687***	1704***	1749***	1697***
Wald Degrees of Freedom	21	22	23	24	23
Adjusted Squared	0.0352	0.0354	0.0357	0.0363	0.0356

Dependent Variable: Net New Equity = (sale of common stock + conversion or retirement of common stock – cash dividends on common stock) / total equity capital * 100. All regressions estimated using random effect estimations. Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1 All banks with capital buffers zero or below are excluded. All banks with less than 8 consecutive observations excluded.

TABLE 11 Impact of economic cycles upon preference share issues.

	Dependent variable: New Preferred Stock			
VARIABLES	(1)	(2)	(3)	(4)
Tier 1 Buffer t-1	-0.0306***	-0.0304***	-0.0300***	-0.0303***
	(0.00732)	(0.00732)	(0.00732)	(0.00732)
Lowest 25% of Tier 1 Buffer t-1	0.0196**	0.0198**	0.0195**	0.0199**
	(0.00795)	(0.00795)	(0.00795)	(0.00795)
Highest 25% of Tier 1 Buffer t-1	0.0141***	0.0140***	0.0141***	0.0139***
	(0.00447)	(0.00447)	(0.00446)	(0.00447)
Log Total Assets t-2	0.108***	0.116***	0.115***	0.119***
	(0.0281)	(0.0283)	(0.0283)	(0.0283)
Return on Equity t-2	-0.00455***	-0.00455***	-0.00455***	-0.00455***
	(0.000208)	(0.000208)	(0.000208)	(0.000208)
Mkt Discipline Subordinated Debts t-2	-0.0265	-0.0235	-0.00926	-0.0214
	(0.0260)	(0.0261)	(0.0261)	(0.0261)
Complexity (FED Reserve) t-2	-0.00906	-0.00930	-0.0103	-0.00946
	(0.00950)	(0.00949)	(0.00950)	(0.00949)
Risk Weighted Assets/Total Assets t-2	0.000198	0.000125	0.000224	9.92e-05
	(0.00173)	(0.00173)	(0.00173)	(0.00173)
Retail 1 Employees t-2	-2.427*	-2.361*	-2.263*	-2.327*
	(1.267)	(1.267)	(1.267)	(1.267)
Liquidity: Cash and US Treasury t-2	0.00475	0.00479	0.00428	0.00478
	(0.00343)	(0.00343)	(0.00343)	(0.00343)
Annual Change Bank Debt to GDP t-2 (economic cycle)	0.0131**	0.0212***	0.0199***	0.0246***
	(0.00568)	(0.00673)	(0.00673)	(0.00669)
Listed Bank	1.807***	2.028***	1.680***	2.101***
	(0.470)	(0.480)	(0.482)	(0.478)
Listed * Log Total Assets t-2	-0.131***	-0.146***	-0.124***	-0.151***
	(0.0343)	(0.0349)	(0.0350)	(0.0348)
Annual change in Econ Cycle * Listed t-2		-0.0239**	0.527***	
		(0.0106)	(0.0758)	
Annual change in Econ Cycle * Listed * log Total Assets t-2			-0.0376***	-0.00233***
			(0.00513)	(0.000715)
TARP Bank	0.0243	0.0203	0.0159	0.0183
	(0.0600)	(0.0601)	(0.0601)	(0.0601)
TARP Bank in 4thq 2008	11.02***	11.04***	11.10***	11.06***
	(0.185)	(0.185)	(0.185)	(0.185)
TARP Bank in 2009	9.420***	9.444***	9.490***	9.457***
	(0.0948)	(0.0954)	(0.0955)	(0.0955)
TARP Bank in 2010	0.360***	0.376***	0.413***	0.385***
	(0.0918)	(0.0920)	(0.0921)	(0.0921)
TARP Bank in 2011	1.912***	1.938***	1.987***	1.952***
	(0.0947)	(0.0954)	(0.0956)	(0.0955)
2014 Dummy variable	-0.101	-0.112*	-0.144**	-0.119*
	(0.0669)	(0.0671)	(0.0672)	(0.0671)
C&I loans /total loans t-2	-0.00615	-0.00606	-0.00662	-0.00606
	(0.00445)	(0.00445)	(0.00446)	(0.00445)
C&I loans /total loans t-2 squared	9.48e-05	9.26e-05	9.27e-05	9.16e-05

	(8.45e-05)	(8.45e-05)	(8.45e-05)	(8.45e-05)
Constant	-0.924**	-1.033**	-1.020**	-1.079***
	(0.406)	(0.409)	(0.409)	(0.409)
Observations	56,912	56,912	56,912	56,912
Number of banks	2,427	2,427	2,427	2,427
Wald Chi Sq	14632***	14638***	14705***	14645***
DF	21	22	23	22
Adjusted Squared	0.211	0.211	0.212	0.211

Dependent variable: New Preferred Stock = (gross sales of preferred stock – cash dividend paid on preferred stock) / total perpetual preferred stock * 100.All regressions estimated using random effect estimations. Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1 All banks with capital buffers zero or below are excluded. All banks with less than 8 consecutive observations excluded.

Table 12 Impact of economic cycles upon retentions and credit risk density.

	Dependent Variable: Tier 1 Capital Buffer			
VARIABLES	(1)	(2)	(3)	(4)
Tier 1 Buffer t-1	0.593***	0.590***	0.603***	0.604***
	(0.128)	(0.128)	(0.129)	(0.129)
Lowest 25% of Tier 1 Buffer t-1	-0.119***	-0.120***	-0.116**	-0.115**
	(0.0456)	(0.0456)	(0.0459)	(0.0459)
Highest 25% of Tier 1 Buffer t-1	0.166**	0.168**	0.161**	0.161**
	(0.0668)	(0.0668)	(0.0671)	(0.0671)
Log Total Assets t-2	-0.0496	-0.0494	-0.0468	-0.0469
	(0.0344)	(0.0343)	(0.0340)	(0.0340)
Return on Equity t-2	-0.000906	-0.000903	-0.000841***	-0.000841***
	(0.000639)	(0.000633)	(0.000145)	(0.000145)
Mkt Discipline Subordinated Debts t-2	-0.0783	-0.0812	-0.0786	-0.0778
	(0.0494)	(0.0501)	(0.0496)	(0.0493)
Complexity (FED Reserve) t-2	-0.00990	-0.0100	-0.00937	-0.00934
	(0.0104)	(0.0105)	(0.0103)	(0.0103)
Risk Weighted Assets/Total Assets t-2	-0.0279***	-0.0281***	-0.0273***	-0.0273***
	(0.00565)	(0.00566)	(0.00564)	(0.00564)
Retail 1 Employees t-2	4.813	4.843	4.755	4.746
	(3.376)	(3.365)	(3.347)	(3.345)
Liquidity: Cash and US Treasury t-2	0.0112	0.0113*	0.0107	0.0107
	(0.00684)	(0.00682)	(0.00675)	(0.00674)
C&I loans /total loans t-2	-0.0190***	-0.0190***	-0.0187***	-0.0187***
	(0.00517)	(0.00516)	(0.00514)	(0.00514)
C&I loans /total loans t-2 squared	0.000365***	0.000366***	0.000360***	0.000360***
	(0.000106)	(0.000105)	(0.000105)	(0.000105)
Annual Change Bank Debt to GDP t-2 (economic cycle)	-0.00254	-0.00234	0.0509*	0.0510*
	(0.00456)	(0.00450)	(0.0298)	(0.0298)
Listed Bank	-0.214	-0.172	-0.151	-0.173
	(0.399)	(0.396)	(0.397)	(0.393)
Listed * Log Total Assets t-2	0.0188	0.0161	0.0141	0.0155
	(0.0296)	(0.0294)	(0.0293)	(0.0291)
Annual change in Econ Cycle * Listed t-2	0.000801	0.000564	-0.00558	-0.00564
	(0.000506)	(0.000461)	(0.00352)	(0.00351)
TARP Bank	-0.166***	-0.168***	-0.163***	-0.163***
	(0.0365)	(0.0365)	(0.0363)	(0.0363)
2014 Dummy variable	0.995***	1.000***	0.986***	0.987***
	(0.122)	(0.122)	(0.122)	(0.122)
TARP Bank in 4th q 2008	0.619***	0.630***	0.601***	0.602***
	(0.110)	(0.110)	(0.110)	(0.111)
TARP Bank in 2009	0.581***	0.601***	0.565***	0.566***
	(0.0985)	(0.0969)	(0.0974)	(0.0976)
TARP Bank in 2010	0.413***	0.413***	0.399***	0.399***
	(0.0770)	(0.0772)	(0.0775)	(0.0777)
TARP Bank in 2011	-0.226***	-0.225***	-0.226***	-0.228***

	(0.0433)	(0.0434)	(0.0435)	(0.0433)
Annual change in Econ Cycle * Return on Assets t-2	1.80e-05	1.77e-05		
	(0.000299)	(0.000295)		
Annual change in Econ Cycle *(Risk Weighted Assets/Total Assets) t-2			-0.000754*	-0.000757*
			(0.000420)	(0.000420)
Annual change in Econ Cycle * Listed * Return on Assets t-2	0.00657			
	(0.00579)			
Annual change in Econ Cycle * Listed * (Risk Weighted Assets/Total Assets)			-0.000415	
			(0.000686)	
Annual change in Econ Cycle * Listed * Log Total Assets * Return on Assets t-2	-0.000397	8.45e-05***		
	(0.000424)	(2.44e-05)		
Annual change in Econ Cycle * Listed * Log Total Assets * (Risk Weighted Assets/Total Assets)			0.000120*	9.27e-05*
			(6.15e-05)	(4.76e-05)
Constant	5.843***	5.874***	5.696***	5.689***
	(1.492)	(1.490)	(1.492)	(1.493)
Observations	57,044	57,044	57,044	57,044
Number of banks	2,428	2,428	2,428	2,428
F Stat	21646***	22621***	21957***	22868***
No. of instruments	27	27	27	26
AR1 p-value	0	0	0	0
AR2 p-value	0.981	0.966	0.937	0.935
Hansen p-value	0.181	0.234	0.164	0.160

Dependent Variable: Tier 1 capital Buffer: Bank level capital holdings of Tier 1 capital in excess of regulatory minimums. Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1 All banks with capital buffers zero or below are excluded. All banks with less than 8 consecutive observations excluded. All regressions estimated with two-step dynamic panel GMM estimations (Arellano and Bond (1991), Arellano and Bover (1995) and Blundell and Bond (1998). The number of instruments are collapsed following Roodman (2009). The finite sample correction of Windmeijer (2005) is applied. All Tier 1 capital buffers are calculated using both system wide and bank-specific capital requirements.

TABLE 13 Impact of Orderly Liquidation Authority and 2014 Capital Reforms

	Dependent Variable: Tier 1 capital Buffer				
VARIABLES	(1)	(2)	(3)	(4)	(5)
GSIB after 2010	16.79**				
	(7.617)				
GSIB after 2014	-17.46**				
	(7.360)				
Systemic Bank after 2010		4.161***			
		(1.277)			
Systemic Bank after 2014		-5.070***			
		(1.229)			
Biggest 25% (assets) after 2010			0.519***		
			(0.102)		
Biggest 25% (assets) after 2014			-0.742***		
			(0.0892)		
Listed bank after 2010				0.209***	
				(0.0387)	
Listed bank after 2014				-0.416***	
				(0.0465)	
Top 5% subordinated after 2010					7.043***
					(2.524)
Top 5% subordinated after 2014					-8.322***
					(2.216)
Lagged Dependent Variables	Y	Y	Y	Y	Y
Bank Level Controls	Y	Y	Y	Y	Y
Controls for High and Low Buffers	Y	Y	Y	Y	Y
Controls for Economic cycles	Y	Y	Y	Y	Y
Controls for TARP	Y	Y	Y	Y	Y
2014 Dummy variable	Y	Y	Y	Y	Y
Constant	3.721***	3.733***	3.952***	3.823***	3.273***
	(0.464)	(0.482)	(0.507)	(0.478)	(0.521)
Observations	57,039	57,039	57,039	57,039	57,039
Number of banks	2,428	2,428	2,428	2,428	2,428
F Stat	38692***	38753***	38866***	39511***	29502***
No. of instruments	30	30	30	30	30
AR1 p-value	0	0	0	0	0
AR2 p-value	0.571	0.579	0.529	0.536	0.979
Hansen p-value	0.163	0.136	0.0488	0.113	0.138

Dependent Variable: Tier 1 capital Buffer: Bank level capital holding of Tier 1 capital in excess of regulatory minimums. Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1 All banks with capital buffers zero or below are excluded. All banks with less than 8 consecutive observations excluded. All regressions estimated with two-step dynamic panel GMM estimations (Arellano and Bond (1991), Arellano and Bover (1995) and Blundell and Bond (1998). The number of instruments are collapsed following Roodman (2009). The finite sample correction of Windmeijer (2005) is applied. All Tier 1 capital buffers are calculated using both system wide and bank-specific capital requirements. GSIB after 2010 measures the impact of the OLA upon Globally Systematically Important Banks (GSIBs). GSIB after 2014 measures the impact of the 2014 regulatory changes (BISIII and accounting changes) upon GSIBs. Dummy 20087 represents a dummy variable to the 2008, while Dummy 2009 representants 2009.

Systemic after 2010 measures the impact of the OLA upon Systematically Important Banks (GSIBs). Systemic after 2014 reflects the impact of the 2014 regulatory changes (BISIII and accounting changes) upon Systemic Banks. We categorise all US GSIBs and those BHCs subject to the annual stress exercise as systemic banks. Biggest 25% after 2010 measures the impact of the OLA upon the largest 25% of BHCs by total assets. Biggest after 2014 reflects the impact of the 2014 regulatory changes (BISIII and accounting changes) upon the largest 25% of BHCs by total assets. Listed Bank after 2010 measures the impact of the OLA upon listed BHCs. Listed Bank after 2014 measures the impact of the 2014 regulatory changes (BISIII and accounting changes) upon Listed BHCs. Top 5% subordinated 2010 measures the impact of the OLA upon those banks with the top 5% of subordinated debt as a proportion of liabilities. Top 5% subordinated 2014 regulatory changes (BISIII and accounting changes) upon those banks with the top 5% of subordinated debt as a proportion of liabilities.

Table 14: Impact of Orderly Liquidation Authority upon Bank Equity Issue.

	Dependent Variable: Net New Equity				
VARIABLES	(1)	(2)	(3)	(4)	(5)
Annual Change Debt to GDP t-2	-0.0465***	-0.0466***	-0.0422***	-0.0478***	-0.0459***
	(0.0148)	(0.0148)	(0.0149)	(0.0148)	(0.0148)
Listed Bank	6.400***	7.041***	6.763***	8.418***	6.282***
	(1.581)	(1.588)	(1.582)	(1.647)	(1.573)
Annual change in Econ Cycle * Listed t-2	-1.198***	-1.369***	-1.287***	-1.160***	-1.191***
	(0.171)	(0.175)	(0.170)	(0.167)	(0.168)
Listed * Log Total Assets t-2	-0.292**	-0.337***	-0.317***	-0.452***	-0.283**
	(0.115)	(0.116)	(0.115)	(0.121)	(0.115)
Annual change in Econ Cycle * Listed * log Total Assets t-2	0.0755***	0.0876***	0.0825***	0.0767***	0.0751***
	(0.0116)	(0.0119)	(0.0116)	(0.0113)	(0.0113)
GSIB after 2010	0.691				
	(0.880)				
GSIB after 2014	0.0555				
	(0.885)				
Systemic Bank after 2010		1.932***			
		(0.485)			
Systemic Bank after 2014		-0.804			
		(0.497)			
Biggest 25% after 2010			0.618***		
			(0.147)		
Biggest 25% after 2014			-0.369**		
			(0.167)		
Listed after 2010				0.761***	
				(0.146)	
Listed after 2014				-0.130	
				(0.168)	
Top 5% subordinated 2010					0.438
					(0.300)
Top 5% subordinated 2014					0.392
					(0.497)
Constant	6.058***	6.205***	6.496***	5.453***	6.042***
	(1.328)	(1.329)	(1.339)	(1.331)	(1.329)
Lagged Dependent Variable	Y	Y	Y	Y	Y
Bank Level Controls	Y	Y	Y	Y	Y
Controls for High and Low Buffers	Y	Y	Y	Y	Y
Controls for TARP	Y	Y	Y	Y	Y
2014 Dummy variable	Y	Y	Y	Y	Y
Observations	56,873	56,873	56,873	56,873	56,873
Number of banks	2,427	2,427	2,427	2,427	2,427
Wald Chi sq	1669***	1685***	1686***	1698***	1673***
DF	26	26	26	26	26
AdjR2	0.0352	0.0353	0.0355	0.0349	0.0351

Dependent Variable: Net New Equity including Treasury stock allows for the sale and redemption of stock as well as equity issue , dividends and conversion or retirement of comment stock. All regressions estimated using random effect estimations. Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1 All banks with capital buffers zero or below are excluded. All banks with less than 8 consecutive observations excluded. GSIB after 2010 measures the impact of the OLA upon Globally Systematically Important Banks (GSIBs). GSIB after 2014 reflect the impact of the 2014 regulatory changes (BISIII and accounting changes) upon GSIBs. Systemic after 2010 measures the impact of the OLA upon

Systematically Important Banks (GSIBs). Systemic after 2014 reflects the impact of the 2014 regulatory changes (BISIII and accounting changes) upon Systemic Banks. We categorise all US GSIBs and those BHCs subject to the annual stress exercise as systemic banks. Biggest 25% after 2010 measures the impact of the OLA upon the largest 25% of BHCs. Biggest after 2014 reflects the impact of the 2014 regulatory changes (BISIII and accounting changes) upon the largest 25% of BHCs by total assets. Listed after 2010 measures the impact of the OLA upon listed BHCs. Listed after 2014 reflects the impact of the 2014 regulatory changes (BISIII and accounting changes) upon Listed BHCs. Top 5% subordinated 2010 measures the impact of the OLA upon those banks with the top 5% of subordinated debt as a proportion of liabilities . Top 5% subordinated 2014 reflects the impact of the 2014 regulatory changes (BISIII and accounting changes) upon those banks with the top 5% of subordinated debt as a proportion of liabilities.

Table 15 Impact of Orderly Liquidation Authority upon Bank Preference Share issues.

	Dependent variable: New Preferred Stock				
VARIABLES	(1)	(2)	(3)	(4)	(5)
Annual Change Debt to GDP t-2	0.0203***	0.0202***	0.0190***	0.0190***	0.0204***
	(0.00673)	(0.00672)	(0.00676)	(0.00673)	(0.00673)
Listed Bank	1.859***	2.019***	1.692***	1.724***	1.719***
	(0.489)	(0.493)	(0.483)	(0.493)	(0.482)
Annual change in Econ Cycle * Listed t-2	0.496***	0.452***	0.533***	0.535***	0.520***
	(0.0775)	(0.0795)	(0.0771)	(0.0758)	(0.0760)
Listed * Log Total Assets t-2	-0.137***	-0.148***	-0.126***	-0.132***	-0.127***
	(0.0355)	(0.0357)	(0.0351)	(0.0361)	(0.0350)
Annual change in Econ Cycle * Listed * log Total Assets t-2	-0.0355***	-0.0324***	-0.0381***	-0.0373***	-0.0371***
	(0.00525)	(0.00539)	(0.00524)	(0.00514)	(0.00514)
GSIB after 2010	0.395				
	(0.376)				
GSIB after 2014	0.141				
	(0.408)				
Systemic Bank after 2010		0.559***			
		(0.208)			
Systemic Bank after 2014		-0.145			
		(0.226)			
Biggest 25% after 2010			0.0352		
			(0.0656)		
Biggest 25% after 2014			-0.196***		
			(0.0750)		
Listed after 2010				0.240***	
				(0.0647)	
Listed after 2014				-0.280***	
				(0.0753)	
Top 5% subordinated 2010					0.188
					(0.132)
Top 5% subordinated 2014					-0.415*
					(0.222)
Constant	-1.045**	-0.977**	-1.161***	-1.089***	-1.065***
	(0.412)	(0.413)	(0.419)	(0.413)	(0.412)
Lagged Dependent Variable	Y	Y	Y	Y	Y
Bank Level Controls	Y	Y	Y	Y	Y
Controls for High and Low Buffers	Y	Y	Y	Y	Y
Controls for TARP	Y	Y	Y	Y	Y
2014 Dummy variable	Y	Y	Y	Y	Y
Observations	56,883	56,883	56,883	56,883	56,883
Number of banks	2,427	2,427	2,427	2,427	2,427
Wald Chisq	14705***	14712***	14712***	14726***	14707***
DF	26	26	26	26	26
AdjR2	0.212	0.212	0.212	0.212	0.212

Dependent variable: New Preferred Stock = (gross sales of preferred stock – cash dividend paid on preferred stock) / total perpetual preferred stock * 100.All regressions estimated using random effect estimations. Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1 All banks with capital buffers zero or below are excluded. All banks with less than 8 consecutive observations excluded. GSIB after 2010 measures the impact of the OLA upon Globally Systematically Important Banks (GSIBs). GSIB after 2014 reflect the impact of the 2014 regulatory changes (BISIII and accounting changes) upon GSIBs. Systemic after 2010 measures the impact of the OLA upon GSIBs. Systemic after 2014 reflects the impact of the 2014 regulatory changes (BISIII and accounting changes) upon Systemic Banks.

We categorise all US GSIBs and those BHCs subject to the annual stress exercise as systemic banks. Biggest 25% after 2010 measures the impact of the OLA upon the largest 25% of BHCs by total assets. Biggest after 2014 reflects the impact of the 2014 regulatory changes (BISIII and accounting changes) upon the largest 25% of BHCs by total assets. Listed after 2010 measures the impact of the OLA upon listed BHCs. Listed after 2014 reflects the impact of the 2014 regulatory changes (BISIII and accounting changes) upon Listed BHCs. Top 5% subordinated 2010 measures the impact of the OLA upon those banks with the top 5% of subordinated debt as a proportion of liabilities . Top 5% subordinated 2014 reflects the impact of the 2014 regulatory changes (BISIII and accounting changes) upon those banks with the top 5% of subordinated debt as a proportion of liabilities.

Table 16 Impact of CATFIN upon Bank Equity issues.

VARIABLES	(1)	(2)	(3)	(4)	(5)
CATFIN t-2	2.551***	2.554***	2.617***	2.734***	2.322***
	(0.265)	(0.266)	(0.312)	(0.312)	(0.311)
Listed * Log Total Assets t-2		0.0277	0.0290	-0.684***	0.00926
		(0.109)	(0.109)	(0.121)	(0.110)
CATFIN * Listed t-2			-0.195	-49.28***	
			(0.509)	(3.724)	
CATFIN * Listed * Log Total Assets t-2				3.376***	0.0498
				(0.254)	(0.0347)
Constant	4.360***	4.563***	4.564***	4.686***	4.525***
	(0.938)	(1.258)	(1.257)	(1.256)	(1.258)
Lagged capital buffers	Y	Y	Y	Y	Y
Bank Level Controls	Y	Y	Y	Y	Y
Controls for High and Low Buffers	Y	Y	Y	Y	Y
Controls for TARP	Y	Y	Y	Y	Y
2014 Dummy variable	Y	Y	Y	Y	Y
Observations	59,814	59,814	59,814	59,814	59,814
Number of banks	2,442	2,442	2,442	2,442	2,442
Wald Chisq	1249***	1249***	1249***	1430***	1251***
DF	20	21	22	23	22
AdjR2	0.0306	0.0305	0.0305	0.0335	0.0306

Dependent Variable: Net New Equity = (sale of common stock + conversion or retirement of common stock – cash dividends on common stock) / total equity capital * 100. All regressions estimated using random effect estimations. Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1 All banks with capital buffers zero or below are excluded. All banks with less than 8 consecutive observations excluded. CATFIN represent the level of banking system wide level of systemic risk, as developed by Allen*, et al.* (2012).