BANK OF ENGLAND

Staff Working Paper No. 647

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February 2017

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Abstract

Using quarterly data on FAS 157 fair value disclosures for US bank holding companies from 2008 to 2013, we test whether capital ratios and the effects of market discipline differ according to extent and nature of assets recognized under Level 3 standards. These standards offer management significant discretion for measuring fair values, potentially reducing bank transparency and affecting market perceptions about bank risk. We find limited evidence that capital ratios are lower at institutions engaging in Level 3 trading activities for given risk levels, consistent with opportunistic behaviour. We also find that market discipline, as measured by whether an institution has a US stock exchange listing or dependence on short-term, uninsured funding sources, is effective in moderating this behaviour. At these institutions capital ratios are higher, consistent with there being a direct (*ex ante*) disciplining effect on bank behaviour.

Key words: Banking, market discipline, accounting discretion, regulatory capital ratios.

JEL classification: G21, G28, G32.

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We would like to thank Stephen Dickinson, Fiona Mann, Matthew Willison and members of the Basel Research Task Force Accounting and Regulation working group for helpful comments on previous drafts. The views expressed in this paper are those of the authors, and not necessarily those of the Bank of England or its committees.

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ISSN 1749-9135 (on-line)

1. Introduction

Regulators continue to champion market discipline as a tool to supplement supervisory oversight and mitigate banks' risk-taking behaviour. Recent Basel and Financial Stability Board initiatives expanding disclosures aimed at improving comparability and consistency of risk measures across firms and over time reflect the ongoing emphasis on market discipline.[1] This emphasis persists in spite of an incomplete understanding of the obstacles that can interfere with market discipline – and, in particular, the market's ability to rely on and interpret such disclosures appropriately. The incentive on the part of the banks to shade disclosures, for instance through the use of accounting discretion, is a case in point.

This paper explores the relationship between accounting discretion allowed under fair value accounting standards and banks' risk-taking behaviour. It also examines the role that market discipline plays in this link. When there is little, if any, market activity for an asset or liability at measurement date, fair value accounting standards give banks considerable discretion in measuring such balance sheet items. In the absence of observable market prices, for example, the Level 3 standards set out under the FASB's Statement of Financial Accounting Standards No. 157 (FAS 157), *Fair Value Measurements*, allow banks to use their own judgment, including internal models, as the basis for fair values recognized in financial statements. This flexibility has implications for the transparency of banks' capital measures and, in turn, market perceptions of overall capital adequacy. A key aim of this paper is to test whether bank risk -- as proxied by banks' choice of capital ratios -- and market discipline differ according to two sources of bank opacity stemming from fair value standards: the share and nature of Level 3 assets in bank balance sheets.

For banks whose permissible activities, lending capacity and dividend payment ability depend directly on their ability to satisfy regulatory capital requirements, there exist significant incentives to ensure that capital remains above minimum requirements. The discretion allowed by the fair value accounting standards expands the scope for managing capital and the expected costs associated with breaching (or approaching) regulatory minimums. Of concern to regulators, however, is whether banks use this flexibility for opportunistic reasons, increasing the likelihood of default and negative externalities for the wider economy. While some steps have been taken to deal with this possibility,[2] the regulatory community in general continues to advocate market discipline as a mechanism to contain bank risk-taking.[3] This emphasis persists despite there being no definitive

[1] See, for example, Basel Committee on Banking Supervision (2012, 2014) and Financial Stability Board (2012).

[2] For example, the European Union Regulation 575/2013 (i.e., the Capital Requirements Regulation) sets out requirements related to prudent valuation adjustments of fair valued positions to determine prudent values that achieve an appropriate degree of certainty having regard to the dynamic nature of trading book positions. The regulation requires that institutions apply prudent valuation standards to all assets in both the trading and banking books measured at fair value. Such prudential valuation standards have also been in place in the UK since 2006. In 2010 the UK Financial Services Authority introduced a formal standardized prudent valuation reporting requirement, providing information on valuation uncertainty and confidence ranges surrounding fair values. Of note, however, prudent valuation information is not publicly disclosed.

[3] This focus is evident in, for example, Basel III and the emphasis placed on Pillar 3 disclosures as a way to harness market discipline to supplement supervisory oversight.

conclusions about whether information asymmetries that potentially derive from accounting discretion influence market discipline and its ability to alter banks' risk-taking behaviour.

This paper attempts to address these issues by examining the links between accounting measures set under more discretionary accounting standards and banks' capital management practices. Previous research examining the determinants of banks' capital management practices is relatively extensive and, for the most part, finds evidence consistent with the idea that capital ratios are influenced by a number of factors, including market discipline.[4] A main insight from that literature is that banks typically hold excess capital buffers as a way of mitigating the expected costs associated with falling below regulatory and implied market minimums. Such costs include, for example, more intrusive supervisory oversight, lost business opportunities and higher funding costs as capital ratios fall and solvency risk increases. Prior research also finds that banks take different actions in response to changes in regulatory and market hurdles. This research finds that banks alter capital directly (e.g., by raising new capital or by retaining a higher proportion of earnings), alter risk-weighted assets (e.g., on- and off-balance sheet compositions) or undertake a combination of these strategies.[5]

Because accounting discretion has the potential to affect the degree of information asymmetry between the bank and market participants, a natural question to ask is to what extent the efficacy of market discipline in influencing bank behaviour may also be affected. A primary objective of this paper is to shed light on whether market discipline affects banks' capital management practices and whether this effect differs according to the share and nature of FAS 157 (Level 3) activities in which they are involved. Prior research shows that banks became increasingly opaque as economic conditions worsened ahead of the recent crisis (e.g., Flannery et al., 2012) and that the market factored this opacity into its pricing decisions, applying higher valuation discounts to banks with more opaque assets (e.g., Jones et al., 2013). Together, these findings suggest that the relationship between capital ratios and measures of market discipline may change as economic conditions change. For that reason we account for this potential influence and examine its impact on banks' choice of capital ratios while also controlling for market discipline, accounting discretion and economic conditions.

Using panel data on more than 600 US bank holding companies spanning from the first quarter 2008 to the fourth quarter 2013, we investigate the determinants of US banking institutions' choice of capital ratios in more detail. Our study contributes to the previous research on this topic in two ways. First, we examine the extent to which accounting discretion may feature in capital management practices, after controlling for a host of other factors found useful in prior research for explaining capital ratios. Altering capital ratios in response to regulatory and market pressures is costly, but discretionary accounting standards

[4] See, for example, Jackson et al. (1999) for a review of early work in this area. VanHoose (2008) reviews more recent work. Ediz et al. (1998), Alfon et al. (2004) and Francis and Osborne (2010) present results for UK banks.

[5] See, for example, Berrospide and Edge (2010), Francis and Osborne (2012), Aiyar at al. (2014) and Bridges et al. (2014).

may offer banking institutions an alternative, and ostensibly cheaper way in which to manage capital ratios. If it is a cheaper alternative, then we might expect to find a more significant association between capital ratios and activities accounted for under Level 3 fair value standards. This alternative, however, may also offer ways for banks to engage in opportunistic risk-taking behaviour, but only to the extent that market participants do not take this possibility into consideration and punish firms accordingly (e.g., demanding higher risk premiums or curtailing funding supply). A second contribution of our paper is that we examine whether the strength of market discipline in influencing capital management practices depends on the degree of accounting discretion embedded in bank's fair value measurements.

Consistent with prior research, we find that discipline from disclosure and short-term debt holders provides incentives for bank holding companies to choose higher risk-based capital ratios for given risk. We find no significant association between capital ratios and the broad share of assets accounted for under Level 3 standard. This finding refutes the idea that holding companies exploited Level 3 discretion for opportunistic reasons.

When looking at the breakdown of Level 3 activities in more detail, however, we find some evidence that firms engaged in Level 3 trading activities have lower capital ratios for given levels of risk. This result is consistent with the idea of Level 3 discretion supporting opportunistic (moral hazard) behaviour. We also find that market discipline, as measured by whether a firm has a US stock exchange listing or the degree of its reliance on short-term funding sources, is effective in moderating this behaviour. Capital ratios are higher at listed banks and banks with greater reliance on short-term funding, and this relationship is more pronounced at institutions reporting Level 3 loans and trading assets. This result provides at least some tentative evidence that the market is effective in reducing the incentives of banks to use accounting discretion for opportunistic (moral hazard) reasons.

The rest of this paper is arranged as follows. Section 2 provides background on fair value accounting and develops our paper's two main hypotheses. Section 3 describes our econometric approach, while Section 4 describes our data. Section 5 presents bank level panel data analysis of the relationship between factors measuring accounting discretion, market discipline and capital ratios. Section 6 discusses additional tests and robustness checks. Finally, Section 7 concludes and discusses policy implications.

2. Accounting discretion and hypotheses development

The purpose of this section is threefold. First, it discusses fair value accounting and the discretion afforded in the FAS 157 fair value hierarchy. Second, it briefly explains how this discretion can act as a source of uncertainty to market participants, including investors and regulators, in pricing risk and assessing the overall capital adequacy of a bank holding company. Third, it discusses the implications of such discretion for bank behaviour and sets out the two hypotheses explored in this paper.

2.1. Background on fair value accounting

Over the past two decades, accounting standards have permitted wider use of a blend of historical cost and fair values for measuring and reporting balance sheet items. In 2006 US accounting standards setters introduced FAS 157 (*Fair Value Measurements*) to help reduce inconsistencies and complexities in the use of fair value measurements in financial statements. Effective for fiscal years beginning after November 15, 2007, FAS 157 provided more guidance on the methods used to measure fair value and expanded disclosures about fair value measurements.[6]

In the absence of observed market prices, fair value measurements may become more opaque and unreliable due to inherent estimation errors or management biases. FAS 157 aimed to address these issues and established a three-level fair value hierarchy of disclosure that depends on the relative reliability of the nature of the inputs used to measure fair values. Level 1 inputs are generally perceived as the most reliable (least discretionary) and include quoted prices in active markets for the assets and liabilities in question. Level 2 inputs include observable prices in active markets for comparable assets and liabilities or observed prices in inactive markets for identical balance sheet items. Level 2 inputs also include prices verified using other market-based techniques (e.g., correlation with credit default swap spreads). Level 3 inputs are not observable and are based on the best information available in the circumstances and judgment about the assumptions that market participants would use in pricing an asset or liability. Discussed in more depth below, Level 3 inputs afford management the greatest degree of discretion in measuring assets and liabilities. This presents market participants with yet another layer of uncertainty potentially affecting their assessments of a bank's capital adequacy.

2.2. Fair value discretion, managerial opportunism and market uncertainty

Under this framework the degree of information asymmetry increases the higher the fair value level employed. Because Level 3 inputs are not observable and the valuation methods and assumptions are more discretionary, Level 3 measurements are most vulnerable to information problems between management and market participants. And when accounting information is more subjective in nature, allowing firms to exercise a high degree of discretion over it increases the chance that firms may bias their estimates for opportunistic reasons.

Indeed, Huizinga and Laeven (2012) document that US banks overstated asset values during the run-up to the 2007-09 financial crisis. This evidence is consistent with the idea that banks used the provisions of the fair value hierarchy to manage capital and mitigate the costs of breaching or approaching regulatory capital requirements. Such costs include, among other

[6] Underpinning this guidance was an emphasis that fair value is a market-determined, as opposed to a firm-specific, measurement. This focus meant that assumptions typically used by market participants in pricing an asset or liability should determine fair value measurements. The guidance distinguished between assumptions based on observable market data or prices in active markets for assets and liabilities (i.e., observable inputs) and those based on a firm's own judgment about market participant valuation assumptions developed based on the best information available in the absence of such information (i.e., unobservable inputs).

things, direct compliance costs associated with increased regulatory oversight and indirect costs stemming from restrictions on capital distributions or heightened market pressures.

Previous research documents that market participants view accounting measures that are more discretionary as being less credible or, in short, less value relevant. Song et al. (2010), for example, provide evidence that investors discount Level 3 measures more than Level 1 and 2 measures that are subject to relatively less discretion and are more verifiable. In addition, Goh et al. (2009) find that investors value Level 3 net assets less than Level 1 net assets.[7] These results suggest that investors are likely to decrease the weight they place on (less reliable) Level 3 fair value measurements in their pricing decisions due to information risk, inherent estimation errors and possible measurement biases.

2.3. Behavioural implications and hypotheses development

Researchers have also shown that, in more general settings, imprecise accounting information can lead to higher corporate bond spreads (e.g., Duffie and Lando (2001) and Yu (2005)). In the context of banking, Pritsker (2010, 2013) sets out the channels through which uncertainty about the drivers of default risk can affect banks' funding costs. He shows analytically how opacity about asset portfolio composition gives rise to 'Knightian' uncertainty (i.e., not measurable) about banks' capital adequacy and default risk and how such uncertainty, in turn, affects the spreads that banks must pay for borrowing in the interbank lending markets. He decomposes the spreads into two components: (i) a default premium for expected losses in a setting in which the determinants of a borrowing bank's default probability are known and (ii) a premium reflecting the amount a borrowing bank must pay because bank creditors are uncertain about the underlying determinants of a borrowing bank's default risk.

In Pritsker's framework the source of this uncertainty premium stems from limited information about borrowing banks' asset portfolio composition -- specifically, the proportion of risky assets held by borrowing banks -- rather than from uncertainty about accounting (fair value) measures per se. Still, the implication here is that uncertainty about accounting information can drive up market participants' adverse selection and information processing costs, in turn increasing a bank's cost of capital overall.[8] Banks' optimal balance sheet management and risk-taking behaviours should reflect such market impacts. Since under FAS 157 the observability of Level 1 and Level 2 inputs is meant to reduce uncertainty, we expect market impacts on risk-taking behaviour, capital management practices and incentives to hold capital buffers to differ from those associated with Level 3 measures. This leads to our first hypothesis (stated in alternative form):

H1: Opportunistic behaviour: *Desired capital ratios at bank holding companies that employ discretionary Level 3 fair value inputs are lower than those of bank holding companies that do not employ such estimates for given levels of risk.*

[7] This study also finds that investors do not value Level 2 and Level 3 net assets differently, implying that they may view the reliability of Level 2 and Level 3 inputs similarly.
[8] See, for example, Diamond and Verrechia (1991) for further exposition on this idea.

Here we are concerned with the idea that bank holding companies may target lower capital buffers because they believe that Level 3 standards offer greater opportunity to manage capital ratios through asset measurements as a way of reducing the expected costs of breaching or approaching regulatory capital requirements. Indeed, Moyer (1990) finds evidence that managers adjust accounting choice as capital regulation is introduced. Huizinga and Laeven (2012) and Laux and Leuz (2010) speculate that banks may have used discretion in accounting rules to keep asset values high relative to concurrent market prices and expectations during the run-up to and height of the crisis.

For the reasons stated above, to the extent that the market demands higher compensation for default risks stemming from accounting uncertainty, then this mechanism may likely reduce incentives to use accounting discretion for opportunistic purposes. Previous studies document that the strength of market discipline may be affected by the transparency of banks' risk choice though public disclosures, as proxied by being listed on a primary US stock exchange (e.g., see Nier and Baumann, 2006), and the degree of short-term, uninsured funding dependence (e.g., Diamond and Rajan, 2001). Banks exposed to these measures and that are involved in Level 3 activities may, as a result, take pre-emptive actions to mitigate the effects of market discipline, which leads to our second hypothesis (stated in alternative form):

H2: Market discipline**:** *Desired capital ratios at bank holding companies that employ discretionary Level 3 fair value estimates are higher if they are listed on a primary US stock exchange or as their reliance on short-term, uninsured funding sources increases (i.e., where the strength of market discipline is greater).*

Here we test for evidence of whether the market is effective in increasing bank holding companies' incentives to fund themselves with additional capital to reduce the (moral hazard) risk of failure and deal with adverse market perceptions about the reliability of Level 3 fair value asset estimates.

3. Econometric set-up

This section describes the econometric approach we take to evaluate the drivers of capital management practices in general and the impact of fair value accounting in particular. We first review the framework typically used in studies on the determinants of capital ratios and then set out our key research questions, data and methodology.

3.1. Determinants of bank capital ratios

Studies of banks' desired capital ratios commonly employ a simple partial adjustment model (see, for example, Alfon et al. (2004), Ayuso et al. (2004), Estrella (2004), Bikker and Metsemakers (2004), Jokipii and Milne (2008), Francis and Osborne (2010)). This model adjusts banks' current capital ratio, $k_{b,t}$, to its targeted level, $k^*_{b,t}$, according to the following:

$$k_{b,t} - k_{b,t-1} = \lambda(k^*_{b,t} - k_{b,t-1}) , \qquad (1)$$

where λ is a positive adjustment factor, b indexes banks and t indexes time. In the long run, $k_{b,t}$ converges to the optimal (or desired) $k^*_{b,t}$. If λ equals zero, no adjustment is made, potentially because adjustment costs outweigh the costs of remaining away from the desired ratio. If λ equals one, then full adjustment is made within one time period of analysis (e.g., one quarter in our setup). Since the desired capital ratio, $k^*_{b,t}$, is not observable, we approximate it as a function of a set of N explanatory factors:

$$k^*_{b,t} = \sum_{n=1}^{N} \beta_n X_{n,b,t} \, , \tag{2}$$

where X is a vector of N explanatory factors and β is a conforming vector of parameters. Combining (1) and (2) yields the following model of a bank's choice of capital ratio:

$$k_{b,t} = (1-\lambda) k_{b,t-1} + \sum_{n=1}^{N} \lambda \beta_n X_{n,b,t} \, . \tag{3}$$

We use equation (3) as the basis for examining our two main research questions. The first is whether banks' desired capital ratios differ according to degree of discretion inherent in activities accounted for under the fair value hierarchy of FAS 157. Here we are specifically interested in examining for evidence on opportunistic behaviour set out in hypothesis 1 above. The second question is whether the influence of market discipline on bank's desired capital ratios (and capital management practices) depend on the degree of accounting discretion inherent in activities accounted for under the fair value hierarchy of FAS 157. Answers to this question will help evaluate the evidence on our second hypothesis related market discipline above.

3.2. Model development

To formulate the empirical tests of the relationships between capital ratios, market discipline and accounting discretion, we begin by specifying a general model of the determinants of banks' targeted capital ratios using the partial adjustment approach above and then modify it to control for accounting discretion, market discipline and macroeconomic and market conditions. Our basic model is represented as follows:[9]

$$\begin{aligned} TOTRBC_{b,q} = {} & \beta_0 + \beta_1 TOTRBC_{b,q-1} + \beta_2 ALLL_{b,q-1} + \beta_3 ROE_{b,q-1} \\ & + \beta_4 SIZE_{b,q-1} + \beta_5 AGGNCO_{q-1} + \beta_7 VIX_{q-1} \\ & + u_b + \pi_q + e_{b,q}. \end{aligned} \tag{4}$$

Our dependent variable, the total risk-based capital ratio (TOTRBC), is calculated as the ratio of total regulatory capital to total risk-weighted assets in the banking and trading books as computed under the Basel 1 Capital Accord. As shown in Figure 1, the median total risk-based capital ratio for all US bank holding companies in our sample (discussed below)

[9] We specify our baseline model in fixed-effects form for reasons discussed below. We recognize that not all variables may be included in the actual estimation due to possibly high correlation between some variables. This issue may be particularly relevant with respect to our measures controlling for market and economic conditions. As a result, to avoid issues with multi-collinearity, we employ slightly modified versions of this specification.

increased gradually from approximately 12% at the beginning of 2008 to over 15% at the end of 2013. Figure 1 also shows that capital ratios are relatively dispersed both across institutions and over time. Figure 1 also reports a subtle upturn in total risk-based capital ratios around the time of the significant jump in market uncertainty near the end of 2008 and the height of the 2007-09 financial crisis.

3.3. Firm-specific controls

We based our selection of explanatory variables largely on previous research on the determinants of bank capitalization. To control for systematic differences in bank holding companies' ability and incentives to adjust capital ratios, we include a proxy for the cost of altering capital ratios. One important factor considered by Estrella (2004), for example, is the opportunity cost associated with holding capital. While in practice measurement of this cost is challenging, we follow previous studies (e.g., Ayuso et al., 2004; Stolz and Wedow, 2005; Bikker and Metzembakers, 2004; Jokipii and Milne, 2008; Francis and Osborne, 2010) and employ firms' return on equity (*ROE*), the ratio of after-tax net income to total equity.[10] Under this cost interpretation, we expect to find a negative association between capital ratios and the *ROE* variable. If, on the other hand, stronger banks with higher ROEs are better able to increase capital ratios through higher retained earnings, then we may expect to observe a positive association with capital ratios.

Estrella (2004) found some evidence consistent with the idea that banks' capital management practices are driven by the expected cost of failure, which depends on the likelihood of default. To control for this possibility, we include two variables to control for the riskiness of bank holding companies' business models. The first is a measure of the bank holding company's own assessment of risk embedded in the asset portfolio, the ratio of the allowance for loan and lease losses to total assets (*ALLL*). Finding a positive association between risk-based capital ratios and *ALLL* would be consistent with bank holding companies attempting to dampen expected cost of failure. A negative association would be consistent with moral hazard behaviour.[11]

The second measure is firm size, measured by the natural log of total assets (SIZE). Prior studies also find that firm size affects capital management practices (e.g., Alfon et al., 2004; Stolz and Wedow, 2005; Jokipii and Milne, 2008; Francis and Osborne, 2010). The arguments for this finding is that larger firms typically have greater ability to diversify risks across asset classes and geographic locations, can capitalize on economies of scale in risk management practices and generally have better access to capital markets, making it easier to raise capital if needed. For these reasons, we expect size to be negatively associated with risk-based capital ratios.

[10] For our quarterly estimations, we annualized all variables involving financial statement flow measures. Results are similar using a rolling 4-quarter calculation.

[11] To account for a more direct measure of the riskiness of the firms' asset portfolio, we also included the proportion of assets past due ninety days or more or on nonaccrual status (*PDNAC*) in additional specifications. Assets that are on nonaccrual status are non-performing and not well-secured or in the process of collection. Interest is not permitted to be accrued on such assets and reflected in revenue until the problems have been corrected. Results remain qualitatively similar when using this variable rather than ALLL.

3.4. Market, industry condition and macroeconomic controls

To account for the influence of system wide risk on capital management practices, we include two aggregate measures of risk. The first is the stock market volatility index, *VIX*, provided by the Chicago Board Options Exchange (i.e., CBOE S&P volatility index). This index represents one measure of the market's expectation of stock market volatility over the near term. Higher readings imply that investors perceive significant risk that the market will move sharply, downward or upward, and, in that sense, the *VIX* gauges uncertainty in the broader market. The second measure includes the ratio of aggregate net charge-offs (i.e., loan write-offs less recoveries) to total loans, *AGGNETCO*, for the banking sector. The ratio reflects the underlying risk of the banking sector's loan portfolio. We expect to find a positive association between total risk-based capital ratios and both of these measures, consistent with the idea that banks desire to hold higher capital ratios to buffer the effects of more volatile conditions and worsening asset quality. Finally, we use period effects to account for changes in macroeconomic conditions that may affect banks' capital ratios simultaneously (e.g., through their ability to generate earnings, accrete capital or issue new capital directly).

3.5. Market discipline variables

Previous research has found evidence that market discipline affects banks' funding costs and access to key capital markets activities (e.g., Flannery and Nikolova, 2004). Bank depositors and creditors can act to contain bank risk-taking if they demand higher rates of return (or withdraw funds) as banks assume additional risk. Profit maximizing (cost minimizing) banks would optimally consider these actions in their risk-taking and capital management practices. To mitigate the pressure from market discipline, banks may, for example, elect to choose higher levels of capital to reduce leverage and therefore the likelihood of failure or regulatory breach.

To account for the degree to which a bank holding company may be subject to market discipline, we include two factors that are likely to affect the strength of market discipline. First, we include an indicator variable set equal to one if the bank holding company is listed on a primary US exchange (NYSE, NASDAQ or the AMEX) and zero otherwise.[12] Nier and Baumann (2006) provide evidence that market discipline is greater for banks listed on a primary US exchange (*LISTING*). Their results provide indirect evidence that the quality and quantity of bank disclosure depends on where it is listed.

Theory suggests that the influence of market discipline should be greater the larger the amount of uninsured funding. More specifically, for a given increase in risk, the consequent market discipline is expected to have a stronger cost impact the more a bank relies on such uninsured funding sources. Indeed, there is some evidence in the United States that subordinated debt holders, which are uninsured and stand behind insured depositors in the event of insolvency, are effective in imposing such discipline (e.g., Covitz et al., 2004). Consistent with this theory, our second measure of market discipline includes the ratio of

[12] In constructing this variable, we relied on the dataset and link produced by the Federal Reserve Bank of New York (see Kovner et al., 2013 for more detail).

short-term, uninsured borrowed funds to total assets (*BORROW*). This measure includes commercial paper and other wholesale funding sources with maturities less than one year. Such short-term funding sources are likely to provide another avenue for market discipline given the relatively more continuous way in which the terms on such borrowings are renegotiated and updated based on a borrowing bank's risk profile.[13]

3.6. Accounting discretion variables

We extend our base model to consider whether accounting discretion affects capital management practices and the influence that market discipline has on such practices. We use measures from the fair value hierarchy to proxy such discretion and include the share of total assets reported under each of the Level 1, 2 and 3 criteria under FAS 157 (*FVA1*, *FVA2* and *FVA3*). As described in more detail below, our data sources facilitate analysis of this relationship on a more granular basis across three asset categories: loans, trading assets, and other assets. Finding a significant association between desired capital ratios and these fair value measures may provide some evidence on how banks employ the fair valuation hierarchy in managing capital ratios. If banks are using discretion opportunistically, then we might expect to find a negative association between desired capital ratios and Level 3 measures after controlling for risk.

3.7. Estimation procedure

Our estimation proceeds as follows. First, we estimate the baseline model (4) incorporating our two measures of market discipline separately to examine their effectiveness in influencing bank holding companies' capital management practices. Second, to explore the relationship between accounting discretion and market discipline, we independently introduce measures from the fair value hierarchy and a moderating parameter which interacts these variables with our measure of market discipline, where *MDISC* is *LISTING* or *BORROW*.

$$\begin{aligned} TOTRBC_{b,q} = {} & \beta_0 + \beta_1 TOTRBC_{b,q-1} + \beta_2 ALLL_{b,q-1} + \beta_3 ROE_{b,q-1} \\ & + \beta_4 SIZE_{b,q-1} + \beta_5 AGGNCO_{q-1} + \beta_6 VIX_{q-1} + \beta_7 MDISC_{b,q-1} \\ & + \beta_8 FVA1_{b,q-1} + \beta_9 FVA2_{b,q-1} + \beta_{10} FVA3_{b,q-1} \\ & + \beta_{11}(MDISC*FVA1)_{b,q-1} + \beta_{12}(MDISC* FVA2)_{b,q-1} \\ & + \beta_{13}(MDISC*FVA3)_{b,q-1} + u_b + \pi_q + e_{b,q}. \end{aligned} \tag{5}$$

The coefficients on the interaction variables measure the marginal impact of market discipline on capital management practices when the bank holding company engages in activities accounted for under the fair value hierarchy. We are particularly interested in evaluating the effect of market discipline on the incentives of bank holding companies involved in Level 3 activities (i.e., activities accounted for using relatively greater management discretion) to hold capital buffers. Finding a statistically significant coefficient

[13] The role of short-term debt as a disciplining device has been discussed in a literature going back to Calomiris and Kahn (1991) and more recently in Diamond and Rajan (2001).

estimate on these interaction terms may provide initial evidence that the market affects capital management practices at firms involved in activities accounted for under the Level 1 to 3 hierarchy. If the market is effective in disciplining holding companies in general, we should observe a positive coefficient on β_7. The relationship between market discipline and accounting discretion becomes more evident upon taking the partial derivative with respect *MDISC*, which yields $\beta_7 + \beta_{11}FVA1_{b,q-1} + \beta_{12}FVA2_{b,q-1} + \beta_{13}FVA3_{b,q-1}$. If β_7 is statistically significant and positive, then this may provide some evidence of a market disciplining effect. Finding that β_{13} is also positive and statistically significant may be evidence of a further moderating influence of market discipline on banks' incentives to use accounting discretion for opportunistic reasons.

We undertake this two-step process using both the broader fair value classes, *FVA1*, *FVA2* and *FVA3*, as well as the more granular categories related to loans, trading assets and other assets. We focus on evaluating the marginal impacts of Level 3 measures initially using the specification below and then extend the analysis to consider Level 1 and Level 2 measures in subsequent tests (discussed in Section 6).

$$\begin{aligned} TOTRBC_{b,q} = {} & \beta_0 + \beta_1 TOTRBC_{b,q-1} + \beta_2 ALLL_{b,q-1} + \beta_3 ROE_{b,q-1} \\ & + \beta_4 SIZE_{b,q-1} + \beta_5 AGGNCO_{q-1} + \beta_6 VIX_{q-1} + \beta_7 MDISC_{b,q-1} \\ & + \beta_8 LOAN\_FVA3_{b,q-1} + \beta_9 TRAD\_FVA3_{b,q-1} + \beta_{10} OTHER\_FVA3_{b,q-1} \\ & + \beta_{11}(MDISC*LOAN\_FVA3)_{b,q-1} \\ & + \beta_{12}(MDISC*TRAD\_FVA3)_{b,q-1} \\ & + \beta_{13}(MDISC*OTHER\_FVA3)_{b,q-1} \\ & + u_b + \pi_q + e_{b,q}\,. \end{aligned} \tag{6}$$

We use bank-time fixed effects panel models, which allow for differences in behaviour across individual bank holding companies and time periods. It also accounts for possible omitted variables. While the presence of a lagged dependent variable may suggest a need for the Generalized Methods of Moment (GMM) estimator, we chose to use fixed effects based on Alvarez and Arellano (2003), which shows that for a relatively long period T, the GMM estimator will be close to the fixed effect estimator. This is because the fixed effects estimator has bias of order T^{-1}, in the presence of lagged dependent variables. Because we have quarterly data for seven years (28 periods), we have used fixed effects in our estimation rather than dynamic panel data (GMM) methods.[14] To deal with non-normal residuals, we employ GLS procedures that give less weight to large residuals when minimizing sum of squared residuals to derive parameter estimates.

[14] Flannery and Hankins (2013) also provide simulation evidence documenting that fixed effects often outperforms GMM estimators in estimating dynamic panel models when the panel length ("T") approaches 30.

One possible problem that we encounter with this specification, however, is that the dependent variable, a bank holding company's total risk-based capital ratio, may exert influence on our measures of market discipline. This is because an institution's ability to tap the short-term, uninsured funding market may be stronger if it is better capitalized. As a result, this effect may imply a positive association between BORROW and capital, with the causality flowing in the opposite direction. To deal with this potential endogeneity problem, we employ a Two Stage Least Square instrumental variables estimation procedure. In particular, we use annualized return on assets, the share of assets that are past due 90 days or more or on nonaccrual status, and the shares of total assets comprised of residential real estate loans, commercial loans and investment securities in a first stage regression to predict BORROW.[15] Since the LISTING variable is relatively unchanged across time, it is less likely to suffer from potential endogeneity bias. For this reason, we do not use instruments for this variable.

4. Data and sample description

Our sample includes an unbalanced panel of financial data from over 600 US bank holding companies spanning from the first quarter 2007 to the fourth quarter 2013. The Federal Reserve Consolidated Financial Statements for Holding Companies, known as the FR Y-9C report, provided the main source of our firm-level data.[16] Filed quarterly by bank holding companies with total consolidated assets of $500 million or more, these reports incorporate over twenty different schedules, providing a host of detailed information about the financial condition and performance of these firms. Schedule HC-Q supplied our main source of Level 1 to 3 fair values measured on a recurring basis by bank holding companies. This schedule reports the fair values as recognized in the bank holding companies' balance sheets and the amounts measured using the Level 1 to 3 fair value hierarchy.

As mentioned, FAS 157 was originally issued in 2006, effective for fiscal years after November 15, 2007. Some bank holding companies began reporting broad categories of Level 1 to 3 fair value measures in 2007 if they voluntarily elected to apply the fair value standards retroactively. In 2008 Schedule HC-Q was amended to include a more detailed breakdown of fair value assets and liabilities, and all bank holding companies were required to report this information.

The Chicago Board Options Exchange supplied the S&P 100 volatility index.[17] The FDIC Quarterly Banking Profile provided aggregate net charge-off measures for the US banking sector.[18] Table 1 lists the firm-specific and macroeconomic control variables along with a brief description and expected association with targeted capital ratios.[19]

[15] We also employed this approach and the same set of exogenous regressors to instrument the interaction terms involving the BORROW variable. Results of the first stage regressions are available upon request.
[16] We obtained these data from the Federal Reserve Bank of Chicago website: http://www.chicagofed.org/webpages/banking/financial_institution_reports/bhc_data.cfm.
[17] Specifically, the index data were available at http://www.cboe.com/micro/VIX/vixintro.aspx.
[18] Available at https://www2.fdic.gov/qbp/.
[19] Annex 1 provides more detail on the construction of these variables using regulatory return data.

Our initial sample included over 23,000 firm-quarter observations, encompassing more than 1,500 individual firms. To mitigate short panel bias, we restricted our sample to bank holding companies that reported at least 24 quarters of data during the period 2007 to 2013.[20] This reduced our firm-quarter observations to just over 14,000, capturing slightly more than 600 bank holding companies overall. Finally, to limit the influence of extreme outliers, we winsorized all variables at the 1st and 99th percentiles.

Table 2 provides summary statistics for these variables.[21] Most US bank holding companies in the sample tended to hold total risk-based capital ratios above the 8% regulatory minimum. The total risk-based capital ratios over the estimation period averaged around 15%, with the majority of the sampled firms holding capital ratios in excess of 12%. The average (median) of our proxy for bank risk choice, the ratio of the allowance for loan and lease losses (ALLL) to total assets, is slightly over 1%. The annualized earnings performance measures vary considerably over our estimation sample, with the average (median) ROE approximating 4% (7%). Roughly a third of our sample has a US stock exchange listing, while over three-quarters of the sample employ short-term, uninsured debt (with the average outstanding reliance on such funding sources around 2%).

Averaging around 14%, the largest share of FAS 157 fair value assets is within the Level 2 category, which compares well above the Level 1 and 3 averages of roughly 4% and 1%, respectively. Looking at the reported percentiles reveals that more than half of the sampled firms reported Level 2 assets and that the use of Level 3 discretion appears to be relatively limited and concentrated in the "Other Asset" category. We also looked at the distribution of FAS 157 Level 1 to 3 assets overall to get a sense of the proportion of firms in our estimation sample that actually engage in such activities. The table shows that 75% of our estimation sample reported assets using the FAS 157 hierarchy, representing at least 9% of these institutions' asset base. This result provides comfort that our estimation sample includes a sufficient share of institutions reporting under the FAS 157 fair value standards.

5. Results

The estimation sample for all results discussed in this section includes bank holding companies that reported at least 24 quarters of data spanning the period 2008 to 2013. Table 4 reports the baseline results with firm-specific and industry condition controls in column (1). We augment the benchmark model with the market discipline variables separately in columns (2) and (3). The coefficients on the listing indicator variable (Listing) and our short-term borrowing measure (Borrow) are both positive and statistically significant. These findings are consistent with the idea that more disclosure (due to being listed on a major exchange) and greater reliance on short-term, uninured funding prompt bank holding companies to choose larger total risk-based capital ratios, all else equal.

[20] While this requirement may introduce some selection bias, we believe this bias is likely less of a concern than that of short panel bias in dynamic panel model estimates. It is primarily for this reason that we do not consider, for example, failed institutions that have fewer than 24 quarterly observations during our sample period. Our estimates do reflect failed institutions to the extent that these may have failed during the last year of our sample period.

[21] Table 3 reports pair-wise correlations between these variables.

To provide some context for understanding the economic significance of these coefficients, it is useful to consider the average total risk-based capital ratio, which is around 15%. The coefficient on the Listing variable suggests that banks that are potentially subject to more stringent market discipline because they disclose more information tend to have total risk-based capital ratios that are, on average, 25 basis points higher than non-listed firms. The coefficient on short-term, uninsured borrowing measure suggests that, everything else equal, a firm that supports its balance sheet with short-term, borrowed funds equal to 1 percent of total assets would have a total risk-based capital ratio of around 50 basis points higher than an institution that does not rely on such funding.

There are a few other results in Table 4 worth highlighting. First, with respect to the lagged capital ratio, coefficient estimates are generally consistent with findings from previous research on the determinants of bank capital ratios. We find that the coefficient on the lagged capital ratio is positive and statistically significant in all specifications, with our results implying a relatively quick adjustment of capital ratios to target. In particular, the estimated average speed is around 50 percent per year base on our benchmark model and not out of line with the 36 and 49 percent speeds reported by Berrospide and Edge (2010) and Flannery and Rangan (2008), respectively, which also employed US bank holding company data. Second, in line with expectations, we find that larger banks tend to choose lower capital ratios and more profitable banks target higher capital ratios. Our measure of risk (ALLL) is negatively associated with capital ratios; however, the relationship is not consistently statistically significant. Third, capital ratios are positively associated with our proxy for aggregate credit conditions in the banking sector, while market volatility is negatively associated with capital ratios.

Overall, the specifications generate reasonable results and suggest that an increase in market discipline can strengthen incentives for bank holding companies to target higher capital ratios. The results show that firms that disclose more information, as proxied by whether it is listed on a US stock exchange, tend to have higher capital ratios relative to firms that disclose less. In addition, we find evidence that short-term, uninsured funds have a disciplining effect.

5.1. Marginal effects of accounting discretion and market discipline

While the results so far provide reasonable evidence on the general effectiveness of the market discipline, they say nothing about the differential effects of market discipline on institutions that employ relatively more accounting discretion. If market discipline exerts an impact on activities accounted for using more management discretion, we should observe differences in the sensitivity of capital decisions across activities that (are generally similar in risk but) differ with respect to the extent that discretion underlies their recognized measures. This subsection discusses results of our tests examining whether capital ratios and the effects of market discipline differ according to the degree to which banks employ discretion under the FAS 157 fair value hierarchy. We are especially interested in testing the hypothesis that the effects of disclosure (i.e., as measured by whether a firm is listed on a US exchange) and

short-term funding may be stronger at institutions that recognize higher shares of assets measured using the more discretionary Level 3 standards.

We focus first on examining for differential effects of broad Level 1 to 3 asset disclosures on capital ratios. Table 5 shows positive and statistically significant associations between capital ratios and assets recognized under Level 1 and 2 fair value standards. This finding suggests that institutions recognizing assets under Level 1 and Level 2 standards tend to have higher risk-based capital ratios. The results also show that while the association between the capital ratio and the share of Level 3 assets is positive (negative) in the column 2 (3), the coefficient estimate is not statistically significant. This result suggests that the capital ratios at institutions employing discretion under Level 3 standards are not different from capital ratios at institutions that do not use Level 3 discretion. At least preliminarily, this result provides no definitive evidence of opportunistic behaviour.

To gain some insight into whether market discipline differentiates among assets that differ according to the degree of management discretion underpinning their recognized measurement, we interact our market discipline variables with each of the broad Level 1 to 3 fair value measures. Column (1) in Table 5 shows that the coefficients on the Level 1 and 2 interaction terms are negative (with the Level 2 term statistically different from zero), while the coefficient on the Level 3 interaction term is positive and statistically significant. This finding suggests that disciplining effects of disclosure are more pronounced the more management discretion plays a role in determining asset measures.

The results in column (2) of Table 5 are also consistent with this interpretation. In particular, the interaction terms for the Level 1 and 2 assets are both negative and statistically significant, while the interaction term for Level 3 assets is not statistically different from zero. Together, these results imply that bank holding companies' capital management practices vary according to the extent to which management judgment underpins recognized asset measures. More specifically, the findings imply that for given exposure to discipline from short-term, debt holders, institutions target relatively higher capital ratios when engaged in Level 3 versus Level 1 and 2 activities.

To sum up, these results suggest that being listed and relying to a greater extent on short-term, borrowed funds may exert an additional disciplining effect on institutions that engage in activities where management discretion is the primary basis for measuring the value of such activities. The evidence indicates that listed institutions that employ Level 3 discretion target higher risk-based capital ratios relative to their non-listed counterparts (who also employ Level 3 discretion). In addition, Listed institutions seem to target higher capital ratios for Level 3 activities versus Level 1 and 2 activities. Finally, the evidence suggests that such behaviour also holds at bank holding companies that rely on short-term, uninsured funding.

5.2. Marginal effects based on the nature of activity

The results based on broad fair value classes can potentially mask more subtle effects that could derive from the share and nature of assets recognized under the FAS 157 Level 3

standards. Because institutions recognize a variety of asset types within each of the broad Level 1 to 3 categories, there could be countervailing effects that we might fail to identify when looking only at the broad measures. Fortunately, the data facilitate analysis of this issue by providing a finer breakdown of the asset types captured within each broad category: loans, trading assets and other assets.[22]

One hypothesis that we can test is whether market discipline is stronger for banks where Level 3 accounting discretion features in measuring loans, trading assets or other assets. We might expect that if market participants question the reliability of (and, therefore, that funding costs are sensitive to) Level 3 discretion in measuring such assets, then this might increase incentives for banks to choose higher capital ratios to mitigate the impact on funding costs. To evaluate this hypothesis, we interact each of our more granular Level 3 asset shares with the Listing variable and with the short-term borrowing variable.

Table 6 reports the results of this analysis. A couple findings stand out. First, firms that use Level 3 discretion to measure trading assets have lower capital ratios, for given levels of risk. This result is consistent with opportunistic (moral hazard) behaviour. Second, while the effects of disclosure (as measured by being listed on a US exchange) and short-term debt holders in providing incentives for firms to choose higher capital ratios are positive, the use of Level 3 accounting discretion appears to amplify this effect. In particular, the interaction terms in column (1) for both loans and trading assets are positive suggesting that the disciplining effect of disclosure is more pronounced for firms relying on Level 3 discretion to measure such assets. Similarly, the interaction terms in column (2) indicate that the disciplining effect of short-term, uninsured debt is more pronounced as the share of trading assets measured using Level 3 discretion increases. These results further point to the effectiveness of market discipline in dampening incentives to exploit Level 3 accounting discretion for opportunistic reasons.

In summary, we find evidence on the general effectiveness of market discipline to provide incentives for bank holding companies to choose higher capital ratios. We also find some limited evidence consistent with moral hazard behaviour, suggesting that banks may have exploited Level 3 discretion in measuring fair values recognized in their trading books. At the same time, however, we document that disclosure and short-term funding are effective in limiting this type of behaviour, providing at least some tentative evidence that market discipline may help deal with distortions that can arise from accounting discretion.

6. Additional tests and robustness checks

The granular analysis above considers the impact of the share and nature of assets recognized under Level 3 standards only. As discussed above, Level 3 standards give management the most flexibility relative to measuring similar asset types under Level 1 and Level 2 standards. To explore for possible further differential effects of market discipline

[22] The other asset category is a catch all class that includes, among other things, available-for-sale securities and intangibles.

across asset types, we augment the specifications to include Level 1 and Level 2 measures, as well as the relevant interaction terms.[23]

Table 7 reports the results of including Level 1 measures, which are based on observable prices in active markets for the same assets. As a result, Level 1 standards are effectively void of management judgment and provide market participants with the most objective and reliable measure of asset value. Finding that the market disciplining effects differ between assets recognized under Level 1 versus Level 3 standards may provide more insight into whether market participants consider the use of accounting discretion in their assessment of capital adequacy.

The results in columns (1) and (2) show that firms engaging in Level 3 trading activities tend to target lower capital ratios for given levels of risk, which is consistent with moral hazard behaviour. The results also provide evidence consistent with the idea that disclosure (as measured by whether a firm has a US listing) is effective in moderating such behaviour. In particular, the coefficient on the interaction term (LIST_TRADING_ASSETS_FVA3) is statistically significantly positive. This result indicates that listed firms engaged in Level 3 trading activities tend to have higher capital ratios than their non-listed peers (who also employ Level 3 discretion for measuring trading assets).

Comparing the Level 1 and Level 3 interaction terms also points to some differential effects. The Level 1 interaction terms are all significantly lower than the Level 3 terms, suggesting that the sensitivity of capital decisions to market discipline is more pronounced at firms involved in Level 3 activities. This comparison holds for both lending and trading assets and is consistent with the conjecture that market participants may consider the degree of accounting judgment underpinning the measurement of loans and trading assets when assessing capital adequacy. Overall, then, these results imply that the disclosure (as mandated by US listing rules) may be effective in raising incentives for bank holding companies that use Level 3 discretion to target higher risk-based capital ratios.

The results in column (2) show that the interaction terms on loans and trading assets are also positive and that the coefficients on the Level 3 terms are greater than the Level 1 coefficients. This result again suggests that the sensitivity of capital decisions to market discipline is more pronounced at firms engaged in Level 3 activities. We note, however, that none of the coefficients is statistically significantly different from zero. As a result, these results are less definitive on whether there exist differential (ex ante) disciplining effects from short-term debt holders between assets measured using discretionary Level 3 standards and assets recognized according to more objective Level 1 standards, where scope for management distortions is lower.

[23] We recognize that while similar in definition, these more granular asset classes may differ in other important ways, including risk, that make it difficult to identify differential effects of market discipline across the three FAS 157 levels. This is an issue for future work.

Table 8 extends the analysis to include Level 2 measures. We do this because Level 2 standards offer management some discretion in valuing assets; however, such flexibility is more limited compared with that afforded under Level 3. Including Level 2 in the specification allows us to examine whether there are differential disciplining effects across all three categories. Since Level 2 standards provide more discretion than Level 1 standards, but less than Level 3 standards, we conjecture that if market participants consider values recognized using greater discretion to be relatively less reliable, the relative sensitivity of bank holding companies' capital decisions to market discipline may become more pronounced moving down the FAS 157 hierarchy from Level 1 to Level 3.

A comparison of the interaction terms in column (1) of Table 8 supports this relationship. Level 1 terms are all negative, though only the coefficient on trading assets is statistically significant. For Level 2, the signs on loans and trading assets are both positive (though not statistically significant), while the coefficient on other assets is negative. The coefficients on Level 3 loans and trading assets are both positive and statistically significant, while the coefficient on other assets is not statistically significantly different from zero. This result suggests that disclosure may heighten incentives for firms to augment their capital ratios when using relatively more discretion to measure such assets. The economic relevance depends on the balance sheet share of Level 3 lending and trading assets. To provide some sense of the economic significance, consider two firms, one listed and one not, with identical proportions of level 3 trading assets equal to 1%. The capital ratio for the listed firm would be roughly 30 basis points higher than its non-listed counterpart.[24]

A comparison of the interaction terms in column (2), which consider the short-term debt market as providing external pressure, is less clear cut about the differential disciplining effects. While the coefficients on the Level 3 terms are generally larger in magnitude relative to the Level 1 and 2 terms, they are not statistically different from zero. Although not different from zero, the coefficient on Level 3 term with other assets is higher than the Level 2 coefficient (-0.9139 and statistically significant at the 0.01 level), which provides some evidence of a differential effect between Level 2 and 3 other assets.

We undertook a couple different tests to evaluate the robustness of our results. In evaluating robustness, we compare results with benchmark regressions that include the more granular breakdowns of Level 1 and Level 3 assets, as reported in Table 7. In our first we introduce a different measure of asset risk to our benchmark regressions of capital, i.e., the proportion of total assets comprised of loans on nonaccrual status and loans past due 90 days or more (PDNAC). Table 9 shows the results of this exercise. We find our results to be robust to the inclusion of a different measure of asset risk for both market discipline variables. The results also show that the moderating effects of each of our market discipline variables on Level 3 discretion continue to hold. The coefficients on the interaction terms with loans and trading assets remain positive and statistically significant in the specification that includes Listing, while the interaction term with Level 3 trading assets remains positive.

[24] We calculate this difference as [0.16 + (-0.3403 + 0.4736) x 1%].

Our second test involved excluding all institutions that did not use Level 3 standards. Our original sample includes a high proportion of firms that did not employ Level 3 discretion. While the firm fixed-effects take care of unexplained differences across these two groups of firms in the capital ratio that they tend to target on average, the inclusion of firms that do not use Level 3 discretion could affect the slope coefficients on the market discipline variables. To examine whether this is the case, we drop all firms that did not report Level 3 assets. Table 10 shows the results. We find that the exclusion of such holding companies form our sample does not have a material impact on the measured slope coefficients and that the sign and size of the interaction terms are similar to the benchmark regressions in Table 7.

7. Conclusions and caveats

Using quarterly data on US bank holding companies from 2007 to 2013, we examine two issues related to fair value information reported under FAS 157. First, we investigate the relationship between banks' capital ratios and the extent and nature of assets recognized under Level 3 standards, which give management significant discretion in measuring fair value. Here we are specifically interested in testing the hypothesis that accounting discretion could be used for opportunistic reasons, by allowing firms to hold lower capital ratios for given levels of risk. Second, we investigate the hypothesis that market discipline is effective in moderating such behaviour by providing incentives for firms to choose higher capital ratios. Data allow us to test whether disciplining effects differ across loans, trading assets and a catch-all asset class, other assets, which includes available-for-sale securities and intangible assets. We analyse the effect of two dimensions of market discipline: the disclosure of banks' risk-choices, as measured by whether a firm is listed on a major US stock exchange, and the degree of short-term, uninsured funding dependence.

We modify the approach taken by previous researchers (e.g., Nier and Baumann, 2006; Alfon et al., 2004; and Wu and Bowe, 2010) examining the determinants of bank capital ratios and test for differential effects across the FAS 157 Level 1 to 3 fair value hierarchy, controlling for exposure to market discipline. Consistent with previous research, we find that capital ratios are higher at US bank holding companies that are listed on a primary stock exchange or that rely to a greater extent on short-term, uninsured wholesale funding sources. We interpret these findings as evidence of a disciplining effect over bank's risk-taking behaviour.

When controlling for the degree of discretion embedded in bank's fair value measurements, as captured by the ***broad share*** of assets accounted for under the Level 1 (no discretion), Level 2 (moderate discretion) and Level 3 (full discretion) standards, we find no significant difference in the capital ratios of firms engaged in Level 3 activities compared with those not involved in such activities. This result is robust to including different proxies for market discipline (Listing and short-term funding) and refutes the conjecture that banks use Level 3 discretion for opportunistic reasons. These results also provide some tentative evidence that disclosure may be effective in providing incentives for firms to choose higher capital ratios. We also document evidence of differential effects of market discipline across activities accounted for under the FAS 157 hierarchy. In particular, we find that for given

exposures to market discipline, bank holding companies target higher capital ratios for Level 3 assets where management discretion plays a large role in determining their measurement than for Level 1 (Level 2) assets where such discretion is not allowed (much more limited).

When accounting for the extent and nature of assets recognized under Level 3 standards in more detail, we find that capital ratios are lower at institutions engaged in Level 3 trading activities. This result provides some evidence consistent with opportunistic, moral hazard behaviour. At the same time, however, our regressions yield results that support the notion that market discipline may be effective in moderating this behaviour, by providing incentives for banks to choose higher capital ratios for given levels of risk. In particular, we find that listed institutions engaged in Level 3 lending and trading activities have higher capital ratios than their non-listed counterparts. This result also holds for institutions that rely on uninsured, wholesale funding sources engaged in such Level 3 trading activities.

Our results are broadly supportive of recent policy efforts to harness and rely to a greater degree on market discipline for containing risk. In addition, while our results point to some tentative evidence on the effectiveness of market discipline with respect to accounting discretion for measuring fair values, there remain important questions about the efficacy of market discipline over management discretion more broadly. Of particular note in this regard is developing a better understanding of the features needed to help the market in limiting distortions arising from greater discretion afforded management in using internal models to set capital requirements and forecast expected loan losses under upcoming revisions to international accounting standards (IFRS 9).

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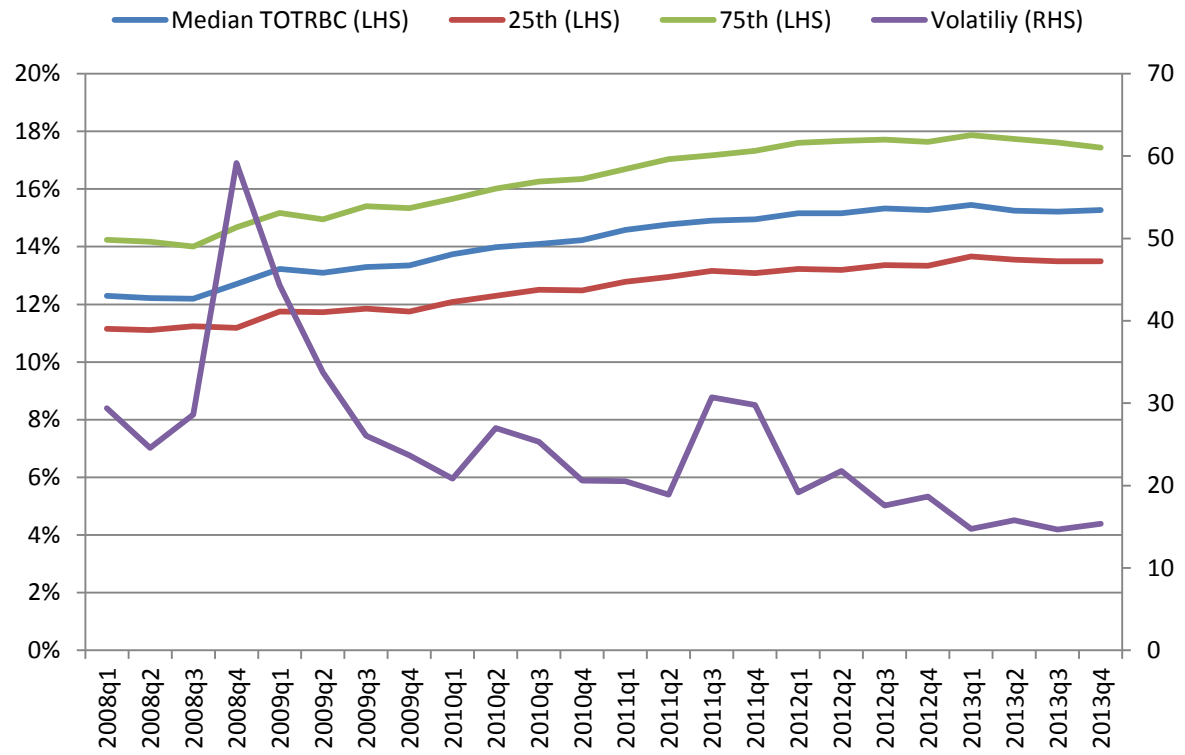
Figure 1: Total risk-based Capital Ratio and Market Volatility



Source: Federal Reserve Y-9C report data and authors' calculations. Volatility information gathered from the Chicago Board Options Exchange.

Table 1: Description of variables

Variable	Expected Sign	Description
BHC-Specific Variables		
TOTRBC Ratio		Ratio of total risk-based capital to risk-weighted assets
T1RBC Ratio		Ratio of tier 1 risk-based capital to risk-weighted assets
Leverage Ratio		Ratio of total equity to total assets
ROE	+/-	Ratio of annualized after-tax net income to total equity
RWA	+/-	Ratio of risk-weighted assets to total assets
ALLL	+	Ratio of allowance for loan and lease losses to total assets
SIZE	-	Natural log of total assets
BHC-Specific Variables		
LISTING	+	Dummy variable equal to 1 if the bank holding company is listed on a primary exchange and 0 otherwise.
BORROW	+	Ratio of short-term, uninsured borrowed funds to total assets
Fair Value Measures		
FVA1	+/-	Ratio of Level 1 assets to total assets
FVA2	+/-	Ratio of Level 2 assets to total assets
FVA3	+/-	Ratio of Level 3 assets to total assets
LOANS_FVA1	+/-	Ratio of Level 1 loans to total assets
LOANS_FVA2	+/-	Ratio of Level 2 loans to total assets
LOANS_FVA3	+/-	Ratio of Level 3 loans to total assets
TRADING_FVA1	+/-	Ratio of Level 1 trading assets to total assets
TRADING_FVA2	+/-	Ratio of Level 2 trading assets to total assets
TRADING_FVA3	+/-	Ratio of Level 3 trading assets to total assets
OTHER_FVA1	+/-	Ratio of Level 1 other assets to total assets
OTHER_FVA2	+/-	Ratio of Level 2 other assets to total assets
OTHER_FVA3	+/-	Ratio of Level 3 other assets to total assets
Sector-level and Macro Variables		
AGGNETCO	+/-	Ratio of aggregate net charge-offs to total loans
VIX	+/-	Chicago Board Options Exchange volatility index

Table 2: Summary Statistics

Variable	N	mean	sd	min	p5	p25	p50	p75	p95	p99	max
Bank Holding Company Variables:											
Total Risk-Based Capital Ratio (%)	14579	14.82	4.74	-0.98	9.80	12.21	14.12	16.48	22.90	35.49	37.33
Tier 1 Risk-Based Capital Ratio (%)	14579	13.20	4.76	-0.98	7.05	10.64	12.57	14.97	21.37	32.60	35.67
Leverage Ratio (%)	14579	8.70	3.30	-1.49	3.62	6.81	8.64	10.33	14.26	19.76	21.14
RWA (% of Total Assets)	14579	71.62	10.81	38.33	52.68	64.70	72.41	78.85	88.58	95.69	97.63
ALLL (% of Total Assets)	14579	1.24	0.62	0.12	0.55	0.83	1.09	1.48	2.43	3.86	4.00
ROE (%)	14579	3.89	19.44	-157.29	-21.63	2.69	7.01	10.69	19.31	36.44	54.75
Size ($Millions)	14579	1,387.16	0.004	78.56	414.07	670.39	987.10	1,927.68	15,667.51	182,020.52	2,370,602.55
Market Discipline Measures:											
Listing (Dummy = 1 if listed)	14579	0.33	0.47	0.00	0.00	0.00	0.00	1.00	1.00	1.00	1.00
BORROW (short-term uninsured debt/TA)	14579	1.99	3.07	0.00	0.00	0.01	0.84	2.61	7.98	13.94	41.13
Fair Value Measures (% of Assets)[(a)]											
Fair Valued Assets Level 1 to 3	13079	18.41	14.47	0.00	0.00	8.74	16.98	25.20	42.77	63.82	127.69
Fair Valued Assets Level 1	13082	3.72	9.13	0.00	0.00	0.00	0.00	1.34	22.86	39.09	114.21
Fair Valued Assets Level 2	13081	14.09	13.50	0.00	0.00	0.00	12.84	21.80	38.30	51.00	117.43
Fair Valued Assets Level 3	13079	0.60	4.33	-0.02	0.00	0.00	0.00	0.15	1.95	8.12	90.69
Fair Valued Loans Level 1 to 3	13188	0.68	5.32	0.00	0.00	0.00	0.00	0.00	1.44	14.46	81.90
Fair Valued Loans Level 1	13188	0.17	2.75	-0.03	0.00	0.00	0.00	0.00	0.00	0.73	77.54
Fair Valued Loans Level 2	13196	0.28	2.92	0.00	0.00	0.00	0.00	0.00	0.63	5.12	81.90
Fair Valued Loans Level 3	13191	0.24	3.50	0.00	0.00	0.00	0.00	0.00	0.00	2.29	73.75
Fair Valued Trading Assets Level 1 to 3	13086	0.34	4.05	-90.79	0.00	0.00	0.00	0.00	0.54	5.26	102.03
Fair Valued Trading Assets Level 1	13086	-0.04	3.03	-205.50	0.00	0.00	0.00	0.00	0.02	1.34	9.62
Fair Valued Trading Assets Level 2	13093	0.36	3.90	0.00	0.00	0.00	0.00	0.00	0.36	5.74	111.76
Fair Valued Trading Assets Level 3	13086	0.02	0.19	0.00	0.00	0.00	0.00	0.00	0.00	0.64	5.96
Fair Valued Other Assets Level 1 to 3	13187	17.17	12.47	0.00	0.00	8.00	16.33	24.39	40.05	51.14	65.62
Fair Valued Other Assets Level 1	13187	3.47	8.20	-13.35	0.00	0.00	0.00	1.15	22.19	38.50	63.24
Fair Valued Other Assets Level 2	13191	13.36	12.50	0.00	0.00	0.00	12.14	21.19	37.18	46.60	88.60
Fair Valued Other Assets Level 3	13193	0.34	1.59	-0.02	0.00	0.00	0.00	0.12	1.45	5.65	30.33
Sector-level and Macro Variables:											
Aggregate Net Charge-offs	14579	1.66	0.74	0.60	0.61	1.09	1.46	2.38	2.88	3.00	3.00
Market Volatility (VIX)	14579	25.14	9.86	14.67	14.72	18.91	23.68	29.39	44.30	59.18	59.18

Notes: (a) Negative values are possible if bank holding companies have netted assets and liabilities under legally enforceable master netting agreements.
Source: Authors' calculations.

Table 3: Correlation matrix for the full estimation sample

	Total RBC Ratio	ALLL	ROE	SIZE	AGG-NETCO	VOLA-TILITY	Listing	BOR-ROW	FVA1	FVA2	FVA3	Loans Level 1	Trading Level 1	Other Level 1	Loans Level 2	Trading Level 2	Other Level 2	Loans Level 3	Trading Level 3	Other Level 3
Total RBC Ratio	1.0000																			
	0.0000																			
ALLL	-0.0897*	1.0000																		
	0.0000	0.0000																		
ROE	0.2002*	-0.3322*	1.0000																	
	0.0000	0.0000	0.0000																	
SIZE	0.0184*	0.0401*	-0.0007	1.0000																
	0.0349	0.0000	0.9350	0.0000																
AGGNETCO	-0.1281*	0.0840*	-0.1859*	-0.0090	1.0000															
	0.0000	0.0000	0.0000	0.3012	0.0000															
VOLATILITY	-0.1109*	-0.0417*	-0.0914*	0.0284*	0.3899*	1.0000														
	0.0000	0.0000	0.0000	0.0012	0.0000	0.0000														
Listing	0.0259*	0.0683*	-0.0268*	0.4155*	0.0052	0.0191*	1.0000													
	0.0030	0.0000	0.0022	0.0000	0.5531	0.0292	0.0000													
BORROW	-0.0925*	-0.0342*	-0.0636*	0.1956*	0.0812*	0.1651*	0.1070*	1.0000												
	0.0000	0.0001	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000												
FVA1	0.1019*	-0.0693*	0.0118	-0.1143*	0.0287*	-0.0780*	-0.1824*	-0.0613*	1.0000											
	0.0000	0.0000	0.1755	0.0000	0.0010	0.0000	0.0000	0.0000	0.0000											
FVA2	0.1960*	-0.0431*	0.0558*	0.1953*	-0.0937*	-0.2578*	0.1473*	-0.0312*	-0.3022*	1.0000										
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0004	0.0000	0.0000										
FVA3	0.0073	0.0826*	-0.0058	0.0084	0.0236*	-0.0133	-0.0277*	0.0158	-0.0262*	0.0136	1.0000									
	0.4028	0.0000	0.5078	0.3342	0.0069	0.1278	0.0015	0.0708	0.0027	0.1210	0.0000									
Loans Lev 1	0.0575*	-0.0082	0.0126	-0.0316*	-0.0183*	-0.0228*	-0.0428*	-0.0073	0.4584*	-0.0412*	-0.0004	1.0000								
	0.0000	0.3485	0.1511	0.0003	0.0362	0.0090	0.0000	0.4019	0.0000	0.0000	0.9646	0.0000								
Trading Lev 1	0.0320*	-0.0177*	0.0103	-0.0838*	-0.0002	-0.0649*	-0.0201*	-0.0813*	0.0158	-0.0822*	-0.0143	0.0009	1.0000							
	0.0002	0.0425	0.2383	0.0000	0.9776	0.0000	0.0218	0.0000	0.0716	0.0000	0.1012	0.9165	0.0000							
Other Lev 1	0.0881*	-0.0740*	0.0086	-0.1374*	0.0381*	-0.0810*	-0.1936*	-0.0725*	0.9586*	-0.3359*	-0.0315*	0.1933*	0.0321*	1.0000						
	0.0000	0.0000	0.3230	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0003	0.0000	0.0002	0.0000						
Loans Lev 2	-0.0260*	0.0585*	-0.0299*	0.0214*	0.0013	-0.0082	0.0511*	0.0376*	-0.0242*	0.2221*	-0.0079	0.0100	-0.0024	-0.0300*	1.0000					
	0.0029	0.0000	0.0006	0.0142	0.8849	0.3501	0.0000	0.0000	0.0056	0.0000	0.3652	0.2524	0.7860	0.0006	0.0000					
Trading Lev 2	0.0441*	0.0285*	-0.0055	0.3449*	0.0038	0.0265*	0.0882*	0.1326*	0.0310*	0.3112*	0.0411*	-0.0056	-0.3640*	-0.0076	0.0051	1.0000				
	0.0000	0.0011	0.5266	0.0000	0.6610	0.0025	0.0000	0.0000	0.0004	0.0000	0.0000	0.5240	0.0000	0.3821	0.5588	0.0000				
Other Lev 2	0.2043*	-0.0692*	0.0691*	0.0984*	-0.1028*	-0.2852*	0.1198*	-0.0840*	-0.3309*	0.9323*	0.0037	-0.0452*	0.0254*	-0.3538*	0.0047	0.0227*	1.0000			
	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.6740	0.0000	0.0036	0.0000	0.5887	0.0095	0.0000			
Loans Lev 3	-0.0106	0.0824*	0.0013	-0.0069	0.0102	-0.0073	-0.0384*	-0.0031	-0.0265*	-0.0149	0.9366*	-0.0042	-0.0008	-0.0278*	-0.0061	-0.0002	-0.0147	1.0000		
	0.2271	0.0000	0.8853	0.4311	0.2447	0.4037	0.0000	0.7227	0.0024	0.0880	0.0000	0.6279	0.9300	0.0015	0.4874	0.9851	0.0936	0.0000		
Trading Lev 3	0.0544*	0.0636*	-0.0076	0.3021*	0.0111	0.0375*	0.0782*	0.1376*	0.0161	0.2029*	0.0504*	-0.0063	-0.3571*	-0.0209*	0.0026	0.6493*	0.0159	-0.0017	1.0000	
	0.0000	0.0000	0.3823	0.0000	0.2039	0.0000	0.0000	0.0000	0.0658	0.0000	0.0000	0.4719	0.0000	0.0170	0.7693	0.0000	0.0690	0.8465	0.0000	
Other Lev 3	0.0365*	0.0349*	-0.0176*	0.0013	0.0403*	-0.0246*	-0.0001	0.0330*	-0.0146	0.0450*	0.6437*	0.0091	0.0063	-0.0218*	-0.0084	0.0326*	0.0404*	0.3379*	0.0187*	1.0000
	0.0000	0.0001	0.0445	0.8846	0.0000	0.0049	0.9950	0.0002	0.0942	0.0000	0.0000	0.3003	0.4694	0.0127	0.3356	0.0002	0.0000	0.0000	0.0322	0.0000

Source: Authors' calculations; * significant at 0.05 level.

Table 4: The effect of market discipline on capital ratios

This table shows results of bank-level panel fixed effects panel regressions of total risk-based capital ratios on market discipline, firm-level controls and market volatility based on a sample of US bank holding companies from 2007 to 2013. Annex 1 defines all variables. The variable, Borrow, in bold italic form has been instrumented using the two-stage least squares estimation.

	(1)		(2)		(3)	
	Total Risk-based Capital Ratio (Benchmark)		**Total Risk-based Capital Ratio (Listing)**		**Total Risk-based Capital Ratio (Borrow)**	
Tot Risk-based Cap Ratio (lag)	0.8707	***	0.8696	***	0.9045	***
ALLL	-0.0121		-0.0115		0.0929	*
ROE	0.0020	***	0.0021	***	0.0019	***
Size	-0.0049	***	-0.0051	***	-0.0125	***
Aggregate Net Charge-offs	0.0126	**	0.0127	**	0.0225	***
Volatility Index (VIX)	-0.0006	***	-0.0006	***	-0.0015	***
Listing			0.0025	**		
Borrow					0.4693	***
Constant	0.0924	***	0.0951	***	0.1918	***
Bank and period fixed effects	Yes		Yes		Yes	
Observations	14562		14562		14562	
Cluster	614		614		614	
Prob > Chi-squared	0.0000		0.0000		0.0000	
Adjusted R-squared	0.9513		0.9534		0.7964	

***, **, * indicate statistical significance at the 0.01, 0.05 and 0.10 levels, respectively.

Table 5: Marginal effects of market discipline on FAS 157 fair value recognition
This table shows the marginal effect of market discipline on capital ratios for bank holding companies that recognize assets under each of the three levels of the FAS 157 fair value hierarchy. Annex 1 defines all variables. The variables in bold italic form have been instrumented using the two-stage least squares estimation.

	(1)		(2)	
	Total Risk-based Capital Ratio (Listing)		**Total Risk-based Capital Ratio (Borrow)**	
Total Risk-based Capital Ratio (lag)	0.8507	***	0.8745	***
ALLL	0.0161		0.1136	*
ROE	0.0025	***	0.0028	***
Size	-0.0070	***	-0.0135	***
Aggregate Net Charge-offs	0.0117	**	0.0209	***
Volatility Index (VIX)	-0.0006	***	-0.0015	***
Listing	0.0022	**		
Borrow			0.4077	***
FVA1_TA	0.0065	***	0.0112	***
FVA2_TA	0.0098	***	0.0126	***
FVA3_TA	0.0013		-0.0098	
LIST_FVA1	-0.0105			
LIST_FVA2	-0.0056	**		
LIST_FVA3	0.0332	*		
BORROW_FVA1			-0.8287	***
BORROW_FVA2			-0.5599	***
BORROW_FVA3			-0.0621	
Constant	0.1211	***	0.0876	***
Bank and period fixed effects	Yes		Yes	
Observations	12742		12735	
Cluster	614		614	
Prob > Chi-squared	0.0000		0.0000	
Adjusted R-squared	0.9555		0.8066	

***, **, * indicate statistical significance at the 0.01, 0.05 and 0.10 levels, respectively.

Table 6: Marginal effects of market discipline on Level 3 FAS 157 fair value recognition
This table shows the marginal effect of market discipline on capital ratios for bank holding companies that recognize specific types of assets under FAS 157 Level 3 standards which afford management the most discretion in measuring values. Annex 1 defines all variables. The variables in bold italic form have been instrumented using the two-stage least squares estimation.

	(1)		(2)	
	Total Risk-based Capital Ratio (Listing)		**Total Risk-based Capital Ratio (Borrow)**	
Total Risk-based Capital Ratio (lag)	0.8541	***	0.8612	***
ALLL	0.0092		0.0279	
ROE	0.0025	***	0.0023	***
Size	-0.0069	***	-0.0082	***
Aggregate Net Charge-offs	0.0036	***	0.0154	***
Volatility Index (VIX)	-0.0008	***	-0.0009	***
Listing	0.0013	*		
Borrow			0.0895	*
LOANS_LEASES_FVA3	-0.0074		-0.0117	
TRADING_ASSETS_FVA3	-0.3737	**	-0.4133	***
OTHER_ASSETS_FVA3	0.0180		0.0347	
LIST_LOANS_LEASES_FVA3	0.1437	***		
LIST_TRADING_ASSETS_FVA3	0.5877	***		
LIST_OTHER_ASSETS_FVA3	-0.0133			
BORROW_LOANS_LEASES_FVA3			0.5743	
BORROW_TRADING_ASSETS_FVA3			5.2621	***
BORROW_OTHER_ASSETS_FVA3			-1.4475	
Constant	0.1237	***	0.1420	***
Bank and period fixed effects	Yes		Yes	
Observations	12742		12742	
Cluster	614		614	
Prob > Chi-squared	0.0000		0.0000	
Adjusted R-squared	0.9555		0.8974	

***, **, * indicate statistical significance at the 0.01, 0.05 and 0.10 levels, respectively.

Table 7: Differential effects of market discipline on Level 1 and Level 3 measures
This table shows the marginal effect of market discipline on capital ratios for bank holding companies that recognize specific types of assets under FAS 157 Level 1 and Level 3 standards. Annex 1 defines all variables. The variables in bold italic form have been instrumented using the two-stage least squares estimation.

	(1)		(2)	
	Total Risk-based Capital Ratio (Listing)		**Total Risk-based Capital Ratio (Borrow)**	
Total Risk-based Capital Ratio (lag)	0.8585	***	0.8675	***
ALLL	0.0100		0.0206	
ROE	0.0023	***	0.0022	***
Size	-0.0075	***	-0.0091	***
Aggregate Net Charge-offs	0.0121	**	0.0144	**
Volatility Index (VIX)	-0.0006	***	-0.0008	***
Listing	0.0011	*		
Borrow			0.1028	**
LOANS_LEASES_FVA1	0.0045		0.0036	
LOANS_LEASES_FVA3	-0.0070		-0.0110	
TRADING_ASSETS_FVA1	0.0307	***	0.0685	
TRADING_ASSETS_FVA3	-0.3650	***	-0.3806	***
OTHER_ASSETS_FVA1	0.0005		0.0073	
OTHER_ASSETS_FVA3	0.0208	**	0.0315	
LIST_LOANS_LEASES_FVA1	-0.3931			
LIST_LOANS_LEASES_FVA3	0.1389	***		
LIST_TRADING_ASSETS_FVA1	-0.0367	***		
LIST_TRADING_ASSETS_FVA3	0.5134	***		
LIST_OTHER_ASSETS_FVA1	-0.0076			
LIST_OTHER_ASSETS_FVA3	-0.0129			
BORROW_LOANS_LEASES_FVA1			-0.0162	
BORROW_LOANS_LEASES_FVA3			0.5759	
BORROW_TRADING_ASSETS_FVA1			0.6150	
BORROW_TRADING_ASSETS_FVA3			3.8811	
BORROW_OTHER_ASSETS_FVA1			0.3945	
BORROW_OTHER_ASSETS_FVA3			-1.1637	
Constant	0.1299	*	0.1524	***
Bank and period fixed effects	Yes		Yes	
Observations	12465		12465	
Cluster	614		614	
Prob > Chi-squared	0.0000		0.0000	
Adjusted R-squared	0.9548		0.8869	

***, **, * indicate statistical significance at the 0.01, 0.05 and 0.10 levels, respectively.

Table 8: Differential effects of market discipline on Level 1, 2 and 3 measures

This table shows the marginal effect of market discipline on capital ratios for bank holding companies that recognize specific types of assets under FAS 157 Level 1, 2 and 3 standards. Annex 1 defines all variables. The variables in bold italic form have been instrumented using the two-stage least squares estimation.

	(1)		(2)	
	Total Risk-based Capital Ratio (Listing)		**Total Risk-based Capital Ratio (Borrow)**	
Total Risk-based Capital Ratio (lag)	0.8549	***	0.8562	***
ALLL	0.0184		-0.0132	
ROE	0.0024	***	0.0021	***
Size	-0.0073	***	-0.0092	***
Aggregate Net Charge-offs	0.0108	*	0.0114	*
Volatility Index (VIX)	-0.0005	***	-0.0006	***
Listing	0.0016	*		
Borrow			0.0492	
LOANS_LEASES_FVA1	0.0043		0.0025	
LOANS_LEASES_FVA2	-0.0146		-0.0066	
LOANS_LEASES_FVA3	-0.0085		-0.0098	
TRADING_ASSETS_FVA1	0.0286	***	-0.0445	
TRADING_ASSETS_FVA2	-0.0130		-0.0388	
TRADING_ASSETS_FVA3	-0.3403	**	-0.2704	
OTHER_ASSETS_FVA1	0.0076		0.0014	
OTHER_ASSETS_FVA2	0.0108	***	0.0219	***
OTHER_ASSETS_FVA3	0.0254	**	0.0084	
LIST_LOANS_LEASES_FVA1	-0.3787			
LIST_LOANS_LEASES_FVA2	0.0149			
LIST_LOANS_LEASES_FVA3	0.1428	***		
LIST_TRADING_ASSETS_FVA1	-0.0337	***		
LIST_TRADING_ASSETS_FVA2	0.0186			
LIST_TRADING_ASSETS_FVA3	0.4736	***		
LIST_OTHER_ASSETS_FVA1	-0.0103			
LIST_OTHER_ASSETS_FVA2	-0.0072	***		
LIST_OTHER_ASSETS_FVA3	-0.0132			
BORROW_LOANS_LEASES_FVA1			0.5245	*
BORROW_LOANS_LEASES_FVA2			-0.2701	
BORROW_LOANS_LEASES_FVA3			0.3872	
BORROW_TRADING_ASSETS_FVA1			0.6713	
BORROW_TRADING_ASSETS_FVA2			0.9689	***
BORROW_TRADING_ASSETS_FVA3			2.3057	
BORROW_OTHER_ASSETS_FVA1			0.2279	
BORROW_OTHER_ASSETS_FVA2			-0.9130	***
BORROW_OTHER_ASSETS_FVA3			0.5633	
Constant	0.1251	*	0.1525	***
Bank and period fixed effects	Yes		Yes	
Observations	12465		12465	
Cluster	614		614	
Prob > Chi-squared	0.0000		0.0000	
Adjusted R-squared	0.9548		0.8788	

***, **, * indicate statistical significance at the 0.01, 0.05 and 0.10 levels, respectively.

Table 9: Differential effects of market discipline on Level 1 and Level 3 measures (Different measure of risk)

This table shows the marginal effect of market discipline on capital ratios for bank holding companies that recognize specific types of assets under FAS 157 Level 1 and Level 3 standards using different measure of risk (PDNAC). Annex 1 defines all variables. The variables in bold italic form have been instrumented using the two-stage least squares estimation.

	(1)		(2)	
	Total Risk-based Capital Ratio (Listing)		**Total Risk-based Capital Ratio (Borrow)**	
Total Risk-based Capital Ratio (lag)	0.8575	***	0.8658	***
PDNAC	-0.0274	***	-0.0278	***
ROE	0.0018	***	0.0016	***
Size	-0.0074	***	-0.0089	***
Aggregate Net Charge-offs	0.0121	**	0.0148	**
Volatility Index (VIX)	-0.0007	***	-0.0008	***
Listing	0.0009	*		
Borrow			0.0917	**
LOANS_LEASES_FVA1	0.0042		0.0036	
LOANS_LEASES_FVA3	-0.0068		-0.0113	
TRADING_ASSETS_FVA1	0.0302	***	-0.0606	
TRADING_ASSETS_FVA3	-0.3571	***	-0.4019	***
OTHER_ASSETS_FVA1	0.0005		-0.0095	
LIST_LOANS_LEASES_FVA1	-0.3755			
LIST_LOANS_LEASES_FVA3	0.1380	***		
LIST_TRADING_ASSETS_FVA1	-0.0360	***		
LIST_TRADING_ASSETS_FVA3	0.5041	***		
LIST_OTHER_ASSETS_FVA1	-0.0080			
LIST_OTHER_ASSETS_FVA3	-0.0130			
BORROW_LOANS_LEASES_FVA1			0.0244	
BORROW_LOANS_LEASES_FVA3			0.6022	
BORROW_TRADING_ASSETS_FVA1			0.5447	
BORROW_TRADING_ASSETS_FVA3			4.5368	*
BORROW_OTHER_ASSETS_FVA1			0.5215	
BORROW_OTHER_ASSETS_FVA3			-1.2099	
Constant	0.1295	***	0.1506	***
Bank and period fixed effects	Yes		Yes	
Observations	12465		12465	
Cluster	614		614	
Prob > Chi-squared	0.0000		0.0000	
Adjusted R-squared	0.9547		0.8869	

***, **, * indicate statistical significance at the 0.01, 0.05 and 0.10 levels, respectively.

Table 10: Differential effects of market discipline on Level 1 and Level 3 measures (Level 3 reporters only)

This table shows the marginal effect of market discipline on capital ratios for bank holding companies that recognize specific types of assets under FAS 157 Level 1 and Level 3 standards excludes firms that do not recognize using Level 3 discretion. Annex 1 defines all variables. The variables in bold italic form have been instrumented using the two-stage least squares estimation.

	(1)		(2)	
	Total Risk-based Capital Ratio (Listing)		**Total Risk-based Capital Ratio (Borrow)**	
Total Risk-based Capital Ratio (lag)	0.8394	***	0.8460	***
ALLL	-0.0015		-0.0103	
ROE	0.0006		0.0008	
Size	-0.0114	***	-0.0120	***
Aggregate Net Charge-offs	0.0041		0.0069	
Volatility Index (VIX)	-0.0002		-0.0004	
Listing	0.0003			
Borrow			0.0751	
LOANS_LEASES_FVA1	0.0108		-0.0683	*
LOANS_LEASES_FVA3	-0.0027		0.0001	
TRADING_ASSETS_FVA1	0.0379	***	-0.0658	
TRADING_ASSETS_FVA3	-0.4644	***	-0.4563	***
OTHER_ASSETS_FVA1	0.0007		-0.0152	
OTHER_ASSETS_FVA3	0.0210		0.0088	
LIST_LOANS_LEASES_FVA1	-0.1126			
LIST_LOANS_LEASES_FVA3	0.1452	***		
LIST_TRADING_ASSETS_FVA1	-0.0435	***		
LIST_TRADING_ASSETS_FVA3	0.5649	***		
LIST_OTHER_ASSETS_FVA1	0.0001			
LIST_OTHER_ASSETS_FVA3	0.0018			
BORROW_LOANS_LEASES_FVA1			0.0752	*
BORROW_LOANS_LEASES_FVA3			0.0732	
BORROW_TRADING_ASSETS_FVA1			0.5735	
BORROW_TRADING_ASSETS_FVA3			4.2148	*
BORROW_OTHER_ASSETS_FVA1			0.7967	*
BORROW_OTHER_ASSETS_FVA3			1.2818	
Constant	0.1924	***	0.2009	***
Bank and period fixed effects	Yes		Yes	
Observations	4773		4773	
Cluster	345		345	
Prob > Chi-squared	0.0000		0.0000	
Adjusted R-squared	0.9513		0.7722	

***, **, * indicate statistical significance at the 0.01, 0.05 and 0.10 levels, respectively.

Annex 1: Definition of Variables used in Empirical Estimation

Variable	Expected Sign	Description	Source
BHC-Specific Variables			
TOTRBC		Total risk-based capital ratio	bhck7205
ROE	+/-	Ratio of annualized after-tax net income to total equity	Annualized bhck4340/bhck3210
ALLL	+	Ratio of allowance for loan and lease losses to total assets	bhck3123/bhck2170
SIZE	-	Natural log of total assets	ln(bhck2170)
PDNAC	+	Ratio of 90+ days past due and nonaccrual loans to total assets	(bhck5525+bhck5526)/bhck2170
Market Discipline Measures			
Listing	+	Dummy = 1 if listed on a US exchange	Sourced from the Federal Reserve Bank of New York database
BORROW	+	Ratio of short-term (maturing < 1 year) uninsured borrowed funds to total assets	(bhck2309+bhck2332)/bhck2170
BORROW2	+	Ratio of the sum of short-term (< 1 year) uninsured borrowed funds and subordinated debt to total assets	(bhck4062+bhck2309+bhck2332)/bhck2170
Fair Value Measures			
FVA1	+/-	Ratio of Level 1 assets to total assets	bhckg504/bhck2170 after 2009Q2; else (bhckf690+bhckf691+bhckf693)/bhck2170
FVA2	+/-	Ratio of Level 2 assets to total assets	bhckg505/bhck2170 after 2009Q2; else (bhckf244+bhckf247+bhckf250)/bhck2170
FVA3	+/-	Ratio of Level 3 assets to total assets	bhckg506/bhck2170 after 2009Q2; else (bhckf245+bhckf248+bhckf242+bhckf251)/bhck2170
LOANS_FVA1	+/-	Ratio of Level 1 loans to total assets	(bhckg485+bhckg490)/bhck2170 after 2009Q2; else (bhckf243-bhckf244-bhckf245-bhckf682)/bhck2170
LOANS_FVA2	+/-	Ratio of Level 2 loans to total assets	(bhckg486+bhckg491)/bhck2170 after 2009Q2; else bhckf244/bhck2170
LOANS_FVA3	+/-	Ratio of Level 3 loans to total assets	(bhckg487+bhckg492)/bhck2170 after 2009Q2; else bhckf245/bhck2170
TRADING_FVA1	+/-	Ratio of Level 1 trading assets to total assets	(bhckf246-bhckf247-bhckf248-bhckf683)/bhck2170 before 2009Q2; else (bhckg494+bhckg499)/bhck2170
TRADING_FVA2	+/-	Ratio of Level 2 trading assets to total assets	bhckf247/bhck2170 before 2009Q2; else (bhckg495+bhckg500)/bhck2170
TRADING_FVA3	+/-	Ratio of Level 3 trading assets to total assets	bhckf248/bhck2170 before 2009Q2; else (bhckg496+bhckg501)/bhck2170
OTHER_FVA1	+/-	Ratio of Level 1 other assets to total assets	(bhckf249-bhckf250-bhckf251-bhckf685)/bhck2170 before 2009Q2; else (bhckg475+bhckg480+bhckg395)/bhck2170
OTHER_FVA2	+/-	Ratio of Level 2 other assets to total assets	bhckf250 /bhck2170 before 2009Q2; else (bhckg476+bhckg481+bhckg396)/bhck2170
OTHER_FVA3	+/-	Ratio of Level 3 other assets to total assets	bhckf251 /bhck2170 before 2009Q2; else (bhckg477+bhckg482+bhckg804)/bhck2170
Sector-level and Macro Variables			
AGGNETCO	+/-	Ratio of aggregate net charge-offs to total loans	FDIC Quarterly Bank Profile
VIX	+/-	Chicago Board Options Exchange S&P 100 volatility index	www.cboe.com/micro/vxn/ Quarterly Averages

Note: Unless indicated otherwise, all firm-level measures derive from the Federal Reserve Y-9C Consolidated Financial Reports for Bank Holding Companies (available at https://www.chicagofed.org/webpages/banking/financial_institution_reports/bhc_data.cfm).