

Procyclicality of US Bank Leverage

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Abstract

We investigate the determinants of procyclical leverage for US commercial and savings banks. Understanding these determinants is important for identifying possible problems and remedies that are as diverse as financial reporting, regulation, and bank management. We find that leverage is strongly procyclical, even after controlling for a large set of economic and bank-specific drivers of leverage. Our results do not suggest that fair-value accounting contributes to procyclical leverage or that historical cost accounting reduces procyclicality. We document a limited effect of risk-based capital regulation and find that leverage procyclicality strongly depends on the bank's business model.

JEL-Classification: E32, G20, G28, G32, M41

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1 Introduction

The recent financial crisis has revived the debate about procyclicality in banking (e.g., [Bank for International Settlements \(2009\)](#) and [Financial Services Authority \(2009\)](#)). One major concern is that banks disproportionately increase debt when expanding their balance sheet and disproportionately reduce it when total assets decrease (procyclical leverage).¹ Debt-financed expansions during a boom could contribute to overheating the economy. If then a crisis hits, banks are in a worse position to deal with distress and the disproportional reduction of debt further magnifies problems in the financial system. Consequently, procyclical leverage magnifies business cycles and deepens financial crises.

In this paper, we investigate the determinants of procyclical leverage for US commercial and savings banks to understand the role of standard setters and regulators relative to economic factors such as the business model of banks. Understanding the drivers of leverage procyclicality is important for identifying potential remedies that are as diverse as financial reporting, regulation, and bank management.

A main reference for the prevalence of procyclical leverage is the work by [Adrian and Shin \(2010\)](#). Regulators, the business press, and academics often refer to this study when they argue that fair-value accounting contributes to procyclicality by increasing bank leverage during booms.² If banks hold securities that are carried at fair value, increases or decreases in fair value are recognized on the balance sheet, even if the change in value is not realized. The main concern is that such a recognition of unrealized gains and losses

¹We use the terms “procyclical (bank) leverage”, “leverage procyclicality”, “procyclicality”, and “procyclical leverage pattern” interchangeably.

²For instance, an article in the [Financial Times \(2008\)](#) explicitly cites the work by [Adrian and Shin \(2010\)](#) when arguing that fair-value accounting “helped to inflate the credit bubble”. For similar examples, see the [Economist \(2008\)](#), [Beccalli et al. \(forthcoming\)](#), and [Damar et al. \(2013\)](#). See also, [Plantin et al. \(2008\)](#), [Persaud \(2008\)](#), and [International Monetary Fund \(2008\)](#) for a more general discussion of the significance and origin of procyclical bank leverage.

contributes to leverage procyclicality by increasing the bank’s equity, which then allows the institution to raise debt and expand its balance sheet. While unrealized fair-value gains on available-for-sale (AfS) securities generally do not affect regulatory capital, opponents are still concerned that its recognition could magnify procyclicality as it makes a bank look healthier and its assets more attractive. The problem is amplified if the proceeds from raising debt are invested again in securities, which then boosts their price, and thereby further increases the value at which these securities are recognized on the balance sheet (see, for example, [Adrian and Shin \(2010\)](#)).

We adopt the definition of procyclical leverage by [Adrian and Shin \(2010\)](#) to allow for a direct comparison and interpretation of results. The authors regress the growth rate of bank leverage on the growth rate of total book assets, where leverage is given by the ratio of total book assets to total book equity.³ Procyclical leverage arises if the regression coefficient of the growth rate of total assets is positive and significant. To identify potential drivers of procyclical bank leverage, we extend this empirical model in several ways. First, as drivers of procyclical leverage might vary for different types of banks, we split our sample into three subgroups: savings banks, commercial banks with less than 20% of total assets measured at fair value (i.e., trading assets and AfS securities), and commercial banks with more than 20% fair-value assets. Second, we include bank-level and macroeconomic controls to see whether they can “explain” procyclical leverage by simultaneously driving leverage growth and asset growth. Third, we interact the growth rate of total assets with potential drivers of procyclical leverage to identify whether these drivers magnify the link between leverage growth and asset growth. In this context, we look at several bank and market characteristics, including unrealized and realized gains and losses on AfS securities,

³A leverage ratio based on book values is important for US banks since the regulatory leverage and capital ratios are based on book values.

realized gains and losses from the sale of loans, trading income, and GDP growth. Finally, we investigate which types of assets and liabilities change disproportionately when banks expand or contract their balance sheet (that is, when total assets increase or decrease, respectively).

The focus of our analysis is on US commercial and savings banks (holding company level) between Q3-1990 and Q1-2013. While banks in our sample hold very few trading assets, they have a high fraction of AfS securities, which are recognized at fair value. The variation in the types of assets that these banks hold and the differences in business models make it particularly interesting to look at the determinants of leverage procyclicality for these institutions.

We find that leverage is strongly procyclical even after controlling for a large set of potential determinants of bank capital structure, including macroeconomic conditions and bank fundamentals. Despite the concern that fair-value accounting could magnify procyclicality, our results are inconsistent with the notion that fair-value accounting drives procyclical leverage. In addition, we only find limited evidence that leverage procyclicality is associated with risk-based capital regulation. Instead, we document that procyclical leverage is strongly driven by the bank's business model and overall economic conditions.

First, procyclical leverage is statistically significantly higher for savings banks than for commercial banks, including those commercial banks with more than 20% fair-value assets. Furthermore, there is no significant difference between the procyclical leverage pattern of banks with more than 95% of total assets recognized at historical cost and banks with more than 30% of total assets recognized at fair value. The distribution of changes in total assets is also similar for both types of banks. As an additional test, we compare leverage procyclicality in the period before and after the widespread introduction of fair-value accounting in the US in the mid-1990s and find that procyclical leverage was stronger

before fair-value accounting was in place.

Second, the coefficient of the interaction term of unrealized gains on AfS securities with total asset growth is insignificant for both the full sample and the different types of banks. In contrast to unrealized gains on AfS securities, realized gains on AfS and HtM securities do affect regulatory capital. Nevertheless, the coefficients of the corresponding interaction terms are also insignificant for both the full sample and the different types of banks. The findings for securities contrast with the findings for loans. The interaction term of realized gains on loans is positive and significant for the full sample as well as for savings banks and commercial banks with less than 20% fair-value assets. As loans are measured at historical cost, banks would have to sell them to recognize a gain. Looking at a subset of banks for which we can directly measure involvement in securitization, we find that leverage procyclicality is stronger for those banks that are more active in securitization.

Third, the interaction term of the bank's regulatory capital ratio is insignificant for the whole sample and the different types of banks. One explanation might be that regulatory capital constraints are not binding since banks hold precautionary buffers. Another reason might be that banks can increase their leverage without changing the regulatory capital ratio if the average risk weight of assets decreases ([Amel-Zadeh et al. \(2014\)](#)). To understand the role of regulatory risk weights, we interact changes in average risk weighted assets with the growth in total assets and distinguish between expansions and contractions of the balance sheet. For commercial banks with more than 20% fair-value assets, we find a negative and significant coefficient for balance sheet expansions. This is consistent with the argument that banks which increase their balance sheet can increase leverage if the average risk weight (of total assets) decreases. However, the coefficient is insignificant for savings banks and commercial banks with less than 20% fair-value assets. Indeed, we find that these banks disproportionately increase loans, not securities (which generally have lower risk

weights), when expanding leverage and total assets. For both types of commercial banks, a procyclical reduction of leverage is strongly associated with an increase in the average risk weight if balance sheets contract. The increase in average risk weight might force banks to disproportionately reduce leverage if their leverage constraint is binding. However, it is also possible that the coefficient captures the (mechanical) effect of banks reducing cash and selling liquid assets with low risk weights as a response to an outflow of deposits. This interpretation is consistent with our findings that banks reduce cash and securities and that deposits decrease disproportionately for commercial banks when reducing leverage and total assets.

Fourth, GDP growth is positively associated with procyclical leverage for commercial banks. This finding shows that banks do react to changes in the business environment by increasing (decreasing) leverage and total assets. The procyclical leverage pattern of commercial banks is also stronger if leverage is low. This is consistent with banks using an expansion of their business to increase their leverage towards some target ratio.

We perform a range of analyses to evaluate the robustness of our findings. Our results remain qualitatively unchanged when we apply alternative tests for the role of fair-value accounting, when we use different business model definitions, when we employ an annual data frequency, when we use lagged accounting variables, and when we distinguish between balance sheet expansions and contractions.

Taken together, our results suggest that the business model and economic conditions are more important for the procyclicality of US bank leverage than prevailing financial reporting standards and regulatory capital requirements.

Following the literature, we derive our measure of procyclicality from a regression that relates the growth rate of a bank's assets to the growth rate of its leverage. A positive coefficient does not imply that leverage increases as total assets increase over time. In

fact, during our sample period from 1990 to 2013, the average leverage ratio of our sample banks decreased, while the average balance sheet size increased by a factor of nearly three (equally weighted). Therefore, procyclical bank leverage is not at odds with banks having time-invariant target leverage ratios ([Berger et al. \(2008\)](#) and [Gropp and Heider \(2010\)](#)).

We contribute to the literature on procyclical bank leverage. [Adrian and Shin \(2011\)](#) and [Greenlaw et al. \(2008\)](#) document a procyclical leverage pattern for US commercial banks. These papers focus on the consequences of procyclical bank leverage on aggregate liquidity, economic growth, and systemic risk. In contrast, our paper is the first comprehensive analysis of the determinants of procyclical leverage for US commercial and savings banks. [Beccalli et al. \(forthcoming\)](#) find that US banks that are more involved in securitization have a more procyclical leverage. However, they do not consider the role of accounting or regulation.⁴ Closest to our work is a contemporaneous paper by [Amel-Zadeh et al. \(2014\)](#). The authors develop a model to show that if a bank’s regulatory capital constraint is binding, procyclicality can only arise if the average risk weight of assets decreases (increases) upon balance sheet expansions (contractions). They test their model empirically and include changes in average risk weight as a control variable when measuring the procyclical leverage of banks. The coefficient of changes in average risk weight is negative and highly statistically significant, while the coefficient of changes in total assets becomes insignificant. Therefore, the authors conclude that procyclicality is mainly an effect of differences in regulatory risk weights, not fair-value accounting. We do not find that the coefficient of changes in total assets becomes insignificant when including changes in average risk weight as a control variable. We discuss the paper by [Amel-Zadeh et al. \(2014\)](#) and other related literature in greater detail in the following section.

⁴[Damar et al. \(2013\)](#) find a positive effect of wholesale funding on procyclical leverage for Canadian banks.

[Xie \(2015\)](#) examines whether fair-value accounting increases the procyclicality of banks' lending behavior, using approval/denial decisions on residential mortgage applications. She finds no evidence that greater fair-value accounting exposure is associated with lower (higher) mortgage denial rates during expansionary (recessionary) periods. Her finding is consistent with our finding that fair-value accounting is not associated with procyclical leverage.

In Section 2, we develop our research questions and hypotheses. In Section 3, we present the methodology. We describe the data in Section 4 and discuss our results in Section 5. In Section 6, we present several robustness checks and extensions. We conclude in Section 7.

2 Research Questions and Hypotheses

We illustrate the basic balance sheet arithmetic of procyclical leverage with an example. This particular example is taken from [Adrian and Shin \(2010\)](#). Similar illustrations can be found in [Adrian and Shin \(2011\)](#) or [Damar et al. \(2013\)](#). Consider a bank with total assets of 100, financed with 10 units of equity and 90 units of debt. The leverage ratio of this bank is 10.

Assets	Liabilities
Total Assets 100	Equity 10
	Debt 90

Let us assume that the value of the assets increases by 1%. The bank's total assets are now 101, equity increases to 11, and the leverage ratio decreases to 9.18. If the bank takes on additional debt of 9 and invests it in assets, its balance sheet increases to 110 and

the leverage ratio stays at 10. As the change in leverage is zero, while the change in total assets is 10%, leverage is not procyclical.

Assets	Liabilities
Total Assets 110	Equity 11
	Debt 99

Alternatively, if the bank takes on more than 9 units of debt, leverage is procyclical. For example, if the institution takes on 10 units of debt, the leverage ratio increases from 10 to 10.09. In this case, an increase in total assets is positively related to an increase in leverage.

Assets	Liabilities
Total Assets 111	Equity 11
	Debt 100

The initial increase in total assets of 1 unit in the example above might stem from unrealized gains on AfS securities. However, the initial increase might also stem from realized gains, e.g., from the sale of securities or loans.

[Adrian and Shin \(2010\)](#) measure procyclical leverage regressing the growth rate of bank leverage on the growth rate of total book assets, where leverage is given by the ratio of total book assets to total book equity. Procyclical leverage arises if the regression coefficient of the growth rate of total assets is positive and significant. The authors use flow of funds data and document a strong procyclical relation for investment banks, but not for commercial banks. This finding likely reinforced the belief that fair-value accounting could be a main driver of procyclical leverage since fair-value accounting plays a larger role for investment

banks than for commercial banks. [Adrian and Shin \(2011\)](#) and [Greenlaw et al. \(2008\)](#) use bank level data and find a strong procyclical relation also for commercial banks.⁵

To tackle the widespread concern that fair-value accounting or regulation could trigger leverage procyclicality, we need to understand the determinants of procyclical leverage. We address this issue by expanding the empirical model of [Adrian and Shin \(2010\)](#) as follows.

First, we split our sample into savings banks, commercial banks with less than 20% fair-value assets, and commercial banks with more than 20% fair-value assets, to see whether procyclical leverage varies for the different types of banks. The fraction of fair-value assets is defined as the sum of AfS securities and trading assets divided by total assets. If fair-value accounting is at the heart of the problem, banks with a higher fraction of assets carried at fair value should exhibit stronger leverage procyclicality than banks with fewer assets carried at fair value.

Second, we include control variables that could drive both leverage growth as well as asset growth. If leverage and a particular control variable are positively related, the coefficient on the control variable will be positive. In addition, if the control variable is also positively related to asset growth, its inclusion reduces the magnitude of the coefficient on asset growth. In this case, the control can explain (parts of) procyclical bank leverage. A typical example is GDP growth. When the economy expands and GDP growth increases, banks may increase both leverage and total assets, which gives rise to a procyclical leverage pattern. Another example is the change in average risk weighted assets, as suggested by [Amel-Zadeh et al. \(2014\)](#). The authors show formally that if a bank's regulatory capital

⁵Several articles study the prevalence of procyclical leverage among European banks and find mixed evidence. For example, [Panetta and Angelini \(2009\)](#) find a procyclical leverage pattern in the United Kingdom, but not in Germany, France, and Italy, using quarterly national financial accounts data between Q2-1987 and Q2-2008. [Baglioni et al. \(2013\)](#) find a strong procyclical leverage pattern for European banks with a strong focus on investment banking, examining 77 large European banks using semi-annual bank-level data between 2000 and 2009.

constraint is binding, procyclicality can only arise if the average risk weight of assets decreases (increases) upon balance sheet expansions (contractions). [Amel-Zadeh et al. \(2014\)](#) test their model empirically using a sample of US commercial banks between Q1-2001 and Q4-2010. They add the change in average risk weighted assets as a control variable to the baseline regression model of [Adrian and Shin \(2010\)](#) and find that the coefficient is negative and highly statistically significant, while the coefficient of asset growth becomes insignificant. [Amel-Zadeh et al. \(2014\)](#) conclude that differences in the risk weights of a bank's assets are a main driver of procyclical leverage. As an additional test of the role of fair-value accounting, they split the change in total assets into different components, distinguishing between those components that are affected by fair-value accounting, those that are not affected by fair-value accounting, and changes in debt. In contrast, we include unrealized gains and losses on AfS securities and net income as additional control variables. Moreover, we split net income into (i) realized gains and losses on AfS and HtM securities, (ii) gains from the sale of loans, (iii) trading income, and (iv) residual net income, which is defined as net income minus (i), (ii), and (iii). The direct effect of these income variables is to reduce leverage. However, if banks respond directly by raising debt, the regression coefficient could be positive.

Third, and more importantly, we interact our key variables of interest with the change in total assets to more directly identify the determinants of procyclical leverage. There are several reasons for why the distinction between unrealized gains and losses on AfS securities and the different components of net income is interesting. First, for US banks, unrealized gains and losses on AfS securities do not affect regulatory capital. The differences in regulatory treatment might result in a difference between realized and unrealized gains and losses. Second, a bank might sell AfS securities to repay debt, thereby realizing gains from AfS securities when total assets and leverage decrease, while total unrealized gains

might result in a balance sheet expansion and an increase in leverage. Finally, given the focus of the discussion about procyclical leverage on securities, it is interesting to see whether there are indeed differences between changes in the value of securities held as AfS and gains from the sale of loans.

A bank realizes a gain (or loss) on a loan if it decides to sell the loan to finance an expansion of its business (e.g., increase lending) or to repay debt (reduce leverage). In both cases, the bank's willingness to sell the loan is higher if the realized gain from the sale is larger. Therefore, higher gains from the sale of loans could be associated with stronger procyclical leverage. As a result, we predict a positive coefficient on the interaction term of realized gains on loan sales with changes in total assets.

In contrast, a bank has to report unrealized gains (or losses) on AfS securities as long as these securities are held on the balance sheet and not other than temporarily impaired. If the critics of fair-value accounting are right and banks expand their balance sheet and leverage when reporting higher unrealized gains on AfS securities, the coefficient on the interaction term of unrealized gains on AfS securities with changes in total assets should be positive and significant for expansions of the balance sheet. If unrealized gains are low or even negative, a bank might be less willing to sell AfS securities. Indeed, if a US bank holds an AfS debt security on which it reports an unrealized loss, it can avoid a negative effect on regulatory capital by not selling the security and arguing that the impairment is temporary. Therefore, lower unrealized gains (or higher unrealized losses) might reduce procyclical leverage, resulting in a positive interaction term when total assets decrease. However, opponents of fair-value accounting might be concerned that the reverse is true and that recognizing unrealized losses during a crisis might trigger a downward spiral where banks downsize and reduce leverage. In this case, the coefficient of the interaction term would be negative when total assets decrease.

In our robustness section, we distinguish between expansions and contractions of the balance sheet when looking at the interaction terms of changes in total assets with unrealized gains on AfS securities, realized gains on AfS and HtM securities, and trading income. We make the same distinction for the interaction of GDP growth with changes in total assets to account for the possibility that the coefficient has different signs for balance sheet expansions and contractions.

To identify the role of capital regulation, we interact the level of regulatory capital as well as the change in average risk weighted assets with the change in total assets. If regulatory capital is high, banks are less constrained to increase leverage when they expand such that procyclical leverage can be stronger. To capture the effect of changes in the average risk weight, we distinguish between increases and decreases of the balance sheet. If changes in average risk weighted assets magnify procyclical leverage, the coefficient of the interaction term should be negative and significant upon balance sheet expansions since a decrease in average risk weighted assets allows banks to increase leverage. In contrast, when balance sheets contract, a positive and significant interaction term is consistent with banks using liquid assets with low risk weights to repay debt.

Fourth, we look at the types of assets and liabilities that are associated with procyclical expansions and contractions of the balance sheet. For example, banks may expand via securities or loans. Expansions of securities are consistent with a decrease in the average risk weight (allowing banks to increase leverage) and positive amplification effects associated with securities carried at fair value. In contrast, expansions of loans would be consistent with procyclical leverage being associated with the standard business model of banks as well as loan origination for securitization. One possible reason for why balance sheets contract is that depositors withdraw money and that the bank uses cash and liquid assets to repay them. In this case, the bank's average risk weighted assets increase while leverage

decreases, and the coefficient on the interaction term of changes in the average risk weight would be positive upon balance sheet contractions. However, the increase in the average risk weight would not per se be a driver of procyclical leverage.

Fifth, we perform several additional analyses to evaluate the robustness of our findings and to further deepen our understanding of procyclical leverage. In a first set of tests, we investigate whether procyclical leverage is stronger for balance sheet contractions or expansions, whether the procyclical leverage pattern prevails if we do not consider the financial crisis, and whether procyclicality was lower before the widespread introduction of fair-value accounting in the US in the 1990s. As alternative tests of the role of fair-value accounting and the bank's business model, we investigate the relationship between procyclical leverage and (i) the fraction of fair-value assets recognized on the balance sheet (continuous variable), (ii) the ratio of non-interest income to interest-income, as well as (iii) involvement in securitization. In a second set of robustness tests, we re-run our empirical analyses based on yearly data and include the previous two quarters in our quarterly model to account for the possibility that banks respond to unrealized and realized gains with some time lag. As a final set of robustness tests, we distinguish between increases and decreases of the balance sheet for the interactions of securities and GDP growth.

3 Empirical Methodology

This section describes the empirical models and defines the variables we employ in our analysis. **Table 1** provides a comprehensive list of all the variables used in this paper.

We explore the cross-sectional and time-series dimensions of bank leverage via a panel regression analysis. As a first step, we investigate whether the leverage of US commercial and savings banks is procyclical. For that purpose, we estimate a regression model that is

similar to the main model of [Adrian and Shin \(2010\)](#). In particular, the leverage growth of bank i in quarter t is given by

$$\Delta \text{Leverage}_{i,t} = \alpha + \alpha_i + \alpha_t + \beta \cdot \Delta \text{Total Assets}_{i,t} + \gamma \cdot \Delta \text{Goodwill}_{i,t} + \epsilon_{i,t} \quad (1)$$

Following [Adrian and Shin \(2010\)](#), we define $\Delta \text{Leverage}_{i,t}$ and $\Delta \text{Total Assets}_{i,t}$ as $\ln[\text{variable}_{i,t}] - \ln[\text{variable}_{i,t-1}]$ and leverage as the ratio of total book assets to total book equity. The main coefficient of interest is β , which captures the relationship between changes in total assets and changes in leverage. If this coefficient is positive and significant, leverage is procyclical. When total assets increase, the numerator of the leverage ratio rises. However, the relation between changes in total assets and changes in leverage is not mechanical. For example, if total assets increase (decrease) by 10%, the coefficient of $\Delta \text{Total Assets}$ is zero if debt and equity also both increase (decrease) by 10%. The coefficient is positive only if debt increases (decreases) by more than 10% (equivalently, equity increases (decreases) by less than 10%) such that the bank's leverage ratio increases (decreases).

In model (1), α denotes the intercept, α_i the bank-fixed effect, α_t the quarter-year-fixed effect, and $\epsilon_{i,t}$ the vector of regression disturbances. $\Delta \text{Goodwill}_{i,t}$ controls for mergers & acquisitions. It is defined as the fraction of $[\text{Goodwill}_{i,t} - \text{Goodwill}_{i,t-1}]$ to $[\text{Total Assets}_{i,t} - \text{Total Assets}_{i,t-1}]$.⁶

The empirical model above is estimated by ordinary least squares and standard errors

⁶Mergers & acquisitions increase total assets and, depending on the leverage ratios and the relative size of the two banks, the book leverage of the combined bank will be larger or smaller. We do not have data on mergers & acquisitions. Instead, we use the growth of a bank's goodwill since the goodwill of the combined/surviving entity typically increases strongly after mergers & acquisitions (the residual of the purchase price and book value of net assets is recognized as goodwill). Many small banks in our sample have zero goodwill on their balance sheet such that $\Delta \text{Goodwill}$ based on log differences is not defined for these banks. To overcome this problem, we use the above definition of $\Delta \text{Goodwill}$, which is economically very similar to the log definition, but has the benefit that $[\text{Total Assets}_{i,t} - \text{Total Assets}_{i,t-1}]$ is typically non-zero.

are adjusted for within-bank clusters (see [Petersen \(2009\)](#)).⁷ We run this regression for the whole sample as well as separately for savings banks, commercial banks with less than 20% fair-value assets, and commercial banks with more than 20% fair-value assets. The fraction of fair-value assets is given by the sum of trading assets and AfS securities divided by total assets.

We extend regression model (1) by including macroeconomic conditions and bank fundamentals as controls since these variables might influence both $\Delta\text{Leverage}$ and $\Delta\text{Total Assets}$. The leverage growth of bank i in quarter t is now given by

$$\begin{aligned}\Delta\text{Leverage}_{i,t} = & \alpha + \alpha_i + \beta \cdot \Delta\text{Total Assets}_{i,t} + \gamma \cdot \Delta\text{GDP}_t + \delta \cdot \text{Leverage}_{i,t-1} \\ & + \zeta \cdot q_{i,t-1} + \eta \cdot \text{Total Reg Capital Ratio}_{i,t-1} + \theta \cdot \Delta\text{Risk Weight}_{i,t} \\ & + \iota \cdot \text{Accounting Items}_{i,t} + \kappa \cdot \Delta\text{Goodwill}_{i,t} + \epsilon_{i,t}\end{aligned}\tag{2}$$

We employ ΔGDP as macroeconomic variable (defined as log difference of real GDP). The real US GDP is an indicator of the overall economic condition in the US.⁸ Since ΔGDP is constant across banks within each quarter, this variable is perfectly collinear with the quarter-year dummy. Therefore, we drop the quarter-year-fixed effect from regression model (2). $\text{Leverage}_{i,t-1}$ denotes the leverage ratio at the beginning of the period (lagged leverage). $q_{i,t-1}$ is the bank's lagged market-to-book ratio of equity to control for a bank's growth opportunities, but also to capture possible differences between the leverage ratio based on market and book values. We include a bank's total regulatory capital ratio and the change in the average risk weight, $\Delta\text{Risk Weight}_{i,t}$, to capture possible effects of

⁷As a robustness check, we cluster standard errors at the quarter level and find that this slightly strengthens the statistical significance of our results.

⁸We use the real GDP chained to the year 2005. For robustness, we also conducted our empirical analysis with the S&P500 index and nominal GDP instead of real GDP. This does not change the nature of our results.

regulation. The total regulatory capital ratio is defined as the sum of tier 1 and tier 2 capital divided by risk-weighted assets, as specified by the *Basel Committee on Banking Supervision*. The average risk weight is given by the ratio of risk-weighted assets to total assets and $\Delta \text{Risk Weight}_{i,t}$ is again defined as a log difference.

We also control for accounting (profitability) by including the vector $\text{Accounting Items}_{i,t}$. In the simplest regression specification, the vector contains unrealized gains and losses on AfS securities as well as net income. In an extended specification, we split up net income as discussed in Section 2. The vector then contains unrealized gains and losses on AfS securities, realized gains and losses on AfS & HtM securities, realized gains and losses from the sale of loans, trading income (for commercial banks), and residual net income. We divide all accounting items by lagged total assets.

In our main empirical model, we interact potential drivers of procyclical leverage with $\Delta \text{Total Assets}$. We estimate the following regression

$$\begin{aligned}
\Delta \text{Leverage}_{i,t} = & \alpha + \alpha_i + \beta \cdot \Delta \text{Total Assets}_{i,t} \\
& + \gamma \cdot \Delta \text{Total Assets}_{i,t} \cdot \text{Accounting Items}_{i,t} \\
& + \delta \cdot \Delta \text{Total Assets}_{i,t} \cdot \text{Total Reg Capital Ratio}_{i,t-1} \\
& + \zeta \cdot \Delta \text{Total Assets}_{i,t} \cdot \Delta \text{Risk Weight}_{i,t} \cdot 1_{\Delta \text{Total Assets} > 0} \\
& + \eta \cdot \Delta \text{Total Assets}_{i,t} \cdot \Delta \text{Risk Weight}_{i,t} \cdot 1_{\Delta \text{Total Assets} < 0} \\
& + \theta \cdot \Delta \text{Total Assets}_{i,t} \cdot \Delta \text{GDP}_t + \iota \cdot \Delta \text{Total Assets}_{i,t} \cdot \text{Leverage}_{i,t-1} \\
& + \kappa \cdot \Delta \text{Total Assets}_{i,t} \cdot q_{i,t-1} + \mu \cdot Z_{i,t} + \epsilon_{i,t}
\end{aligned} \tag{3}$$

Each interaction term measures the relationship between the procyclical leverage pat-

tern and the interacted variable. As discussed in Section 2, our main variables of interest are the accounting items ($\text{Accounting Items}_{i,t}$) as well as the regulatory measures ($\text{Total Reg Capital Ratio}_{i,t-1}$ and $\Delta\text{Risk Weight}_{i,t}$). We introduce two interaction terms for $\Delta\text{Risk Weight}_{i,t}$ (increasing and decreasing total assets) to properly account for the potential non-linear relationship between this variable and procyclical leverage. The vector $Z_{i,t}$ contains the stand-alone values of the interacted variables as well as $\Delta\text{Goodwill}$.

4 Data

4.1 Data Sources and Sample Selection

We obtain our bank-level data from the bank fundamentals database of *SNL Financial* and the real GDP data from the homepage of the *Bureau of Economic Analysis* (BEA). SNL’s bank database contains detailed information about the balance sheet and income statement of all active, acquired/defunct and listed/non-listed US financial institutions that report to the SEC, the Federal Reserve System, the FDIC or the Comptroller of the Currency. In this paper, we focus on US commercial and savings banks at the holding company level. Specifically, we investigate all commercial and savings banks that file Y-9C and 10-Q reports.⁹ Our sample covers the time period from Q3-1990 to Q1-2013.¹⁰

We include a bank in our sample if it has non-missing and positive values for total

⁹All US bank holding companies are directly regulated and supervised by the Federal Reserve System and, in the case of total book assets exceeding \$150 million (\$500 million as of 2006), required to file a quarterly Y-9C report (Consolidated Financial Statements of Holding Companies). If the holding company has more than 300 shareholders, it is also required to register with the SEC and to file quarterly 10-Q and annual 10-K reports.

¹⁰Broker-dealers that became a bank holding company during the financial crisis (e.g., Goldman Sachs and Morgan Stanley) are not included in the sample. Broker-dealers that were acquired by a commercial or savings bank are considered. For example, Merrill Lynch was a pure broker-dealer before its acquisition by Bank of America in 2009. We do not include Merrill Lynch in our sample before 2009. However, Merrill Lynch implicitly became part of our sample once it got absorbed by Bank of America. There are very few such cases.

assets and total (book) equity. We eliminate outliers by excluding the top and bottom 1% of observations based on the growth of total assets and the growth of leverage.¹¹ These selection criteria result in an initial sample of 42670 bank-quarter observations attributable to 934 banks. Focusing our attention on banks for which all regression variables are non-missing reduces our sample to 21620 bank-quarter observations (800 institutions).¹²

4.2 Descriptive Statistics

Table 2 reports averages for key characteristics of our sample banks (full sample and by business model). The average balance sheet size of institutions in our sample is \$11.34 billion. With average total assets of \$1.92 billion, savings banks are smaller than commercial banks. Among commercial banks, those with more than 20% fair-value assets are significantly larger (average balance sheet of \$22.32 billion). The leverage ratio of a typical bank in our sample is 11.36 and thus lower than the leverage of the largest US investment banks, which is in the range of 20 to 35 (see, for example, Figure 16 in [Adrian and Shin \(2010\)](#)). The average savings bank has a lower leverage ratio and a higher regulatory capital ratio than the average commercial bank. The average risk weight of our sample banks is 0.69. The asset structure of the observed institutions is typical for commercial and savings banks. Loans are the largest asset class and account for 65.85% of total bank assets on average. AfS securities constitute the second largest asset class (17.60%) and HtM securities cover only 3.81% of the balance sheets of our sample banks. Trading assets play a minor role for most banks in our sample (0.21% of total assets). The liability-side

¹¹We first cut by the growth of leverage and then by the growth of total assets. Our results do not change qualitatively if we reverse the order or if we use different exclusion thresholds. A possible reason for outliers are large mergers and acquisitions. By cutting the top/bottom 1% we do not eliminate the effects of medium-sized and small mergers and acquisitions. Therefore, we control for these business combinations by including $\Delta \text{Goodwill}_{i,t}$ in our regression analysis.

¹²The number of unique banks per quarter increases from 75 in Q3-1990 to 702 in Q1-2007 and stabilizes around 700 thereafter.

of the balance sheet reveals that deposits and senior debt are the two dominant sources of funding for US commercial and savings banks.

Table 3 shows summary statistics for the variables of our empirical analysis. Between Q3-1990 and Q1-2013, the average growth of total assets and leverage of our sample banks was 1.72% and 0.17% per quarter. Commercial banks tend to have a higher net income and a higher market-to-book ratio of equity ($q_{i,t-1}$) than savings banks. Average realized gains on loans (0.33‰ of total assets) are higher than both realized gains on AfS & HtM securities (0.05‰) and unrealized gains and losses on AfS securities (0.03‰). Consistent with the asset structure of our sample banks, trading income is very small (0.02‰). For savings banks, trading income is zero for 97.75% of all observations. This lack of empirical variation makes a reliable statistical inference impossible. Therefore, we will run our regressions for savings banks excluding trading income (stand-alone and interaction with $\Delta\text{Total Assets}$).

5 Results

Figure 1 plots $\Delta\text{Total Assets}$ and $\Delta\text{Leverage}$ for all bank-quarter observations of our sample and **Figure 2** visualizes the same relationship for savings and commercial banks. Each of the graphs shows a strong procyclical leverage pattern.

In **Table 4**, we provide the estimation results of regression equations (1) and (2) for the full sample. The coefficient of $\Delta\text{Total Assets}$ is positive and highly statistically significant across all regression models. When we include controls to account for macroeconomic conditions and bank fundamentals, the coefficient of $\Delta\text{Total Assets}$ slightly increases. Therefore, the procyclical leverage pattern does not seem to be heavily driven by these additional

variables.¹³

To quantify the economic magnitude of procyclical leverage, we look at our average sample bank, which has total assets of \$11.34 billion and a leverage ratio of 11.36. The bank’s expected balance sheet and leverage at the end of the subsequent quarter is \$11.54 billion and 11.38, respectively. The procyclical leverage coefficient of 0.758 in the full regression model implies that a one standard-deviation increase in asset growth results in a balance sheet of \$11.94 billion and a leverage ratio of 11.69 at the end of the next quarter. This asset growth implies an increase in the balance sheet of \$408 million, which stems from an increase of debt of \$400 million and an increase of equity of \$8 million. Therefore, the marginal leverage ratio of the additional assets is 51 and more than 4 times as high as the leverage of the bank’s existing balance sheet.

The coefficient of Δ Risk Weight is negative, which implies that an increase in the average risk-weight goes along with a reduction in the leverage ratio. However, the coefficient is only weakly significant and becomes insignificant in the full regression model. Moreover, the procyclical leverage pattern remains strong. In contrast, [Amel-Zadeh et al. \(2014\)](#) find that the coefficient on Δ Total Assets becomes insignificant when Δ Risk Weight (negative and significant coefficient) is added to their regression model. To understand the difference in findings, we replicate the regression setup of [Amel-Zadeh et al. \(2014\)](#) as closely as possible. In particular, we only consider commercial banks between Q1-2001 and Q4-2010 and employ identical sample selection criteria, data modifications, variable definitions, and regression specifications. Our replicated sample consists of 12667 bank-quarter observations,

¹³In untabulated results, we quantify the incremental explanatory power of the bank-fixed effect and the quarter-year-fixed effect respectively. Adding the bank-fixed effect to regression model (1) increases the adjusted R^2 from 19.5% (model without any fixed effects) to 22.1%. The quarter-year-fixed effect raises the explanatory power to 26.4%. Including both types of fixed effects results in an adjusted R^2 of 28.9% as reported in Table 4 ([1]). The coefficient of Δ Total Assets is positive and highly statistically significant across all these specifications.

which is comparable to the 12486 bank-quarter observations of [Amel-Zadeh et al. \(2014\)](#). In the replicated regression analysis we find that the coefficient of Δ Total Assets decreases from 0.448 to 0.390 when we add Δ Risk Weight as explanatory variable. However, the coefficient of Δ Total Assets remains highly statistically significant.

Table 5 provides the estimation results of regression equation (2) by business model, splitting net income into different components. We find strong procyclicality both for savings banks and commercial banks. Indeed, the coefficient of Δ Total Assets is significantly higher for savings banks than for commercial banks with more than 20% fair-value assets (the difference in coefficients is 0.144 and the p-value of the null hypothesis that this difference is zero equals 0.00%). This is true despite the fact that savings banks hold substantially less AfS securities and trading assets. As an alternative test, we compare the procyclical leverage pattern of all sample banks with more than 30% fair-value assets with the procyclical leverage pattern of banks with at least 95% of total assets recognized at historical cost. We find that leverage procyclicality is not significantly stronger for banks that mainly use fair-value accounting (difference: 0.013; p-value: 40.52%). Importantly, the distribution of Δ Total Assets is also similar for both types of banks. Again, this finding suggests that fair-value accounting is not a driver of procyclical bank leverage or that historical cost accounting reduces procyclicality. Increases in unrealized gains on AfS securities and the different components of net income directly feed into equity and thus reduce leverage, which is reflected in the negative and statistically significant coefficients.

In **Table 6**, we provide the estimation results of regression equation (3) for the whole sample. Of particular interest for the fair-value debate is the interaction term with unrealized gains and losses on AfS securities. The coefficient is negative and statistically insignificant. Therefore, higher unrealized fair-value gains on AfS securities per se do not seem to contribute to the procyclical leverage pattern of our sample banks. In contrast,

the statistically significant interaction term with net income highlights that overall bank profitability positively affects leverage procyclicality. The coefficient of the interaction term with ΔGDP is positive and highly statistically significant. This confirms the intuition that leverage procyclicality is strongly associated with the business cycle. We also find that the procyclical leverage pattern is weaker for banks with a high leverage and a high market-to-book ratio. The interaction term of the regulatory capital ratio is insignificant. One explanation for this result might be that regulatory capital constraints are not binding since banks hold precautionary buffers. However, as pointed out by [Amel-Zadeh et al. \(2014\)](#), another reason might be that banks can increase their leverage and balance sheet size without changing the regulatory capital ratio if the average risk weight of assets decreases. The interaction term of changes in average risk weighted assets with changes in total assets is negative and significant for balance sheet expansions, which is consistent with the argument of [Amel-Zadeh et al. \(2014\)](#). In addition, we find that a procyclical reduction of leverage is strongly associated with an increase in the average risk weight if balance sheets contract. One reason might be that the increase in average risk weight is forcing banks to disproportionately reduce leverage, given a binding leverage constraint. However, it is also possible that the coefficient captures the mechanical effect of banks reducing cash and selling liquid assets (both have low risk weights) as a response to an outflow of deposits, which is consistent with our findings below.

Table 7 provides the estimation results of regression model (3) by business model, splitting net income into different components. Equivalent to the full sample, the interaction term of unrealized gains on AfS securities is insignificant for all three types of banks, again suggesting that fair-value accounting does not contribute to procyclical leverage. For savings banks, the only variable for which the coefficient of the interaction term is significant is realized gains on loans. The estimate is positive.

The interactions of ΔGDP , the leverage ratio, and $\Delta\text{Risk Weight}$ upon balance sheet contractions are significant for both types of commercial banks. An interesting difference arises with respect to the interaction of $\Delta\text{Total Assets}$ with $\Delta\text{Risk Weight}$ if total assets increase. The coefficient is negative and highly statistically significant only for commercial banks with more than 20% fair-value assets.

To understand the drivers of procyclical leverage, it is important to investigate which types of assets banks increase and reduce throughout the cycle. Therefore, we take a closer look at the different asset classes of our sample banks. In particular, we split $\Delta\text{Total Assets}$ from model (1) into the quarterly growth rates of loans, AfS securities, HtM securities, and cash. **Table 8** provides the estimation results for the asset-component analysis of procyclical leverage. We split the sample into balance sheet expansions and contractions and find that for expansions the coefficient of ΔLoans is the largest (highly significant) across all banks. This result is not due to the fact that loans are the largest asset class on the balance sheets of our sample banks as the regression coefficient captures the sensitivity of leverage to percentage changes in loans. For balance sheet contractions, the coefficient of ΔLoans is not significant. Consequently, banks disproportionally expand via loans, not securities, when they increase leverage and total assets. In contrast, our sample banks reduce securities and cash upon procyclical balance sheet contractions.

In **Table 9**, we investigate how banks finance procyclical expansions and which types of liabilities banks reduce upon procyclical contractions. Specifically, we replace $\Delta\text{Total Assets}$ (model (1)) with the quarterly changes of deposits, senior debt, and subordinated debt. Leverage procyclicality is mainly driven by disproportional expansions and contractions of deposits. Looking again separately at increases and decreases of the balance sheet, we find that for savings banks deposits are only significant when total assets increase, not when they decrease. For commercial banks, the coefficient of $\Delta\text{Deposits}$ is significant both

for increasing and decreasing total assets. This is consistent with savings banks relying more on insured deposits than commercial banks. Unfortunately, for reasons of data availability, we cannot differentiate between insured and uninsured deposits or interbank and non-interbank deposits.

6 Robustness and Extensions

To further deepen our understanding of procyclical leverage, we extend regression model (2) by including several additional variables that we interact with $\Delta\text{Total Assets}$. We report the results of this analysis in **Table 10**.

First, we investigate whether procyclical leverage is stronger for balance sheet contractions or expansions. In particular, we introduce a dummy variable that is equal to one if $\Delta\text{Total Assets}$ is negative and zero otherwise. We find that the interaction term of this dummy with $\Delta\text{Total Assets}$ is positive and statistically significant, which implies that procyclicality is stronger if banks contract their balance sheets.

Second, we analyze the impact of the recent financial crisis on procyclical leverage. We introduce a dummy variable for the crisis period (Q3-2007 to Q4-2009), which we interact with $\Delta\text{Total Assets}$. We find that the coefficient of the interaction term is negative but not statistically significant. This suggests that procyclicality was not materially different during the crisis period and that leverage remains procyclical even if we exclude the financial crisis.

Third, we compare the magnitude of procyclical leverage before and after the widespread introduction of fair-value accounting in the 1990s to test whether procyclicality increased. In particular, we define a dummy variable, which is one for the time period Q3-1990 to Q4-1991 (pre fair-value accounting) and zero for the quarters Q1-1994 to Q1-2013 (post

fair-value accounting). We exclude the years 1992 and 1993 from our analysis since SFAS 107 already became effective for fiscal years ending after December 15, 1992. This accounting standard required the disclosure of fair values for certain financial instruments and was a predecessor of SFAS 115, which introduced the fair-value recognition rules for fiscal years ending after December 15, 1993. As a result, fiscal years 1992 and 1993 were already affected by fair-value accounting. To examine whether leverage procyclicality changed after the introduction of the fair-value recognition rule, we interact the time dummy with Δ Total Assets. We find that the interaction term is positive and statistically significant.¹⁴ Therefore, consistent with our previous findings, the introduction of fair-value accounting did not magnify procyclical leverage. However, one needs to be cautious not to overinterpret the results of this analysis due to potential effects associated with the earlier introduction of SFAS 107 or other confounding events (e.g., full implementation of Basel I risk-based capital requirements in the US in Q3-1993).

Fourth, we investigate the relation between procyclical leverage and the fraction of fair-value assets recognized on a bank's balance sheet. In line with our previous results, we find that the interaction term of Δ Total Assets with the lagged fraction of fair-value assets is statistically insignificant.

Fifth, we use the ratio of non-interest income to interest income as an alternative measure capturing the business model of banks. We find that the corresponding interaction term is positive and statistically significant. Consistent with our previous findings, this suggests that the bank's business model is an important determinant of procyclical leverage.

Finally, we investigate the relation between procyclical leverage and off-balance sheet

¹⁴We estimate regression model (2) without unrealized gains on AfS securities. As this variable is only available for the post fair-value accounting period, the time dummy would always take a value of one such that the interaction term and Δ Total Assets would be perfectly collinear. In unreported results, we alternatively define the post fair-value accounting period as 1994 to 2000, 1994 to 1995, or 1994 and find that the interaction term remains positive but becomes statistically insignificant.

guarantees provided by large commercial banks for special purpose vehicles (conduits) through which these banks engage in securitization. Off-balance sheet guarantees are a good proxy for securitization activity as the amount of these guarantees increases with the bank's involvement in securitization. We use the data of [Acharya et al. \(2013\)](#), which we retrieve from the homepage of Philipp Schnabl. The authors collect US and European conduit-level data from rating reports by Moody's Investor Services from January 2001 to December 2009. We manually match this data to our quarterly panel of US commercial and savings banks. It is typically large commercial banks that engage in securitization through special-purpose vehicles. As a result, we are able to match the data on off-balance sheet guarantees to only 12 large commercial banks in our sample. Our focus is on liquidity guarantees since commercial banks primarily use this type of guarantee (see, for example, [Acharya et al. \(2013\)](#)). We find that the interaction term of Δ Total Assets with the amount of off-balance sheet guarantees is positive and statistically significant for these 12 banks. Therefore, leverage procyclicality is stronger for banks that are more involved in securitization, consistent with [Beccalli et al. \(forthcoming\)](#).

In our empirical analysis, we use quarterly data to investigate the leverage procyclicality of US commercial and savings banks. For robustness, we also estimate our regressions with annual data. In **Table 11**, we find that leverage remains highly procyclical. However, the coefficient of Δ Total Assets is smaller compared to our analysis based on quarterly data (0.524 versus 0.770 for the full sample). The interaction term of unrealized gains on AfS securities remains insignificant for both the full sample and all individual bank splits. Realized gains on AfS & HtM securities are now positively related to procyclical leverage for commercial banks with less than 20% fair-value assets. Finally, the interaction of trading income with Δ Total Assets becomes negative and statistically significant for commercial banks with more than 20% fair-value assets. However, these results are sensitive to whether

we consider balance sheet expansions or contractions as we discuss below.

Banks might react to both unrealized and realized gains with a time lag. To test for this possibility, we add the previous two quarters to the corresponding accounting items of the current quarter and re-run our empirical analyses. **Table 12** documents the results of this robustness test. The interaction terms of unrealized gains on AfS securities and realized gains on AfS & HtM securities remain insignificant for both the full sample and the individual subsamples. Realized gains on loan sales are no longer significantly related to procyclical leverage for savings banks. In contrast, the interaction of trading income becomes positive and statistically significant for commercial banks with less than 20% fair-value assets.

As discussed in Section 2, it might be important to distinguish between expansions and contractions of the balance sheet for the interaction terms of securities reported at fair value and GDP growth. We perform this analysis for our main empirical model as well as for the versions with lagged accounting variables and yearly data and report the results in **Table 13**. All interaction terms of unrealized gains on AfS securities remain insignificant with one exception. For commercial banks with less than 20% fair-value assets, the coefficient becomes marginally significant for balance sheet expansions when including the previous two quarters. However, the coefficient is negative, not positive. Therefore, higher unrealized gains on AfS securities are associated with weaker, not stronger, leverage procyclicality when these banks expand their balance sheet (controlling for any direct effect that unrealized gains on AfS securities might have on leverage). For the quarterly models, the interaction terms of realized gains on AfS & HtM securities remain insignificant for the full sample and all types of banks. However, when looking at yearly data, higher realized gains on AfS & HtM securities are associated with stronger procyclical leverage for commercial banks. Interestingly, for commercial banks with less than 20% fair-value assets,

the effect is only present for balance sheet expansions. In contrast, for commercial banks with more than 20% fair-value assets, we find the effect only for balance sheet contractions. The latter finding is consistent with the argument that banks are more willing to sell AfS & HtM securities to reduce leverage when the sale of these securities results in a gain.

In our main empirical model, the interaction term of trading income becomes positive and significant when commercial banks with less than 20% fair-value assets expand their balance sheet. This is in line with the argument that trading income might contribute to procyclical leverage. However, for commercial banks with more than 20% fair-value assets, the coefficient is not significant for increasing total assets although these banks have a much higher fraction of trading assets. Instead, the coefficient is positive and significant for balance sheet contractions. Therefore, when these banks reduce their balance sheet, deleveraging (procyclicality) is stronger when trading gains are higher, not when they are lower. If we include the previous two quarters, the interaction term of trading income upon balance sheet contractions is no longer significant for commercial banks with more than 20% fair-value assets. In addition, for yearly data, the interactions of trading income are insignificant for the individual banks, but marginally significant and negative for the full sample if total assets decrease.

Overall, we do not find any evidence that would support the claim that unrealized gains on AfS securities contribute to procyclical leverage. The evidence on trading income is mixed and sensitive to the inclusion of lags and the use of quarterly or yearly data. While most people do not question the use of fair-value accounting for trading assets, they might still be concerned about its effect on procyclical leverage. Therefore, it is interesting that we do not find a clear and strong effect of trading income on leverage procyclicality. Indeed, in many cases we do not find a significant association between the level of trading income and procyclical leverage. In other cases, the coefficient is significant, but has a

different sign than predicted. However, the banks in our sample only hold very little trading assets. Moreover, those banks that do hold trading assets may do so for very different reasons (e.g., proprietary trading, market making, and hedging) with different effects on procyclical leverage.

In our paper and in the related literature following [Adrian and Shin \(2010\)](#), procyclical leverage measures the relationship between the growth rate of a bank's assets and the growth rate of its leverage. A positive coefficient does not imply that leverage increases as total assets increase over time. Indeed, as **Figure 3** shows, the balance sheet of the average (equally-weighted) bank in the full sample increased by a factor of nearly three between 1990 and 2013. During the same time period, the average leverage ratio decreased from 14 to 10. This pattern also holds individually for savings banks as well as commercial banks with more, respectively less, than 20% of fair-value assets.

7 Conclusion

We provide empirical evidence on the prevalence and determinants of leverage procyclicality for US commercial and savings banks in the period from Q3-1990 to Q1-2013. Understanding the determinants of procyclical bank leverage is important for the identification of possible problems and remedies that are as diverse as financial reporting, regulation, and bank management.

Leverage is strongly procyclical for both savings and commercial banks, even after controlling for a large set of economic and bank-specific determinants of leverage. We do not find any evidence that fair-value accounting contributes to procyclical leverage or that historical cost accounting reduces procyclicality. Procyclical leverage is higher for savings banks than for commercial banks, including those commercial banks with more than 20%

fair-value assets. Moreover, the interaction term of unrealized gains on AfS securities with changes in total assets is insignificant for the full sample and the different types of banks.

We find limited evidence that risk-based capital regulation systematically magnifies procyclical leverage. The interaction term with the regulatory capital ratio is insignificant for all regression specifications. Only for commercial banks with more than 20% fair-value assets, a reduction of the average risk weight contributes to procyclical leverage when balance sheets expand. The lack of significance for the other banks is consistent with our finding that leverage procyclicality is mainly driven by an expansion of loans (high risk weights), not securities (low risk weights). When banks contract their balance sheet, an increase in the average risk weight is positively related to procyclical leverage. Our evidence highlights that this result is driven by the fact that reductions (outflows) in deposits go along with reductions in cash and liquid securities.

Taken together, our findings suggest that the business model and economic conditions are more important for the procyclicality of US bank leverage than prevailing financial reporting standards and regulatory capital requirements.

References

- Acharya, V., Schnabl, P. and Suarez, G. (2013), ‘Securitization Without Risk Transfer’, *Journal of Financial Economics* **107**(3), 515–536.
- Adrian, T. and Shin, H. S. (2010), ‘Liquidity and Leverage’, *Journal of Financial Intermediation* **19**(3), 418–437.
- Adrian, T. and Shin, H. S. (2011), ‘Financial Intermediary Balance Sheet Management’, *Annual Review of Financial Economics* **3**, 289–307.
- Amel-Zadeh, A., Barth, M. E. and Landsman, W. R. (2014), ‘Procyclical Leverage: Bank Regulation or Fair Value Accounting?’, *Working Paper* .
- Baglioni, A. S., Beccalli, E., Boitani, A. and Monticini, A. (2013), ‘Is the Leverage of European Banks Procyclical?’, *Empirical Economics* **45**, 1251–1266.
- Bank for International Settlements (2009), ‘The Role of Valuation and Leverage in Procyclicality’, *Committee on the Global Financial System* (34).
- Beccalli, E., Boitani, A. and Di Giuliantonio, S. (forthcoming), ‘Leverage Pro-Cyclicality and Securitization in US Banking’, *Journal of Financial Intermediation* .
- Berger, A., DeYoung, R., Flannery, M. J., Lee, D. and Öztekin, O. (2008), ‘How Do Large Banking Organizations Manage Their Capital Ratios?’, *Journal of Financial Services Research* **34**(2), 123–149.
- Damar, H. E., Meh, C. A. and Terajima, Y. (2013), ‘Leverage, Balance-Sheet Size and Wholesale Funding’, *Journal of Financial Intermediation* **22**(4), 639–662.
- Economist (2008), ‘The Financial System: What Went Wrong’.
- Financial Services Authority (2009), ‘The Turner Review: A Regulatory Response to the Global Banking Crisis’.
- Financial Times (2008), ‘Insight: True Impact of Mark-to-Market on the Credit Crisis’.
- Greenlaw, D., Hatzius, J., Kashyap, A. K. and Shin, H. S. (2008), ‘Leveraged Losses: Lessons from the Mortgage Market Meltdown’, *US Monetary Policy Forum Report No. 2* .
- Gropp, R. and Heider, F. (2010), ‘The Determinants Of Bank Capital Structure’, *Review of Finance* **14**(4), 587–622.
- International Monetary Fund (2008), ‘Chapter 3: Fair Value Accounting and Procyclicality’, *Global Financial Stability Report* .

- Panetta, F. and Angelini, P. (2009), ‘Financial Sector Pro-Cyclicality: Lessons from the Crisis’, *Banca D’Italia: Occasional Paper* (44).
- Persaud, A. (2008), ‘Regulation, Valuation and Systemic Liquidity’, *Banque de France, Financial Stability Review: Special Issue on Valuation* (12).
- Petersen, M. A. (2009), ‘Estimating Standard Errors in Finance Panel Data Sets: Comparing Approaches’, *Review of Financial Studies* **22**(1), 435–480.
- Plantin, G., Sapra, H. and Shin, H. S. (2008), ‘Fair Value Accounting and Financial Stability’, *Banque de France, Financial Stability Review: Special Issue on Valuation* (12).
- Xie, B. (2015), ‘Does Fair Value Accounting Exacerbate the Procyclicality of Bank Lending?’, *Working Paper* .

Tables and Figures

Table 1: Definition of Regression Variables

This table defines the variables used in our panel regression analysis and indicates their respective data source.

Variable	Definition	Data Source
Total Assets _{<i>i,t</i>}	Book value of all assets recognized on the balance sheet of bank <i>i</i> at the end of quarter <i>t</i>	SNL Financial
Leverage _{<i>i,t</i>}	Total Assets _{<i>i,t</i>} / Total Book Equity _{<i>i,t</i>}	SNL Financial
GDP _{<i>t</i>}	Real US gross domestic product at the end of quarter <i>t</i>	BEA
q _{<i>i,t</i>}	Market Capitalization _{<i>i,t</i>} / Total Book Equity _{<i>i,t</i>}	SNL Financial
RWA _{<i>i,t</i>}	Total risk-weighted assets of bank <i>i</i> at the end of quarter <i>t</i>	SNL Financial
Total Reg. Capital Ratio _{<i>i,t</i>}	Total tier 1 and tier 2 capital of bank <i>i</i> at the end of quarter <i>t</i> / RWA _{<i>i,t</i>}	SNL Financial
Risk Weight _{<i>i,t</i>}	Total risk-weighted assets of bank <i>i</i> at the end of quarter <i>t</i> / Total Assets _{<i>i,t</i>}	SNL Financial
Goodwill _{<i>i,t</i>}	Excess of purchase price paid over value of net assets acquired of bank <i>i</i> at the end of quarter <i>t</i>	SNL Financial
ΔTotal Assets _{<i>i,t</i>}	$\ln(\text{Total Assets}_{i,t}) - \ln(\text{Total Assets}_{i,t-1})$	SNL Financial
ΔLeverage _{<i>i,t</i>}	$\ln(\text{Leverage}_{i,t}) - \ln(\text{Leverage}_{i,t-1})$	SNL Financial
ΔGDP _{<i>i,t</i>}	$\ln(\text{GDP}_t) - \ln(\text{GDP}_{t-1})$	BEA
ΔRisk Weight _{<i>i,t</i>}	$\ln(\text{Risk Weight}_{i,t}) - \ln(\text{Risk Weight}_{i,t-1})$	SNL Financial
ΔGoodwill _{<i>i,t</i>}	$(\text{Goodwill}_{i,t} - \text{Goodwill}_{i,t-1}) / (\text{Total Assets}_{i,t} - \text{Total Assets}_{i,t-1})$	SNL Financial
Unrealized Gains AfS _{<i>i,t</i>}	Change in net unrealized gain on AfS securities of bank <i>i</i> during quarter <i>t</i> / Total Assets _{<i>i,t-1</i>}	SNL Financial
Net Income _{<i>i,t</i>}	Net income of bank <i>i</i> during quarter <i>t</i> / Total Assets _{<i>i,t-1</i>}	SNL Financial
Realized Gains Loans _{<i>i,t</i>}	Net gains on the sale of loans of bank <i>i</i> during quarter <i>t</i> / Total Assets _{<i>i,t-1</i>}	SNL Financial
Realized Gains AfS & HtM _{<i>i,t</i>}	Net gains on the sale of HtM and AfS securities of bank <i>i</i> during quarter <i>t</i> / Total Assets _{<i>i,t-1</i>}	SNL Financial
Trading Income _{<i>i,t</i>}	Realized & unrealized gains and losses from trading assets of bank <i>i</i> during quarter <i>t</i> / Total Assets _{<i>i,t-1</i>}	SNL Financial
Residual Net Income _{<i>i,t</i>}	Net Income _{<i>i,t</i>} - Realized Gains Loans _{<i>i,t</i>} - Realized Gains AfS & HtM _{<i>i,t</i>} - Trading Income _{<i>i,t</i>}	SNL Financial

Table 2: Bank Characteristics

This table reports averages for various bank characteristics from Q3-1990 to Q1-2013 by business model and for the full sample. Panel A reports asset-specific variables and Panel B lists variables which are related to the liability-side of the banks' balance sheets. In Panel A, all figures are normalized by total assets (except for total assets). In Panel B, all figures are normalized by total assets except for leverage, the tier 1 capital ratio and the total regulatory capital ratio. Other financial assets include cash, interbank deposits, reverse repurchase agreements and fed funds. Other liabilities include all liabilities that cannot be classified as deposits, senior debt or subordinated debt. The fraction of fair-value assets is given by the sum of trading assets and AfS securities divided by total assets. Bank fundamentals are obtained from *SNL Financial*.

Panel A: Assets

	Full Sample	Savings Banks	Commercial Banks $\leq 20\%$ FV-Assets	Commercial Banks $> 20\%$ FV-Assets
Trading Assets [%]	0.21	0.05	0.08	0.45
Available-for-Sale [%]	17.60	14.79	11.57	28.69
Held-to-Maturity [%]	3.81	5.57	4.24	2.24
Loans [%]	65.85	68.09	71.21	56.87
Other Financial Assets [%]	6.33	5.12	6.68	5.67
Total Financial Assets [%]	93.80	93.62	93.78	93.92
Risk-Weighted Assets [%]	69.57	60.72	75.26	64.92
Total Assets (US\$ billion)	11.34	1.92	6.11	22.32

Panel B: Liabilities

	Full Sample	Savings Banks	Commercial Banks $\leq 20\%$ FV-Assets	Commercial Banks $> 20\%$ FV-Assets
Deposits [%]	77.65	71.49	79.90	77.06
Senior Debt [%]	10.54	15.59	8.39	10.75
Subordinated Debt [%]	0.87	0.44	1.09	0.79
Other Liabilities [%]	1.35	1.31	1.29	2.02
Total Liabilities [%]	90.41	88.83	90.67	90.62
Leverage	11.36	10.25	11.56	11.42
Tier 1 Capital Ratio [%]	13.69	17.33	12.50	14.20
Total Reg. Capital Ratio [%]	15.11	18.41	13.96	15.64

Table 3: Descriptive Statistics

This table reports descriptive statistics for key variables of our empirical analysis. We report the 1% quantile ($Q_{0.01}$), 25% quantile ($Q_{0.25}$), median, mean, 75% quantile ($Q_{0.75}$), 99% quantile ($Q_{0.99}$), standard deviation (SD) and the number of observations (N). Panel A provides the statistics of the macroeconomic variables. Panels B to E list the descriptive statistics of bank-related variables for the full sample, savings banks, commercial banks $\leq 20\%$ fair-value assets and commercial banks $> 20\%$ fair-value assets. The fraction of fair-value assets is given by the sum of trading assets and AfS securities divided by total assets. Δ GDP, Δ Leverage, Δ Total Assets, Δ Risk Weight, Δ Goodwill and the lagged total regulatory capital ratio are denoted in percent. Unrealized gains AfS, net income, realized gains loans, realized gains AfS & HtM, trading income, and residual net income are given in per mil of total assets. Total assets are denoted in US\$ billion. Bank fundamentals are obtained from *SNL Financial* and real GDP is retrieved from the homepage of the *Bureau of Economic Analysis* (US Department of Commerce).

	$Q_{0.01}$	$Q_{0.25}$	Median	Mean	$Q_{0.75}$	$Q_{0.99}$	SD	N
Panel A: Macroeconomic Variables								
Δ GDP [%]	-2.33	0.32	0.59	0.50	0.84	1.78	0.67	42670
Panel B: Full Sample								
Δ Leverage [%]	-16.83	-2.25	-0.07	0.17	2.45	15.40	5.10	42670
Δ Total Assets [%]	-5.87	-0.42	1.32	1.72	3.32	14.15	3.60	42670
Δ Risk Weight [%]	-10.22	-1.56	0.17	0.07	1.77	9.50	4.09	33421
Δ Goodwill [%]	-7.52	0.00	0.00	0.20	0.00	13.38	5.07	38097
Unrealized Gains AfS [‰]	-5.10	-0.53	0.01	0.03	0.67	4.49	1.69	35638
Net Income [‰]	-7.56	1.35	2.25	1.92	3.00	5.49	2.38	42370
Realized Gains Loans [‰]	-0.06	0.00	0.05	0.33	0.27	4.72	1.16	36494
Realized Gains AfS & HtM [‰]	-1.51	0.00	0.00	0.05	0.06	1.68	0.90	42029
Trading Income [‰]	-0.05	0.00	0.00	0.02	0.00	0.56	0.22	40549
Residual Net Income [‰]	-9.14	0.91	1.90	1.50	2.73	5.04	2.56	34756
Total Regulatory Capital Ratio $_{t-1}$ [%]	9.06	12.13	13.9	15.13	16.53	35.31	5.02	38013
q_{t-1}	0.18	0.89	1.31	1.41	1.79	3.84	0.75	39331
Leverage $_{t-1}$	4.59	9.30	10.97	11.35	12.86	21.92	3.80	42670
Total Assets [US\$ billion]	0.16	0.31	0.61	11.34	1.64	167.83	102.96	42670
Panel C: Savings Banks								
Δ Leverage [%]	-13.13	-1.69	0.30	0.72	2.82	15.36	4.81	6956
Δ Total Assets [%]	-5.81	-0.71	0.89	1.31	2.73	13.42	3.43	6956
Δ Risk Weight [%]	-11.25	-1.42	0.33	0.26	1.93	11.41	4.09	4773
Δ Goodwill [%]	-2.45	0.00	0.00	0.15	0.00	8.43	3.52	5644
Unrealized Gains AfS [‰]	-4.98	-0.35	0.00	0.01	0.44	4.14	1.77	6151
Net Income [‰]	-8.25	0.84	1.66	1.38	2.36	5.51	2.44	6936
Realized Gains Loans [‰]	-0.13	0.00	0.06	0.45	0.33	6.88	1.47	6351
Realized Gains AfS & HtM [‰]	-1.87	0.00	0.00	0.07	0.05	2.21	1.31	6796
Residual Net Income [‰]	-11.06	0.40	1.26	0.79	1.94	4.74	2.68	5690
Total Regulatory Capital Ratio $_{t-1}$ [%]	10.00	13.10	16.10	18.54	21.44	48.66	7.99	5335
q_{t-1}	0.20	0.78	1.06	1.17	1.44	3.50	0.62	6531
Leverage $_{t-1}$	3.81	7.67	9.83	10.19	12.14	21.40	4.06	6956
Total Assets [US\$ billion]	0.15	0.26	0.52	1.92	1.27	25.01	4.93	6956
Panel D: Commercial Banks $\leq 20\%$ FV-Assets								
Δ Leverage [%]	-18.99	-2.14	0.00	0.18	2.45	15.50	5.20	20657
Δ Total Assets [%]	-5.92	-0.33	1.48	1.86	3.57	13.89	3.64	20657
Δ Risk Weight [%]	-9.57	-1.49	0.15	0.06	1.70	9.20	4.33	16448
Δ Goodwill [%]	-7.58	0.00	0.00	0.20	0.00	13.29	5.15	18952
Unrealized Gains AfS [‰]	-3.01	-0.38	0.01	0.03	0.49	2.60	1.01	17687
Net Income [‰]	-8.56	1.33	2.29	1.88	3.06	5.59	2.60	20507
Realized Gains Loans [‰]	-0.07	0.00	0.06	0.36	0.30	5.34	1.29	18138
Realized Gains AfS & HtM [‰]	-1.47	0.00	0.00	0.02	0.02	1.38	0.60	20434
Trading Income [‰]	-0.02	0.00	0.00	0.02	0.00	0.39	0.23	19942
Residual Net Income [‰]	-10.13	0.87	1.98	1.46	2.81	5.13	2.81	17491
Total Regulatory Capital Ratio $_{t-1}$ [%]	8.80	11.70	13.17	13.97	15.10	28.20	3.81	18794
q_{t-1}	0.17	0.91	1.34	1.42	1.81	3.87	0.77	18948
Leverage $_{t-1}$	5.40	9.60	11.09	11.53	12.90	22.14	3.84	20657
Total Assets [US\$ billion]	0.16	0.30	0.56	6.11	1.52	106.11	41.27	20657
Panel E: Commercial Banks $> 20\%$ FV-Assets								
Δ Leverage [%]	-15.73	-2.65	-0.27	-0.03	2.43	15.26	5.11	12942
Δ Total Assets [%]	-5.74	-0.42	1.28	1.66	3.20	14.19	3.53	12942
Δ Risk Weight [%]	-10.08	-1.66	0.16	0.04	1.83	9.28	3.71	10891
Δ Goodwill [%]	-8.42	0.00	0.00	0.24	0.00	15.03	5.31	11986
Unrealized Gains AfS [‰]	-6.89	-1.05	0.08	0.06	1.33	5.96	2.38	11304
Net Income [‰]	-5.67	1.64	2.44	2.20	3.10	5.26	1.98	12869
Realized Gains Loans [‰]	-0.04	0.00	0.03	0.21	0.22	2.57	0.62	11278
Realized Gains AfS & HtM [‰]	-1.53	0.00	0.00	0.08	0.16	1.95	1.08	12842
Trading Income [‰]	-0.08	0.00	0.00	0.02	0.00	0.72	0.20	12592
Residual Net Income [‰]	-5.57	1.26	2.15	1.89	2.85	5.10	1.97	10978
Total Regulatory Capital Ratio $_{t-1}$ [%]	9.98	12.85	14.82	15.65	17.29	30.93	4.37	12182
q_{t-1}	0.20	0.97	1.40	1.50	1.90	4.03	0.78	12009
Leverage $_{t-1}$	5.67	9.41	11.01	11.43	12.81	21.47	3.35	12942
Total Assets [US\$ billion]	0.16	0.36	0.68	22.32	1.82	713.62	172.17	12942

Figure 1: Procyclical Leverage of US Commercial and Savings Banks

This scatter plot shows the positive and highly significant relationship between $\Delta\text{Total Assets}$ and $\Delta\text{Leverage}$ (procyclical leverage) of US commercial and savings banks between Q3-1990 and Q1-2013 (42670 bank-quarter observations). $\Delta\text{Total Assets}$ and $\Delta\text{Leverage}$ are defined as $\ln[\text{variable}_t] - \ln[\text{variable}_{t-1}]$ and the data is obtained from *SNL Financial*.

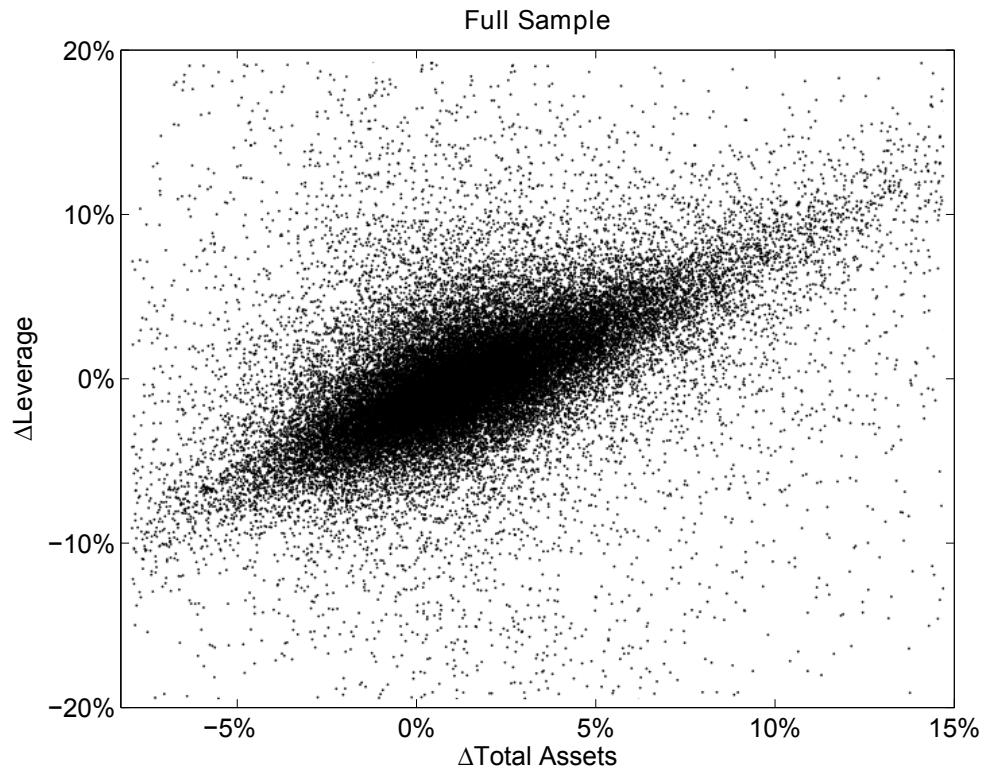


Figure 2: Procyclical Leverage by Business Model

This scatter plot shows the leverage procyclicality of US commercial and savings banks between Q3-1990 and Q1-2013 by business model (6956 bank-quarter observations for savings banks, 20657 bank-quarter observations for commercial banks $\leq 20\%$ fair-value assets and 12942 bank-quarter observations for commercial banks $> 20\%$ fair-value assets). The fraction of fair-value assets is given by the sum of trading assets and AFS securities divided by total assets. $\Delta\text{Total Assets}$ and $\Delta\text{Leverage}$ are defined as $\ln[\text{variable}_t] - \ln[\text{variable}_{t-1}]$ and the data is obtained from *SNL Financial*.

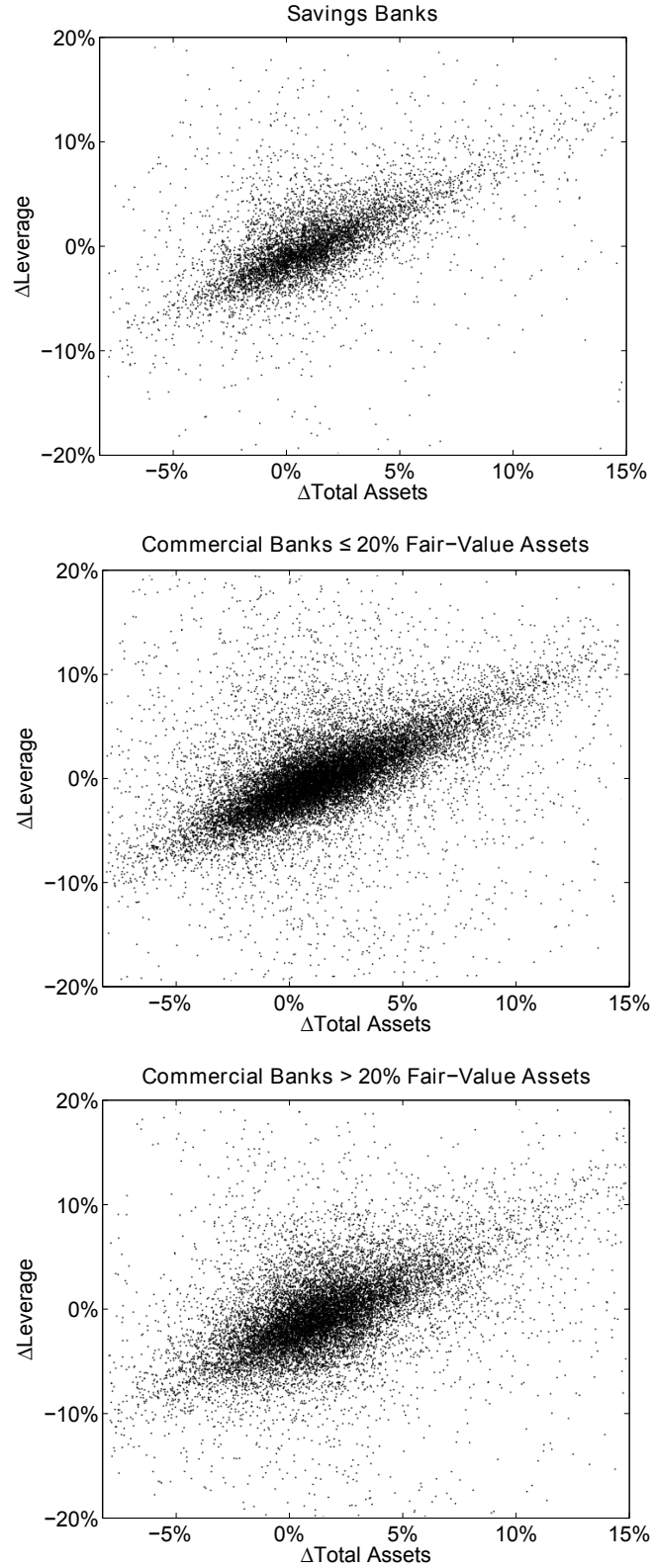


Table 4: Leverage Regressions

This table reports the estimation results for regression equations (1) and (2). The dependent variable is the quarterly growth rate of leverage ($\Delta\text{Leverage}$). The explanatory variables are the quarterly growth rates of total assets ($\Delta\text{Total Assets}$), real GDP (ΔGDP), the average risk weight ($\Delta\text{Risk Weight}$), and goodwill ($\Delta\text{Goodwill}$) as well as lagged leverage (Leverage_{t-1}), lagged q (q_{t-1}), the lagged total regulatory capital ratio (Total Reg. Capital Ratio $_{t-1}$), unrealized gains on AFS securities (Unrealized Gains AFS), and net income (Net Income). Bank fundamentals are obtained from *SNL Financial* and real GDP is retrieved from the homepage of the *Bureau of Economic Analysis* (US Department of Commerce). This sample covers US commercial and savings banks during the time period Q3-1990 to Q1-2013. Clustered standard errors at the bank level (e.g. Petersen (2009)) are given in parentheses. Significance is indicated by: *** < 0.01 , ** < 0.05 , * < 0.10 .

	Full Sample								
	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]
	$\Delta\text{Leverage}$	$\Delta\text{Leverage}$	$\Delta\text{Leverage}$	$\Delta\text{Leverage}$	$\Delta\text{Leverage}$	$\Delta\text{Leverage}$	$\Delta\text{Leverage}$	$\Delta\text{Leverage}$	$\Delta\text{Leverage}$
$\Delta\text{Total Assets}$	0.691*** (0.013)	0.671*** (0.013)	0.670*** (0.013)	0.661*** (0.013)	0.687*** (0.013)	0.683*** (0.014)	0.674*** (0.016)	0.782*** (0.013)	0.758*** (0.016)
ΔGDP			0.503** (0.051)						0.528*** (0.061)
Leverage_{t-1}				-0.002*** (0.000)					-0.002*** (0.000)
q_{t-1}					-0.005*** (0.001)				0.002*** (0.001)
Total Reg. Capital Ratio $_{t-1}$						0.001*** (0.000)			0.001*** (0.000)
$\Delta\text{Risk Weight}$							-0.021* (0.011)		-0.015 (0.010)
Unrealized Gains AFS								-10.377*** (0.448)	-9.927*** (0.396)
Net Income								-8.038*** (0.276)	-8.237*** (0.299)
$\Delta\text{Goodwill}$	-0.003 (0.008)	-0.004 (0.008)	-0.004 (0.008)	-0.004 (0.008)	-0.003 (0.008)	-0.004 (0.008)	-0.003 (0.009)	-0.033*** (0.006)	-0.034*** (0.007)
Constant	-0.027*** (0.001)	-0.028*** (0.000)	-0.031*** (0.000)	-0.007 (0.005)	-0.020*** (0.001)	-0.043*** (0.002)	-0.029*** (0.000)	-0.001 (0.001)	0.012* (0.007)
Observations	38097	38097	38097	38097	35423	34185	30234	32456	24441
Adjusted R^2	0.289	0.221	0.226	0.228	0.222	0.241	0.232	0.427	0.448
Bank Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Quarter-Year Fixed Effects	Yes	No	No	No	No	No	No	No	No
Clustering Level	Bank	Bank	Bank	Bank	Bank	Bank	Bank	Bank	Bank

Table 5: Leverage Regressions by Business Model

This table reports the estimation results for regression equation (2) by business model. The dependent variable is the quarterly growth rate of leverage ($\Delta\text{Leverage}$). The explanatory variables are the quarterly growth rates of total assets ($\Delta\text{Total Assets}$), real GDP (ΔGDP), the average risk weight ($\Delta\text{Risk Weight}$), and goodwill ($\Delta\text{Goodwill}$) as well as lagged leverage (Leverage_{t-1}), lagged q (q_{t-1}), the lagged total regulatory capital ratio (Total Reg. Capital Ratio $_{t-1}$), unrealized gains on AFS securities (Unrealized Gains AFS), realized gains from the sale of loans (Realized Gains Loans), realized gains on AFS and HtM securities (Realized Gains AFS & HtM), trading account income (Trading Income), and residual net income (Residual Net Income). Bank fundamentals are obtained from *SNL Financial* and real GDP is retrieved from the homepage of the *Bureau of Economic Analysis* (US Department of Commerce). This sample covers US commercial and savings banks during the time period Q3-1990 to Q1-2013. Clustered standard errors at the bank level (e.g. Petersen (2009)) are given in parentheses. Significance is indicated by: *** < 0.01 , ** < 0.05 , * < 0.10 .

	Full Sample [10] $\Delta\text{Leverage}$	Savings Banks [11] $\Delta\text{Leverage}$	CB < 20% Fair Value [12] $\Delta\text{Leverage}$	CB > 20% Fair Value [13] $\Delta\text{Leverage}$	Full Sample > 95% Historical Cost [14] $\Delta\text{Leverage}$	Full Sample > 30% Fair Value [15] $\Delta\text{Leverage}$
$\Delta\text{Total Assets}$	0.770*** (0.017)	0.912*** (0.025)	0.736*** (0.025)	0.768*** (0.029)	0.865*** (0.041)	0.878*** (0.037)
ΔGDP	0.484*** (0.065)	0.263* (0.150)	0.637*** (0.092)	0.239** (0.109)	0.669** (0.274)	-0.145 (0.151)
Leverage_{t-1}	-0.002*** (0.000)	-0.004*** (0.001)	-0.003*** (0.001)	-0.003*** (0.001)	-0.007*** (0.003)	-0.005*** (0.001)
q_{t-1}	0.001* (0.001)	0.004* (0.002)	0.001 (0.001)	0.002 (0.001)	-0.002 (0.003)	-0.000 (0.002)
Total Reg. Capital Ratio $_{t-1}$	0.001** (0.000)	0.000 (0.000)	0.000 (0.001)	0.000 (0.000)	-0.001 (0.001)	-0.001 (0.001)
$\Delta\text{Risk Weight}$	-0.012 (0.010)	0.019 (0.022)	-0.009 (0.012)	-0.036* (0.022)	0.003 (0.005)	0.026 (0.036)
Unrealized Gains AFS	-9.929*** (0.444)	-7.088*** (1.223)	-10.413*** (0.425)	-10.518*** (0.393)	-12.533*** (2.819)	-10.172*** (0.579)
Realized Gains Loans	-9.858*** (0.768)	-9.535*** (0.742)	-9.650*** (1.165)	-10.555*** (0.966)	-7.972*** (0.914)	-10.318*** (0.704)
Realized Gains AFS & HtM	-8.931*** (0.543)	-8.762*** (0.949)	-10.280*** (0.859)	-8.512*** (0.677)	-7.477** (3.350)	-9.936*** (0.908)
Trading Income	-8.265*** (2.406)		-6.901*** (2.334)	-11.055* (6.427)	-49.131* (28.115)	-20.007*** (7.152)
Residual Net Income	-8.368*** (0.319)	-8.039*** (0.443)	-8.146*** (0.435)	-9.117*** (0.538)	-8.564*** (0.792)	-9.665*** (0.865)
$\Delta\text{Goodwill}$	-0.036*** (0.007)	-0.033* (0.019)	-0.037*** (0.012)	-0.036*** (0.009)	-0.117** (0.056)	-0.027 (0.018)
Constant	0.013* (0.008)	0.045* (0.025)	0.049*** (0.014)	0.034*** (0.012)	0.092*** (0.029)	0.074*** (0.017)
Observations	21581	3020	10984	7402	1264	2714
Adjusted R^2	0.457	0.594	0.380	0.560	0.486	0.670
Bank Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Quarter-Year Fixed Effects	No	No	No	No	No	No
Clustering Level	Bank	Bank	Bank	Bank	Bank	Bank

Table 6: Determinants of Procyclical Bank Leverage

This table reports the estimation results for regression equation (3). The dependent variable is the quarterly growth rate of leverage ($\Delta\text{Leverage}$). The explanatory variables are the quarterly growth rates of total assets ($\Delta\text{Total Assets}$), real GDP (ΔGDP), the average risk weight ($\Delta\text{Risk Weight}$), and goodwill ($\Delta\text{Goodwill}$) as well as lagged leverage (Leverage_{t-1}), lagged q (q_{t-1}), the lagged total regulatory capital ratio ($\text{Total Reg. Capital Ratio}_{t-1}$), unrealized gains on AfS securities ($\text{Unrealized Gains AfS}$), net income (Net Income), a dummy variable ($1_{\Delta\text{TA}>0}$), and 8 interaction terms as discussed in Section 3. Bank fundamentals are obtained from *SNL Financial* and real GDP is retrieved from the homepage of the *Bureau of Economic Analysis* (US Department of Commerce). This sample covers US commercial and savings banks during the time period Q3-1990 to Q1-2013. Clustered standard errors at the bank level (e.g. Petersen (2009)) are given in parentheses. Significance is indicated by: *** < 0.01, ** < 0.05, * < 0.10.

	Full Sample							
	[16]	[17]	[18]	[19]	[20]	[21]	[22]	[23]
	$\Delta\text{Leverage}$	$\Delta\text{Leverage}$	$\Delta\text{Leverage}$	$\Delta\text{Leverage}$	$\Delta\text{Leverage}$	$\Delta\text{Leverage}$	$\Delta\text{Leverage}$	$\Delta\text{Leverage}$
$\Delta\text{Total Assets (TA)}$	0.706*** (0.021)	0.674*** (0.025)	1.000*** (0.052)	0.753*** (0.030)	0.543*** (0.061)	0.692*** (0.023)	0.666*** (0.025)	0.895*** (0.108)
$\Delta\text{TA} * \Delta\text{GDP}$		7.166*** (2.305)						7.134*** (2.247)
$\Delta\text{TA} * \text{Leverage}_{t-1}$			-0.027*** (0.005)					-0.022*** (0.006)
$\Delta\text{TA} * q_{t-1}$				-0.031* (0.018)				-0.047** (0.021)
$\Delta\text{TA} * \text{Total Reg. Capital Ratio}_{t-1}$					0.011*** (0.004)			0.003 (0.003)
$\Delta\text{TA} * \Delta\text{Risk Weight} * 1_{(\Delta\text{TA}>0)}$						-0.605* (0.351)		-0.620* (0.348)
$\Delta\text{TA} * \Delta\text{Risk Weight} * 1_{(\Delta\text{TA}<0)}$						2.704*** (0.645)		2.808*** (0.644)
$\Delta\text{TA} * \text{Unrealized Gains AfS}$							-8.265 (8.889)	-1.264 (9.081)
$\Delta\text{TA} * \text{Net Income}$							19.051*** (6.377)	20.213*** (7.227)
ΔGDP	0.528*** (0.061)	0.388*** (0.064)	0.527*** (0.061)	0.534*** (0.061)	0.530*** (0.061)	0.526*** (0.061)	0.505*** (0.061)	0.373*** (0.063)
Leverage_{t-1}	-0.002*** (0.000)	-0.002*** (0.000)	-0.002*** (0.000)	-0.002*** (0.000)	-0.002*** (0.000)	-0.002*** (0.000)	-0.002*** (0.000)	-0.002*** (0.000)
q_{t-1}	0.002*** (0.001)	0.002*** (0.001)	0.003*** (0.001)	0.002*** (0.001)	0.002*** (0.001)	0.002*** (0.001)	0.002*** (0.001)	0.003*** (0.001)
$\text{Total Reg. Capital Ratio}_{t-1}$	0.001*** (0.000)	0.001*** (0.000)	0.000* (0.000)	0.001*** (0.000)	0.000* (0.000)	0.001*** (0.000)	0.001*** (0.000)	0.000*** (0.000)
$\Delta\text{Risk Weight}$	-0.012 (0.010)	-0.014 (0.010)	-0.012 (0.010)	-0.012 (0.010)	-0.013 (0.010)	0.028** (0.014)	-0.013 (0.010)	0.028** (0.013)
$\text{Unrealized Gains AfS}$	-9.964*** (0.398)	-9.953*** (0.396)	-9.949*** (0.391)	-9.964*** (0.401)	-9.959*** (0.395)	-9.947*** (0.396)	-9.846*** (0.458)	-9.913*** (0.462)
Net Income	-8.282*** (0.300)	-8.258*** (0.301)	-8.279*** (0.298)	-8.319*** (0.300)	-8.226*** (0.306)	-8.293*** (0.299)	-8.195*** (0.302)	-8.226*** (0.305)
$1_{(\Delta\text{TA}>0)}$	0.006*** (0.001)	0.006*** (0.001)	0.006*** (0.001)	0.006*** (0.001)	0.006*** (0.001)	0.006*** (0.001)	0.006*** (0.001)	0.006*** (0.001)
$\Delta\text{Goodwill}$	-0.033*** (0.007)	-0.034*** (0.007)	-0.033*** (0.007)	-0.033*** (0.007)	-0.033*** (0.007)	-0.033*** (0.007)	-0.037*** (0.007)	-0.037*** (0.007)
Constant	0.008 (0.007)	0.008 (0.007)	0.010 (0.006)	0.007 (0.007)	0.013** (0.006)	0.008 (0.007)	0.008 (0.006)	0.009 (0.006)
Observations	24441	24441	24441	24441	24441	24441	24441	24441
Adjusted R^2	0.450	0.451	0.454	0.450	0.452	0.451	0.451	0.457
Bank Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Quarter-Year Fixed Effects	No	No	No	No	No	No	No	No
Clustering Level	Bank	Bank	Bank	Bank	Bank	Bank	Bank	Bank

Table 7: Determinants of Procyclical Bank Leverage by Business Model

This table reports the estimation results for regression equation (3) by business model. The dependent variable is the quarterly growth rate of leverage ($\Delta\text{Leverage}$). The explanatory variables are the quarterly growth rates of total assets ($\Delta\text{Total Assets}$), real GDP (ΔGDP), the average risk weight ($\Delta\text{Risk Weight}$), and goodwill ($\Delta\text{Goodwill}$) as well as lagged leverage (Leverage_{t-1}), lagged q (q_{t-1}), the lagged total regulatory capital ratio ($\text{Total Reg. Capital Ratio}_{t-1}$), unrealized gains on AfS securities (Unrealized Gains AfS), realized gains from the sale of loans (Realized Gains Loans), realized gains on AfS and HtM securities (Realized Gains AfS & HtM), trading account income (Trading Income), residual net income (Residual Net Income), a dummy variable ($1_{\Delta\text{TA}>0}$), and 11 interaction terms as discussed in Section 3. Bank fundamentals are obtained from *SNL Financial* and real GDP is retrieved from the homepage of the *Bureau of Economic Analysis* (US Department of Commerce). This sample covers US commercial and savings banks during the time period Q3-1990 to Q1-2013. Clustered standard errors at the bank level (e.g. Petersen (2009)) are given in parentheses. Significance is indicated by: *** < 0.01 , ** < 0.05 , * < 0.10 .

	Full Sample [24] $\Delta\text{Leverage}$	Savings Banks [25] $\Delta\text{Leverage}$	CB < 20% FV [26] $\Delta\text{Leverage}$	CB > 20% FV [27] $\Delta\text{Leverage}$
$\Delta\text{Total Assets (TA)}$	0.945*** (0.110)	0.702*** (0.212)	0.885*** (0.143)	0.897*** (0.175)
$\Delta\text{TA} * \Delta\text{GDP}$	7.525*** (2.509)	-0.861 (5.665)	9.126** (3.606)	8.232* (4.263)
$\Delta\text{TA} * \text{Leverage}_{t-1}$	-0.025*** (0.006)	0.000 (0.016)	-0.021*** (0.008)	-0.020** (0.009)
$\Delta\text{TA} * q_{t-1}$	-0.044* (0.024)	0.032 (0.039)	-0.052 (0.032)	-0.067** (0.033)
$\Delta\text{TA} * \text{Total Reg. Capital Ratio}_{t-1}$	0.001 (0.003)	0.006 (0.006)	-0.000 (0.004)	0.003 (0.005)
$\Delta\text{TA} * \Delta\text{Risk Weight} * 1_{(\Delta\text{TA}>0)}$	-0.629* (0.354)	-0.057 (0.680)	-0.385 (0.352)	-1.562*** (0.596)
$\Delta\text{TA} * \Delta\text{Risk Weight} * 1_{(\Delta\text{TA}<0)}$	2.999*** (0.707)	0.566 (1.199)	3.071** (1.192)	3.588*** (1.066)
$\Delta\text{TA} * \text{Unrealized Gains AfS}$	-2.565 (9.866)	-17.885 (15.885)	-16.707 (20.177)	4.652 (12.281)
$\Delta\text{TA} * \text{Realized Gains Loans}$	31.923*** (8.258)	47.574** (19.124)	33.522*** (9.698)	22.579 (34.141)
$\Delta\text{TA} * \text{Realized Gains AfS \& HtM}$	21.713 (18.772)	-5.121 (15.088)	10.850 (20.589)	25.472 (32.937)
$\Delta\text{TA} * \text{Trading Income}$	65.055 (67.526)		55.907 (50.961)	274.931 (178.065)
$\Delta\text{TA} * \text{Residual Net Income}$	19.645** (7.796)	14.003 (11.439)	22.556** (9.742)	13.147 (14.054)
ΔGDP	0.326*** (0.067)	0.243 (0.165)	0.435*** (0.098)	0.075 (0.105)
Leverage_{t-1}	-0.002*** (0.000)	-0.004*** (0.001)	-0.003*** (0.001)	-0.003*** (0.001)
q_{t-1}	0.002*** (0.001)	0.004 (0.003)	0.002* (0.001)	0.004*** (0.001)
$\text{Total Reg. Capital Ratio}_{t-1}$	0.000** (0.000)	0.000 (0.000)	0.001 (0.000)	-0.000 (0.000)
$\Delta\text{Risk Weight}$	0.032** (0.014)	0.024 (0.033)	0.024 (0.017)	0.039 (0.030)
$\text{Unrealized Gains AfS}$	-9.906*** (0.510)	-7.069*** (1.089)	-10.139*** (0.426)	-10.573*** (0.505)
$\text{Realized Gains Loans}$	-10.294*** (0.655)	-9.837*** (0.860)	-10.080*** (1.033)	-11.128*** (0.964)
$\text{Realized Gains AfS \& HtM}$	-8.832*** (0.515)	-8.495*** (0.938)	-9.835*** (0.854)	-8.682*** (0.654)
Trading Income	-9.061*** (2.558)		-7.194*** (2.215)	-17.614** (7.004)
$\text{Residual Net Income}$	-8.306*** (0.325)	-7.804*** (0.451)	-8.045*** (0.445)	-9.258*** (0.573)
$1_{(\Delta\text{TA}>0)}$	0.006*** (0.001)	0.001 (0.002)	0.007*** (0.001)	0.006*** (0.002)
$\Delta\text{Goodwill}$	-0.038*** (0.007)	-0.040** (0.017)	-0.039*** (0.012)	-0.033*** (0.009)
Constant	0.011 (0.007)	0.048** (0.024)	0.041*** (0.012)	0.033*** (0.012)
Observations	21581	3020	10984	7402
Adjusted R^2	0.465	0.596	0.390	0.567
Bank Fixed Effects	Yes	Yes	Yes	Yes
Quarter-Year Fixed Effects	No	No	No	No
Clustering Level	Bank	Bank	Bank	Bank

Table 8: Asset-Component Analysis of Procyclical Bank Leverage

This table reports the estimation results for the modified regression equation (1). The dependent variable is the quarterly growth rate of leverage ($\Delta\text{Leverage}$). The explanatory variables are the quarterly growth rates of loans (ΔLoans), available-for-sale securities ($\Delta\text{Available-for-Sale}$), held-to-maturity securities ($\Delta\text{Held-to-Maturity}$), cash & equivalents (ΔCash), and goodwill ($\Delta\text{Goodwill}$) as well as a dummy variable ($1_{\Delta\text{TA}>0}$). For each asset component, we differentiate between balance sheet expansions and contractions by forming interaction terms. Bank fundamentals are obtained from *SNL Financial*. This sample covers US commercial and savings banks during the time period Q3-1990 to Q1-2013. Clustered standard errors at the bank level (e.g. Petersen (2009)) are given in parentheses. Significance is indicated by: *** < 0.01 , ** < 0.05 , * < 0.10 .

	Full Sample [28] $\Delta\text{Leverage}$	Savings Banks [29] $\Delta\text{Leverage}$	CB < 20% FV [30] $\Delta\text{Leverage}$	CB > 20% FV [31] $\Delta\text{Leverage}$
$\Delta\text{Loans} * 1_{(\Delta\text{TA}>0)}$	0.211*** (0.020)	0.288*** (0.038)	0.256*** (0.027)	0.125*** (0.035)
$\Delta\text{Loans} * 1_{(\Delta\text{TA}<0)}$	0.0006 (0.027)	-0.007 (0.046)	-0.013 (0.042)	0.059 (0.043)
$\Delta\text{Available-for-Sale} * 1_{(\Delta\text{TA}>0)}$	0.023*** (0.003)	0.015*** (0.004)	0.018*** (0.003)	0.073*** (0.01)
$\Delta\text{Available-for-Sale} * 1_{(\Delta\text{TA}<0)}$	0.004** (0.002)	0.004** (0.002)	0.000 (0.002)	0.046*** (0.01)
$\Delta\text{Held-to-Maturity} * 1_{(\Delta\text{TA}>0)}$	0.006*** (0.001)	0.003 (0.005)	0.008*** (0.001)	0.009*** (0.002)
$\Delta\text{Held-to-Maturity} * 1_{(\Delta\text{TA}<0)}$	-0.000 (0.001)	0.006* (0.003)	-0.000 (0.001)	-0.001 (0.003)
$\Delta\text{Cash} * 1_{(\Delta\text{TA}>0)}$	0.022*** (0.001)	0.011*** (0.003)	0.028*** (0.002)	0.024*** (0.002)
$\Delta\text{Cash} * 1_{(\Delta\text{TA}<0)}$	0.011*** (0.001)	0.003 (0.002)	0.013*** (0.003)	0.015*** (0.003)
Observations	20404	3160	10617	6627
Adjusted R^2	0.232	0.251	0.202	0.348
Other Controls	Yes	Yes	Yes	Yes
Bank Fixed Effects	Yes	Yes	Yes	Yes
Quarter-Year Fixed Effects	Yes	Yes	Yes	Yes
Clustering Level	Bank	Bank	Bank	Bank

Table 9: Liability Analysis of Procyclical Bank Leverage

This table reports the estimation results for the modified regression equation (1). The dependent variable is the quarterly growth rate of leverage ($\Delta\text{Leverage}$). The explanatory variables are the quarterly growth rates of deposits ($\Delta\text{Deposits}$), senior debt ($\Delta\text{Senior Debt}$), subordinated debt ($\Delta\text{Subordinated Debt}$), and goodwill ($\Delta\text{Goodwill}$) as well as a dummy variable ($1_{\Delta\text{TA}>0}$). For each financing component, we differentiate between balance sheet expansions and contractions by forming interaction terms. Bank fundamentals are obtained from *SNL Financial*. This sample covers US commercial and savings banks during the time period Q3-1990 to Q1-2013. Clustered standard errors at the bank level (e.g. Petersen (2009)) are given in parentheses. Significance is indicated by: *** < 0.01, ** < 0.05, * < 0.10.

	Full Sample [32] $\Delta\text{Leverage}$	Savings Banks [33] $\Delta\text{Leverage}$	CB < 20% FV [34] $\Delta\text{Leverage}$	CB > 20% FV [35] $\Delta\text{Leverage}$
$\Delta\text{Deposits} * 1_{(\Delta\text{TA}>0)}$	0.374*** (0.029)	0.382*** (0.085)	0.406*** (0.036)	0.374*** (0.041)
$\Delta\text{Deposits} * 1_{(\Delta\text{TA}<0)}$	0.294*** (0.080)	0.190 (0.133)	0.292*** (0.106)	0.336*** (0.091)
$\Delta\text{Senior Debt} * 1_{(\Delta\text{TA}>0)}$	0.020*** (0.004)	0.069*** (0.016)	0.019*** (0.005)	0.024*** (0.005)
$\Delta\text{Senior Debt} * 1_{(\Delta\text{TA}<0)}$	0.022*** (0.005)	0.037* (0.020)	0.021*** (0.007)	0.019** (0.008)
$\Delta\text{Subordinated Debt} * 1_{(\Delta\text{TA}>0)}$	0.011*** (0.004)	0.015 (0.019)	0.012* (0.006)	0.011* (0.006)
$\Delta\text{Subordinated Debt} * 1_{(\Delta\text{TA}<0)}$	0.021*** (0.007)	0.039* (0.022)	0.017* (0.010)	0.025** (0.010)
Observations	12975	1330	7550	4095
Adjusted R^2	0.197	0.202	0.176	0.280
Other Controls	Yes	Yes	Yes	Yes
Bank Fixed Effects	Yes	Yes	Yes	Yes
Quarter-Year Fixed Effects	Yes	Yes	Yes	Yes
Clustering Level	Bank	Bank	Bank	Bank

Table 10: Balance Sheet Split, Financial Crisis Split, Alternative Tests for the Role of Fair-Value Accounting, as well as Different Business Model Definitions

This table reports the estimation results for regression equation (2) for several additional variables (X) that we interact with Δ Total Assets as discussed in Section 6. The dependent variable is the quarterly growth rate of leverage (Δ Leverage). The key explanatory variables are the quarterly growth rate of total assets (Δ Total Assets), a dummy variable for balance sheet contractions ($1_{\Delta TA < 0}$), a dummy variable capturing the financial crisis ($1_{\text{Crisis Period}}$), a dummy variable for the time period before the introduction of fair-value accounting (1_{FVA}), the lagged fraction of fair-value assets (Fair Value Assets $_{t-1}$), the lagged fraction of non-interest to interest income (Non-Interest Income $_{t-1}$), the amount of off-balance sheet guarantees provided by large commercial banks for securitization purposes, and 6 interaction terms. The remaining explanatory variables are the quarterly growth rates of real GDP (Δ GDP), the average risk weight (Δ Risk Weight), and goodwill (Δ Goodwill) as well as lagged leverage (Leverage $_{t-1}$), lagged q (q $_{t-1}$), the lagged total regulatory capital ratio (Total Reg. Capital Ratio $_{t-1}$), unrealized gains on AfS securities (Unrealized Gains AfS), and net income (Net Income). Bank fundamentals are obtained from *SNL Financial* and real GDP is retrieved from the homepage of the *Bureau of Economic Analysis* (US Department of Commerce). This sample covers US commercial and savings banks during the time period Q3-1990 to Q1-2013. Clustered standard errors at the bank level (e.g. Petersen (2009)) are given in parentheses. Significance is indicated by: *** < 0.01, ** < 0.05, * < 0.10.

X	$1_{(\Delta TA < 0)}$ [36] Δ Leverage	$1_{\text{(Crisis Period)}}$ [37] Δ Leverage	$1_{\text{(Before FVA)}}$ [38] Δ Leverage	Fair-Value Assets $_{t-1}$ [39] Δ Leverage	Non-Interest Income $_{t-1}$ [40] Δ Leverage	Off-Balance Sheet Guarantees [41] Δ Leverage
Δ Total Assets	0.688*** (0.024)	0.769*** (0.017)	0.746*** (0.016)	0.748*** (0.027)	0.744*** (0.019)	0.597*** (0.102)
Δ Total Assets * X	0.146*** (0.039)	-0.055 (0.033)	0.122* (0.063)	0.055 (0.114)	0.070** (0.034)	0.167** (0.074)
X	-0.004*** (0.001)	0.001 (0.001)	0.004 (0.003)	0.002 (0.005)	-0.009** (0.004)	0.008 (0.006)
Δ GDP	0.528*** (0.061)	0.516*** (0.063)	0.914*** (0.058)	0.531*** (0.061)	0.528*** (0.061)	2.359*** (0.529)
Leverage $_{t-1}$	-0.002*** (0.000)	-0.002*** (0.000)	-0.003*** (0.000)	-0.002*** (0.000)	-0.002*** (0.000)	-0.004*** (0.001)
q $_{t-1}$	0.002*** (0.001)	0.002*** (0.001)	0.003*** (0.001)	0.002*** (0.001)	0.002** (0.001)	0.005 (0.003)
Total Reg. Capital Ratio $_{t-1}$	0.001*** (0.000)	0.001*** (0.000)	0.000** (0.000)	0.001** (0.000)	0.001*** (0.000)	0.001 (0.003)
Δ Risk Weight	-0.011 (0.010)	-0.015 (0.010)	0.013 (0.008)	-0.015 (0.010)	-0.014 (0.010)	0.076 (0.119)
Unrealized Gains AfS	-9.978*** (0.397)	-9.928*** (0.396)		-9.930*** (0.396)	-9.929*** (0.399)	-9.573*** (1.688)
Net Income	-8.345*** (0.301)	-8.230*** (0.304)	-8.227*** (0.298)	-8.237*** (0.300)	-8.169*** (0.297)	-3.148 (2.159)
Δ Goodwill	-0.032*** (0.007)	-0.035*** (0.007)	-0.028*** (0.007)	-0.035*** (0.007)	-0.036*** (0.007)	-0.021 (0.038)
Constant	0.014** (0.007)	0.012* (0.007)	0.014** (0.006)	0.012* (0.006)	0.016** (0.007)	-0.003 (0.039)
Observations	24441	24441	27686	24172	24303	259
Adjusted R^2	0.451	0.449	0.342	0.448	0.449	0.453
Bank Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Quarter-Year Fixed Effects	No	No	No	No	No	No
Clustering Level	Bank	Bank	Bank	Bank	Bank	Bank

Table 11: Yearly Data Frequency

This table reports the estimation results for regression equations (2) and (3) by business model using yearly data. The dependent variable is the quarterly growth rate of leverage ($\Delta\text{Leverage}$). The explanatory variables are the quarterly growth rates of total assets ($\Delta\text{Total Assets}$), real GDP (ΔGDP), the average risk weight ($\Delta\text{Risk Weight}$), and goodwill ($\Delta\text{Goodwill}$) as well as lagged leverage (Leverage_{t-1}), lagged q (q_{t-1}), the lagged total regulatory capital ratio ($\text{Total Reg. Capital Ratio}_{t-1}$), unrealized gains on AFS securities ($\text{Unrealized Gains AFS}$), realized gains from the sale of loans ($\text{Realized Gains Loans}$), realized gains on AFS and HtM securities ($\text{Realized Gains AFS \& HtM}$), trading account income (Trading Income), residual net income ($\text{Residual Net Income}$), a dummy variable ($1_{\Delta\text{TA}>0}$), and 11 interaction terms. Bank fundamentals are obtained from *SNL Financial* and real GDP is retrieved from the homepage of the *Bureau of Economic Analysis* (US Department of Commerce). This sample covers US commercial and savings banks during the time period Q3-1990 to Q1-2013. Clustered standard errors at the bank level (e.g. Petersen (2009)) are given in parentheses. Significance is indicated by: *** < 0.01 , ** < 0.05 , * < 0.10 .

	Full Sample [42] $\Delta\text{Leverage}$	Savings Banks [43] $\Delta\text{Leverage}$	CB < 20% FV [44] $\Delta\text{Leverage}$	CB > 20% FV [45] $\Delta\text{Leverage}$	Full Sample [46] $\Delta\text{Leverage}$	Savings Banks [47] $\Delta\text{Leverage}$	CB < 20% FV [48] $\Delta\text{Leverage}$	CB > 20% FV [49] $\Delta\text{Leverage}$
$\Delta\text{Total Assets (TA)}$	0.524*** (0.031)	0.873*** (0.065)	0.423*** (0.048)	0.558*** (0.049)	0.868*** (0.229)	1.055** (0.447)	1.210*** (0.407)	0.676* (0.402)
$\Delta\text{TA} * \Delta\text{GDP}$					3.618*** (1.270)	-0.497 (3.599)	3.676** (1.746)	2.222 (2.150)
$\Delta\text{TA} * \text{Leverage}_{t-1}$					-0.0475*** (0.0119)	-0.0316 (0.0281)	-0.0618*** (0.0195)	-0.0348* (0.0206)
$\Delta\text{TA} * q_{t-1}$					-0.0722** (0.0340)	0.0871 (0.115)	-0.0815* (0.0477)	-0.0836 (0.0527)
$\Delta\text{TA} * \text{Total Reg. Capital Ratio}_{t-1}$					0.00524 (0.00701)	-0.00629 (0.0113)	-0.0126 (0.0153)	0.0138 (0.0120)
$\Delta\text{TA} * \Delta\text{Risk Weight} * 1_{(\Delta\text{TA}>0)}$					-0.981*** (0.323)	-0.324 (0.864)	-0.369 (0.423)	-1.321** (0.568)
$\Delta\text{TA} * \Delta\text{Risk Weight} * 1_{(\Delta\text{TA}=0)}$					2.525** (1.008)	1.893 (1.210)	1.981 (2.278)	4.974*** (1.742)
$\Delta\text{TA} * \text{Unrealized Gains AFS}$					0.161 (8.505)	28.37 (31.51)	-12.96 (17.02)	-1.102 (11.39)
$\Delta\text{TA} * \text{Realized Gains Loans}$					14.91*** (4.471)	16.88 (25.21)	17.32*** (5.402)	18.35** (8.436)
$\Delta\text{TA} * \text{Realized Gains AFS \& HtM}$					14.31 (10.70)	-9.427 (26.19)	45.33*** (14.48)	4.036 (7.183)
$\Delta\text{TA} * \text{Trading Income}$					-46.13 (33.37)		9.511 (56.90)	-92.38*** (28.30)
$\Delta\text{TA} * \text{Residual Net Income}$					10.37*** (3.657)	12.20 (9.097)	11.69** (4.672)	10.80 (6.577)
ΔGDP	0.284*** (0.084)	-0.164 (0.225)	0.498*** (0.126)	0.102 (0.139)	-0.0130 (0.104)	-0.172 (0.261)	0.126 (0.153)	-0.0759 (0.171)
Leverage_{t-1}	-0.017*** (0.002)	-0.019*** (0.005)	-0.021*** (0.003)	-0.017*** (0.003)	-0.0141*** (0.00206)	-0.0185*** (0.00461)	-0.0168*** (0.00319)	-0.0152*** (0.00288)
q_{t-1}	0.015*** (0.003)	0.033*** (0.010)	0.015*** (0.005)	0.012*** (0.004)	0.0220*** (0.00353)	0.0278*** (0.0115)	0.0232*** (0.00579)	0.0191*** (0.00510)
$\text{Total Reg. Capital Ratio}_{t-1}$	0.003*** (0.001)	0.002 (0.002)	0.001 (0.001)	0.001 (0.001)	0.00143 (0.000870)	0.00192 (0.00148)	0.00233 (0.00172)	-0.000248 (0.00139)
$\Delta\text{Risk Weight}$	0.025 (0.025)	0.154** (0.060)	-0.006 (0.040)	0.006 (0.041)	0.149*** (0.0358)	0.219* (0.0989)	0.0639 (0.0519)	0.189*** (0.0685)
$\text{Unrealized Gains AFS}$	-8.370*** (0.598)	-5.333*** (1.127)	-8.496*** (1.239)	-9.285*** (0.635)	-8.509*** (0.803)	-6.918*** (2.228)	-7.806*** (1.525)	-9.200*** (0.859)
$\text{Realized Gains Loans}$	-6.324*** (0.786)	-8.876*** (1.141)	-5.603*** (1.072)	-7.485*** (0.956)	-6.935*** (0.817)	-8.727*** (1.421)	-6.603*** (1.097)	-8.964*** (1.960)
$\text{Realized Gains AFS \& HtM}$	-6.112*** (0.863)	-6.196*** (0.934)	-6.367*** (1.631)	-5.533*** (1.212)	-6.442*** (0.900)	-6.061*** (1.098)	-7.788*** (1.418)	-5.137*** (1.122)
Trading Income	-8.472*** (2.949)		-9.113* (5.098)	-7.311* (3.912)	-3.049 (4.425)		-10.14** (4.683)	7.445* (4.058)
$\text{Residual Net Income}$	-6.203*** (0.421)	-8.085*** (0.690)	-5.808*** (0.607)	-6.113*** (0.644)	-6.372*** (0.423)	-7.588*** (0.692)	-6.093*** (0.623)	-6.330*** (0.609)
$1_{(\Delta\text{TA}>0)}$					0.0191*** (0.00434)	0.00838 (0.0122)	0.0178*** (0.00647)	0.0156** (0.00762)
$\Delta\text{Goodwill}$	-0.042 (0.037)	0.073 (0.060)	-0.025 (0.057)	-0.018 (0.040)	-0.0556 (0.0364)	0.0467 (0.0643)	-0.0439 (0.0567)	-0.0244 (0.0413)
Constant	0.121*** (0.031)	0.182* (0.100)	0.233*** (0.060)	0.147*** (0.045)	0.0886*** (0.0325)	0.180* (0.0928)	0.148** (0.0621)	0.121** (0.0467)
Observations	6887	771	3536	2434	6887	771	3536	2434
Adjusted R^2	0.356	0.519	0.312	0.428	0.388	0.519	0.349	0.462
Bank Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Quarter-Year Fixed Effects	No	No	No	No	No	No	No	No
Clustering Level	Bank	Bank	Bank	Bank	Bank	Bank	Bank	Bank

Table 12: Accounting Items Including Lags

This table reports the estimation results for regression equation (3) by business model using cumulative accounting items ($\sum_{i=0}^2 \text{Accounting Item}_{t-i}$) as discussed in Section 6. The dependent variable is the quarterly growth rate of leverage ($\Delta \text{Leverage}$). The explanatory variables are the quarterly growth rates of total assets ($\Delta \text{Total Assets}$), real GDP (ΔGDP), the average risk weight ($\Delta \text{Risk Weight}$), and goodwill ($\Delta \text{Goodwill}$) as well as lagged leverage (Leverage_{t-1}), lagged q (q_{t-1}), the lagged total regulatory capital ratio (Total Reg. Capital Ratio $_{t-1}$), unrealized gains on AfS securities (Unrealized Gains AfS), realized gains from the sale of loans (Realized Gains Loans), realized gains on AfS and HtM securities (Realized Gains AfS & HtM), trading account income (Trading Income), residual net income (Residual Net Income), a dummy variable ($1_{\Delta \text{TA} > 0}$), and 11 interaction terms. Bank fundamentals are obtained from *SNL Financial* and real GDP is retrieved from the homepage of the *Bureau of Economic Analysis* (US Department of Commerce). This sample covers US commercial and savings banks during the time period Q3-1990 to Q1-2013. Clustered standard errors at the bank level (e.g. Petersen (2009)) are given in parentheses. Significance is indicated by: *** < 0.01, ** < 0.05, * < 0.10.

	Full Sample [50] $\Delta \text{Leverage}$	Savings Banks [51] $\Delta \text{Leverage}$	CB < 20% FV [52] $\Delta \text{Leverage}$	CB > 20% FV [53] $\Delta \text{Leverage}$
$\Delta \text{Total Assets (TA)}$	0.771*** (0.138)	0.684*** (0.253)	0.565** (0.224)	0.909*** (0.255)
$\Delta \text{TA} * \Delta \text{GDP}$	10.255*** (2.730)	0.461 (7.042)	12.243*** (3.769)	10.870** (4.437)
$\Delta \text{TA} * \text{Leverage}_{t-1}$	-0.020*** (0.007)	-0.000 (0.019)	-0.011 (0.011)	-0.026* (0.013)
$\Delta \text{TA} * q_{t-1}$	-0.066** (0.028)	0.035 (0.047)	-0.078** (0.039)	-0.060 (0.048)
$\Delta \text{TA} * \text{Total Reg. Capital Ratio}_{t-1}$	0.006 (0.004)	0.005 (0.006)	0.009 (0.008)	0.002 (0.007)
$\Delta \text{TA} * \Delta \text{Risk Weight} * 1_{(\Delta \text{TA} > 0)}$	-0.799** (0.352)	0.148 (0.873)	-0.296 (0.329)	-2.266*** (0.720)
$\Delta \text{TA} * \Delta \text{Risk Weight} * 1_{(\Delta \text{TA} < 0)}$	3.761*** (0.881)	0.569 (1.506)	3.569** (1.506)	5.359*** (1.260)
$\Delta \text{TA} * \text{Unrealized Gains AfS (incl. lags)}$	-1.655 (7.597)	-20.746 (15.430)	-19.158 (13.212)	0.699 (9.754)
$\Delta \text{TA} * \text{Realized Gains Loans (incl. lags)}$	17.764*** (4.194)	19.078 (15.085)	20.046*** (5.038)	23.316 (19.754)
$\Delta \text{TA} * \text{Realized Gains AfS \& HtM (incl. lags)}$	14.783 (10.460)	-7.810 (20.828)	-4.369 (18.178)	22.487 (15.821)
$\Delta \text{TA} * \text{Trading Income (incl. lags)}$	50.369* (27.043)		63.790** (27.707)	49.113 (78.611)
$\Delta \text{TA} * \text{Residual Net Income (incl. lags)}$	14.226*** (3.825)	14.292 (10.548)	17.558*** (4.846)	6.708 (8.983)
ΔGDP	0.461*** (0.070)	0.259 (0.159)	0.469*** (0.105)	0.537*** (0.104)
Leverage_{t-1}	-0.004*** (0.000)	-0.005*** (0.001)	-0.004*** (0.001)	-0.006*** (0.001)
q_{t-1}	0.003*** (0.001)	0.004* (0.003)	0.004*** (0.001)	0.001 (0.002)
$\text{Total Reg. Capital Ratio}_{t-1}$	0.000 (0.000)	0.000 (0.000)	0.001* (0.000)	-0.001** (0.001)
$\Delta \text{Risk Weight}$	0.061*** (0.019)	0.048 (0.033)	0.024 (0.025)	0.120*** (0.037)
$\text{Unrealized Gains AfS (incl. lags)}$	-3.229*** (0.189)	-1.841*** (0.538)	-3.267*** (0.266)	-3.523*** (0.206)
$\text{Realized Gains Loans (incl. lags)}$	-3.467*** (0.277)	-3.701*** (0.396)	-3.430*** (0.419)	-3.639*** (0.620)
$\text{Realized Gains AfS \& HtM (incl. lags)}$	-2.155*** (0.320)	-1.173** (0.535)	-2.970*** (0.559)	-2.214*** (0.409)
$\text{Trading Income (incl. lags)}$	-3.794*** (0.992)		-3.119*** (1.074)	-7.077* (3.631)
$\text{Residual Net Income (incl. lags)}$	-2.732*** (0.158)	-2.347*** (0.206)	-2.750*** (0.238)	-2.831*** (0.305)
$1_{(\Delta \text{TA} > 0)}$	0.005*** (0.001)	0.000 (0.002)	0.008*** (0.002)	0.002 (0.002)
$\Delta \text{Goodwill}$	-0.023** (0.011)	-0.059 (0.054)	-0.024* (0.015)	-0.018 (0.016)
Constant	0.033*** (0.008)	0.066*** (0.025)	0.054*** (0.012)	0.090*** (0.019)
Observations	18494	2562	9340	6446
Adjusted R^2	0.315	0.457	0.290	0.342
Bank Fixed Effects	Yes	Yes	Yes	Yes
Quarter-Year Fixed Effects	No	No	No	No
Clustering Level	Bank	Bank	Bank	Bank

Table 13: Balance Sheet Expansions and Contractions

This table reports the estimation results for regression equation (3) by business model, distinguishing between balance sheet expansions and contractions for the baseline model as well as the versions with lagged accounting items and yearly data. The dependent variable is the quarterly growth rate of leverage ($\Delta \text{Leverage}$). The explanatory variables are the quarterly growth rates of total assets ($\Delta \text{Total Assets}$), real GDP (ΔGDP), the average risk weight ($\Delta \text{Risk Weight}$), and goodwill ($\Delta \text{Goodwill}$) as well as lagged leverage (Leverage_{t-1}), lagged q (q_{t-1}), the lagged total regulatory capital ratio ($\text{Total Reg. Capital Ratio}_{t-1}$), unrealized gains on AFS securities (Unrealized Gains AFS), realized gains from the sale of loans (Realized Gains Loans), realized gains on AFS and HTM securities (Realized Gains AFS & HTM), trading account income (Trading Income), residual net income (Residual Net Income), a dummy variable ($1_{\Delta \text{TA} > 0}$), and 15 interaction terms as discussed in Section 6. Bank fundamentals are obtained from *SNL Financial* and real GDP is retrieved from the homepage of the *Bureau of Economic Analysis* (US Department of Commerce). This sample covers US commercial and savings banks during the time period Q3-1990 to Q1-2013. Clustered standard errors at the bank level (e.g. Petersen (2009)) are given in parentheses. Significance is indicated by: *** < 0.01, ** < 0.05, * < 0.10.

	Baseline Model				Accounting Items Including Lags				Yearly Data			
	Full Sample	Savings Banks	CB < 20% FV	CB > 20% FV	Full Sample	Savings Banks	CB < 20% FV	CB > 20% FV	Full Sample	Savings Banks	CB < 20% FV	CB > 20% FV
	[54] ΔAverage	[55] ΔAverage	[56] ΔAverage	[57] ΔAverage	[58] ΔAverage	[59] ΔAverage	[60] ΔAverage	[61] ΔAverage	[62] ΔAverage	[63] ΔAverage	[64] ΔAverage	[65] ΔAverage
ΔTotal Assets (TA)	0.940*** (0.108)	0.699*** (0.213)	0.891*** (0.143)	0.888*** (0.174)	0.768*** (0.139)	0.721*** (0.261)	0.572*** (0.225)	0.907*** (0.254)	0.873*** (0.231)	1.043*** (0.452)	1.201*** (0.411)	0.734* (0.404)
ΔTA * ΔGDP * 1 _(ΔTA>0)	7.210** (3.174)	-0.326 (7.077)	8.840* (4.529)	6.590 (5.218)	11.285*** (3.443)	4.887 (8.947)	14.341*** (4.731)	10.884*** (5.464)	3.425*** (1.337)	0.031 (4.260)	2.492 (1.844)	3.011 (2.288)
ΔTA * ΔGDP * 1 _(ΔTA<0)	9.233** (4.560)	-1.822 (7.171)	9.767 (6.832)	15.479* (8.849)	5.384 (4.970)	-12.885 (9.009)	3.174 (7.207)	11.532 (7.471)	5.743 (4.127)	-5.237 (9.090)	14.784** (6.564)	-2.978 (6.799)
ΔTA * Leverage _{t-1}	-0.024*** (0.006)	0.001 (0.016)	-0.021*** (0.008)	-0.020*** (0.009)	-0.020*** (0.007)	-0.001 (0.019)	-0.011 (0.011)	-0.026* (0.013)	-0.048*** (0.012)	-0.031 (0.028)	-0.062*** (0.020)	-0.038* (0.021)
ΔTA * q _{t-1}	-0.044* (0.024)	0.029 (0.041)	-0.054* (0.032)	-0.067*** (0.032)	-0.067*** (0.028)	0.035 (0.052)	-0.082*** (0.039)	-0.062*** (0.047)	-0.074*** (0.034)	0.091 (0.118)	-0.076 (0.048)	-0.089* (0.053)
ΔTA * Total Reg. Capital Ratio	0.001 (0.003)	0.006 (0.006)	-0.000 (0.004)	0.003 (0.005)	0.006 (0.004)	0.004 (0.006)	0.008 (0.008)	0.002 (0.007)	0.005 (0.007)	-0.007 (0.011)	-0.011 (0.015)	0.012 (0.012)
ΔTA * ΔRisk Weight * 1 _(ΔTA>0)	-0.608* (0.348)	-0.017 (0.612)	-0.387 (0.351)	-1.554*** (0.593)	-0.818*** (0.354)	0.334 (0.823)	-0.326 (0.332)	-2.300*** (0.720)	-0.967*** (0.323)	-0.258 (0.910)	-0.333 (0.420)	-1.329*** (0.556)
ΔTA * ΔRisk Weight * 1 _(ΔTA<0)	2.928*** (0.747)	0.579 (1.208)	3.177*** (1.277)	3.298*** (1.032)	3.984*** (0.923)	1.150 (1.523)	3.776*** (1.613)	5.219*** (1.265)	2.507*** (1.001)	1.906 (1.266)	1.393 (2.258)	5.519*** (1.771)
ΔTA * Unrealized Gains AFS * 1 _(ΔTA>0)	5.830 (12.061)	-11.965 (42.127)	-24.821 (27.611)	8.870 (13.716)	-5.342 (9.300)	-9.130 (20.400)	-31.712* (18.294)	-1.910 (11.826)	2.756 (9.686)	49.731 (40.850)	-6.189 (20.851)	-2.561 (13.596)
ΔTA * Unrealized Gains AFS * 1 _(ΔTA<0)	-30.094 (26.217)	-26.336 (23.752)	9.653 (40.812)	-14.452 (26.499)	8.307 (15.433)	-51.115 (47.501)	33.083 (25.051)	9.115 (16.180)	-21.438 (31.853)	-73.381 (71.792)	-108.358 (78.107)	26.416 (30.911)
ΔTA * Realized Gains Loans	31.905*** (8.320)	47.589*** (18.619)	33.527*** (9.776)	22.046 (34.915)	17.658*** (4.223)	17.410 (15.552)	20.141*** (5.104)	23.837 (19.771)	15.022*** (4.488)	15.253 (25.177)	17.940*** (5.360)	16.713* (9.086)
ΔTA * Realized Gains AFS & HM * 1 _(ΔTA>0)	29.140 (28.319)	2.733 (24.688)	29.905 (45.445)	26.634 (44.361)	19.350 (13.575)	45.717 (32.799)	-28.606 (32.001)	14.826 (16.301)	17.177 (12.601)	-11.712 (25.878)	59.190*** (12.205)	-1.160 (8.100)
ΔTA * Realized Gains AFS & HM * 1 _(ΔTA<0)	2.234 (29.890)	-23.727 (44.056)	-5.697 (40.127)	29.185 (53.628)	8.806 (26.153)	-71.081 (43.526)	39.631 (32.158)	51.572 (38.582)	-19.791 (31.264)	67.818 (120.321)	-72.042 (48.952)	62.771*** (31.572)
ΔTA * Trading Income * 1 _(ΔTA>0)	134.418 (89.701)	216.943*** (87.449)	216.943*** (87.449)	33.123 (172.346)	69.635 (53.343)	125.952*** (57.819)	-7.379 (105.164)	-7.379 (105.164)	-20.061 (35.210)	17.042 (55.655)	17.042 (55.655)	-75.886 (63.486)
ΔTA * Trading Income * 1 _(ΔTA<0)	-93.924 (234.261)	-262.536 (255.613)	-262.536 (255.613)	1668.705*** (589.432)	14.336 (48.484)	-33.530 (60.586)	251.871 (157.090)	251.871 (157.090)	-226.282* (120.044)	-87.017 (177.759)	-87.017 (177.759)	-157.347 (168.947)
ΔTA * Residual Net Income	19.752*** (7.850)	13.800 (11.744)	22.677*** (9.795)	14.894 (14.191)	14.023*** (3.844)	14.138 (10.576)	17.569*** (4.889)	7.300 (9.048)	10.462*** (3.640)	11.656 (9.472)	11.957*** (4.584)	10.627 (6.509)
Observations	21581	3020	10984	7402	18494	2562	9340	6446	6887	771	3536	2434
Adjusted R ²	0.466	0.596	0.390	0.567	0.315	0.460	0.290	0.342	0.389	0.519	0.351	0.463
Stand-Alone Variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bank Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Quarter-Year Fixed Effects	No	No	No	No	No	No	No	No	No	No	No	No
Clustering Level	Bank	Bank	Bank	Bank	Bank	Bank	Bank	Bank	Bank	Bank	Bank	Bank

Figure 3: Time-Series of Leverage, Capital Ratios and Total Assets

This figure shows the evolution of leverage, capital ratios and total assets from Q3-1990 to Q1-2013 for the average (equally weighted) US commercial and savings bank. Leverage is defined as the ratio of total assets to total book equity. The tier 1 and the total regulatory capital ratio are given in percent. Total assets are denoted in US\$ billion. The data is obtained from *SNL Financial*.

