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

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Abstract: We consider the impact of economic cycles and regulatory reforms upon the capital decisions of a large sample of U.S. bank holding companies. We document that bank holdings of Tier 1 capital above the regulatory minimum (buffers of quality capital) are pro-cyclical for large listed banks, and have no economic cyclicality for other banks. Counter cyclicality of bank equity issues is limited to listed banks, while preference share issues are pro-cyclical for listed and unlisted banks. We argue banks adopt a pecking order approach to capital, issuing cheaper preference shares during positive economic cycles; reconciling cyclical bank buffer quality with counter-cyclical equity issues. The Orderly Liquidation Authority of the Dodd-Frank Act stimulated increased equity issues and larger capital buffers by those banks most exposed to regulatory bail-ins. Banks with subordinated debtholders most exposed to bail-in imposed losses increased buffers of quality capital and issued more equity. The regulatory environment following the GFC delinked bank capital from pecking order preferences. We demonstrate that bank capital behaviour is not entirely comparable across the dimensions of bank size and listed status. Thus, care must be taken when developing regulatory policies based on studies that consider listed banks or large listed banks only.

(abstract 195 words)

Key words: Bank Capital, buffers of Tier 1 capital, capital cyclicality, Orderly Resolution Authority

JEL categories: G21, G38, C23

1. Introduction.

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

The increased attention paid to research 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, whereby increased bank equity issues increases overall bank cost of capital due to the lack of compensating reductions in cost of debt (bank cost of debt is already viewed as nearly risk free due to actual and implied government guarantees). In implementing his model Baron (2020) makes 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. Further, his work focussed on the net issue of new equity without considering other instruments that comply with the various elements of the capital adequacy process.

The process of regulatory reforms that followed the GFC resulted in a series of amendments focusing on bank capital quality. The Orderly Liquidation Authority introduced in 2010 as part of the Dodd-Frank Act saw the focus of regulatory intervention into distressed financial institutions shift from bail-out via equity injections to bail-in via equity write off and junior debt holdings converted to equity (Berger, *et al.*, 2022). Developing and empirically testing a model of bank bail-ins, Berger, *et al.* (2022) demonstrated that optimally designed bail-in regimes do not generate incentives to engage

in morally hazardous asset substitution, but instead result in increased holdings of equity capital.[1] This increased holding of equity capital is attributed to pressure from junior (subordinated) debt holders upon bank management to reduce the likelihood of their being forcibly converted into equity and so coercing bank holding company managers to hold increased buffers of high quality (Tier 1) capital.

In addition, 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, it is still unknown what is the economic significance when a larger sample of listed banks is included together with a large sample of unlisted banks. We argue that considering a larger sample of both larger and smaller 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. Furthermore, we find no evidence in the literature of implementing 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 holding of quality (Tier 1) capital are important from and number of perspectives and to a number of stakeholders. The general consensus of theories of bank capital such as Repullo (2004) emphasise the importance of bank capital as a buffer against unexpected losses. Increased bank capital has the beneficial proper 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 (1999a), Koehn and Santomero (1980)). After the financial crisis of 2008, the regulatory crisis has emphasised banks holding increased amounts of higher quality of 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),

[1] Berger*, et al.* (2022) tested their model upon a sample of the 50 largest listed U.S bank holding companies. One contribution of our paper will be to consider their results in the light of a wider sample while also considering the impact of economic cycles, and other structural changes discussed below.

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 buffer of bank quality capital above the regulatory minimums.

Our paper differs from previous studies in several ways. First, we scrutinize buffers of quality capital (Tier 1 capital above the regulatory minimum) of BHCs. 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. 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 quality 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 size based accounting issues raised by Gong*, et al.* (2018), as well as the introduction of the Troubled Asset Relief Program.

Furthermore, we consider the impact of retail intensity, operational complexity and the quality of their loan portfolios. This is important as the US BHCs examined in this paper are subject to 'Prompt Corrective Action' (PCA) [required regulatory intervention of increasing severity as a function of decreasing bank capital holdings] under the US Federal Deposit Insurance Corporation Improvement Act (FDICIA).[2] We also investigate whether US BHCs trade–off capital buffer quality with their liquid asset investments. For example, Jokipii and Milne (2011) suggest that banks with greater investments in liquid assets can offset the lower liquidity risk that follows by holding smaller capital buffers. However, it is currently unclear if this theme persists across the quality of a bank's capital

[2] Section 131 of FDICIA prescribes prompt corrective action (PCA) for the Federal Deposit Insurance Corporation for early intervention into troubled banks. PCA establishes zones of bank capitalisation. As a bank's capitalisation declines, each zone corresponds with escalating degrees of regulatory interference with a bank's operations (Aggarwal and Jacques (2001; FDICIA (1991). These regulations emphasise restricting bank dividends as capital buffers fall.

buffer. We conduct an extensive series of robustness tests to ensure that any results observed differences between listed and unlisted banks are not the result of endogeneity.

We find that bank buffers of quality capital are pro-cyclical for large, listed banks only. Thus, policies addressing the issue of bank capital cyclicality must adopt a nuanced perspective allowing for these differences and encourage the use of retained earnings by unlisted banks with less market equity access. These results also indicate that there are limits upon developing regulatory policies based on studies of large, listed banks. We conduct a variety of robustness tests to ensure that our results are not the outcome of endogeneity of either listed bank status or bank size. We also argue that pecking order theory provides a reconciliation between the results of Baron (2020), who finds that banks equity issues are counter cyclical and our finding of pro-cyclical bank issues of preference shares. We argue that when the economy is in an up-cycle, banks will issue cheaper preference shares and only issue equity when the economy is in a down cycle because other cheaper sources of complying capital are either not available or prohibitively expensive. In further support of this argument, we document that more profitable banks hold smaller capital buffers of quality capital and issue less equity or preference shares, instead relying on retained earnings as needed, consistent with pecking order.

We exploit the large and varied nature of our sample to document increased bank issues of equity following the introduction of the Orderly Liquidation Authority (OLA). We demonstrate that those banks most exposed to the bail-in provisions of OLA increased their equity issues and capital buffers while also reducing preference share issues after the introduction of OLA. This result confirms that of Berger*, et al.* (2022), who studied a smaller sample of large listed banks. We also find that the size based accounting changes introduced in 2014 (Gong*, et al.*, 2018) resulted in an observed reduction of bank buffers of quality capital after 2014. We argue that the process of regulatory attention upon bank equity following the GFC has generated a long run increase in bank equity issues to improvee the quality of their capital holdings, despite the prior predilection to use complying preference shares to increase their quality capital buffers.

The rest of this paper is structured as follows the next sections discusses the relevant theories and provides a selected review of the relevant literature while also developing our hypotheses. The third section discusses the nature of our sample and presents our empirical setup. In the fourth section we

present our results and any robustness test. The final section provides our conclusions and discusses the policy implications of our results.

2. Theory and literature review

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.[3] Tier 1 capital – largely composed of shareholder funds and retained earnings – is recognised as superior in terms of its loss-absorbent characteristics (BCBS, 2011).[4] On the other hand, Tier 2 capital (complying subordinated debt instruments and general provisions) has inferior loss-absorbent qualities but is less costly.[5] 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 banks to hold higher

[3] 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.

[4] 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.

[5] Tier 2 capital is subordinated to depositors and general creditors and must have an original maturity of at least five years (BCBS, 2011).

levels of quality capital, and minimising 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, in order to ensure banks continue to exist as profitable going concerns, as well as fostering the important economic functions that banks provide. Striking a balance 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).[6] 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).[7]

Banks 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.[8]

[6] Each nation is free to accept, reject or modify the Capital Adequacy process (Hohl*, et al.*, 2018).

[7] 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.

[8] 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.

Banks also consider the costs to shareholders of loss of its 'franchise value' or 'charter value'.[9] 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 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 (Heid (2007), Ayuso, *et al.* (2004), Estrella (2004)). 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 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 buffer 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

[9] 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).

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 capital buffers, but instead include credit cycles in our model with potentially important policy implications for the results.

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.[10] 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) 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)).[11] The risk is that a bank, driven by a moral hazard, favours cheaper financing, such as complying subordinated debt (i.e. Tier 2 capital) 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 capital buffer proves 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

[10] 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 is also phased in to 2019.

[11] 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.

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 stronger capitalisation during banking crises.[12] 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),[13] permitted banks to engage in previously restricted non-traditional 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

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

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 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 minimum 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.[14] 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 upon 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 (2014b) that the overall relationship between bank risk and capital is U-shaped.[15] Williams (2014b) 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 (1999a), and Williams (2013; Williams (2014a). An important element in this on-linear relationship is the degree of regulatory intensity (Shrieves and Dahl (1992), Brimmer and Dahl (1975), Calem and Rob (1999a)), with lower regulatory intensity being accompanied by increased bank risk seeking in the presence of capital regulations. Eisenbach*, et al.* (2022) find that allocation of United States

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

supervisory resources are 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. Thus, we include credit risk measures in our model but we do not propose a direction for the relationship between bank credit risk and buffers of quality capital.

Jokipii and Milne (2011) rationalise 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.[16] 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.[17] 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.

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

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, 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.[18] 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.[19] 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.

For mergers and acquisitions, the target and acquirer 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.

[18] 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.
[19] 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:

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

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,

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

or,

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

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:

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

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).[20] 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.[21] 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

[20] 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.
[21] 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.

Tables 1 and 2 about here.

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 historical 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.[22] Over our sample period the Federal Reserve Board has left the CCyB at 0%.[23]

While introducing 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).[24] 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 buffer. 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,[25] we will treat those banks subject to the annual USA stress test 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 International Settlements. In order to benchmark our results with those of Baron (2020), our measure

[22] 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.

[23] 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.

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

[25] "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

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. 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[26], (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 assts), (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). 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.

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

[26] 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.

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 twenty 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.[27] We include two measures of the impact of listed bank status, a dummy variable representing

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

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 test does not reject the hypothesis of model misspecification, 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.

Table 5 about here

In contrast to the Baron (2020) finding that bank equity issues are counter cyclical, we find that bank buffers of quality capital are pro-cyclical at the ten percent level of significance. To determine if listed versus unlisted banks status impact on bank capital cyclicality, we include in our model a measure listed * economic cycle. We find that the pro-cyclicality of bank buffers of quality capital is significant only for listed banks. (see column (3) of Table 4). 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 mainly the outcome of 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 confirm this hypothesis and thus provide additional evidence that the too big to fail and market access effects apply not only to overall bank holdings of capital but to the higher cost and higher quality Tier 1 capital.

We find limited 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. At best this variable is significant at the ten per cent level and has limited impact upon the bank capital decision. 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 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 as measured by the proportion of commercial and industrial loans in the loan portfolio has no relationship the size of buffers of quality capital. However, credit risk density as measured by risk weighted assets divided by total assets is found to be negatively associated with bank capital buffers. As discussed above bank capital can have a non-linear relationship with bank risk (Calem and Rob (1999a), with banks with both low and high levels of capital engaging in risk seeking activities, with different motivations for each group of banks.[28]

[28] In a separate regression we confirm the argument of Calem and Rob (1999a)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

Bank buffers of quality capital are found to have a positive relationship with bank holding of liquid assets. This is opposite to our expectations and may again represent managerial risk aversion in that higher holdings of liquid assets and bank capital reduce the likelihood of bank failure. 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 demonstrate 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 4 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 smaller buffers of quality capital, unlike the GMM which found no difference 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

average higher credit risk portfolios, due to the adverse impact of deposit insurance. 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 supervisory attention does not necessarily focus upon those banks with riskier portfolios.

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 4. Thus, our result that bank buffers of quality capital are procyclical only for larger listed banks remains supported.

Tables 7 and 8 about here.

Equity and Preference Share issues.

At first glance our results are apparently 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 do 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 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.

Contrary to Baron (2020), we find no evidence that economic cycles have any impact on equity issues for all banks in our sample. Instead we find that the impact of economic cycles on equity issue is isolated to listed banks, with the same counter cyclical behaviour found by 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 lower counter cyclical tendency as compared to other listed banks. We argue that larger listed banks are subject to more monitoring from both prudential regulators as well as market participants, resulting a slightly lower level of counter cyclical equity issuance. This is consistent with Berger*, et al.* (2022), who argue that the passing of the OLA placed increased pressure on larger banks to increase equity holdings to 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 proportionate subordinated debt on issue and issues of equity, consistent with Berger*, et al.* (2022). Furthermore, we find that TARP banks immediately increased equity issues, which accounts for eighty-five percent of TARP funds being repaid by 2011. Rapid repayment of TARP funds were no doubt stimulated the restrictions associated with TARP participation such as restrictions of 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 will consider if OLA resulted in a continuation of increased bank equity issues, once we control for TARP effects.[29]

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 buffers of quality capital is reinforced

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

by the impact of holding liquid and high-quality assets, which is also associated with larger equity issues. Consistent with pecking order theory, (Myers and Majluf, 1984), more profitable banks have smaller equity issues. The positive coefficient for our loan loss variable indicates that an important motivation factor for equity issues is declining asset quality (consistent with Baron (2020). We also find that larger banks make proportionately smaller equity issues, as do retail active banks, and banks with higher levels of credit risk density make larger equity issues, consistent with our results for loan losses.

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.[30]

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 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-in.

[30] We re-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, with the same results as discussed.

In a later section we will explore if this effect predated the introduction of the OLA, due to the impact of the TARP program.

We also find that lower loan quality motivates preference share issues as well as equity issues, that larger banks make proportionately larger issues of preference shares and credit risk density further increases the size of these issues. Retail focussed banks make smaller issues of preference shares, most likely indicating a bias toward deposit funding. 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.[31]

The impacts of the Orderly Liquidation Authority and Changed Accounting for Subsidiaries.

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 bailing-in 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[32] bank management to raise additional equity to insulate the subordinated debt holders from the likelihood of mandatory conversion into equity holders.

We follow the arguments presented in Berger*, et al.* (2022) and assume that the G-SIBs are the group of banks most likely to be subject to regulatory invention during a financial crisis. This logic is supported 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

[31] 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.

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

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 12 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 size-based accounting change results in a reduction in reported capital buffer by all of our categories of banks that we argue are most exposed to the impact of OLA. Thus, failure to control for this accounting change in our sample (which includes a larger sample of banks than Berger*, et al.* (2022), with a larger variation in bank size), results in the counterintuitive result that bank capital buffers fell subsequent to the introduction of OLA. Once we control for the impact of the 2104 accounting change. we find, however, that OLA resulted in no change in G-SIB capital buffers.

Bearing in mind that our sample includes both listed and unlisted banks as well as a wider range of banks than Berger*, et al.* (2022), who considered the top 50 U.S banks by size, we re-estimated our model with a more constrained sample that considered only the largest U.S listed banks in our sample. Our results were not affected by this change in sample. Thus, we must conclude that the main source of difference between our results and those of Berger*, et al.* (2022) is due to the differences in

econometric modelling.[33] Additionally, we find that TARP banks continued to hold higher buffers of quality capital, over and above the impact of OLA.

Table 12 about here.

After G-SIBs, the next groups of banks most likely to be subject to the bail-in provision 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 accounting change 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 capital buffer declined after the 2014 accounting change.

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 accounting change 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

[33] Using a double fixed effects (bank and time fixed effects) difference in difference approach we were able to replicate the results of Berger*, et al.* (2022) for a sample constrained to larger banks. However, as our model includes a lagged dependent variable these results are subject to the cautions raised by Nickell (1981)

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.

Issuing Equity and Preference shares, OLA and accounting changes.

In this section we examine the impact of the 2010 OLA and the 2014 accounting change 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 accounting change to have any impact on the marginal propensity of banks to issue additional capital. 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 13.[34] 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. We also find that while TARP banks increased their equity issues after 2008, OLA had an additional marginal impact, increasing equity issues. Accordingly, 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. We also consider this perspective by considering those banks with proportionately higher levels of subordinated debt of issue and find the introduction of OLA was significant at the ten percent level.

Table 13 about here.

Our previous results indicated that banks issues of Tier 1 capital has a cyclical component with preference shares more likely to be issued during positive economic cycles and equity more likely to be issued during economic downturns. 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 emphasis upon banks holding increased quantities of equity capital in their capital buffers, as opposed to other complying Tier 1 capital such as preference shares. If holders of subordinated debt are fully cognisant of the quality distinction between equity and preference shares

[34] 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.

we would expect to see the increased equity issues documented in the previous section accompanied by reduced 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 an 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 14.[35]

Table 14 about here.

We find no evidence that systemically important banks (GSIBs and stress test banks) changed their pattern of preference share issues after the introduction of OLA. In the case of the largest twenty five percent of banks by assets we find that both the OLA and the size-based accounting change of 2014 saw decreased preference share issues. As stated above we can see no reason why the 2014 accounting change would produce a change in preference share issues. Thus, we argue that these observed effects represent the 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. Given our results above, we argue that the OLA provided a stimulus to new equity issues, which has been accompanied with reduced use of preference shares.

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 has re-confirmed this importance. By studying a large sample of both listed and unlisted banks we are able to offer several contributions to the existing literature considering bank capital. Previous studies have emphasised large and / or listed banks. However, not all financial crises original from large or listed banks, and 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 are extendable to a wider

[35] 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.

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 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 only for large listed banks. 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 of bank buffers of quality (Tier 1) capital are pro-cyclical. We are able to reconcile these results by considering the cyclicality of different elements of bank capital issues. 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 is driven by the behaviour of listed banks only, 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 comparted to unlisted banks, polices aimed in increasing pro-cyclicality of unlisted bank capital quality will need to incentivise increased earnings retention.

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 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 twenty 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 some 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 size-based accounting reforms of 2014 we are also able to demonstrate that these accounting changes acted to offset the post-TARP and post-OLA increases in observed holdings of bank high-quality capital buffers, without impacting upon bank equity issues. 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. 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, care must also be taken that smaller and unlisted banks do not become a source of a future financial crisis.

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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. [36] 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)	BHCK7205 if year<2015 BHCA7205 if year<2015

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

[36] 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	0.796***	0.796***	0.795***	0.795***	0.570***
	(0.0164)	(0.0164)	(0.0164)	(0.0163)	(0.153)
Lowest 25% of Tier 1 Buffer t-1	-0.0487***	-0.0488***	-0.0496***	-0.0496***	-0.127**
	(0.0111)	(0.0111)	(0.0111)	(0.0111)	(0.0529)
Highest 25% of Tier 1 Buffer t-1	0.0595***	0.0595***	0.0599***	0.0599***	0.177**
	(0.00638)	(0.00637)	(0.00637)	(0.00636)	(0.0793)
Log Total Assets t-2	-0.0466***	-0.0554***	-0.0579***	-0.0579***	-0.0705**
	(0.0136)	(0.0214)	(0.0214)	(0.0214)	(0.0335)
Return on Equity t-2	-0.000996***	-0.000996***	-0.000995***	-0.000995***	-0.000819***
	(9.07e-05)	(9.05e-05)	(9.04e-05)	(9.03e-05)	(0.000162)
Mkt Discipline Subordinated Debts t-2	-0.00936	-0.0113	-0.0128	-0.0134	-0.0654
	(0.0233)	(0.0235)	(0.0236)	(0.0236)	(0.0522)
Complexity (FED Reserve) t-2	-0.00687	-0.00654	-0.00626	-0.00619	-0.0128
	(0.00557)	(0.00554)	(0.00552)	(0.00552)	(0.00947)
Risk Weighted Assets/Total Assets t-2	-0.0212***	-0.0212***	-0.0212***	-0.0212***	-0.0311***
	(0.00214)	(0.00212)	(0.00212)	(0.00212)	(0.00711)
Retail 1 Employees t-2	3.826**	3.770**	3.749*	3.748*	5.603*
	(1.881)	(1.911)	(1.912)	(1.912)	(3.233)
Liquidity: Cash and US Treasury t-2	0.00789**	0.00780**	0.00784**	0.00786**	0.0140*
	(0.00391)	(0.00389)	(0.00389)	(0.00389)	(0.00743)
C&I loans /total loans t-2	-0.00131	-0.00137	-0.00135	-0.00133	-0.00138
	(0.00110)	(0.00110)	(0.00110)	(0.00110)	(0.00164)
Annual Change Bank Debt to GDP t-2 (economic cycle)	-0.00261	-0.00273	-0.00829***	-0.00826***	-0.0121***
	(0.00261)	(0.00260)	(0.00284)	(0.00284)	(0.00420)
Listed Bank	0.00793	-0.179	-0.247	-0.223	-0.121
	(0.0241)	(0.245)	(0.247)	(0.250)	(0.384)
Listed * Log Total Assets t-2		0.0136	0.0178	0.0162	0.0121
		(0.0183)	(0.0184)	(0.0186)	(0.0282)
Annual change in Econ Cycle * Listed t-2			0.0154***	-0.0205	
			(0.00471)	(0.0377)	
Annual change in Econ Cycle * Listed * log Total Assets t-2				0.00244	0.00104***
				(0.00259)	(0.000370)
TARP Bank	-0.132***	-0.133***	-0.130***	-0.130***	-0.170***
	(0.0209)	(0.0209)	(0.0209)	(0.0210)	(0.0406)
2014 Dummy variable	-0.188***	-0.187***	-0.186***	-0.185***	-0.149***
	(0.0302)	(0.0302)	(0.0302)	(0.0302)	(0.0401)
TARP Bank in 4thq 2008	0.931***	0.932***	0.920***	0.919***	0.966***
	(0.114)	(0.114)	(0.114)	(0.114)	(0.117)
TARP Bank in 2009	0.503***	0.504***	0.491***	0.489***	0.684***
	(0.0471)	(0.0471)	(0.0473)	(0.0475)	(0.140)
TARP Bank in 2010	0.483***	0.484***	0.473***	0.471***	0.624***
	(0.0523)	(0.0523)	(0.0525)	(0.0526)	(0.118)
TARP Bank in 2011	0.360***	0.361***	0.346***	0.344***	0.470***
	(0.0400)	(0.0401)	(0.0403)	(0.0405)	(0.0968)
Constant	3.710***	3.827***	3.871***	3.871***	6.338***
	(0.407)	(0.491)	(0.492)	(0.492)	(1.771)

Observations	71,481	71,481	71,481	71,481	71,481
Number of banks	2,455	2,455	2,455	2,455	2,455
F Stat	3707***	3567***	3413***	3268***	1715***
No. of instruments	22	23	24	25	23
AR1 p-value	0	0	0	0	0
AR2 p-value	0.771	0.771	0.765	0.763	0.589
Hansen p-value	0.135	0.136	0.177	0.184	0.252

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	(3) 2ndstage GLS Dependent Variable Tier 1 Capital Buffers
Tier 1 Buffer t-1	0.721***	0.0000161	0.757***
	(0.0252)	(0.0000447)	(0.00555)
Lowest 25% of Tier 1 Buffer t-1	-0.138***	0.000052	-0.120***
	(0.0183)	(0.0000476)	(0.00608)
Highest 25% of Tier 1 Buffer t-1	0.0890***	-0.0000474*	0.0628***
	(0.00915)	(0.0000269)	(0.00359)
Log Total Assets t-2	-0.0291	-0.0497397***	4.056***
	(0.0199)	(0.0002033)	(1.454)
Return on Equity t-2	-0.000883***	0.000000473	-0.000841***
	(0.000124)	(0.000001)	(0.000125)
Mkt Discipline Subordinated Debts t-2	-0.0434	-0.0024773***	0.236***
	(0.0447)	(0.0001756)	(0.0751)
Complexity (FED Reserve) t-2	-0.00136	0.0002422***	-0.0248**
	(0.0104)	(0.0000784)	(0.0120)
Risk Weighted Assets/Total Assets t-2	-0.0235***	0.0000272**	-0.0267***
	(0.00353)	(0.000013)	(0.00179)
Retail 1: Employees t-2	8.355***	-0.1932984***	29.59***
	(2.902)	(0.0138161)	(6.029)
Liquidity: Cash and US Treasury t-2	-0.000207	-0.0001664***	0.0124*
	(0.00581)	-0.0000448	(0.00732)
C&I loans /total loans t-2	-0.000726	-0.0000642***	-0.000998
	(0.00191)	-0.0000166	(0.00279)
Annual Change Bank Debt to GDP t-2 (economic cycle)	-0.00252		
	(0.00401)		
Listed Bank (predicted value from column 2 in column 3)	-0.0132		84.67***
	(0.0397)		(29.14)
Annual change in Econ Cycle * Listed t-2		0.0006072***	-0.0478**
		-0.0000469	(0.0186)
Audit Expenses t-2	0.0315*	0.000522***	
	(0.0172)	(0.000123)	
Annual Change Debt to GDP		-0.0004223***	0.0313**
		-0.0000327	(0.0131)
TARP Bank	-0.149***	-0.0033694***	0.216*
	(0.0370)	(0.0006048)	(0.125)
2014 Dummy variable	-0.187***	-0.00000666	-0.164***
	(0.0332)	(0.0002688)	(0.0333)
TARP Bank in 4thq 2008	0.962***	0.0039331***	0.815***
	(0.119)	(0.0008502)	(0.155)
TARP Bank in 2009	0.516***	0.0033126***	0.233**
	(0.0554)	(0.0004651)	(0.112)
TARP Bank in 2010	0.491***	0.0037861***	0.102

	(0.0570)	(0.0004528)	(0.123)
TARP Bank in 2011	0.368***	0.0026816***	0.111
	(0.0467)	(0.0004595)	(0.0968)
Constant	4.153***	0.6891976***	-52.78***
	(0.586)	(0.0031752)	(20.17)
Observations	32,929	34,718	34,718
Number of banks	1,282	1,302	1,302
F Stat	1211***		
No. of instruments	23		
AR1 p-value	0		
AR2 p-value	0.381		
Hansen p-value	0.200		
Overall R squared			0.611
Chi Square		4100000***	90243***

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 license 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 licence 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	0.800***	0.800***	0.799***	0.799***	0.571***
	(0.0161)	(0.0161)	(0.0161)	(0.0161)	(0.153)
Lowest 25% of Tier 1 Buffer t-1	-0.0464***	-0.0465***	-0.0473***	-0.0473***	-0.126**
	(0.0109)	(0.0110)	(0.0109)	(0.0109)	(0.0531)
Highest 25% of Tier 1 Buffer t-1	0.0580***	0.0580***	0.0584***	0.0584***	0.176**
	(0.00628)	(0.00627)	(0.00627)	(0.00626)	(0.0795)
Log Total Assets t-2	-0.0449***	-0.0547***	-0.0572***	-0.0571***	-0.0699**
	(0.0139)	(0.0212)	(0.0213)	(0.0213)	(0.0335)
Return on Equity t-2	-0.000999***	-0.000999***	-0.000998***	-0.000998***	-0.000820***
	(9.07e-05)	(9.05e-05)	(9.05e-05)	(9.04e-05)	(0.000162)
Mkt Discipline Subordinated Debts t-2	-0.00919	-0.0114	-0.0129	-0.0135	-0.0664
	(0.0231)	(0.0235)	(0.0235)	(0.0235)	(0.0526)
Complexity (FED Reserve) t-2	-0.00751	-0.00720	-0.00693	-0.00687	-0.0136
	(0.00554)	(0.00551)	(0.00549)	(0.00549)	(0.00952)
Risk Weighted Assets/Total Assets t-2	-0.0211***	-0.0210***	-0.0211***	-0.0211***	-0.0311***
	(0.00212)	(0.00211)	(0.00211)	(0.00211)	(0.00715)
Retail 1 Employees t-2	3.784**	3.724**	3.703*	3.702*	5.567*
	(1.866)	(1.894)	(1.895)	(1.895)	(3.233)
Liquidity: Cash and US Treasury t-2	0.00776**	0.00765**	0.00769**	0.00770**	0.0139*
	(0.00387)	(0.00386)	(0.00386)	(0.00386)	(0.00743)
C&I loans /total loans t-2	-0.00127	-0.00133	-0.00131	-0.00130	-0.00134
	(0.00109)	(0.00109)	(0.00110)	(0.00110)	(0.00164)
Annual Change Bank Debt to GDP t-2 (economic cycle)	-0.00335	-0.00348	-0.00886***	-0.00883***	-0.0126***
	(0.00253)	(0.00252)	(0.00279)	(0.00279)	(0.00415)
Listed Bank	0.00407	-0.213	-0.280	-0.259	-0.167
	(0.0238)	(0.248)	(0.250)	(0.254)	(0.389)
Listed * Log Total Assets t-2		0.0158	0.0199	0.0185	0.0152
		(0.0185)	(0.0186)	(0.0189)	(0.0286)
Annual change in Econ Cycle * Listed t-2			0.0150***	-0.0163	
			(0.00471)	(0.0423)	
Annual change in Econ Cycle * Listed * log Total Assets t-2				0.00214	0.00102***
				(0.00292)	(0.000374)
TARP Bank	-0.128***	-0.129***	-0.127***	-0.127***	-0.167***
	(0.0206)	(0.0207)	(0.0207)	(0.0207)	(0.0404)
TARP Bank in 4thq 2008	0.920***	0.920***	0.909***	0.908***	0.956***
	(0.115)	(0.115)	(0.115)	(0.115)	(0.118)
TARP Bank in 2009	0.501***	0.501***	0.489***	0.487***	0.682***
	(0.0476)	(0.0476)	(0.0477)	(0.0479)	(0.140)
TARP Bank in 2010	0.479***	0.480***	0.470***	0.468***	0.621***
	(0.0527)	(0.0527)	(0.0529)	(0.0530)	(0.118)
TARP Bank in 2011	0.354***	0.355***	0.341***	0.339***	0.464***
	(0.0402)	(0.0403)	(0.0405)	(0.0407)	(0.0956)
2014 Dummy variable	-0.208***	-0.207***	-0.206***	-0.205***	-0.168***
	(0.0247)	(0.0246)	(0.0247)	(0.0247)	(0.0371)
Constant	3.651***	3.781***	3.825***	3.825***	6.321***
	(0.405)	(0.486)	(0.487)	(0.487)	(1.778)
Observations					
Number of banks	71,288	71,288	71,288	71,288	71,288
F Stat	2,455	2,455	2,455	2,455	2,455
No. of instruments	3752	3619	3463	3318	1720

AR1 p-value	0	0	0	0	0
AR2 p-value	22	23	24	25	23
Hansen p-value	0	0	0	0	0

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	-0.00461	-0.00451	-0.00483	-0.00435	-0.00484
	(0.0167)	(0.0167)	(0.0167)	(0.0167)	(0.0167)
Lowest 25% of Tier 1 Buffer t-1	-0.0164	-0.0166	-0.0146	-0.0146	-0.0149
	(0.0171)	(0.0171)	(0.0171)	(0.0171)	(0.0171)
Highest 25% of Tier 1 Buffer t-1	0.0483***	0.0481***	0.0485***	0.0477***	0.0486***
	(0.00987)	(0.00988)	(0.00987)	(0.00987)	(0.00987)
Log Total Assets t-2	-0.701***	-0.728***	-0.676***	-0.673***	-0.684***
	(0.0606)	(0.0890)	(0.0895)	(0.0895)	(0.0895)
Return on Equity t-2	-0.00150***	-0.00150***	-0.00150***	-0.00151***	-0.00150***
	(0.000493)	(0.000493)	(0.000493)	(0.000492)	(0.000493)
Mkt Discipline Subordinated Debts t-2	0.184***	0.183***	0.200***	0.180***	0.200***
	(0.0604)	(0.0604)	(0.0605)	(0.0606)	(0.0605)
Complexity (FED Reserve) t-2	-0.0221	-0.0219	-0.0233	-0.0211	-0.0234
	(0.0239)	(0.0239)	(0.0238)	(0.0239)	(0.0239)
Risk Weighted Assets/Total Assets t-2	0.00677	0.00690	0.00667	0.00668	0.00670
	(0.00445)	(0.00445)	(0.00445)	(0.00445)	(0.00445)
Loan Losses / Total Assets t-2	0.760***	0.761***	0.756***	0.750***	0.758***
	(0.0402)	(0.0402)	(0.0402)	(0.0402)	(0.0402)
Retail 1 Employees t-2	-33.91***	-34.12***	-33.79***	-33.81***	-33.84***
	(3.741)	(3.765)	(3.765)	(3.764)	(3.765)
Liquidity: Cash and US Treasury t-2	0.100***	0.100***	0.101***	0.102***	0.101***
	(0.00818)	(0.00820)	(0.00820)	(0.00820)	(0.00820)
Annual Change Bank Debt to GDP t-2 (economic cycle)	-0.0350***	-0.0350***	0.00489	0.00612	-0.00116
	(0.0122)	(0.0122)	(0.0143)	(0.0143)	(0.0143)
Listed Bank	2.592***	1.964	3.499**	4.006***	3.207**
	(0.207)	(1.438)	(1.466)	(1.470)	(1.463)
Listed * Log Total Assets t-2		0.0462	-0.0595	-0.0925	-0.0396
		(0.105)	(0.107)	(0.107)	(0.107)
Annual change in Econ Cycle * Listed t-2			-0.114***	-0.860***	
			(0.0215)	(0.154)	
Annual change in Econ Cycle * Listed * log Total Assets t-2				0.0508***	-0.00659***
				(0.0103)	(0.00145)
TARP Bank	0.542**	0.537**	0.517**	0.523**	0.519**
	(0.242)	(0.242)	(0.242)	(0.242)	(0.242)
TARP Bank in 4thq 2008	0.316	0.317	0.455	0.394	0.443
	(0.410)	(0.410)	(0.411)	(0.411)	(0.411)
TARP Bank in 2009	2.419***	2.419***	2.541***	2.486***	2.530***
	(0.212)	(0.212)	(0.213)	(0.213)	(0.213)
TARP Bank in 2010	3.168***	3.168***	3.253***	3.215***	3.245***
	(0.209)	(0.209)	(0.210)	(0.210)	(0.210)
TARP Bank in 2011	0.835***	0.835***	0.970***	0.915***	0.957***
	(0.213)	(0.213)	(0.215)	(0.215)	(0.215)
2014 Dummy variable	0.204	0.206	0.191	0.207	0.192
	(0.129)	(0.129)	(0.129)	(0.129)	(0.129)

Constant	6.865***	7.205***	6.517***	6.470***	6.624***
	(0.927)	(1.253)	(1.259)	(1.259)	(1.259)
Observations	71,325	71,325	71,325	71,325	71,325
Number of banks	2,454	2,454	2,454	2,454	2,454
Wald Chi Squared	1492***	1493***	1521***	1546***	1514***
Wald Degrees of Freedom	19	20	21	22	21
Adjusted Squared	0.0276	0.0274	0.0280	0.0282	0.0279

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	-0.0230***	-0.0230***	-0.0234***	-0.0230***
	(0.00601)	(0.00601)	(0.00601)	(0.00601)
Lowest 25% of Tier 1 Buffer t-1	0.0150**	0.0151**	0.0151**	0.0152**
	(0.00654)	(0.00654)	(0.00654)	(0.00654)
Highest 25% of Tier 1 Buffer t-1	0.0103***	0.0103***	0.0107***	0.0103***
	(0.00372)	(0.00372)	(0.00372)	(0.00372)
Log Total Assets t-2	0.0846***	0.0883***	0.0872***	0.0903***
	(0.0214)	(0.0215)	(0.0215)	(0.0215)
Return on Equity t-2	-0.00458***	-0.00458***	-0.00458***	-0.00458***
	(0.000198)	(0.000198)	(0.000198)	(0.000198)
Mkt Discipline Subordinated Debts t-2	-0.0368*	-0.0347*	-0.0241	-0.0330
	(0.0203)	(0.0203)	(0.0203)	(0.0203)
Complexity (FED Reserve) t-2	-0.00840	-0.00862	-0.00970	-0.00879
	(0.00739)	(0.00738)	(0.00739)	(0.00739)
Risk Weighted Assets/Total Assets t-2	-8.42e-05	-0.000123	-0.000150	-0.000146
	(0.00137)	(0.00137)	(0.00137)	(0.00137)
Loan Losses / Total Assets t-2	-0.0230	-0.0235	-0.0203	-0.0236
	(0.0147)	(0.0147)	(0.0147)	(0.0147)
Retail 1 Employees t-2	-1.933*	-1.898*	-1.897*	-1.879*
	(1.016)	(1.016)	(1.016)	(1.016)
Liquidity: Cash and US Treasury t-2	0.00545*	0.00550*	0.00495*	0.00550*
	(0.00284)	(0.00284)	(0.00284)	(0.00284)
Annual Change Bank Debt to GDP t-2 (economic cycle)	0.0105**	0.0159***	0.0152***	0.0189***
	(0.00482)	(0.00568)	(0.00568)	(0.00565)
Listed Bank	1.291***	1.397***	1.102***	1.441***
	(0.353)	(0.357)	(0.360)	(0.356)
Listed * Log Total Assets t-2	-0.0940***	-0.101***	-0.0817***	-0.104***
	(0.0257)	(0.0260)	(0.0262)	(0.0260)
Annual change in Econ Cycle * Listed t-2		-0.0154*	0.442***	
		(0.00846)	(0.0611)	
Annual change in Econ Cycle * Listed * log Total Assets t-2			-0.0311***	-0.00162***
			(0.00412)	(0.000570)
TARP Bank	0.0281	0.0247	0.0194	0.0226
	(0.0443)	(0.0443)	(0.0444)	(0.0443)
TARP Bank in 4thq 2008	10.80***	10.82***	10.86***	10.84***
	(0.166)	(0.166)	(0.166)	(0.166)
TARP Bank in 2009	9.564***	9.580***	9.614***	9.591***
	(0.0849)	(0.0853)	(0.0854)	(0.0854)
TARP Bank in 2010	0.353***	0.364***	0.388***	0.371***
	(0.0839)	(0.0841)	(0.0841)	(0.0841)
TARP Bank in 2011	1.940***	1.957***	1.992***	1.969***
	(0.0853)	(0.0858)	(0.0859)	(0.0859)
2014 Dummy variable	-0.0661	-0.0677	-0.0767	-0.0691
	(0.0518)	(0.0518)	(0.0518)	(0.0518)
Constant	-0.725**	-0.776**	-0.755**	-0.803***
	(0.310)	(0.311)	(0.311)	(0.311)

Observations	71,341	71,341	71,341	71,341
Number of banks	2,454	2,454	2,454	2,454
Wald Chi Sq	18507***	18511***	18582***	18517***
DF	20	21	22	21
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 Orderly Liquidation Authority

	Dependent Variable: Tier 1 capital Buffer				
VARIABLES	(1)	(2)	(3)	(4)	(5)
GSIB after 2010	-20.67**				
	(8.313)				
GSIB after 2014	15.15**				
	(6.511)				
Systemic Bank after 2010		4.226***			
		(1.244)			
Systemic Bank after 2014		-6.340***			
		(1.494)			
Biggest 25% (assets) after 2010			0.477***		
			(0.0851)		
Biggest 25% (assets) after 2014			-0.756***		
			(0.0791)		
Listed bank after 2010				0.477***	
				(0.0851)	
Listed bank after 2014				-0.756***	
				(0.0791)	
Top 5% subordinated after 2010					6.789***
					(2.250)
Top 5% subordinated after 2014					-9.774***
					(2.273)
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	3.959***	3.896***	4.031***	4.031***	3.510***
	(0.430)	(0.448)	(0.454)	(0.440)	(0.484)
Observations	71,467	71,467	71,467	71,467	71,467
Number of banks	2,455	2,455	2,455	2,455	2,455
F Stat	2524***	2610***	3037***	3336***	1920***
No. of instruments	29	29	29	29	29
AR1 p-value	0	0	0	0	0
AR2 p-value	0.795	0.793	0.836	0.832	0.564
Hansen p-value	0.251	0.176	0.0602	0.123	0.108

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 change in accounting for minority interests in subsidiaries 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 change in accounting for minority interests in subsidiaries 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 change in accounting for minority interests in subsidiaries 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 change in accounting for minority interests in subsidiaries 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 change in accounting for minority interests in subsidiaries upon those banks with the top 5% of subordinated debt as a proportion of liabilities.

Table 13: 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	-0.00561	-0.00582	-0.00230	-0.00757	-0.00508
	(0.0143)	(0.0143)	(0.0144)	(0.0144)	(0.0143)
Listed Bank	5.628***	6.109***	6.164***	8.576***	5.360***
	(1.481)	(1.486)	(1.490)	(1.571)	(1.473)
Annual change in Econ Cycle * Listed t-2	-0.903***	-1.041***	-0.980***	-0.819***	-0.857***
	(0.158)	(0.161)	(0.157)	(0.154)	(0.154)
Listed * Log Total Assets t-2	-0.218**	-0.252**	-0.255**	-0.448***	-0.199*
	(0.108)	(0.108)	(0.109)	(0.115)	(0.108)
Annual change in Econ Cycle * Listed * log Total Assets t-2	0.0539***	0.0637***	0.0605***	0.0525***	0.0509***
	(0.0106)	(0.0109)	(0.0106)	(0.0104)	(0.0104)
GSIB after 2010	1.596**				
	(0.798)				
GSIB after 2014	-0.640				
	(0.827)				
Systemic Bank after 2010		1.979***			
		(0.461)			
Systemic Bank after 2014		-0.859*			
		(0.474)			
Biggest 25% after 2010			0.706***		
			(0.141)		
Biggest 25% after 2014			-0.342**		
			(0.153)		
Listed after 2010				0.877***	
				(0.142)	
Listed after 2014				-0.0303	
				(0.151)	
Top 5% subordinated 2010					0.552*
					(0.291)
Top 5% subordinated 2014					-0.208
					(0.441)
Constant	6.451***	6.589***	7.066***	5.677***	6.400***
	(1.275)	(1.276)	(1.286)	(1.280)	(1.275)
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	71,295	71,295	71,295	71,295	71,295
Number of banks	2,454	2,454	2,454	2,454	2,454
Wald Chi sq	1403***	1418***	1425***	1447***	1403***
DF	25	25	25	25	25
AdjR2	0.0267	0.0267	0.0268	0.0262	0.0265

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 change in accounting 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 change in accounting 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 change in accounting 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 change in accounting on 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 change in accounting upon those banks with the top 5% of subordinated debt as a proportion of liabilities.

Table 14 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	0.0152***	0.0152***	0.0136**	0.0131**	0.0152***
	(0.00567)	(0.00567)	(0.00569)	(0.00569)	(0.00567)
Listed Bank	1.195***	1.210***	1.013***	0.958***	1.067***
	(0.367)	(0.369)	(0.361)	(0.368)	(0.360)
Annual change in Econ Cycle * Listed t-2	0.427***	0.417***	0.459***	0.460***	0.450***
	(0.0624)	(0.0638)	(0.0622)	(0.0612)	(0.0613)
Listed * Log Total Assets t-2	-0.0888***	-0.0897***	-0.0765***	-0.0749***	-0.0797***
	(0.0266)	(0.0268)	(0.0262)	(0.0270)	(0.0262)
Annual change in Econ Cycle * Listed * log Total Assets t-2	-0.0301***	-0.0294***	-0.0323***	-0.0315***	-0.0316***
	(0.00421)	(0.00431)	(0.00421)	(0.00412)	(0.00413)
GSIB after 2010	0.230				
	(0.295)				
GSIB after 2014	0.403				
	(0.334)				
Systemic Bank after 2010		0.202			
		(0.173)			
Systemic Bank after 2014		0.0918			
		(0.189)			
Biggest 25% after 2010			0.00694		
			(0.0544)		
Biggest 25% after 2014			-0.172***		
			(0.0596)		
Listed after 2010				0.200***	
				(0.0543)	
Listed after 2014				-0.274***	
				(0.0586)	
Top 5% subordinated 2010					0.0610
					(0.111)
Top 5% subordinated 2014					-0.254
					(0.171)
Constant	-0.671**	-0.627**	-0.805**	-0.666**	-0.672**
	(0.314)	(0.314)	(0.319)	(0.314)	(0.313)
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					
Observations	71,307	71,307	71,307	71,307	71,307
Number of banks	2,454	2,454	2,454	2,454	2,454
Wald Chisq	18580***	18579***	18592***	18607***	18578***
DF	25	25	25	25	25
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 change in accounting upon GSIBs. Systemic after 2010 measures the impact of the OLA upon GSIBs. Systemic after 2014 reflects the impact of the 2014 change in accounting 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 change in accounting 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 change in accounting for minority interests in subsidiaries 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 change in accounting for minority interests in subsidiaries upon those banks with the top 5% of subordinated debt as a proportion of liabilities.