The Contribution of Bank Regulation and Fair Value Accounting to Procyclical Leverage

Amir Amel-Zadeh*
Saïd Business School
University of Oxford

Mary E. Barth
Graduate School of Business
Stanford University

Wayne R. Landsman
Kenan-Flagler Business School
University of North Carolina

March 2017

Review of Accounting Studies, *forthcoming*

* Corresponding author: Saïd Business School, University of Oxford, amir.amelzadeh@sbs.ox.ac.uk. We appreciate comments and suggestions from Martien Lubberink, Dushyant Vyas, an anonymous reviewer, and seminar participants at the University of California at Berkeley, University of Glasgow, University of Graz, Indiana University, London Business School, University of Minnesota Empirical Conference, University of North Carolina, Rice University, Rotterdam School of Management, Stanford University Graduate School of Business, University of Texas, University of Toronto Rotman Accounting Research Conference, American Accounting Association annual meeting—especially discussant Anya Kleymenova, European Accounting Association Annual Congress—especially discussant Thorsten Sellhorn, Financial Accounting and Reporting Section of the American Accounting Association midyear meeting, and US Securities and Exchange Commission Division of Economic and Risk Analysis seminar. We also appreciate funding from the Cambridge Endowment for Research in Finance, Judge Business School.

The Contribution of Bank Regulation and Fair Value Accounting to Procyclical Leverage

Abstract

Our analytical description of how banks' responses to asset price changes can result in procyclical leverage reveals that for banks with a binding regulatory leverage constraint, absent differences in regulatory risk weights across assets, procyclical leverage does not occur. For banks without a binding constraint, fair value and bank regulation both can contribute to procyclical leverage. Empirical findings based on a large sample of US commercial banks reveal that bank regulation explains procyclical leverage for banks relatively close to the regulatory leverage constraint and contributes to procyclical leverage for those that are not. We also show that fair value accounting does not contribute to procyclical leverage by finding (i) the portion of comprehensive income attributable to fair value accounting, i.e., fair value comprehensive income, has a negative relation with change in leverage as expected for any increase in equity, (ii) no evidence of a positive relation between fair value comprehensive income and banks' net purchases of assets, and (iii) the relation between change in leverage and fair value comprehensive income is more negative than that between change in leverage and change in equity.

The Contribution of Bank Regulation and Fair Value Accounting to Procyclical Leverage

1. *Introduction*

This study addresses the question of whether commercial banks exhibit procyclical leverage and, if they do, the extent to which bank regulation and fair value accounting are contributing factors. Procyclical leverage is evidence of excessive asset purchases or sales by banks, which can have negative consequences to the financial system. Many academic researchers, policy-makers, and other practitioners contend that fair value accounting contributes to excessive responses by banks to changes in asset prices, and hence contributes to procyclical leverage.[1] However, this contention fails to consider that regulatory leverage requirements can contribute to banks' procyclical responses. Our findings reveal that bank regulation explains procyclical leverage for banks relatively close to the regulatory leverage constraint and contributes to procyclical leverage for those that are not. We also find that fair value accounting does not contribute to procyclical leverage.

Studying whether commercial banks exhibit procyclical leverage and, if they do, the extent to which bank regulation and fair value accounting are contributing factors is important to helping policy-makers determine how best to minimize the effects of shocks to financial asset prices on the macro economy. A provision of the Emergency Economic Stabilization Act of 2008 required the US Securities and Exchange Commission to investigate the extent to which fair value accounting contributed to the collapse of financial asset prices and instability of the financial system during the 2008-2009 financial crisis. Underlying this requirement is the belief

[1] See, for example, "Are the Bean Counters Ensuring a Crash?" *The Economist*, March 6, 2008; "The Crisis and Fair Value Accounting," *The Economist*, September 18, 2008; and "Mark-to-Market Accounting Exacerbates the Crisis," *The Wall Street Journal*, October 15, 2008. See also Allen and Carletti (2008), IMF (2008), Plantin, Sapra, and Shin (2008), and Adrian and Shin (2010).

that fair value accounting was a major factor contributing to the crisis because it fueled excessive asset sales by banks.

To gain insight regarding the way bank regulation can contribute to procyclical leverage, we describe analytically actions commercial banks can take in response to economic gains and losses on their assets resulting from upturns and downturns in the economy. A bank's regulatory leverage cannot exceed an amount set by the regulator. A key reason regulatory leverage differs from accounting leverage is that risk weights are applied to assets in determining the former but not the latter.[2] The analysis shows that for banks with a binding regulatory leverage constraint, procyclical leverage can result when the weighted average regulatory risk weight of assets bought (sold) in response to increases (decreases) in asset values is less than the weighted average risk weight of the assets in its investment portfolio prior to the purchase (sale). That is, in the analysis, absent differences in regulatory risk weights across assets, leverage is not procyclical for such banks, and thus procyclical leverage is attributable to bank regulatory requirements. For banks without a binding regulatory leverage constraint, both fair value accounting and bank regulatory requirements can contribute to procyclical leverage.

Based on insights from the analysis, we design empirical tests to assess the extent to which bank regulatory leverage requirements contribute to procyclical leverage. Our empirical tests are based on quarterly financial statement and regulatory data for a large sample of US commercial banks from 2001 to 2013. Following prior research, we first estimate the relation between change in leverage and change in assets and find that the relation is significantly positive, which indicates that leverage is procyclical. However, consistent with predictions from the analysis, for banks relatively close to the regulatory leverage constraint this procyclical

[2] Henceforth, for ease of exposition, we use the term "leverage" to refer to accounting leverage, i.e., the ratio of total assets to equity book value, and "regulatory leverage" to refer to regulatory leverage, i.e., the ratio of risk-weighted assets to regulatory capital, where weights are set by a regulator.

relation evaporates when the change in a bank's weighted average regulatory risk weight is included in the estimating equation. For banks relatively far from the regulatory leverage constraint, change in a bank's weighted average regulatory risk weight contributes to, but does not fully explain, procyclical leverage. We provide additional evidence that banks manage their regulatory leverage, thereby contributing to procyclical leverage, by showing that the positive relation between change in assets and change in leverage is greater for changes in assets with lower risk weights, particularly for banks relatively close to the regulatory leverage constraint.

We then design tests to examine the extent to which fair value accounting contributes to procyclical leverage. First, we extend the relation between change in leverage and change in assets by including a measure of the portion of comprehensive income attributable to fair value accounting, i.e., fair value comprehensive income. If fair value accounting contributes to procyclical leverage, we expect fair value comprehensive income is positively related to change in leverage. Not only do we fail to find a positive relation, but also we find that the fair value comprehensive income measure has a negative relation with change in leverage as expected for any increase in equity. Second, we extend this relation by including the interaction of the measure and the bank's net purchases of assets. If fair value accounting contributes to procyclical leverage, we expect the interaction is positively related to change in leverage. Contrary to this prediction, we find no evidence of a positive relation between fair value comprehensive income and banks' net purchases of assets.

Third, we estimate the relation between change in leverage and change in assets, disaggregating change in assets into fair value comprehensive income, change in equity other than that arising from comprehensive income, change in debt, and other changes in assets. If fair value accounting contributes to procyclical leverage, we expect the relation between change in leverage and fair value comprehensive income is less negative than that between change in leverage and change in equity. Contrary to this prediction, we find that the relation is more negative than that between change in leverage and change in equity. Taken together, these findings reveal no evidence that fair value accounting contributes to procyclical leverage.

Because of the asymmetry in accounting for gains and losses under modified historical cost accounting and because the concerns about fair value accounting and procyclicality arose during the economic downturn that followed the financial crisis, we estimate the relations described above separately for quarters of economic upturns and downturns. Inferences based on these separate estimations are essentially the same as those for the combined sample. Most importantly, in upturns and downturns there is no evidence of procyclical leverage for banks relatively close to the regulatory leverage constraint when the change in a bank's weighted average risk weight is included in the estimating equation or that fair value accounting contributes to procyclical leverage.

We also test whether there is an association between fair value accounting and procyclical leverage for broker-dealers, which are not subject to risk-weighted regulatory leverage requirements, but could maintain capital to meet an internally imposed value-at-risk criterion. Findings reveal a positive relation between change in leverage and change in assets, i.e., procyclical leverage, for broker-dealers, and there is no evidence that fair value accounting contributes to this relation.

The paper proceeds as follows. The next section provides a discussion of the institutional background and related research. Section 3 presents our analysis of how bank regulation and fair value accounting can contribute to procyclical leverage. Section 4 develops our empirical predictions and specifies our estimating equations. Section 5 describes the data and sample selection, and section 6 presents the empirical results. Section 7 provides summary and concluding remarks.

2. *Institutional Background and Related Research*

2.1 Procyclical Leverage

Shocks to financial asset prices cause changes in bank leverage. Other things equal, when asset prices increase (decrease) leverage decreases (increases). If banks manage to a target leverage ratio, in the face of increasing (decreasing) asset values banks likely will buy (sell) assets and issue (repay) debt in amounts sufficient to restore leverage to the level it was at before the increase (decrease) in asset values. If asset purchases (sales) are excessive, i.e., exceed the amount necessary to restore leverage to the level before the shock, then leverage will be higher (lower) than it was before the shock, i.e., leverage will be procyclical. Thus, procyclical leverage is evidence of excessive asset purchases or sales by banks.

Although such excessive purchases or sales may be apposite for an individual bank, they can have negative consequences to the financial system. In the case of a negative shock, asset sales by one bank can cause a drop in asset prices arising from an increase in supply, which in turn can cause other banks to sell assets. This contagion, or feedback, effect (Kiyotaki and Moore, 1997; Cifuentes, Ferrucci, and Shin, 2005) on asset prices can lead to a downward spiral in asset prices, as was alleged to be the case in the 2008-2009 financial crisis. Shleifer and Vishny (2010) shows that banks transmit asset price fluctuations into the real economy. In the case of a negative shock to financial asset prices, the shrinkage of financial institutions results in a reduction of available credit, which leads to a downturn throughout the economy. The converse is true in the case of a positive shock to asset prices. To the extent that asset purchases or sales are excessive, the effects on the financial sector and real economy are magnified.

2.2 Fair Value Accounting, Bank Regulation, and Procyclical Leverage

Several studies posit a link between fair value accounting and procyclical leverage. Most notably, Adrian and Shin (2008; 2010) provide empirical evidence of procyclical leverage by documenting a positive relation between quarterly changes in total assets and changes in leverage for five investment banks from the third quarter of 1992 through the first quarter of 2008. Adrian and Shin (2008; 2010) interpret this as evidence that fair value accounting is the cause of procyclical leverage based on the assumption that most investment bank assets are measured at fair value. However, the studies provide no direct evidence that fair value accounting *per se* caused the procyclical leverage.[3]

Other studies posit a link between fair value accounting and procyclical leverage through the impact of fair value accounting on bank regulation (Allen and Carletti 2008; IMF 2008; Plantin, Sapra, and Shin 2008). A key feature of bank regulation is that commercial banks must meet regulatory leverage requirements. Fair value accounting can affect bank regulatory leverage through recognition of fair value gains and losses on some assets and impairment of other assets. Because of the central role that commercial banks play in the economy, many academic researchers, policy-makers, and other practitioners believe that fair value accounting was a major factor contributing to the 2008-2009 financial crisis.[4] A basis for this belief is that impairment of investments in securities to fair value during the crisis likely resulted in decreases in banks' regulatory capital, thereby affecting bank behavior that results in procyclical leverage.[5]

[3] Other studies examine the relation between fair value accounting and procyclicality in contexts other than procyclical leverage of banks. For example, Khan (2014) finds that the probability that a bank experiences extreme negative returns when money center banks are performing poorly is higher when fair value is used more extensively in financial reporting. Bhat et al. (2011) finds that for banks that hold relatively large portfolios of mortgage backed securities (MBS), changes in MBS holdings are positively associated with changes in MBS prices.

[4] See footnote 1 as well as Barth and Landsman (2010) for a broader discussion of the link between financial reporting—including fair value accounting—and the financial crisis.

[5] There are other ways in which fair value accounting allegedly contributed to the financial crisis. One way is that fair value-based write-downs resulted in potentially unwarranted asset sales by banks, which contributed to the

However, Shaffer (2010) provides evidence that the decline in Tier 1 regulatory capital arising from impairment to fair value of available-for-sale and held-to-maturity securities averaged only 2.1% during the financial crisis for the 14 largest US banks. Similarly, Badertscher, Burks, and Easton (2012) finds that impairments of non-Treasury available-for-sale and held-to-maturity securities to fair value had minimal effect on regulatory capital during the financial crisis for 150 bank holding companies. Badertscher, Burks, and Easton (2012) finds mixed evidence that banks sold securities in response to these asset impairments and concludes the sales were economically insignificant because there is no evidence of an industry- or firm-level increase in sales of securities during the financial crisis.

Two recent related studies investigate the roles of bank regulation and fair value accounting in contributing to procyclical bank lending. Behn et al. (2016) finds evidence that German bank regulation contributes to procyclical bank lending following the Lehman Brothers bankruptcy in the third quarter of 2008. In particular, Behn et al. (2016) finds fewer loans are originated to borrowers by banks with a higher percentage of loans for which the bank determines regulatory risk weights using internal models rather than the fixed risk weights specified by the regulator. Xie (2016) finds no evidence of a relation between residential mortgage approval rates for US banks and the extent to which they recognize assets at fair value.

A closely related contemporaneous study is Laux and Rauter (2017). The study examines determinants of procyclical bank leverage and finds that total asset growth and GDP growth contribute to procyclical leverage. The study concludes that the findings are not consistent with

---

amplified asset price declines and subsequent contagion (Allen and Carletti, 2008; Plantin, Sapra, and Shin, 2008; Sapra, 2008). Another way is that because fair value accounting amounts often are based on estimates, particularly in illiquid markets, managerial incentives can play a role in determining fair value accounting amounts. As a result, bank asset fair values allegedly were overstated before the financial crisis. To the extent that these overstated asset values were written down during the crisis, the increase in leverage was greater than if the asset values had not been overstated. Neither the allegedly unwarranted assets sales nor the write-downs of previously overstated asset values necessarily resulted in procyclical leverage, which is the focus of our study.

fair value accounting contributing to procyclical leverage, and suggest that the business model of banks, the regulatory capital ratio, and accounting leverage are more important for procyclical leverage than accounting or regulatory risk weights. A key difference between our study and Laux and Rauter (2017) is that, as predicted by our analytical description, our empirical findings reveal that bank regulation, specifically the change in banks' weighted average regulatory risk weights, fully explains procyclical leverage for banks that are close to the regulatory leverage constraint. Another important difference is that although both studies find no link between fair value accounting and procyclical leverage, our study demonstrates that fair value comprehensive income has the expected negative relation with change in leverage, i.e., not a procyclical relation, and, contrary to the prediction of Adrian and Shin (2008, 2010), is not associated with increases in purchases or sales of assets.

3. Analytical Description and Basis of Predictions

To gain insight regarding the way fair value accounting and bank regulation can contribute to procyclical leverage, we describe analytically actions commercial banks can take in response to economic gains and losses on their assets resulting from upturns and downturns in the economy. In doing so, we do not model equilibrium bank behavior. Rather, we design the analytical description to focus on how a binding regulatory leverage constraint can result in procyclical accounting leverage.[6] Thus, we characterize banks as maximizing leverage subject to a constraint on a regulatory leverage ratio, which is the reciprocal of the regulatory capital ratio. The regulatory leverage constraint could be that imposed by the regulator or one that builds in a

[6] The evidence of procyclical leverage in Adrian and Shin (2008, 2010) for five investment banks raises the question of how regulation can explain procyclical leverage for regulated commercial banks when it exists in unregulated investment banks. The answer is that Adrian and Shin (2008; 2010) assume investment banks maximize return on equity by maximizing leverage subject to maintaining capital to meet an internally imposed value-at-risk criterion, which can play a role for investment banks that is analogous to the role of regulatory leverage for commercial banks. See also Adrian and Shin (2014).

buffer the bank views as an effective constraint. The analysis shows that for a bank with a binding regulatory leverage constraint, procyclical leverage is attributable to bank regulatory leverage requirements and not fair value accounting. For a bank that does not face a binding regulatory leverage constraint, it is possible that fair value accounting contributes to procyclical leverage. Our empirical tests developed in section 4 distinguish banks based on the proximity of their regulatory leverage to the externally imposed regulatory leverage constraint.

Our analytical description assumes that, similar to other entities, banks seek to maximize economic return on equity (Adrian and Shin, 2010). Thus, banks use debt financing to acquire risky assets, which increases leverage.[7] Although banks would seek to buy an unlimited amount of risky assets funded by debt, debt capital providers charge increasingly higher prices as debt increases because higher levels of debt are associated with a higher likelihood of financial distress. As a result, banks are limited in the amount of risky assets they can buy and cannot increase leverage indefinitely (Kraus and Litzenberger, 1973). Unlike other entities, banks face an additional constraint on leverage that is imposed externally by the regulator. It is an empirical question whether the market or regulatory constraint is more binding.

There is no consensus in the finance literature as to whether there is an optimal capital structure (e.g., Modigliani and Miller, 1958; Kraus and Litzenberger, 1973; Myers, 1984; Myers and Majluf, 1984). Accordingly, we make no assumptions regarding the optimality of banks' capital structures. However, Flannery and Rangan (2006) provides evidence that industrial firms have target capital structures, and manage leverage ratios to achieve their targets. If banks manage to a target leverage level, then we assume they will take actions to maintain this level. That is, in the face of increasing (decreasing) asset values, banks likely will buy (sell) assets and

[7] Although using equity financing typically does not maximize return on equity, some banks issue and repurchase equity for reasons we do not incorporate into the analytical description. Nonetheless, in our empirical tests we include as an explanatory variable changes in equity other than the change attributable to comprehensive income.

issue (repay) debt in amounts sufficient to restore leverage to the level it was at before the increase (decrease) in asset values. However, if banks buy or sell assets to maintain a target leverage level, there would be no observed change in leverage and hence no reason to expect a relation between change in leverage and change in assets. Thus, observing a positive relation between change in leverage and change in assets is evidence that banks do not manage accounting leverage to a targeted amount, or do so with a lag.

A key reason regulatory leverage differs from accounting leverage is that risk weights are applied to assets in determining the former but not the latter. In particular, regulatory leverage can be smaller than accounting leverage if a bank invests in assets with risk weights less than one. Because regulatory leverage depends on the risk weights regulators assign to a bank's assets, in striving to maximize return on equity, banks need to take into account the tradeoff between buying (selling) assets with lower risk weights—and thus lower expected return per dollar of assets bought (sold)—and fewer assets with higher risk weights—and thus higher expected return per dollar of assets bought (sold).

To assess the effects on leverage of banks striving to achieve their assumed objective—i.e., buying or selling assets to maximize leverage subject to a regulatory leverage constraint—we proceed in two steps. First, we analyze how regulatory and accounting leverage change during the period if the bank does not buy or sell assets in response to the income it earns. Second, we derive how regulatory and accounting leverage change if the bank buys or sells assets to meet its assumed objective.

We analyze a bank for a single period, where t_0 marks the beginning of the period and t_1 the end. At t_0 the bank has assets $A_0 > 0$, equity capital $K_0 > 0$, and debt $D_0 > 0$, with

$A_0 = K_0 + D_0$. The bank's leverage ratio is $L_0 = \frac{A_0}{K_0}$.[8] For risk-based capital regulation, bank assets are assigned risk weights from a vector, *V*.[9] We denote the bank's weighted average risk weight at t_0 as $V_0 \geq 0$, which results in a regulatory leverage ratio of $R_0 = \frac{V_0 \times A_0}{K_0}$. Thus, in the analysis, if risk weights equal one for all assets, then accounting and regulatory leverage are the same, and hence $\Delta L = 0$ when $\Delta R = 0$.[10]

The purpose of our analytical description is to determine the circumstances under which it is possible for accounting leverage to be procyclical, i.e., $\Delta L > 0$ in upturns and $\Delta L < 0$ in downturns when banks manage regulatory leverage to maintain it at the regulatory constraint, i.e., $\Delta R = 0$. The analytical description shows that $\Delta L > 0$ ($\Delta L < 0$) in upturns (downturns) when $\Delta R = 0$ is possible only when assets are risk weighted in determining *R* but not in determining *L* and banks buy (sell) assets with risk-weights lower than the weighted average risk-weight of their existing assets. Procyclical leverage does not arise from including fair value accounting in the analysis.

For simplicity, our analysis does not distinguish between accounting equity and regulatory capital, i.e., the bank's capital comprises only accounting equity. However, regulatory leverage is based on regulatory capital, which is accounting equity adjusted for items the regulator excludes from regulatory capital. For example, unrealized gains and losses on

[8] The literature dealing with capital structure choice typically assumes debt capital providers assess a firm's leverage based on the market values of debt and equity. We make the same assumption in the analytical description. In our empirical tests, we use leverage based on accounting amounts, which is consistent with other empirical studies examining procyclical leverage, e.g., Adrian and Shin (2008; 2010).

[9] During our sample period, regulatory risk weight categories are 0, 20, 50, and 100 percent. Cash, the least risky asset, is assigned a risk weight of 0, and increasingly riskier assets are assigned increasingly higher risk weights, i.e., 20, 50, or 100 percent.

[10] There are other aspects of bank regulation that we do not include in the analysis. For example, some assets, e.g., goodwill, are deducted from capital rather being assigned a risk weight. Assuming a regulatory leverage limit of 12.5, such a deduction is equivalent to assigning a risk weight of 1250%.

available-for-sale debt securities are not included in regulatory capital, and although unrealized losses of available-for-sale equity securities are included, 55% of unrealized gains are excluded. In addition, banks are subject to other regulatory leverage constraints, one that depends on a different measure of regulatory capital, and another that depends on accounting assets rather than risk-weighted assets (Bens and Monahan, 2008; Beatty and Liao, 2014).[11] As described in section 4, our empirical tests include the effects of these unmodeled differences between regulatory leverage based on risk-weighted assets and that based on accounting assets.

Between t_0 and t_1 the economy can expand, contract, or remain unchanged. We denote positive (negative, zero) economic growth by a growth factor, $g > 1$ ($0 < g < 1$, $g = 1$). The bank earns income during the period, I_1, that depends on the state of the economy, where $I_1 = (g - 1)A_0$.[12] Because our focus is on the potential relation between fair value accounting and procyclical leverage, in the analysis the bank's only income comprises fair value gains or losses. I_1 is positive if the economy expands and negative if the economy contracts. At t_1 the bank has assets of $A_1 = gA_0$ and capital of $K_1 = K_0 + I_1$.[13] Because leverage at t_1 and t_0 differ, we assume the bank will buy or sell assets if the return on equity it achieves from taking such actions is higher than from not taking such actions. As shown below, subject to its regulatory leverage

---

[11] The leverage measures based on risk-weighted assets and accounting assets both use regulatory capital in the denominator. Untabulated statistics reveal these regulatory leverage measures are positively correlated. However, untabulated statistics also reveal that the regulatory leverage constraint based on risk-weighted assets is far more binding. For example, for the top quintile of banks ranked on regulatory leverage based on total regulatory capital and risk-weighted assets, the mean ratio of banks' regulatory leverage to the regulatory leverage constraint is 73.3%, whereas the analogous percentage for regulatory leverage based on accounting assets is 2.4%.

[12] We do not consider hedging of risk in the analytical description or empirical tests. Derivatives are measured at fair value and hedge accounting is optional. Thus, even if a bank hedges its risks, assets and equity could change. Regardless, if hedging results in no change in accounting assets and equity, and thus accounting leverage, even though asset values change, we would find no evidence of procyclical leverage.

[13] For ease of exposition and parsimony, the analytical description assumes that all of the income, I_1, accrues to equityholders. The analysis easily can be extended to include a fixed return to debtholders. In this case, the income to equityholders is reduced by the amount due to debtholders, i.e., $I_1 = (g - 1)A_0 - \lambda D_0$, where λ is the interest rate on the debt. The result of this extension is that procyclical leverage is less (more) pronounced when $g > 1$ ($g < 1$). However, none of the predictions we derive from the analytical description is affected.

constraint, when the economy expands (contracts), i.e., $g > 1$ ($g < 1$), the bank has an incentive to buy (sell) assets. Without loss of generality, in the analysis regulatory risk weights remain constant throughout the economic cycle, i.e., they are independent of g.

When the bank does not buy or sell assets in response to the income it earns, changes in its regulatory and accounting leverage depend on the state of the economy, that is, depend on whether the bank has fair value gains or losses. In particular,

$$R_1 = \frac{V_0 \times A_1}{K_1} = \frac{V_0 \times gA_0}{K_0 + I_1} \tag{1}$$

$$L_1 = \frac{A_1}{K_1} = \frac{gA_0}{K_0 + I_1}. \tag{2}$$

Equations (1) and (2) illustrate the mechanical relation between change in leverage and change in asset value. That is, regulatory and accounting leverage do not change, i.e., $\Delta R = 0$ and $\Delta L = 0$, where $\Delta R = R_1 - R_0$ and $\Delta L = L_1 - L_0$, if the economy exhibits no growth, i.e., $g = 1$. If the economy expands (contracts), i.e., $g > 1$ ($g < 1$), regulatory and accounting leverage decrease (increase), i.e., $\Delta R < 0$ and $\Delta L < 0$ ($\Delta R > 0$ and $\Delta L > 0$). Adrian and Shin (2010) makes a similar observation that, in the absence of action taken by the bank, there is an inverse relation between the size of bank's balance sheet and leverage.

When the bank buys or sells assets to achieve its objective of maximizing leverage to maximize return on equity, the bank takes steps to counteract the mechanical relation between fair value gains or losses and leverage. Because the bank seeks to maximize leverage, the bank finances its asset purchases with debt or uses proceeds from asset sales to repay debt. If $d > 0$ ($d < 0$) represents the amount of assets the bank buys (sells) to maintain its regulatory leverage ratio, R_0, then assets in period one, A_1, is the sum of gA_0 and d, where $d = \Delta D = D_1 - D_0$. To maintain its regulatory leverage at the regulatory constraint, i.e., $\Delta R = 0$, the bank chooses d such that:

$$d = \frac{V_0 A_0}{V^*}\left[1 + (g-1)L_0 - g\right]. \tag{3}$$

V^* denotes the weighted average regulatory risk weight of assets bought or sold. Equation (3) reveals that the amount of asset purchases (sales) during economic upturns (downturns) depends on growth in the economy, g, the bank's initial leverage, L_0, and the weighted average risk weight of the assets bought or sold relative to that of the bank's initial assets, V_0/V^*.

Of key importance to our research question is that equation (3) reveals that because $L_0 > 1$, $d > 0$ ($d < 0$) when $g > 1$ ($g < 1$), procyclical leverage is possible only if the weighted average regulatory risk weight, V^*, of assets bought or sold to achieve $\Delta R = 0$, d, is less than the bank's initial weighted average regulatory risk weight, V_0, i.e., only if $V^* < V_0$. Moreover, in the context of the analytical description, $g > 1$ ($g < 1$) implies that $\Delta L > 0$ ($\Delta L < 0$) if and only if $V_0/V^* > 1$, i.e., $V^* < V_0$.[14] As a result, the existence of procyclical leverage does not arise because of fair value gains or losses.[15]

To show how procyclical leverage results if the weighted average regulatory risk weight of assets bought or sold is less than that of its initial assets, consider the following illustration relating to asset purchases. Assume a bank has 100 in assets with a risk weight of one, 80 in debt, and 20 in equity, which implies that its accounting and regulatory leverage are both five, and $V_0 = 1$. Assume further that the bank's assets increase in value by five to 105, and the risk

[14] See the Internet Appendix for support for this statement.

[15] More generally, it can be shown that procyclical leverage does not arise from any particular accounting for gains or losses, e.g., even if banks were to apply pure historical cost accounting with no recognition of fair value gains and losses or impairment. Although recognition of fair value gains and losses can result in banks buying or selling assets sooner than if they applied pure historical cost accounting, procyclical leverage occurs only if the weighted average regulatory risk weight of assets bought or sold is less than the bank's initial weighted average regulatory risk weight.

weights of the assets do not change. Absent taking any action, the bank's accounting and regulatory leverage both decrease to 4.2 (= 105 / 25). However, in its quest to maximize leverage, the bank buys 30 in assets by issuing 30 in debt. Because its regulatory leverage constraint is five, the mix of assets the bank buys is 10 with a risk weight of zero and 20 with a risk weight of one. Thus, $V^* = [(10 \times 0) + (20 \times 1)] / 30$, which is less than $V_0 = 1$. This action results in regulatory leverage of 5 (= $[(125 \times 1) + (10 \times 0)] / 25$) and leverage of 5.4 (= 135 / 25), which is procyclical. Other asset purchase combinations can achieve this goal.

As an illustration relating to asset sales, consider a bank that has 120 in assets, 100 (20) of which have a risk weight of one (zero), 100 in debt, and 20 in equity, implying that its leverage is six, regulatory leverage is five, and $V_0 = 0.83 = [(100 \times 1) + (20 \times 0)] / 120$. Assume that the bank's risky assets, i.e., those with a risk weight of one, decrease in value by 10 to 90. Absent taking any action, the bank's accounting and regulatory leverage increase to 11 (= 110 / 10) and 9 (= $[(90 \times 1) + (20 \times 0)] / 10$). To achieve procyclical leverage while restoring regulatory leverage to five, the bank needs to sell 40 of its risky assets and more than 10 of its riskless assets. For example, if the bank sells 12 of its riskless assets in addition to the 40 risky assets, leverage decreases to 5.8 (= $[(90 - 40) + (20 - 12)] / 10$). Thus, $V^* = 0.77$ (= $[(40 \times 1) + (12 \times 0)] / 52$), which is less than $V_0 = 0.83$.[16]

[16] Our analysis does not distinguish between unrealized fair value gains and losses that are and are not included in regulatory capital. This simplification results in our analysis overstating the extent to which regulatory capital mechanically decreases (increases) during economic upturns (downturns), which in turn results in our analysis overstating the extent to which accounting leverage can be procyclical. To see this, consider a bank that is close to its regulatory leverage constraint and has assets comprising only available-for-sale debt securities. Because unrealized gains and losses on these securities are not included in regulatory capital, during an economic upturn regulatory leverage would remain unchanged and accounting leverage would mechanically decrease. Because the bank is near its regulatory leverage constraint, the bank is unable to respond to the decrease in accounting leverage by purchasing assets and, as a result, accounting leverage would be countercyclical rather than procyclical. More generally, the greater is the extent to which a bank's fair value gains or losses are not included in regulatory capital, the less likely the bank will exhibit procyclical leverage.

An additional implication of equation (3) is that if d is sufficiently positive (negative) in economic upturns (downturns) to result in procyclical leverage, then the extent to which leverage is procyclical is proportional to V_0/V^*. That is, assuming $V^* < V_0$, the lower the weighted average risk weight of the assets a bank buys (sells) to maintain its regulatory leverage, i.e., $\Delta R = 0$, during upturns (downturns), the higher (lower) is d and the greater is the increase (decrease) in L, i.e., the more leverage is procyclical. To illustrate why this is the case, suppose that during upturns the bank buys assets with one of four possible risk weights, V_1, V_2, V_3, and V_4. If $V_1 < V_2 < V_3 < V_4$, then the amount of assets the bank can buy and achieve $\Delta R = 0$, d, is decreasing across the risk weight categories, i.e., $d_1 > d_2 > d_3 > d_4$. This in turn implies that $\Delta L_1 > \Delta L_2 > \Delta L_3 > \Delta L_4$, i.e., the extent to which leverage is procyclical is higher the lower is the risk weight category of the assets purchased.[17] More generally, the bank can buy assets in all four risk weight categories. To the extent that a bank buys more assets in lower risk weight categories, the resulting V^* is lower. Equation (3) reveals the lower is V^*, the more assets the bank can buy, i.e., the larger is d, which in turn results in a larger increase in L, i.e., the more leverage is procyclical.

Although the above discussion explains how procyclical leverage can occur, it does not consider why a bank would find it beneficial to buy or sell assets with a weighted average risk weight less than that of its initial assets. To gain insight into this question, assume a bank can buy and sell a risky asset with a risk weight of one and a riskless asset with a risk weight of zero. When the bank experiences a gain and buys assets, it will buy as much of the risky asset as the regulator allows. In addition, the bank will buy as much of the riskless asset as possible, conditional on the marginal cost of debt, because even riskless assets have a positive return,

[17] See Internet Appendix for support for this statement.

which increases the bank's return on equity.[18] When the bank experiences a loss and sells assets, it will sell as little of the risky asset as the regulator allows. In addition, the bank will sell as much of the riskless asset as necessary to lower the marginal cost of debt to an acceptable level. For leverage to be procyclical, the bank needs to buy or sell enough riskless assets such that V^* is less than V_0, i.e., the weighted average risk weight before the asset purchases or sales.[19]

Plantin, Sapra, and Shin (2008) shows that when there is illiquidity in financial asset markets, contagion can result, whereby the price of a financial asset is sensitive to the decisions of other financial institutions. For example, during economic downturns, fundamental values decrease, but there are negative externalities generated by other banks selling assets. When other banks sell a financial asset, its price is lower than its fundamental value, thereby exerting a negative effect on other banks, especially those that hold the asset. Anticipating this negative effect, the bank may attempt to preempt the price decrease by selling the asset it holds. However, such preemptive action amplifies the price decline. Thus, during an economic downturn, fair value accounting amplifies asset price declines relative to changes in fundamental value.[20]

[18] In practice, the marginal cost of borrowing for a bank likely is less than the riskless rate. This is because banks typically fund their operations using deposits, short-term interbank loans, and repos, all of which have a lower rate than longer-term US Treasury bonds. That is, banks exploit the maturity mismatch between their shorter-term funding sources and Treasury bonds to earn a spread (DeAngelo and Stulz, 2015; Hanson, Shleifer, Stein and Vishny, 2015).

[19] Buying (selling) assets with risk weights lower than the bank's initial weighted average risk weight implies that the expected income from buying (selling) these assets is higher relative to their risk weight than assets with risk weights greater than or equal to the bank's initial weighted average risk weight. A difference in relative income could arise from mispricing of assets with lower risk weights or risk weights that underestimate the assets' risk. Prior research suggests both attributes played a role during the credit boom that led to the 2008-2009 financial crisis (e.g., Coval, Jurek, and Stafford, 2009; Shleifer and Vishny, 2010; Erel, Nadauld, and Stulz, 2014).

[20] The analytical description can be modified to incorporate contagion in either economic downturns or upturns and regardless of its source. However, doing so does not alter our conclusion that procyclical leverage is possible only if the weighted average regulatory risk weight of assets bought or sold is less than the bank's initial weighted average regulatory risk weight, i.e., if $V^* < V_0$, and does not depend on the magnitude of fair value gains and losses. See Internet Appendix for details.

4. *Empirical Predictions and Estimating Equations*

Based on the analysis in section 3, we design tests to assess the extent to which bank regulatory leverage requirements contribute to procyclical leverage. We then design tests to examine the extent to which fair value accounting contributes to procyclical leverage. Finally, we examine whether inferences we draw from these tests apply in both economic upturns and downturns.

4.1 Procyclical Leverage and Regulation

We begin by estimating equation (5), which is based on Adrian and Shin (2008; 2010), to assess whether commercial banks exhibit procyclical leverage:

$$\Delta L_{iq} = \beta_0 + \beta_1 \Delta A_{iq} + \varepsilon_{iq}, \tag{5}$$

where ΔL is quarterly percentage change in leverage, ΔA is quarterly percentage change in assets, and i and q refer to bank i and quarter q. Equation (5) and those that follow also include fixed effects for each bank and year-quarter, which we do not tabulate.[21] If leverage is, on average, procyclical as prior research finds (Adrian and Shin, 2008; 2010), then we predict β_1 is positive.

To test whether any procyclical leverage observed in equation (5) is attributable to change in a bank's weighted average risk weight, we estimate equation (6):

$$\Delta L_{iq} = \beta_0 + \beta_1 \Delta A_{iq} + \beta_2 \Delta V_{iq} + \varepsilon_{iq}, \tag{6}$$

[21] Use of bank and time fixed effects assumes that the unobserved effects are bank and time invariant. Although research shows leverage ratios are fairly stable, leverage changes occur over longer time horizons (Lemmon et al. 2008; Huang and Ritter, 2009). Because we cannot use lagged dependent variables with fixed effects (Nickel, 1981), we estimated all equations using lagged dependent variables with up to four lags as explanatory variables. Untabulated findings reveal negligible differences in estimated ΔA and ΔV coefficients and standard errors from those we tabulate. Also, for expositional convenience, we use the same notation for coefficients and error terms in equations (5) through (12). In all likelihood they differ.

where ΔV is the quarterly change in the bank's weighted average regulatory risk weight, i.e., regulatory risk-weighted assets deflated by total assets.[22] ΔV reflects the change in the bank's weighted average risk weight arising from changes in the bank's portfolio of assets as well as from changes in economic conditions.

Because the analysis in section 3 predicts that for banks with a binding regulatory leverage constraint any procyclical leverage results from ΔV, we predict β_1 is zero in equation (6) if the regulatory constraint is, on average, binding. If the regulatory constraint is not binding, on average, then we predict β_1 is positive as in equation (5) because the section 3 analysis provides no prediction for the role of ΔV in explaining procyclical leverage in this circumstance. Based on the analysis, we also predict β_2 is negative if the regulatory constraint is, on average, binding because procyclical leverage resulting from asset purchases or sales only occurs if the weighted average risk weight of the assets bought or sold is less than the weighted average risk weight of the assets in the investment portfolio prior to the purchase or sale. Thus, because asset purchases (sales) are associated with increases (decreases) in leverage, increases (decreases) in leverage are associated with decreases (increases) in V.[23] The section 3 analysis provides no prediction for the role of ΔV if the regulatory constraint is not binding, and thus β_2 can be zero. However, β_2 can be negative to the extent that banks with non-binding regulatory constraints manage their regulatory capital.

[22] Our measure of ΔV does not include implied changes in regulatory risk weights arising from changes in regulatory deductions described in footnote 10. To the extent that such deductions are large relative to our measure of ΔV, this will bias against finding a significantly negative coefficient for ΔV.

[23] Our estimating equations assume that banks take actions in response to gains and losses in the same quarter as the gains and losses occur. This is because banks must meet regulatory leverage requirements at the end of the quarter. Nonetheless, we estimated versions of equations (5) and (6) including as additional explanatory variables four quarterly lagged change in assets, i.e., ΔA_{t-k}, $k = 1,\ldots,4$. Untabulated findings reveal inferences identical to those revealed by table 2.

To test the prediction regarding the influence of the regulatory leverage constraint, we also estimate equations (5) and (6) and all equations that follow for banks with relatively high or low regulatory leverage. We partition the sample into two groups based on their regulatory leverage because, as explained in section 5, our sample excludes banks that are in violation of regulatory leverage requirements and, as explained in section 3, the regulatory leverage constraint could be one that builds in a buffer the bank views as an effective constraint. To create the partition, we sort all bank-quarter observations into quintiles based on total regulatory leverage, i.e., Tier 1 + Tier 2 regulatory leverage, and on Tier 1 regulatory leverage, which yields ten sets of observations. We assign bank-quarter observations in the top two quintiles of both leverage measures into the high regulatory leverage group, and the remaining observations into the low group. We interpret the high (low) regulatory leverage group as being relatively close to (far from) the regulatory leverage constraint. If the partitioning fails to distinguish banks based on proximity to the banks' perceived regulatory leverage constraint, then we will not find evidence consistent with our predictions.[24]

We next test the implication of equation (3) that the lower the weighted average risk weight of the assets a bank buys (sells) to maintain its regulatory leverage, during upturns (downturns), the greater is the increase (decrease) in *L*, i.e., the more leverage is procyclical. To do so, we estimate equation (7), which disaggregates change in assets into change in assets in each risk-weight category specified by bank regulators.

$$\Delta L_{iq} = \beta_0 + \beta_1 \Delta RWA(0)_{iq} + \beta_2 \Delta RWA(20)_{iq} + \beta_3 \Delta RWA(50)_{iq} + \beta_4 \Delta RWA(100)_{iq} + \beta_5 \Delta NWA_{iq} + \varepsilon_{iq} \quad (7)$$

[24] As a validity check of the partition, we estimate equations (5) and (6) for each of the ten sets of observations to determine whether β_1 is positive in equation (5), and is insignificantly different from zero in equation (6). Untabulated statistics reveal that for equation (5), β_1 is significantly positive for all sets, which indicates procyclical leverage is pervasive, and that for equation (6), β_1 is insignificantly different from zero (significantly positive) for the top two (bottom three) quintiles based on either regulatory leverage measure. These untabulated findings support the validity of the partition.

$RWA(\text{J})$ is assets in risk-weight category J, J = 0, 20, 50, and 100 percent, deflated by lagged total assets.[25] ΔNWA is change in non-risk-weighted assets, i.e., $\Delta A - \sum \Delta RWA(\text{J})$.

We predict $\beta_1 > \beta_2 > \beta_3 > \beta_4$ because it is likely that banks in the cross-section buy and sell assets in each of the risk weight categories.[26, 27] As with equations (5) and (6), we also predict that any greater positive relation for changes in assets with lower risk weights is more pronounced for banks relatively close to the regulatory leverage constraint. Thus, we predict that the difference between β_1 and β_4 is greater for banks relatively close to the regulatory leverage constraint. Findings consistent with our predictions provide additional evidence that banks manage their regulatory leverage, thereby contributing to procyclical leverage.

4.2 Procyclical Leverage and Fair Value Accounting

To examine the extent to which fair value accounting contributes to procyclical leverage we estimate equations (8) and (9), which extend equations (5) and (6) by including a measure of fair value comprehensive income as an additional explanatory variable.

$$\Delta L_{iq} = \beta_0 + \beta_1 \Delta A_{iq} + \beta_3 FVCIdecile_{iq} + \varepsilon_{iq} \qquad (8)$$

$$\Delta L_{iq} = \beta_0 + \beta_1 \Delta A_{iq} + \beta_2 \Delta V_{iq} + \beta_3 FVCIdecile_{iq} + \varepsilon_{iq} \qquad (9)$$

FVCIdecile is the quarterly cross-sectional decile rank of *FVCI*, which is fair value comprehensive income deflated by lagged total assets. Therefore, *FVCIdecile* ranges from zero to one. Fair value comprehensive income is the sum of the components of comprehensive

---

[25] Assets in risk-weight category 0, 20, 50, and 100 percent also include allocated trading assets with equivalent risk weights less than or equal to 10%; greater than 10% and less than or equal to 35%; greater than 35% and less than or equal to 75%; and greater than 75%.

[26] Untabulated statistics reveal that this is likely; for our sample, the means of $\Delta RWA(0)$, $\Delta RWA(20)$, $\Delta RWA(50)$, and $\Delta RWA(100)$ are 0.12, 0.45, 0.23, and 1.30 percent.

[27] For example, consider the illustration in section 3 in which a bank initially has 100 of assets with a risk weight of one, i.e., 100%. Following a gain of 5, the bank buys 30 of assets, 20 with a risk weight of one and 10 with a risk weight of zero. For this bank, we predict $\beta_1 > \beta_4$ and, in particular, $\beta_1 = 0.04$ and $\beta_4 = 0$. Moreover, applying the same logic, if a bank buys or sell assets in each of the risk-weight categories, then $\beta_1 > \beta_2 > \beta_3 > \beta_4$.

income relating to assets and liabilities measured at fair value, i.e., gains or losses relating to securities measured at fair value, derivatives, and any assets or liabilities the bank elects to measure at fair value using the fair value option.[28] We construct *FVCIdecile* based on *FVCI* rather than the ratio of fair value comprehensive income to total comprehensive income because both fair value comprehensive income and total comprehensive income can be positive or negative, which can confound interpretation of the ratio and hence its coefficient.[29] If changes in assets attributable to fair value accounting contribute to procyclical leverage more than other changes in assets, then β_3 is positive in equation (8) and positive in equation (9) for banks relatively far from the regulatory leverage constraint.

To test whether procyclical leverage arises from the interaction of asset purchases (sales) and fair value gains (losses), i.e., fair value gains (losses) cause banks to issue (repurchase) more debt and buy (sell) more assets than would be the case under modified historical cost accounting, we estimate equations (10) and (11), which extend equations (8) and (9).

$$\Delta L_{iq} = \beta_0 + \beta_1 NETPUR_{iq} + \beta_2 FVCIdecile_{iq} + \beta_3 NETPUR_{iq} \times FVCIdecile_{iq} + \varepsilon_{iq} \quad (10)$$

$$\Delta L_{iq} = \beta_0 + \beta_1 NETPUR_{iq} + \beta_2 FVCIdecile_{iq} + \beta_3 NETPUR_{iq} \times FVCIdecile_{iq} + \beta_4 \Delta V_{iq} + \varepsilon_{iq} \quad (11)$$

NETPUR is change in assets other than that resulting from comprehensive income, including fair value gains and losses, i.e., $\Delta A - CI$, where *CI* is comprehensive income. If procyclical leverage

[28] In equations (8) and (9), we use *FVCIdecile* rather than *FVCI* to facilitate comparison with equations (10) and (11), in which we use *FVCIdecile* to construct an interaction variable. Expressing fair value comprehensive income as a variable that ranges from zero to one facilitates interpretation of the interaction variable's coefficient. We also estimated equations (8) through (11) replacing *FVCIdecile* with fair value comprehensive income, alternatively deflated by lagged assets and lagged equity. Untabulated findings reveal the same inferences as those based on the tables 4 and 5 findings.

[29] We also estimate equations (8) and (9) but constructing *FVCIdecile* to exclude gains or losses relating to liabilities banks elect to measure at fair value. Doing so enables us to interpret inclusion of *FVCIdecile* as permitting the coefficient on ΔA to vary depending on the extent of fair value comprehensive income. Although data for gains or losses relating to liabilities are available only for approximately 25 percent of sample banks, untabulated findings based on this alternative construction of *FVCIdecile* reveal inferences identical to those based on the table 4 findings.

arises from the interaction of asset purchases (sales) and fair value gains (losses), then the coefficient on *NETPUR* × *FVCIdecile*, β_3, is positive in equation (10) and in equation (11) for banks relatively far from the regulatory leverage constraint.

As an alternative way to examine the extent to which fair value accounting contributes to procyclical leverage, we estimate equation (12), which disaggregates change in assets, ΔA, into components that are affected by fair value accounting, *FVCI*, and components that are not, $\Delta K - CI$, ΔD, and $OTH\_\Delta A$. That is, $\Delta A = FVCI + (\Delta K - CI) + \Delta D + OTH\_\Delta A$, where ΔK and ΔD are change in equity and change in debt and $OTH\_\Delta A$ is other changes in assets. All variables are deflated by lagged total assets.

$$\Delta L_{iq} = \beta_0 + \beta_1 FVCI_{iq} + \beta_2 OTH\_\Delta A_{iq} + \beta_3 (\Delta K - CI)_{iq} + \beta_4 \Delta D_{iq} + \varepsilon_{iq} \quad (12)$$

Based on the mechanical relations between change in leverage and changes in debt and equity, we predict β_3 is negative and β_4 is positive. If *FVCI* does not contribute to procyclical leverage, we predict β_1 is negative. However, if *FVCI* contributes to procyclical leverage, then its relation to ΔL is less negative than it would be in the absence of any contribution to procyclical leverage; the relation could be positive if its contribution is sufficiently large. Hence, if changes in assets attributable to fair value accounting contribute to procyclical leverage more than changes in assets arising from non-income changes in equity, $\Delta K - CI$, then β_1 is positive or less negative than β_3. Conversely, if changes in assets attributable to fair value accounting contribute to procyclical leverage no differently from changes in assets arising from non-income changes in equity, then $\beta_1 = \beta_3$.[30]

4.3 Economic Upturns and Downturns

[30] We also estimated equation (12) replacing *FVCI* with *FVCIdecile*. Untabulated findings reveal the same inferences as those based on the table 6 findings.

Accounting standards in place during our sample period permitted recognition of fair value gains, which are expected to be observed during economic upturns, only for a subset of investment securities. However, accounting standards required banks—and other entities—to recognize impairment losses, which are expected to be observed during economic downturns, for all assets. Because of this asymmetry in accounting requirements, to the extent there is procyclical leverage and it stems from fair value accounting, we predict any procyclical leverage and its association with fair value accounting is more pronounced in economic downturns than economic upturns. Thus, we estimate equations (5), (6), and (8) through (12) separately for economic upturns and downturns. We define economic upturns (downturns) as those quarters with positive (negative) S&P 500 index returns, and refer to them as up (down) markets. In particular, for equations (5), (6), and (8) through (11) we predict β_1 is more positive in down markets, and for equation (12), the extent to which β_1 is less negative than β_3 is greater in down markets. In addition, for equations (8) and (9), we predict β_3 is more positive in down markets, and for equations (10) and (11), β_1 and β_3 are more positive in down markets.

5. Sample and Data

We obtain quarterly financial statement data from the Compustat Bank files (three-digit SIC 602) and the WRDS Bank Regulatory Database, which includes accounting and regulatory data from regulatory forms filed with the Federal Reserve System, Federal Deposit Insurance Corporation, and the Comptroller of the Currency, from the first quarter of 2001 to the fourth quarter of 2013. Our sample period begins in 2001 because that is when data are available on other comprehensive income, which we require for estimating equations (8) through (12).[31] The

[31] In principle, when estimating equations (5) through (7) we could begin our sample period in 1992, the first year Basel Capital requirements were implemented in the US. However, the Basel Capital requirements and risk-weight calculations differ before and after 2001, and implementation of these requirements was amended several times

sample comprises US commercial banks and bank holding companies that file Call Reports and Federal Reserve Y-9C reports.[32] We require all sample banks to have Tier 1 (total) regulatory leverage less than or equal to 25 (12.5) to exclude banks that are in violation of regulatory leverage requirements in effect during our sample period. We also exclude bank-quarter observations for banks that acquired other banks during the quarter with total assets greater than 10 percent of the acquiring bank's assets to mitigate the effect of bank acquisitions on the bank's change in assets (Collins and Hribar, 2002). All sample banks have non-negative values for total assets and equity in all quarters of the sample period. We winsorize all continuous regression variables at the 1% and 99% levels.[33] The final sample consists of 19,725 bank-quarter observations of 764 commercial banks. The appendix provides definitions for all variables.

Table 1, panels A and B, presents distributional statistics and correlations for the regression variables. Panel A reveals that the mean and median percentage change in leverage, ΔL, are 0.20% and −0.10%. The mean and median percentage change in assets, ΔA, 2.11% and 1.44%, largely are attributable to change in debt (mean and median ΔD = 1.92% and 1.28%). Untabulated statistics reveal that, on average, assets measured at fair value comprise 17% of total assets and 188% of equity, and fair value gains and losses comprise 3% of net interest revenue. Additional untabulated statistics reveal that change in weighted average regulatory risk weight, ΔV, arises from changes in loans, and held-to-maturity, available-for-sale, and trading securities.

---

between 1992 and 2001. In particular, measurement of the capital ratio and risk-weights for some assets changed, and risk-weights for trading assets were amended in 1998, 1999, and 2001. Thus, it is difficult to develop clear and consistent predictions for years before 2001. Nonetheless, untabulated findings relating to estimation of equations (5) through (7) for 1996, when asset risk weight information is first available, through 2001 reveal inferences that largely are consistent with those based on the tables 2 and 3 findings. A notable exception is that leverage is procyclical for HIGH banks when change in weighted average risk weight is included in the estimating equation.

[32] To merge Compustat with the Call Reports and Y-9Cs we use the CRSP-FRB link provided by the New York Federal Reserve between regulatory entity codes and CRSP PERMCOs.

[33] Inferences based on untabulated findings from estimation of all equations using variables that are not winsorized, that are winsorized at the 5% and 95% levels, or after eliminating outliers alternatively identified using studentized residuals larger than 3 in absolute value and Cooke's D-statistic larger than 4/n are the same as those based on tabulated findings.

In particular, the increase(s) in loans (held-to-maturity, available-for-sale, and trading securities) is (are) significantly associated with increases (decreases) in *V*. Panel A also reveals that ΔV arises from changes in risk weights within each asset class.

Table 1, panel B, reveals that ΔL is positively correlated with ΔA (Spearman and Pearson correlations = 0.48 and 0.21), which is consistent with procyclical leverage. However, the Spearman (Pearson) correlation between ΔL and fair value comprehensive income, *FVCI*, is negative, –0.20 (–0.10), which is inconsistent with fair value accounting being a source of procyclical leverage. In addition, consistent with predictions, the correlation between ΔL and change in weighted average regulatory risk weight, ΔV, is negative (Spearman and Pearson correlations = –0.29 and –0.21). All of these correlations are significantly different from zero.

6. *Empirical Results*

6.1 Procyclical Leverage and Regulation

Table 2 presents regression summary statistics from estimations of equations (5) and (6). Table 2, and all subsequent tables, reports findings for the full sample, labeled as FULL, and for observations relatively far from (close to) the regulatory constraint, which for ease of exposition we refer to as LOW (HIGH) banks.

Regarding the FULL sample, the findings in table 2 relating to equation (5) reveal evidence of procyclical leverage. In particular, the relation between change in leverage, ΔL, and change in assets, ΔA, is significantly positive (ΔA coefficient = 0.36, t-statistic = 7.99).[34] The findings relating to equation (6) support the prediction of the analysis in section 3 that the relation between change in leverage, ΔL, and change in a bank's weighted average regulatory

[34] Reported t-statistics relating to all estimating equations are based on standard errors clustered by bank and calendar quarter. We thank Dan Taylor for making his STATA code available on his website for fixed-effects models with two-way clustered standard errors (see Gow, Ormazabal, and Taylor, 2010).

risk weight of its assets, ΔV, is significantly negative (ΔV coefficient = –0.36, t-statistic = –7.98). However, the significantly positive coefficient for ΔA (coefficient = 0.26, t-statistic = 5.07) indicates that, on average, banks have procyclical leverage even in the presence of ΔV.[35]

Regarding LOW and HIGH banks, the findings in table 2 reveal that inferences we draw from equation (5) pertain to LOW and HIGH banks. In particular, the relations between change in leverage, ΔL, and change in assets, ΔA, are significantly positive (ΔA coefficients = 0.46 and 0.25, t-statistics = 10.83 and 4.00). However, the findings in table 2 reveal that inferences we draw from equation (6) depend on whether the bank is relatively close to the regulatory constraint. In particular, whereas for the LOW banks the ΔA coefficient is significantly positive in the presence of ΔV (coefficient = 0.40, t-statistic = 8.60), for HIGH banks it is insignificantly different from zero (coefficient = 0.09, t-statistic = 1.22).[36] The finding relating to HIGH banks is consistent with the prediction of the analysis in section 3 that after controlling for change in weighted average regulatory risk weight, there is no procyclical leverage for banks relatively close to the regulatory leverage constraint.[37]

[35] Although, as noted in section 3, there is no consensus regarding optimal capital structure, there is a literature that identifies determinants of the level of leverage. For example, Gropp and Heider (2010) finds that the equity market-to-book ratio, profits, assets, and an indicator for whether a firm pays dividends are determinants. Accordingly, we estimated versions of equations (5) and (6) that include change in the equity market-to-book ratio, change in comprehensive income, and change in the indicator variable for whether a bank pays dividends. Untabulated findings reveal that although some of the additional variables have significant incremental explanatory power, inferences regarding the coefficients on ΔA and ΔV are identical to those relating to the findings in table 2.

[36] Finding that accounting leverage is procyclical for banks that do not face binding regulatory leverage constraints raises the question of what sources other than bank regulation can contribute to procyclical leverage. One possible source is that banks could maintain capital to meet an internally imposed value-at-risk criterion (Adrian and Shin, 2014). Another possible source relates to the fact that banks fund new asset purchases in repo markets by pledging assets as collateral. In economic upturns (downturns) banks can obtain more (less) financing per unit of assets that they pledge, thereby increasing (decreasing) leverage (Gorton and Metrick, 2009). Other funding mechanisms for banks, such as short-term interbank or money markets, could similarly induce procyclical leverage.

[37] As additional evidence of the importance of bank regulation in contributing to procyclical leverage, we estimated equations (5) and (6) partitioning banks into HIGH and LOW groups based on accounting leverage. Untabulated findings reveal that regardless of whether change in weighted average regulatory risk weight is included in the equation, both HIGH and LOW banks evidence procyclical leverage. The t-statistics associated with the ΔA coefficients for LOW (HIGH) banks in equations (5) and (6) are 5.94 and 4.49 (7.80 and 4.73).

Table 2 also reveals that the ΔV coefficient is significantly negative for both LOW and HIGH banks (coefficients = –0.20 and –0.65; t-statistics –4.86 and –7.05). In addition, the ΔA coefficient is smaller in the presence of ΔV for both sets of banks, although the effect on ΔA's coefficient from including ΔV is more pronounced for HIGH than LOW banks (0.16 = 0.25 – 0.09 vs. 0.06 = 0.46 – 0.40). The findings relating to LOW banks reveal that the presence of regulatory risk weights on assets contributes to procyclical leverage even for banks relatively far from the regulatory leverage constraint.[38]

Equations (5) and (6) include bank and year-quarter fixed effects as controls for unspecified bank-specific and time-specific factors associated with change in leverage. To allow for the possibility that bank (time) factors are not temporally (cross-sectionally) invariant, we re-estimate equations (5) and (6) including bank and macroeconomic variables (Beatty and Liao, 2014; Acharya and Ryan, 2016; Laux and Rauter, 2017). The bank variables include lagged equity market-to-book ratio, lagged percentage change in loan growth, an indicator variable for whether the bank changed its dividend, lagged leverage, and change in the ratio of regulatory capital to accounting equity. The macroeconomic variables include percentage change in the S&P 500 VIX, percentage change in the S&P 500 equity index, percentage change in Moody's Baa-rated corporate bond spreads, and percentage change in the 10-year US Treasury bond yield. We also include bank and year fixed effects.

[38] As explained in section 3, the analytical description does not distinguish between accounting equity and regulatory capital. As a result, inferences we draw from the table 2 findings regarding the influence of ΔV could be affected by differences between the two capital measures. Thus, we re-estimate equation (6) including the change in the ratio of regulatory capital to accounting equity. Untabulated findings reveal that the change in the ratio has a significantly negative coefficient for HIGH banks, which means that the difference between accounting equity and regulatory capital helps explain change in accounting leverage for banks that are closer to their regulatory leverage constraints (coefficient = –0.002 and t-statistic = –1.98). However, inclusion of this additional variable does not affect the inferences we draw regarding the role of ΔV and procyclical leverage for HIGH banks. The coefficients (t-statistics) for ΔA and ΔV are essentially the same as those in table 2 for HIGH and LOW banks and the FULL sample.

Untabulated findings reveal that although some of these variables are significant in explaining change in leverage, their inclusion does not affect the inferences we draw from table 2. In particular, regarding equation (5), for the FULL sample and LOW and HIGH banks, the ΔA coefficients, 0.36, 0.48, and 0.18, are significantly positive (t-statistics = 7.82, 11.58, and 2.87). Regarding equation (6), for the FULL sample and LOW banks, the ΔA coefficients, 0.25 and 0.40, are significantly positive (t-statistics = 4.92 and 8.99), and that for HIGH banks, the ΔA coefficient, 0.00, is insignificantly different from zero (t-statistic = 0.01). In addition, for the FULL sample and LOW and HIGH banks, the ΔV coefficients, –0.39, –0.23, and –0.70, are significantly negative (t-statistics = –9.20, –5.50, and –8.47).

The findings in table 3, panel A, which presents regression summary statistics relating to equation (7), provide additional support for our interpretation of the findings in table 2. In particular, as predicted, $\beta_1 > \beta_2 > \beta_3 > \beta_4$ for the FULL sample as well as LOW and HIGH banks. That is, finding that the positive relation between change in assets and change in leverage is greater for changes in assets with lower risk weights is evidence that banks manage their regulatory capital in a way that contributes to procyclical leverage. The findings from tests for coefficient differences in table 3, panel B, generally confirm the significance of the monotonic relation for each sample. All coefficient differences are significant with the following exceptions: the differences between β_2 and β_3 for all three samples and the differences between β_1 and β_2 and between β_1 and β_3 for LOW banks. Also as predicted, the difference between β_1 and β_4 is larger for HIGH than LOW banks (0.65 = 0.93 – 0.28 vs. 0.28 = 0.69 – 0.41). Untabulated statistics reveal this difference is significant ($\chi^2 = 11.46$; p-value < 0.001).

6.2 Procyclical Leverage and Fair Value Accounting

Table 4 presents regression summary statistics from estimations of equations (8) and (9). The findings are inconsistent with fair value accounting contributing to procyclical leverage. In fact, the findings are consistent with fair value accounting reducing procyclical leverage. In particular, the *FVCIdecile* coefficients are significantly negative in all six estimations, with coefficients (t-statistics) ranging from –0.02 to –0.03 (–4.38 to –5.91). All inferences relating to ΔA and ΔV are the same as those based on the findings in table 2.

Table 5 presents regression summary statistics from estimations of equations (10) and (11). The findings are inconsistent with procyclical leverage arising from the interaction of asset purchases (sales) and fair value gains (losses). In particular, the $NETPUR \times FVCIdecile$ coefficient is not significantly positive in any estimation. For the FULL sample and LOW banks, it is negative but insignificantly different from zero (coefficients range from –0.07 to –0.09; t-statistics range from –0.72 to –1.10). For HIGH banks, it is significantly negative (coefficients = –0.23 and –0.22; t-statistics = –2.06 and –2.20), which suggests that fair value accounting not only is not associated with an increase in net purchases of other assets, but also is associated with a reduction of net purchases of other assets. All inferences relating to *NETPUR*, ΔV, and *FVCIdecile* are the same as those based on the findings in table 4 relating to ΔA, ΔV, and *FVCIdecile*.

Table 6 presents regression summary statistics from estimations of equation (12). The findings in table 6 are consistent with the expected relations between change in leverage and changes in debt and equity, and inconsistent with procyclical leverage being associated with fair value accounting.[39] In particular, for the FULL sample, the coefficients on fair value

[39] To assess whether the relation between *FVCI* and change in leverage depends on the sign of *FVCI*, we re-estimated equation (10) including an indicator variable for whether *FVCI* is positive and the interaction of this indicator variable with *FVCI*. Untabulated findings reveal that the coefficient on neither the indicator variable nor

comprehensive income, *FVCI*, and other changes in equity, $\Delta K - CI$, are significantly negative (coefficients = −10.61 and −7.58, t-statistics = −18.61 and −23.99), and the coefficient on change in debt, ΔD, is significantly positive (coefficient = 0.95, t-statistic = 41.54).[40] More importantly, the *FVCI* coefficient is significantly more negative than the $\Delta K - CI$ coefficient (untabulated F-statistic = 29.62, p-value < 0.001). This is inconsistent with fair value accounting being a source of procyclical leverage. The findings relating to HIGH and LOW banks reveal the same inferences as those relating to the FULL sample.

6.3 Economic Upturns and Downturns

Table 7, panel A (B, C, and D), presents regression summary statistics from estimations of equations (5) and (6) ((8) and (9), (10) and (11), and (12)) separately for economic upturns and downturns. Table 7 reveals inferences based on the upturn and downturn findings that are the same as those based on tables 2, 4, 5, and 6, with a few exceptions for HIGH banks in downturns. In particular, in panel A there is no procyclical leverage (ΔA coefficient = 0.16; t-statistic = 1.21); in panel B there is no procyclical leverage (ΔA coefficient = 0.17; t-statistic = 1.25), and whereas the *FVCIdecile* coefficients are significantly negative in table 4, they are negative but insignificantly so in panel B; in panel C, whereas the *NETPUR* coefficient is significantly positive in table 5 in the presence of ΔV, it is positive but insignificantly different from zero (*NETPUR* coefficient = 0.23; t-statistic = 1.31), and whereas the *FVCIdecile*

---

the interaction is significantly different from zero, which indicates that the relation does not vary depending on the sign of *FVCI*.

[40] The coefficient magnitudes are consistent with banks being highly levered. For a highly levered bank, change in debt has an almost one-to-one correspondence with change in leverage. To see this, consider, e.g., a bank with A = 120, D = 110, and K = 10, the relative magnitudes of which are representative of the average of our sample banks. If the bank issues debt of 1 and buys assets of 1, the implied coefficient on ΔD would equal 1 (=$\Delta L/\Delta K$ = 0.00833/0.00833). All else equal, change in equity has a larger effect on change in leverage. In this example, if the increase of 1 in assets instead is financed by equity, the implied coefficient on ΔK would equal −10 (= $\Delta L/\Delta K$ = −0.0833/0.00833). That the coefficient on $\Delta K - CI$ in table 5 is less negative than −10 suggests that, on average, banks are not simply issuing (repurchasing) equity and buying (selling) an equal amount of assets, but rather at the same time they are buying (selling) more assets using debt.

coefficients are significantly negative in table 4, they are negative but insignificantly so in panel C. Regardless, table 7 reveals no evidence that fair value accounting contributes to procyclical leverage for HIGH or LOW banks in upturns or downturns.[41]

6.4 Estimations using Broker-dealers

The empirical analyses in Adrian and Shin (2008, 2010) are based on a sample of five investment banks, whereas our study's findings are based on a sample of over 700 commercial banks. A key distinction between investment banks and commercial banks during the studies' sample periods is that investment banks were not subject to risk-weighted regulatory leverage requirements.[42] Because most investment banks either became or were acquired by commercial banks or ceased operations, we are unable to replicate our study on a sample of investment banks. To assess whether our inferences regarding the lack of an association between fair value accounting and procyclical leverage extend to financial institutions that are not subject to regulation, but could maintain capital to meet an internally imposed value-at-risk criterion (Adrian and Shin, 2014), we estimate equation (12) for a sample of broker-dealers. Before doing so, we estimate equation (5) to determine whether broker-dealers exhibit procyclical leverage.

Untabulated findings from estimation of equation (5) reveal a significant positive relation between change in leverage and change in assets (ΔA coefficient = 0.48, t-statistic = 4.95). Thus, consistent with Adrian and Shin (2008, 2010), broker-dealers exhibit procyclical leverage. However, untabulated findings from estimation of equation (12) reveal there is no evidence that fair value accounting contributes to this relation. In particular, the coefficients (t-statistics) for

[41] We also estimated equations (5), (6), and (8) through (12) for the subset of downturn quarters that comprise the 2008-2009 financial crisis, i.e., the seven quarters beginning with the last quarter of 2007. Untabulated findings reveal inferences identical to those relating to downturns in table 7. In addition, we also estimated (5), (6), and (8) through (12) for the subset of bank-quarters above (below) the median ratio of loan loss provision to average loans (Beatty, Ke, and Petroni, 2002). Findings from these estimations reveal the same inferences as those we obtain based on tables 2, 4, 5, and 6.

[42] Although broker-dealers are subject to net capital requirements, their assets are not risk weighted in determining net capital.

FVCI, *OTH_ΔA*, *ΔK – CI*, and *ΔD* are −2.36, −2.33, −0.51, and 0.82 (−4.50, −3.13, −3.28, and 12.04). Thus, as with the commercial banks, there is no evidence that fair value comprehensive income has a less negative or positive coefficient than other changes in equity.

7. Summary and Concluding Remarks

This study addresses the question of whether commercial banks exhibit procyclical leverage and, if they do, the extent to which bank regulation and fair value accounting are contributing factors. We describe analytically actions banks can take in response to economic gains and losses on their assets resulting from upturns and downturns in the economy. The analysis shows that for banks with a binding regulatory leverage constraint, absent differences in regulatory risk weights across assets, procyclical leverage does not occur. For banks without a binding regulatory leverage constraint, fair value accounting and bank regulatory requirements both can contribute to procyclical leverage.

Based on insights from the analytical description, we design empirical tests to assess the extent to which bank regulatory leverage requirements contribute to procyclical leverage. First, we estimate the relation between change in leverage and change in assets and find that the relation is significantly positive, which indicates that leverage is procyclical. However, consistent with predictions from the analysis, for banks relatively close to the regulatory leverage constraint this procyclical relation evaporates when the change in a bank's weighted average regulatory risk weight is included in the estimating equation. For banks relatively far from the regulatory leverage constraint, change in a bank's weighted average regulatory risk weight contributes to but does not fully explain procyclical leverage. We provide additional evidence that banks manage their regulatory leverage, thereby contributing to procyclical leverage, by showing that the positive relation between change in assets and change in leverage is greater for changes in assets with lower risk weights, particularly for banks relatively close to the regulatory leverage constraint.

Second, we design three tests to examine the extent to which fair value accounting contributes to procyclical leverage. First, we extend the relation between change in leverage and change in assets by including a measure of fair value comprehensive income, and find that fair value comprehensive income has a negative relation with change in leverage as expected for any increase in equity. Second, we extend the relation by including the interaction between the measure of fair value comprehensive income and the banks' net purchases of assets and find no evidence of a positive relation between fair value comprehensive income and the banks' net purchases of assets. Third, we estimate the relation between change in leverage and change in assets, disaggregating change in assets into fair value comprehensive income, change in equity other than that arising from comprehensive income, change in debt, and other changes in assets and find that the relation between change in leverage and fair value comprehensive income is even more negative than that between change in leverage and change in equity. Taken together, these findings provide no evidence that fair value accounting contributes to procyclical leverage. Inferences relating to the extent to which bank regulation and fair value accounting contribute to procyclical leverage based on separate estimations using quarters of economic upturns and downturns are the same as those for the combined sample.

Taken together, the findings reveal that bank regulation contributes to procyclical leverage—particularly banks that are relatively close to the regulatory leverage constraint—but fair value accounting does not. These findings should be helpful to policy-makers as they consider how best to minimize the effects of shocks to financial asset prices on the macro economy.

Appendix
Variable Definitions

ΔA	Quarterly percentage change in assets (atq or if unavailable bhck2170), $(assets_t - assets_{t-1}) / assets_{t-1}$
ΔL	Quarterly percentage change in leverage, $(leverage_t - leverage_{t-1}) / leverage_{t-1}$, where *leverage* is assets, deflated by equity
ΔV	Quarterly change in weighted average regulatory risk weight, i.e., regulatory risk-weighted assets (bhcka223), deflated by assets subject to risk weighting and market risk equivalent conversion (bhck2170–bhce2170+bhce3545)
CI	Comprehensive income (citotalq or if unavailable bhck4340+bhckb511), deflated by lagged assets
FVCI	Components of comprehensive income determined by fair value (tdsgq+ciderglq+cisecglq or if unavailable taiq+ciderglq+cisecglq or if unavailable bhcka220+bhck8434+Δbhck4336), deflated by lagged assets
$OTH\_\Delta A$	Other changes in assets, $\Delta A - (FVCI + \Delta K - CI + \Delta D)$, deflated by lagged assets
FVCIdecile	*FVCI* decile rank scaled to be between zero and one
ΔD	Quarterly change in debt (ltq or if unavailable bhck2948 - bhck3000), deflated by lagged assets
$\Delta K - CI$	Quarterly change in equity (seqq or if unavailable bhck3210) minus comprehensive income *CI*, deflated by lagged assets
NETPUR	Change in assets other than amounts attributable to comprehensive income, deflated by lagged assets
$\Delta RWA(0)$	Quarterly change in risk-weighted assets in risk-weight category 0% (bhc02170) plus allocated trading assets with equivalent risk weight less than or equal to 10 percent (bhck1651/bhck3545), deflated by lagged assets
$\Delta RWA(20)$	Quarterly change in risk-weighted assets in risk-weight category 20% (bhc22170) plus allocated trading assets with equivalent risk weight greater than 10 percent and less than or equal to 35 percent (bhck1651/bhck3545), deflated by lagged assets
$\Delta RWA(50)$	Quarterly change in risk-weighted assets in risk-weight category 50% (bhc52170) plus allocated trading assets with equivalent risk weight greater than 35 percent and less than or equal to 75 percent (bhck1651/bhck3545), deflated by lagged assets

Appendix - continued
Variable Definitions

$\Delta RWA(100)$	Quarterly change in risk-weighted assets in risk-weight category 100% (bhc92170) plus allocated trading assets with equivalent risk weight greater than 75 percent (bhck1651/bhck3545), deflated by lagged assets
ΔNRW	Quarterly change in assets not subject to risk weighting excluding trading assets (bhce2170-bhce3545), deflated by lagged assets

Item identifiers in parentheses are from Compustat and Y-9C reports.

Internet Appendix

This Appendix provides analytical support for particular statements in the analytical description in section 3.

1. Equation (3) reveals that $g > 1$ ($g < 1$) implies $\Delta L > 0$ ($\Delta L < 0$) if and only if $V_0/V^* > 1$, i.e., $V^* < V_0$.

Because $d > 0$ ($d < 0$) when $g > 1$ ($g < 1$), d has a positive (negative) effect on leverage during economic upturns, i.e., $g > 1$ (downturns, i.e., $g < 1$), such that

$$\textit{if } g>1 \Rightarrow \Delta L>0 \textit{ iff } \frac{gA_0+d}{K_1} > \frac{A_0}{K_0} \text{ and } \textit{if } g<1 \Rightarrow \Delta L<0 \textit{ iff } \frac{gA_0-d}{K_1} < \frac{A_0}{K_0}.$$

During economic upturns leverage is procyclical if and only if asset purchases d are large enough such that $\frac{gA_0+d}{K_1} > \frac{A_0}{K_0}$. Solving for d and substituting for d from equation (3) yields $d > \frac{A_0K_1}{K_0} - gA_0 \Rightarrow d > \frac{A_0}{K_0}\left[K_0 + (g-1)A_0\right] - gA_0$

$$\Rightarrow \frac{V_0A_0}{V^*}\left[1+(g-1)\frac{A_0}{K_0} - g\right] > \frac{A_0}{K_0}\left[K_0 + (g-1)A_0\right] - gA_0$$

$$\Rightarrow \frac{V_0}{V^*} > \frac{1+(g-1)\frac{A_0}{K_0}-g}{1+(g-1)\frac{A_0}{K_0}-g} \Rightarrow \frac{V_0}{V^*} > 1.$$

Using the same analysis, during economic downturns:

$$\frac{gA_0-d}{K_1} < \frac{A_0}{K_0} \Rightarrow d > \frac{A_0K_1}{K_0} - gA_0 \Rightarrow \frac{V_0}{V^*} > 1.$$

2. The extent to which leverage is procyclical is higher the lower is the risk weight category of the assets purchased.

Returning to the example of a bank during an economic upturn that that can buy assets with one of four possible risk weights, V_1, V_2, V_3, and V_4. If $V_1 < V_2 < V_3 < V_4$, then the amount of assets the bank can buy and achieve $\Delta R = 0$, d, is decreasing across the risk weight categories, i.e., $d_1 > d_2 > d_3 > d_4$. This in turn implies that $\Delta L_1 > \Delta L_2 > \Delta L_3 > \Delta L_4$. This result follows from equation (3) and specifying the amount of assets purchased (sold) in each risk weight category as $d_k = \frac{V_0}{V_k} A_0 \left[1 + (g-1)L_0 - g\right]$, for $k = 1, 2, 3$, and 4. Solving equation (3) for V_k and replacing $\theta = A_0 \left[1 + (g-1)L_0 - g\right]$ for ease of exposition, then $V_k = \frac{V_0}{d_k}\theta$. Substituting $V_1 = \frac{V_0}{d_1}\theta$, $V_2 = \frac{V_0}{d_2}\theta$, $V_3 = \frac{V_0}{d_3}\theta$, and $V_4 = \frac{V_0}{d_4}\theta$ into $V_1 < V_2 < V_3 < V_4$, and solving for d_k results in $d_1 > d_2 > d_3 > d_4$.

3. Contagion does not affect the conclusion that procyclical leverage is possible only if the weighted average regulatory risk weight of assets bought or sold is less than the bank's initial weighted average regulatory risk weight.

To incorporate contagion in either economic downturns or upturns and regardless of its source—including asset market illiquidity—into the analysis, let $\gamma \in [0,1]$ be the correlation of buying or selling activities between banks. Thus, the bank's fair value income at t_1 is $I_1 = (g^{1+\gamma} - 1)A_0$. Assume there is contagion, i.e., $\gamma > 0$. In economic upturns, i.e., when $g > 1$, $g^{1+\gamma} > g$; in economic downturns, i.e., when $g < 1$, $g^{1+\gamma} < g$. Thus, a bank's fair value gain (loss) during economic upturns (downturns) is larger than when there is no contagion. As a result, the bank will buy (sell) more assets to achieve its regulatory leverage target. That is, relative to the case in which there is no contagion, contagion serves to exacerbate excessive asset purchases (sales), and thus procyclical leverage. However, it is straightforward to show that, as is the case without contagion, i.e., $\gamma = 0$, when there is contagion, i.e., $\gamma > 0$, procyclical leverage is possible only if the weighted average regulatory risk weight of assets bought or sold is less than the bank's initial weighted average regulatory risk weight, i.e., if $V^* < V_0$, and does not depend on the magnitude of fair value gains and losses.

The analytical description also can be enhanced to incorporate the possibility that regulators set counter-cyclical risk weights, i.e., risk weights that increase (decrease) during economic downturns (upturns), by expressing V_1 as V_1/g. However, incorporating counter-cyclical risk weights into the analysis only serves to exacerbate any procyclical leverage, and otherwise does not alter any insights we obtain from the analysis.

References

Acharya, V.V., and S.G. Ryan. 2016. Banks' Financial Reporting and Financial System Stability. *Journal of Accounting Research* 54: 277-340.

Adrian, T., and H. Shin. 2008. Liquidity and Financial Cycles. Bank for International Settlements Working Paper No. 256.

Adrian, T., and H.S. Shin. 2010. Liquidity and Leverage. *Journal of Financial Intermediation* 19: 418-437.

Adrian, T., and H. Shin. 2014. Procyclical Leverage and Value-at-Risk. *Review of Financial Studies* 27: 373-403.

Allen F., and E. Carletti. 2008. Mark-to-market accounting and liquidity pricing. *Journal of Accounting and Economics* 45: 358-378.

American Bankers Association (ABA). 2008. Letter to Robert H. Herz, Chairman, Financial Accounting Standards Board (November 13).

Badertscher, B.A., J.J. Burks, and P.D. Easton. 2012. A Convenient Scapegoat: Fair Value Accounting by Commercial Banks during the Financial Crisis. *The Accounting Review* 87: 59-90.

Bank of International Settlements (BIS). 1996. Amendment to the Capital Accord to Incorporate Market Risks. Basel, January 1996.

Barth, M.E., and W.R. Landsman. 2010. How Did Financial Reporting Contribute to the Financial Crisis? *European Accounting Review* 19: 399-423.

Beatty, A., B. Ke, and K.R. Petroni. 2002. Earnings Management to Avoid Earnings Declines across Publicly and Privately Held Banks. *The Accounting Review* 77: 547-570.

Beatty, A., and S. Liao. 2014. Financial Accounting in the Banking Industry: A Review of the Empirical Literature. *Journal of Accounting and Economics* 58: 339-383.

Behn, M., R. Haselmann, and P. Wachtel. 2016. Procyclical Capital Regulation and Lending, *Journal of Finance* 71: 919-956.

Bens, D.A., and S.J. Monahan. 2008. Altering Investment Decisions to Manage Financial Reporting Outcomes: Asset-Backed Commercial Paper Conduits and FIN 46. *Journal of Accounting Research* 46: 1017–1055

Bhat, G., R. Frankel, and X. Martin. 2011. Panacea, Pandora's box, or placebo: Feedback in bank mortgage-backed security holdings and fair value accounting. *Journal of Accounting and Economics* 52: 153-173.

Cifuentes R., G. Ferrucci, and H.S. Shin. 2005. Liquidity Risk and Contagion. *Journal of the European Economic Association* 3: 556-566.

Collins, D.W., and P. Hribar. 2002. Errors in Estimating Accruals: Implications for Empirical Research. *Journal of Accounting Research* 40: 105-134.

Coval, J., J. Jurek, and E. Stafford. 2009. The Economics of Structured Finance. *Journal of Economic Perspectives* 23: 3-25.

DeAngelo, H., and R. Stulz. 2015. Liquid-Claim Production, Risk Management, and bank capital structure: Why high leverage is optimal for banks. *Journal of Financial Economics* 116: 219-236.

Erel, I., T. Nadauld, and R. Stulz. 2014. Why Did Holdings of Highly Rated Securitization Tranches Differ So Much across Banks? *Review of Financial Studies* 27: 404-453.

Flannery, M.J., and K.P. Rangan. 2006. Partial Adjustment Toward Target Capital Structures. *Journal of Financial Economics* 79: 469-506.

Gow, I. D., G. Ormazabal, and D. J. Taylor. 2010. Correcting for Cross-Sectional and Time-series Dependence in Accounting Research. *The Accounting Review* 85: 483-512.

Gropp, R., and F. Heider. 2010. The Determinants of Bank Capital Structure. *Review of Finance* 14: 587-622.

Hanson, S., Shleifer, A., J. C. Stein, R. W. Vishny. 2015. Banks as Patient Fixed-Income Investors. *Journal of Financial Economics* 117: 449-469.

Huang, R., and J.R. Ritter. 2009. Testing Theories of Capital Structure and Estimating the Speed of Adjustment. *Journal of Financial and Quantitative Analysis* 44: 237-271.

International Monetary Fund (IMF). 2008. Fair Value Accounting and Procyclicality, in Global Financial Stability Report, October 2008: Chapter 3.

Khan, U. 2014. Does Fair Value Accounting Contribute to Systemic Risk in the Banking Industry? Working paper, Columbia University.

Kiyotaki, N., and J. Moore. 1997. Credit Cycles. *Journal of Political Economy* 105: 211-248.

Kraus, A., and R.H. Litzenberger. 1973. A State-Preference Model of Optimal Financial Leverage. *Journal of Finance* 28: 911-922.

Laux, C., and T. Rauter. 2017. Procyclicality of US Bank Leverage. *Journal of Accounting Research*, forthcoming.

Lemmon, M.L., M.R. Roberts, and J.F. Zender. 2008. Back to the Beginning: Persistence and the Cross-Section of Corporate Capital Structure. *Journal of Finance* 63: 1575-1608.

Modigliani, F., and Miller, M. H. 1958. The Cost of Capital, Corporation Finance and the Theory of Investment. *American Economic Review* 48: 261-297.

Myers, S. C. 1984. The Capital Structure Puzzle. *Journal of Finance* 39: 575-592.

Myers, S. C., and Majluf, N. S. 1984. Corporate Financing and Investment Decisions when Firms Have Information that Investors Do Not Have. *Journal of Financial Economics* 13: 187-221.

Nickel, S. 1981. Biases in Dynamic Models with Fixed Effects. *Econometrica* 49: 1417-1426.

Plantin, G., H. Sapra, and H.S. Shin. 2008. Marking-to-market: Panacea or Pandora's box, *Journal of Accounting Research* 46: 435-460.

Sapra, H. 2008. Do Accounting Measurement Regimes Matter? A Discussion of Mark-to-Market Accounting and Liquidity Pricing. *Journal of Accounting and Economics* 45: 379-387.

Shaffer, S. 2010. Fair Value Accounting: Villain or Innocent Victim—Exploring the Links between Fair Value Accounting, Bank Regulatory Capital and the Recent Financial Crisis. Working paper, Federal Reserve Bank of Boston Quantitative Analysis Unit.

Shleifer, A., and R. Vishny. 2010. Unstable banking. *Journal of Financial Economics* 97: 306-318.

Xie, B. 2016. Does Fair Value Accounting Exacerbate the Procyclicality of Bank Lending? *Journal of Accounting Research* 54: 235-274.

Table 1
Descriptive Statistics

Panel A: Distributional Statistics	Mean	Median	Std. Dev
(1) Δ*L*	0.20	–0.10	7.43
(2) Δ*V*	0.10	0.16	3.09
(3) Δ*A*	2.11	1.44	4.77
(4) *FVCI*	0.09	0.04	0.21
(5) *OTHCI*	0.27	0.24	0.48
(6) *NETPUR*	1.78	1.05	4.77
(7) Δ*K–CI*	–0.15	–0.10	0.76
(8) Δ*D*	1.92	1.28	4.51
(9) *OTH_*Δ*A*	2.04	1.36	4.79
(10) *FVCIdecile*	0.55	0.56	0.29
(11) Δ*RWA*(0)	0.12	0.00	1.78
(12) Δ*RWA*(20)	0.45	0.16	2.96
(13) Δ*RWA*(50)	0.23	0.09	1.71
(14) Δ*RWA*(100)	1.30	0.92	3.04
(15) Δ*NRW*	0.02	–0.01	0.49

Table 1 - continued

Descriptive Statistics

Panel B: Correlations	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
(1) ΔL		−0.29*	0.48*	−0.20*	−0.11*	0.54*	−0.17*	0.56*	0.51*	−0.14*
(2) ΔV	−0.21*		−0.34*	−0.03*	0.11*	−0.35*	−0.08*	−0.35*	−0.32*	−0.01
(3) ΔA	0.21*	−0.33*		0.06*	0.21*	0.95*	0.03*	0.98*	0.97*	0.01
(4) *FVCI*	−0.10*	−0.03*	0.05*		0.05*	−0.01	−0.28*	0.03*	0.00	0.64*
(5) *OTHCI*	−0.32*	0.10*	0.16*	0.03*		0.10*	−0.57*	0.18*	0.21*	−0.10*
(6) *NETPUR*	0.26*	−0.33*	0.96*	0.01	0.06*		0.11*	0.94*	0.99*	−0.02*
(7) $\Delta K - CI$	−0.38*	−0.08*	0.29*	−0.19*	−0.38*	0.33*		−0.01	0.04*	−0.09*
(8) ΔD	0.33*	−0.34*	0.98*	0.04*	0.12*	0.95*	0.19*		0.95*	−0.00
(9) $OTH\_\Delta A$	0.23*	−0.32*	0.96*	0.01	0.16*	0.99*	0.28*	0.95*		−0.03*
(10) *FVCIdecile*	−0.08*	−0.02	0.00	0.62*	−0.07*	−0.02	−0.05*	−0.01	−0.02*	

This table presents distributional statistics, in panel A, and Pearson (below the diagonal) and Spearman (above the diagonal) correlations, in panel B, for quarterly observations for US commercial banks from 2001 to 2013 (N = 19,725). For ease of exposition, all statistics except those relating to *FVdecile* are multiplied by 100. See the appendix for variable definitions. * denotes significance at the $p < 0.01$ level.

Table 2
Leverage Changes and Regulatory Risk Weights

$$(5)\ \Delta L_{iq} = \beta_0 + \beta_1 \Delta A_{iq} + \varepsilon_{iq}$$

$$(6)\ \Delta L_{iq} = \beta_0 + \beta_1 \Delta A_{iq} + \beta_2 \Delta V_{iq} + \varepsilon_{iq}$$

	FULL		LOW		HIGH	
ΔA	0.36	0.26	0.46	0.40	0.25	0.09
	(7.99)***	(5.07)***	(10.83)***	(8.60)***	(4.00)***	(1.22)
ΔV		−0.36		−0.20		−0.65
		(−7.98)***		(−4.86)***		(−7.05)***
Observations	19,725	19,725	12,845	12,845	6,880	6,880
Adj. R^2	0.10	0.12	0.16	0.17	0.13	0.17

This table presents regression summary statistics based on quarterly observations for US commercial banks from 2001 to 2013. See the appendix for variable definitions. FULL refers to the full sample; LOW (HIGH) refers to observations relatively far from (close to) the regulatory leverage constraint. The regressions include bank and year-quarter fixed effects; standard errors are clustered by bank and calendar quarter. *t*-statistics are in parentheses. *** denotes significance at the $p < 0.01$ level.

Table 3
Changes in Risk Weighted Assets

$$(7)\ \Delta L_{iq} = \beta_0 + \beta_1 \Delta RWA(0)_{iq} + \beta_2 \Delta RWA(20)_{iq} + \beta_3 \Delta RWA(50)_{iq} + \beta_4 \Delta RWA(100)_{iq} + \beta_5 \Delta NRW_{iq} + \varepsilon_{iq}$$

Panel A: Leverage Changes and Changes in Risk Weights

	FULL	LOW	HIGH
$\Delta RWA(0)$	0.77	0.69	0.93
	(14.60)***	(11.16)***	(9.07)***
$\Delta RWA(20)$	0.61	0.60	0.74
	(21.77)***	(15.74)***	(17.41)***
$\Delta RWA(50)$	0.56	0.56	0.64
	(9.37)***	(7.33)***	(7.78)***
$\Delta RWA(100)$	0.31	0.41	0.28
	(5.65)***	(7.91)***	(3.43)***
ΔNRW	−4.88	−3.25	−6.90
	(−9.00)***	(−7.01)***	(−7.36)***
Observations	19,725	12,845	6,880
Adj. R^2	0.24	0.25	0.39

Table 3 – continued

Changes in Risk Weighted Assets

Panel B: F-statistics (p-values) for Tests of Differences in Panel A Coefficients	FULL	LOW	HIGH
$\Delta RWA(0) - \Delta RWA(20) = 0$	8.98	1.82	5.01
	(<0.01)	(0.18)	(0.03)
$\Delta RWA(0) - \Delta RWA(50) = 0$	7.12	2.08	6.67
	(<0.01)	(0.15)	(0.01)
$\Delta RWA(0) - \Delta RWA(100) = 0$	35.06	16.53	25.74
	(<0.01)	(<0.01)	(<0.01)
$\Delta RWA(20) - \Delta RWA(50) = 0$	0.72	0.33	1.57
	(0.38)	(0.57)	(0.21)
$\Delta RWA(20) - \Delta RWA(100) = 0$	37.15	17.80	29.58
	(<0.01)	(<0.01)	(<0.01)
$\Delta RWA(50) - \Delta RWA(100) = 0$	13.52	6.1	15.01
	(<0.01)	(0.01)	(<0.01)

This table presents regression summary statistics based on quarterly observations for US commercial banks from 2001 to 2013. See the appendix for variable definitions. FULL refers to the full sample; LOW (HIGH) refers to observations relatively far from (close to) the regulatory leverage constraint. The regressions include bank and year-quarter fixed effects; standard errors are clustered by bank and calendar quarter. *t*-statistics (p-values in panel B) are in parentheses. *** denotes significance at the $p < 0.01$ level.

Table 4
Leverage Changes and Fair Value Gains and Losses

$$(8)\ \Delta L_{iq} = \beta_0 + \beta_1 \Delta A_{iq} + \beta_3 FVCIdecile_{iq} + \varepsilon_{iq}$$

$$(9)\ \Delta L_{iq} = \beta_0 + \beta_1 \Delta A_{iq} + \beta_2 \Delta V_{iq} + \beta_3 FVCIdecile_{iq} + \varepsilon_{iq}$$

	FULL		LOW		HIGH	
ΔA	0.36	0.26	0.46	0.40	0.26	0.10
	(8.13)***	(5.18)***	(10.95)***	(8.72)***	(4.10)***	(1.31)
FVCIdecile	−0.02	−0.02	−0.02	−0.02	−0.03	−0.03
	(−5.77)***	(−5.91)***	(−5.83)***	(−5.87)***	(−4.43)***	(−4.38)***
ΔV		−0.36		−0.20		−0.65
		(−7.99)***		(−4.87)***		(−7.03)***
Observations	19,725	19,725	12,845	12,845	6,880	6,880
Adj. R^2	0.11	0.12	0.17	0.17	0.14	0.18

This table presents regression summary statistics based on quarterly observations for US commercial banks from 2001 to 2013. See the appendix for variable definitions. FULL refers to the full sample; LOW (HIGH) refers to observations relatively far from (close to) the regulatory leverage constraint. The regressions include bank and year-quarter fixed effects; standard errors are clustered by bank and calendar quarter. *t*-statistics are in parentheses. *** denotes significance at the $p < 0.01$ level.

Table 5
Leverage Changes and Net Asset Purchases

$$(10)\ \Delta L_{iq} = \beta_0 + \beta_1 NETPUR_{iq} + \beta_2 FVCIdecile_{iq} + \beta_3 NETPUR_{iq} \times FVCIdecile_{iq} + \varepsilon_{iq}$$

$$(11)\ \Delta L_{iq} = \beta_0 + \beta_1 NETPUR_{iq} + \beta_2 FVCIdecile_{iq} + \beta_3 NETPUR_{iq} \times FVCIdecile_{iq} + \beta_4 \Delta V_{iq} + \varepsilon_{iq}$$

	FULL		LOW		HIGH	
NETPUR	0.48	0.40	0.56	0.51	0.47	0.32
	(8.39)***	(6.52)***	(9.49)***	(8.32)***	(6.38)***	(4.25)***
FVCIdecile	−0.02	−0.02	−0.02	−0.02	−0.02	−0.02
	(−5.09)***	(−5.17)***	(−5.63)***	(−5.67)***	(−3.18)***	(−3.25)***
NETPUR × *FVCIdecile*	−0.08	−0.09	−0.07	−0.07	−0.23	−0.22
	(−1.02)	(−1.10)	(−0.72)	(−0.73)	(−2.06)**	(−2.20)**
ΔV		−0.32		−0.17		−0.59
		(−8.64)***		(−4.41)***		(−7.57)***
Observations	19,725	19,725	12,845	12,845	6,880	6,880
Adj. R^2	0.13	0.14	0.19	0.19	0.16	0.19

This table presents regression summary statistics based on quarterly observations for US commercial banks from 2001 to 2013. See the appendix for variable definitions. FULL refers to the full sample; LOW (HIGH) refers to observations relatively far from (close to) the regulatory leverage constraint. The regressions include bank and year-quarter fixed effects; standard errors are clustered by bank and calendar quarter. *t*-statistics are in parentheses. *** and ** denote significance at the $p < 0.01$ and $p < 0.05$ levels.

Table 6
Leverage Changes and Disaggregated Changes in Assets

$$(12)\ \Delta L_{iq} = \beta_0 + \beta_1 FVCI_{iq} + \beta_2 OTH\_\Delta A_{iq} + \beta_3 (\Delta K - CI)_{iq} + \beta_4 D_{iq} + \varepsilon_{iq}$$

	FULL	LOW	HIGH
FVCI	−10.61	−9.23	−13.15
	(−18.61)***	(−17.09)***	(−15.66)***
OTH_ΔA	−12.29	−9.56	−15.30
	(−20.34)***	(−19.92)***	(−19.05)***
Δ*K* − *CI*	−7.58	−7.04	−8.68
	(−23.99)***	(−24.34)***	(−9.74)***
Δ*D*	0.95	0.96	0.99
	(41.54)***	(36.47)***	(20.89)***
Observations	19,725	12,845	6,880
Adj. R^2	0.78	0.79	0.80

This table presents regression summary statistics based on quarterly observations for US commercial banks from 2001 to 2013. See the appendix for variable definitions. FULL refers to the full sample; LOW (HIGH) refers to observations relatively far from (close to) the regulatory leverage constraint. The regressions include bank and year-quarter fixed effects; standard errors are clustered by bank and calendar quarter. *t*-statistics are in parentheses. *** denotes significance at the $p < 0.01$ level.

Table 7
Leverage Changes in Economic Upturns and Downturns

Panel A: Leverage Changes and Regulatory Risk Weights

(5) $\Delta L_{iq} = \beta_0 + \beta_1 \Delta A_{iq} + \varepsilon_{iq}$; (6) $\Delta L_{iq} = \beta_0 + \beta_1 \Delta A_{iq} + \beta_2 \Delta V_{iq} + \varepsilon_{iq}$

	UP				DOWN			
	LOW		HIGH		LOW		HIGH	
ΔA	0.52	0.46	0.27	0.11	0.37	0.3	0.16	−0.02
	(13.47)***	(10.34)***	(4.43)***	(1.47)	(4.98)***	(3.89)***	(1.21)	(−0.12)
ΔV		−0.20		−0.61		−0.23		−0.76
		(−4.33)***		(−6.05)***		(−3.49)***		(−4.37)***
Observations	8,060	8,060	4,321	4,321	4,785	4,785	2,559	2,559
Adj. R^2	0.17	0.18	0.17	0.20	0.16	0.17	0.12	0.17

Panel B: Leverage Changes and Fair Value Gains and Losses

(8) $\Delta L_{iq} = \beta_0 + \beta_1 \Delta A_{iq} + \beta_3 FVCIdecile_{iq} + \varepsilon_{iq}$; (9) $\Delta L_{iq} = \beta_0 + \beta_1 \Delta A_{iq} + \beta_2 \Delta V_{iq} + \beta_3 FVCIdecile_{iq} + \varepsilon_{iq}$

	UP				DOWN			
	LOW		HIGH		LOW		HIGH	
ΔA	0.52	0.46	0.28	0.12	0.38	0.31	0.17	−0.01
	(13.51)***	(10.38)***	(4.57)***	(1.61)	(5.09)***	(3.95)***	(1.25)	(−0.09)
FVCIdecile	−2.48	−2.51	−6.66	−6.43	−4.10	−4.12	−2.84	−3.51
	(−3.21)***	(−3.35)***	(−2.77)***	(−2.80)***	(−2.52)**	(−2.53)**	(−1.12)	(−1.36)
ΔV		−0.20		−0.61		−0.23		−0.76
		(−4.30)***		(−6.10)***		(−3.57)***		(−4.33)***
Observations	8,060	8,060	4,321	4,321	4,785	4,785	2,559	2,559
Adj. R^2	0.18	0.19	0.17	0.21	0.16	0.17	0.13	0.18

Table 7 - continued
Leverage Changes in Economic Upturns and Downturns

Panel C: Leverage Changes and Net Asset Purchases

$$(10)\ \Delta L_{iq} = \beta_0 + \beta_1 NETPUR_{iq} + \beta_2 FVCIdecile_{iq} + \beta_3 NETPUR_{iq} \times FVCIdecile_{iq} + \varepsilon_{iq}$$

$$(11)\ \Delta L_{iq} = \beta_0 + \beta_1 NETPUR_{iq} + \beta_2 FVCIdecile_{iq} + \beta_3 NETPUR_{iq} \times FVCIdecile_{iq} + \beta_4 \Delta V_{iq} + \varepsilon_{iq}$$

	UP				DOWN			
	LOW		HIGH		LOW		HIGH	
NETPUR	0.6	0.56	0.46	0.31	0.45	0.38	0.43	0.23
	(10.63)***	(9.12)***	(5.43)***	(3.60)***	(3.59)***	(3.08)***	(2.38)**	(1.31)
FVCIdecile	−0.02	−0.02	−0.02	−0.02	−0.02	−0.02	−0.02	−0.03
	(−4.66)***	(−4.61)***	(−2.19)**	(−2.18)**	(−2.51)**	(−2.63)***	(−2.30)**	(−2.61)***
NETPUR × *FVCIdecile*	−0.04	−0.05	−0.26	−0.23	−0.02	0.00	−0.17	−0.13
	(−0.41)	(−0.53)	(−1.74)*	(−1.59)	(−0.08)	(0.01)	(−0.74)	(−0.60)
ΔV		−0.17		−0.56		−0.20		−0.65
		(−3.88)***		(−6.57)***		(−3.04)***		(−4.35)***
Observations	8,060	8,060	4,321	4,321	4,785	4,785	2,559	2,559
Adj. R^2	0.21	0.21	0.19	0.22	0.18	0.19	0.15	0.18

Table 7 - continued
Leverage Changes in Economic Upturns and Downturns

Panel D: Leverage Changes and Disaggregated Changes in Assets				
(12) $\Delta L_{iq} = \beta_0 + \beta_1 FVCI_{iq} + \beta_2 OTH\_\Delta A_{iq} + \beta_3(\Delta K - CI)_{iq} + \beta_4 D_{iq} + \varepsilon_{iq}$				
	UP		DOWN	
	LOW	HIGH	LOW	HIGH
FVCI	−8.33	−13.13	−10.26	−14.28
	(−15.70)***	(−14.28)***	(−11.42)***	(−12.01)***
OTH_ΔA	−8.83	−15.09	−10.49	−15.45
	(−15.14)***	(−13.51)***	(−14.43)***	(−12.13)***
Δ*K* − *CI*	−6.74	−9.84	−7.61	−7.50
	(−18.99)***	(−12.55)***	(−19.59)***	(−5.38)***
Δ*D*	0.96	−1.01	0.97	1.01
	(28.15)***	(17.95)***	(27.21)***	(14.15)***
Observations	8,060	4,321	4,785	2,559
Adj. R^2	0.82	0.82	0.79	0.81

This table presents regression summary statistics based on quarterly observations for US commercial banks from 2001 to 2013. UP (DOWN) are quarters with positive (negative) S&P 500 index returns. See the appendix for variable definitions. FULL refers to the full sample; LOW (HIGH) refers to observations relatively far from (close to) the regulatory leverage constraint. The regressions include bank and year-quarter fixed effects; standard errors are clustered by bank and calendar quarter. *t*-statistics are in parentheses. ***, **, and * denote significance at the $p < 0.01$, $p < 0.05$, and $p < 0.10$ levels.