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Abstract

Conventional discussions of balance sheet management by nonf nancial f rms take the set of positive net present value (NPV) projects as given, which in turn determines the size of the f rm's assets. The focus is on the composition of equity and debt in funding such assets. In contrast, the balance sheet management of f nancial intermediaries reveals that it is equity that behaves like the predetermined variable, and the asset size of the bank or f nancial intermediary is determined by the degree of leverage that is permitted by market conditions. The relative stickiness of equity reveals possible nonpecuniary benef ts to bank owners so that they are reluctant to raise new equity, even during boom periods when raising equity is associated with less stigma and, hence, smaller discounts. We explore the empirical evidence for both market-based f nancial intermediaries such as the Wall Street investment banks, as well as the commercial bank subsidiaries of the large U.S. bank holding companies. We further explore the aggregate consequences of such behavior by the banking sector for the propagation of the f nancial cycle and securitization.

Key words: capital, debt, leverage, procyclicality

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INTRODUCTION

Banks and other financial intermediaries channel funding from savers to borrowers. The balance sheet management of the intermediaries determines the ease at which credit supply is provided to the wider economy. The recent financial crisis has highlighted the importance of a properly functioning financial sector, and hence the importance of understanding the motivation, mechanics, and consequences of financial intermediary balance sheet management.

The literature on balance sheet composition is largely based on models where the composition and size of assets are assumed to be exogenous. A famous result is given by the Modigliani and Miller (MM) theorem, which says that the decisions of size of the balance sheet and the composition of financing between equity and debt can be modeled separately (Modigliani & Miller 1958). However, there is a growing body of evidence that suggests things may not be so simple for financial intermediaries. In fact, empirical analysis of the balance sheets of financial intermediaries suggests that these institutions behave as if equity, not assets, is the fixed quantity, using leverage adjustment to change the size of their balance sheets.

Several theories have emerged to explain why financial intermediaries seem to manage their balance sheets so differently than other institutions. First, the issuance of equity might be more costly for financial institutions than for other firms, due to the opacity of their balance sheets and business models. As a consequence, equity issuance might incur a potentially large adverse selection premium. Second, equity might be relatively more costly than debt due to distortions in the pricing of debt. The pricing of debt is influenced by the existence of government backstops, the tax shield, and insufficient monitoring by creditors.

The ability of financial intermediaries to lever their capital determines their balance sheet capacity. When funding in-debt markets is abundant, leverage constraints are loose, and

intermediaries have abundant capacity to extend credit. However, under more adverse economic conditions---for example in the midst of financial crisis---intermediaries will be forced to deleverage as their funding conditions deteriorate. In practice, the deleveraging tends to be tightly linked to increases in market volatility.

We begin this article by providing additional background about financing decisions. We then review the empirical evidence on the procyclicality of leverage, and discuss how this relates to the stickiness of financial intermediary equity and the varying intermediary balance sheet capacity. We conclude by covering recent insights on financial system risk, systemic risk, and shadow banking.

BACKGROUND

In a world where the MM theorems (Modigliani & Miller 1958) hold, we can separate the decision on the size of the balance sheet (selection of the projects to take on) from the financing of the projects (composition of liabilities in terms of debt and equity). In popular textbook discussions of corporate financing decisions (see, for instance, Brealey et al. 20011), the set of positive net present value (NPV) projects is taken as given, and thus the size of balance sheets are considered exogenous. The remaining focus is on the liabilities side of the balance sheet in determining the relative mix of equity and debt. Textbook discussions deal with the trade-offs involved when employing debt and equity. When capital markets are perfect and the conditions of the MM theorems hold, the mix of debt and equity is irrelevant to the value of the firm, and the capital structure of the firm is indeterminate.

The MM theorems hold when capital markets are frictionless**.** However, even without making these assumptions the textbook discussion starts with the assets of the firm as given, to focus on the financing decision alone. Miller (1977) raised the importance of taxes in influencing

the corporate financing choice by making debt financing more attractive when debt interest payments are tax deductible. However, when there are costs associated with bankruptcy or financial distress more generally, there is a trade-off between debt and equity financing. The optimal capital structure is then determined by the optimal level of debt that strikes the best balance between tax advantages (with high debt levels) and minimizing costs associated with bankruptcy low debt levels (with low debt levels).

In a static context, the choice can be depicted as in **Figure 1**. The assets of the firm are fixed, given exogenously by the set of projects that have positive NPV. The fixed nature of the assets of the firm is indicated by the gray shaded asset side of the balance sheet Having fixed the asset side of the balance sheet, the discussion turns to how those assets are financed—that is, the composition of the liabilities side of the balance sheet.

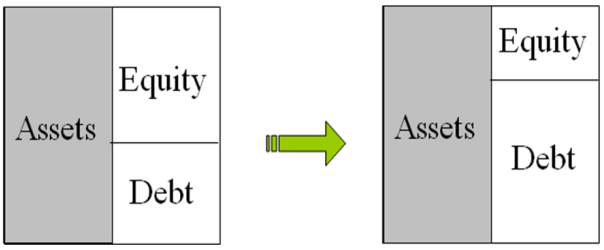

Figure 1: Balance Sheet Financing by Debt and Equity

On the left-hand panel of **Figure 1** is a balance sheet on which the assets are financed predominantly by equity. The arrow indicates a shift in the funding mix where equity is replaced by debt. For exampleincreased leverage could be accomplished by issuing debt to repurchase equity. Hence, as the leverage of the firm is defined as the ratio of assets to equity, the shift depicted in **Figure 1** leads to an increase in the leverage of the firm, but without any change in the size of balance sheet as a whole

The diagram in **Figure 2** is useful for visualizing changes in firm balance sheets. The horizontal axis gives the change in the leverage of the firm, and the vertical axis gives the change in the firm's assets. The changes in assets and leverage are measured in percentage terms. Point *A* in **Figure 2** illustrates the increase in leverage given in **Figure 1**, where leverage increases through a shift in the composition of equity and debt, without a change in the asset size of the firm itself.

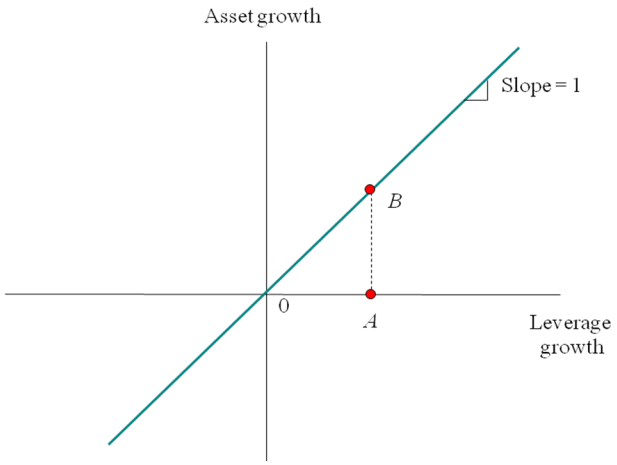

Figure 2: Asset Growth and Leverage Growth

Even in a dynamic setting, if the assets of the firm evolve exogenously, the focus remains on the liabilities side of the balance sheet, and how the funding mix is determined between debt and equity. Leland (1994) presents a fully fledged dynamic model where the assets of the firm evolve exogenously according to a diffusion process, and solves for the optimal financing between debt and equity given the trade-off between taxes and costs of financial distress.

By assuming that assets evolve exogenously, Leland's paper follows in the footsteps of Merton's (1974) celebrated examination of the pricing of corporate debt. He uses the insight that the payoff to holding debt is identical to holding a portfolio consisting of cash equal to the face value of the debt plus a short position in a put option on the assets of the firm, where the strike price is given by the face value of the debtLeland (1994) examines the corporate financing

decision where debt and equity choices are made initially, once and for all. This feature is shared with the original Merton (1974) model. However, to the extent that the asset value of the firm evolves dynamically, so does the leverage of the firm. Nevertheless, the change in the leverage of the firm is a consequence of the exogenous shift in the asset value of the firm.

RELATIONSHIP BETWEEN LEVERAGE AND BALANCE SHEET SIZE

When financing choices are made initially in a once-and-for-all way, leverage changes result from the passive pricing effects of debt and equity. Consider a simple example of such shifts in leverage for a household balance sheet where the household has bought a house financed with a mortgage.

Suppose that the house is the only asset owned by the household. Then, as the house price fluctuates, so will the leverage of the household. Because the equity of the household changes much more sensitively in percentage terms than the changes in asset values, the leverage of the household moves in the opposite direction from the change in the household's asset value.

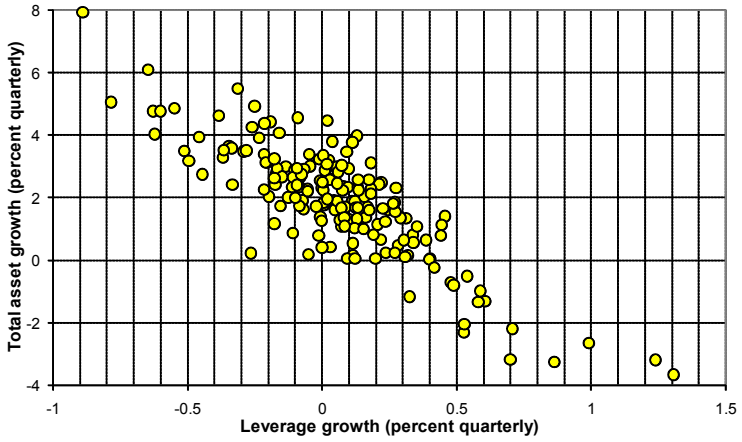

Figure 3: Relationship between Asset Growth and Leverage Growth for US Household Sector (Source: Adrian and Shin (2010))

When the house price increases by 1%, the equity of the household will increase by approximately 10% if the household is leveraged 10 to 1.[1] Hence, leverage will fall when assets increase. Asset growth and leverage growth will thus be negatively related. **Figure 3** shows the relationship between asset growth and leverage growth for the aggregate U.S. household sector, taken from Adrian & Shin (2010). There is a clear negative relationship between the two, suggesting that leverage adjusts in a passive way for households.

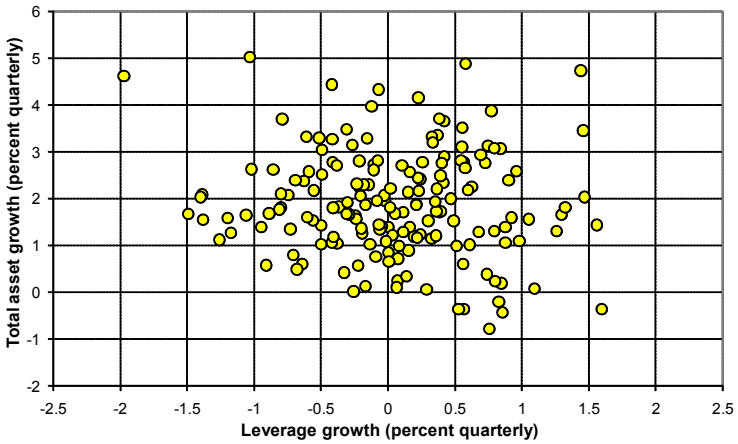

Figure 4. Relationship between Asset Growth and Leverage Growth for US Non-financial corporate sector (Source: Adrian and Shin (2010))

For nonfinancial corporations, the relationship between asset growth and leverage growth is less clearly negative, as shown in **Figure 4**. The cluster of dots shows a less clearly negative relationship between asset growth and leverage growth, suggesting more active management of balance sheets. Nevertheless, a fitted regression line can still be negative, suggesting that for nonfinancial corporates, the predominant influence on the adjustment of leverage is through the passive impact of changes in asset values.

For financial firms, and in particular for banks and other financial intermediaries, there is evidence of much more active management of balance sheets, as compared to households and

nonfinancial firms. To develop the point more clearly, it is useful to have some preliminary discussion on a framework for assessing active management of balance sheets.

First, consider the two axes in **Figure 2**. The vertical axis shows asset growth, which we can write as the change in the log assets of the firm from date t to date $t + 1$. That is,

$$\text{Asset growth} = \log A(t + 1) - \log A(t).$$

Accordingly, leverage growth (the horizontal axis measure) can be defined as the change in log assets minus the change in log equity. In other words,

$$\text{Leverage growth} = \log A(t + 1) - \log A(t) - (\log \text{E}(t + 1) - \log \text{E}(t)).$$

Then, the 45-degree line in **Figure 2** represents the set of points where

$$\log \text{E}(t + 1) - \log \text{E}(t) = 0$$

In other words, the 45-degree line represents the points where equity is unchanged. In **Figure 2**, point *B* corresponds to the change in the balance sheet where equity is unchanged, but only leverage increases so that the new leverage is the same as in point *A*.

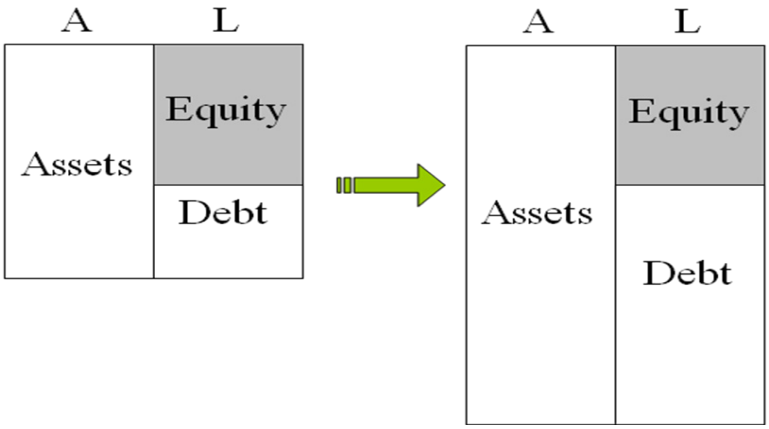

Figure 5: Increased Leverage through Expansion in Balance Sheet Size

Figure 5 depicts the change in the firm's balance sheet that corresponds to point *B* in **Figure 2**. In **Figure 5**, equity is shaded in gray so as to indicate that equity remains constant as

the balance sheet increases in size. The firm takes on new assets funded by new issuance of debt and increases the total size of its balance sheet at the same rate as it increases its leverage.

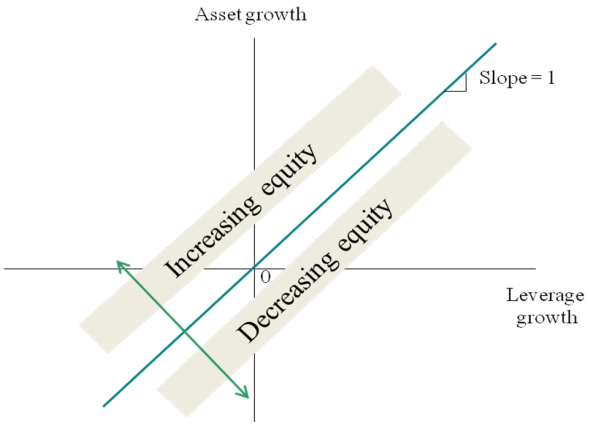

Figure 6: Regions of Increasing and Decreasing Equity

A diagram depicting shifts in the balance sheet can also yield information on whether equity is increasing or decreasing. In **Figure 6**, the points above the 45-degree line indicate the balance sheet shifts where asset growth is larger than leverage growth. That is, the set of points where we have

$$\log A(t+1) - \log A(t) > \log A(t+1) - \log A(t) - (\log \mathrm{E}(t+1) - \log \mathrm{E}(t)),$$

or equivalently,

$$\log \mathrm{E}(t+1) - \log \mathrm{E}(t) > 0.$$

In other words, the set of points above the 45-degree line indicate shifts in the balance sheet where equity is increasing, whereas the set of points below the 45-degree line indicate shifts where equity is decreasing. Indeed, any straight line with slope 1 and with intercept g indicates the set of points where equity is increasing at the rate g. **Figure 7** shows the relation between asset and leverage growth for an equity growth rate g and another growth rate of zero to illustrate the impact of shifts in the return on equity.

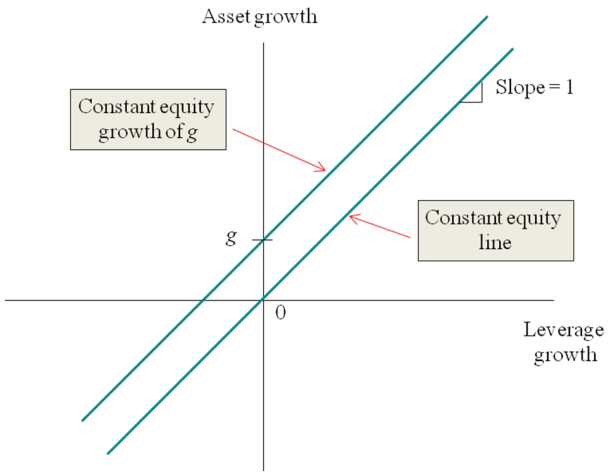

Figure 7. Set of Points with Constant Equity Growth

The distinguishing feature of banking sector assets is that they fluctuate over the financial cycle. Credit increases rapidly during the boom but increases less rapidly (or even decreases) during the downturn. Some of the variation in the size of banking assets could be accounted for by the fluctuations in the size of the pool of positive NPV projects, but some part of the fluctuations in banking sector assets may be due to shifts in the banks' willingness to take on risky positions over the cycle.

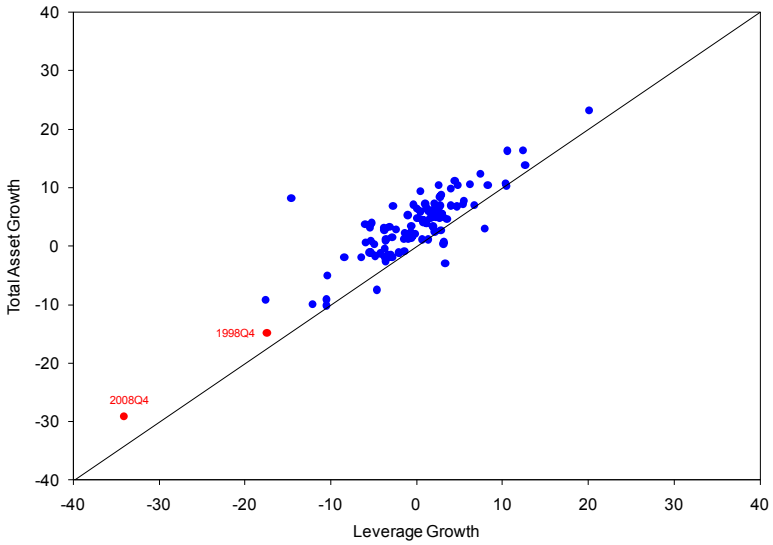

Figure 8: Leverage Growth and Asset Growth of US Investment Banks (Source SEC; Adrian and Shin (2010), updated)

Figure 8 taken from Adrian & Shin (2010) and updated with data up to the end of 2008, shows the scatter chart of the quarterly change in assets against the quarterly change in leverage of the (then) five stand-alone U.S. investment banks. The investment banks are Bear Stearns, Goldman Sachs, Lehman Brothers, Merrill Lynch and Morgan Stanley. The total asset growth and the leverage growth are aggregated by taking averages weighted by total assets.

We see in **Figure 8** that leverage is large when total assets are large—that is, leverage is procyclical. This is exactly the opposite finding of households or nonfinancial firms, whose leverage rises when balance sheets contract. We also see that the slope of the scatter chart is close to 1, implying that equity increases at a constant rate on average. Thus, unlike the textbook discussion of the MM theorem, or in the framework of Merton (1974) or Leland (1994), equity seems to play the role of the predetermined variable, and total assets (the size of the balance sheet) is the endogenous choice variable that is determined by the willingness of banks to take on risky exposure given the realized value of equity. Although we have focused on the balance sheet adjustment of the market-based financial intermediaries, a similar picture emerges for commercial banks, which take up a much larger portion of the financial intermediary sector.

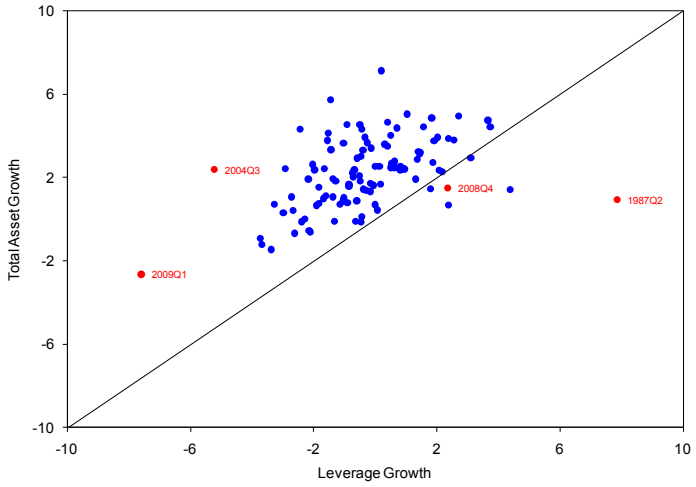

Figure 9: Leverage Growth and Asset Growth for US Commercial Banks (Source: FDIC Call Reports)

In **Figure 9**, we plot the asset and leverage changes of commercial banks. We obtain the commercial banks' balance sheet data from the Federal Deposit Insurance Corporation's (FDIC's) call reports. The total assets and total equity from this data are based on the balance sheet of the commercial bank subsidiary of larger bank holding companies (BHCs). We first generate asset growth and equity growth for each bank, for the period 1984Q1 to 2010Q1. We then aggregate asset growth and equity growth each quarter by value weighting with the previous quarter's outstanding assets and equity. We then compute leverage growth for this aggregated series by taking the difference between log asset growth and log equity growth. Hence, growth rates are computed as log differences, and expressed in percent quarterly changes.

The chart shows that the commercial bank subsidiaries exhibit the procyclical leverage behavior similar to the investment banks studied above. However, there are some notable differences when inspecting the plot in more detail. First of all, the quarters that correspond to episodes of sharp deleveraging in the investment banking sector typically are not quarters where the commercial banking sector is unwinding. In particular, 2008Q3, 2008Q4, 1998Q3, and 1987Q4 are quarters where commercial banks increase leverage. The difference in the timing of balance changes is revealing in the respective role of commercial banks and market-based intermediaries. Commercial banks play a buffering role during downturns in the financial cycle, standing ready to provide financing when the financial market itself may be drying up. Commercial banks may offer lines of credit to their customers, who then turn to such credit lines when the financial market is displaying signs of distress. The most recent example of the divergent behavior of commercial banks and the market-based intermediaries prior to the recent financial crisis was during the long-term capital management crisis of 1998, when bank credit substituted for the decline in market-based borrowing.

We should note that the finding of a procyclical balance sheet of the commercial banks is consistent with Greenlaw et al. (2008), but differs from Adrian & Shin (2010). Whereas Greenlaw et al. aggregate individual commercial bank balance sheets for the five largest commercial banks, Adrian & Shin (2010) rely on the balance sheets from the U.S. flow of funds. It appears that the procyclical relationship gets lost in the flow of funds data, but is clearly present in **Figure 9** as well as in Greenlaw et al. (2008).

STICKINESS OF EQUITY

The important point to take away from **Figure 9** is that commercial banks share with the investment banks the feature that leverage growth and asset growth are positively related, and that the scatter chart is aligned along the 45-degree line, indicating that equity is again the predetermined variable that determines the other items on the balance sheet. In this respect, the empirical evidence on the balance sheet adjustment of banks has some interesting contrasts when compared to the textbook discussion of corporate finance and how balance sheets are determined.

First, the textbook discussions assume that the assets of the firm are given exogenously, and given by the set of positive NPV projects. Empirically, we see that the investment banks' assets vary widely over the cycle, often changing by more than 10% from one quarter to the next. If the textbook discussion is correct, then we must believe that the set of positive NPV value projects is also varying quite widely over the cycle.

Second, even if we entertain the possibility that the positive NPV projects vary so widely over the cycle, it is a challenge for the textbook discussion as to why equity is so sticky in the sense that equity is the predetermined variable that increases at a constant rate on average, irrespective of the size of the balance sheet. If the textbook trade-off theory of the capital structure were true, then we would expect to see the equity-debt mix remain roughly stable, as

long as the tax advantage and bankruptcy costs remain roughly constant. Instead, we see that equity is best characterized as growing at a constant rate, and all the adjustment in leverage comes from the shift in the size of total assets.

That equity is sticky has some candidate explanations. During severe downturns when there are doubts about the solvency of a bank, the adverse selection problem associated with debt overhang will mean that any new equity will have to repay the existing debt holders rather than create a stake on the assets for the new equity investors. Thus, during downturns, we would expect that equity is sticky and most of the adjustment is taken on by shrinking assets, or in other words, through the deleveraging of the banking sector. Hanson et al. (2010) note that deleveraging of the intermediary sector will be associated with the contraction of credit to the economy, so that raising new equity should be given priority.

Debt overhang during downturns is well understood, but what is more striking in **Figure 8** is that equity seems to remain sticky even when assets are expanding during an upturn. When the financial intermediary is experiencing rapid asset growth, we would presume that the bank is well capitalized and that debt overhang is not an issue. However, the equity is still increasing at a constant rate on average, suggesting that equity remains sticky even during an upturn.

Adverse selection may also be important in such cases, too, as suggested by Myers & Majluf (1984), who present a framework with adverse selection where outside investors are less capable of assessing the true financial health of a firm than the managers themselves. Myers & Majluf (1984) argue that in such instances, any new equity raised by the existing owners will face a lemons problem and will suffer a discount relative to the true value of the claim. Thus, any new issuance will be associated with a dilution of the value of the stakes of the existing owners. Foreseeing this, the existing owners with control will be reluctant to raise new equity. Only those

firms that are willing to accept the discount (and hence whose value is truly subpar) will be issuing equity.

The stickiness of bank equity raises the possibility that there may be a divergence between the privately optimal level of bank capital and the socially optimal level. Admati et al. (2010) make the case that standard arguments put forward by the banking industry against higher required capital for banks rest on weak foundations. In particular, they take issue with the claim that bank equity is an expensive form of funding relative to debt if the objective is to find the socially optimal capital structure for banks rather than the privately optimal one. Miles et al. (2011) also argue that the socially optimal level of bank capital may be considerably higher than the levels that have been put forward in existing regulation.

The stickiness of equity and the possible divergence between the privately optimal level of bank capital relative to the social optimum raises issues concerning the restrictions on depletion of bank capital through dividends. Rosengren (2010) has estimated that approximately $80 billion of bank capital could have been retained in the 19 banks that underwent the U.S. stress tests (SCAP), had dividend payments been suspended promptly at the beginning of the financial crisis in the summer of 2007. Acharya et al. (2010) provide a more detailed breakdown of dividend payouts and capital raising by U.S. and European banks during the crisis years. The sum paid out in dividends ($80 billion) is roughly half of the public capital injection into the SCAP banks through the U.S. government's Capital Purchase Program.

BALANCE SHEET CAPACITY

There is an additional perspective on the fluctuations in leverage in relation to balance sheet capacity. In particular, we can understand the fluctuations in leverage in terms of the implicit maximum leverage permitted by the creditors of financial institutions. Institutions obtain leverage via a variety of debt instruments. Short-term instruments include commercial paper,

certificates of deposit, and repurchase agreements (repos). Such short-term debt instruments allow financial intermediaries to adjust leverage in response to changing economic conditions (see Adrian & Shin 2010 for the case of investment banks). Short-term debt aggregates can thus be viewed as indicators of balance sheet capacity. Geanakoplos (2010) provides a general equilibrium framework where the balance sheet capacity is determined endogenously. In the case of the investment banks, it should be noted that much of the fluctuations in their leverage offer a glimpse of broader funding conditions in financial markets, as their net funding in the repo markets is small (see Adrian & Fleming 2005), whereas their gross repo positions are large.

Fluctuations in leverage are also influenced by the risk management policies of financial intermediaries, as suggested by Adrian & Shin (2008). Suppose that banks aim to keep enough equity capital to meet their overall value at risk (VaR). If we denote by V the VaR per dollar of assets, and A is total assets, then equity capital E must satisfy $E = V \times A$, implying that leverage L satisfies

$$L = A/E = 1/V$$

If VaR is low in expansions and high in contractions, leverage is high in expansions and low in contractions—leverage is procyclical. Total assets are determined once the leverage of the firm is applied to the given equity.

The above discussion suggests that there is a well-defined notion of balance sheet capacity for financial intermediaries that depends on (*a*) the size of its capital base (its equity) and (*b*) the amount of lending that can be supported by each unit of capital. Total assets are then determined by the multiplication of the two.

Balance sheet capacity increases during a boom, given that the greater profitability of the banks adds to the capital base. In addition, measured risks are low during a boom, implying that the banks' willingness to lend for each unit of capital is also high.

A high balance sheet capacity translates into a higher supply of credit. The greater supply of credit by the banking sector means that the size of the banking sector becomes large relative to the total credit in the economy. An increased supply of loans may also imply a narrowing of risk spreads and/or the lowering of lending standards (see Adrian & Shin 2011 and Shin 2010 for a more formal development of the argument).

When booms turn to busts, the balance sheet capacity of the banking sector shrinks for two reasons. First, loan losses lower bank capital, while the greater measured risks lower the lending that is available for each unit of capital. When the downturn is severe, the lower balance sheet capacity may result in a credit crunch. Central bank intervention in the financial market such as the direct purchase of risky assets is one way to make up for the shortfall in private sector balance sheet capacity.

As new debt is issued, there will also be implications for the composition of debt funding. The core funding available to the banking sector is retail deposits of household savers. However, retail deposits grow in line with the aggregate wealth of the household sector. In a lending boom when credit is growing very rapidly, the pool of retail deposits is not sufficient to fund the increase in bank credit. Other sources of funding are tapped to fund rapidly increasing bank lending. The state of the financial cycle is thus reflected in the composition of bank liabilities.

Figure 10 shows the composition of the liabilities of Northern Rock, the UK bank whose failure in 2007 heralded the global financial crisis (see Shin 2009). In the nine years from 1998 to 2007, Northern Rock's lending increased 6.5 times. This increase in lending far outstripped the funds raised through retail deposits (in yellow), with the rest of the funding gap being made up by wholesale funding (in red and blue).

Northern Rock's case illustrates the general lesson that during credit booms, the rapid increase in bank lending outstrips the core deposit funding available to banks. As the boom progresses, the bank resorts to alternative, noncore liabilities to finance its lending. Therefore, the proportion of banks' noncore liabilities might serve as a useful indicator of the financial cycle's stage and the banking system's degree of vulnerability to a downturn of the financial cycle.

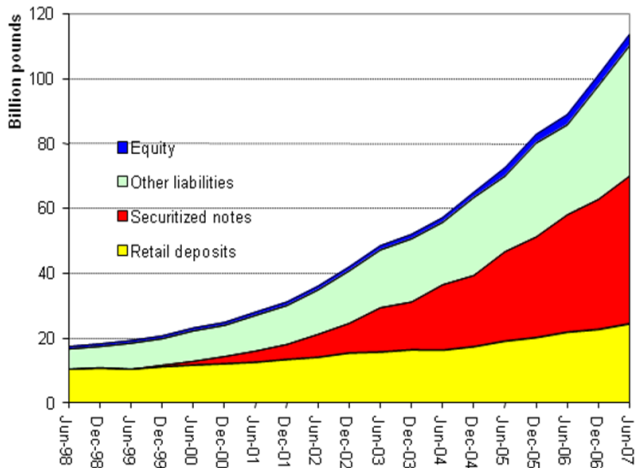

Figure 10: Northern Rock's Liabilities (1998 – 2007)

FINANCIAL SYSTEM RISK

Consider a domestic financial system consisting of ultimate borrowers (domestic firms and households) and ultimate creditors (domestic households). The domestic banking sector channels funds from ultimate creditors to ultimate borrowers. There is also a foreign creditor sector that stands ready to supply funds to the domestic banking sector.

Suppose there are n banks in the domestic banking system. The term bank should be interpreted widely, to include securities firms and other intermediaries. We denote the banks by an index that takes values in the set $\{1, 2, \ldots, n\}$. The domestic household creditor sector is given the index $n+1$. The foreign creditor sector is given the index $n+2$.

Bank *i* has two types of assets. First, there are loans to end users such as corporates or households. Denote the loans by bank *i* to such end users as y_i. Next, there are the claims against other financial institutions. Call these the interbank assets, although the term covers all claims on other intermediaries. The total interbank assets held by bank *i* are

$$\sum_{j=1}^{n} x_j \pi_{ji},$$

where x_j is the total debt of bank *j* and π_{ji} is the share of bank *j*'s debt held by bank *i*.

Note that $\pi_{i,n+1}$ is the proportion of the bank's liabilities held by the domestic creditor sector (e.g., in the form of deposits), and $\pi_{i,n+2}$ is the proportion of the bank's liabilities held by foreign creditors (e.g., in the form of short-term foreign currency–denominated debt).

Because banks $n+1$ and $n+2$ are not leveraged, we have $x_{n+1} = x_{n+2} = 0$. The balance sheet identity of bank *i* is given by

$$y_i + \sum_{j=1}^{n} x_j \pi_{ji} = e_i + x_i.$$

The left-hand side is the total assets of the bank. The right-hand side is the sum of equity and debt. Letting $x = \begin{bmatrix} x_1 & \cdots & x_n \end{bmatrix}$ and $y = \begin{bmatrix} y_1 & \cdots & y_n \end{bmatrix}$, we can write in vector notation the balance sheet identities of all banks as

$$y + x\Pi = e + x,$$

where Π is the matrix whose (i, j)th entry is π_{ij}. Solving for *y*,

$$y = e + x\left(I - \Pi\right).$$

Define leverage as the ratio of total assets to equity, given by

$$\frac{a_i}{e_i} = \lambda_i.$$

Then defining Λ as the diagonal matrix with λ_i along the diagonal, we can write

$$y = e + e(\Lambda - I)(I - \Pi),$$

where Π is the matrix of interbank liabilities. By summing up the rows of the vector equation above, we have the following balance sheet identity:

$$\sum_i y_i = \sum_i e_i + \sum_i e_i z_i (\lambda_i - 1),$$

where z_i is given by the *i*th row of $(I - \Pi)u$. Here, z_i has the interpretation of the proportion of the bank's liabilities that come from outside the banking sector—that is, the proportion of funding that comes from either the ultimate domestic creditors (e.g., deposits) or the foreign sector (e.g., foreign currency–denominated banking sector liabilities).

Therefore, we can rewrite the aggregate balance sheet identity in the following way.

Total Credit = Total Equity of Banking Sector
+ Liabilities to Nonbank Domestic Creditors
+ Liabilities to Foreign Creditors.

The accounting framework outlined above helps us to understand the connection between (*a*) the procyclicality of the banking system, (*b*) systemic risk spillovers, and (*c*) the stock of noncore liabilities of the banking system. Let us define the core liabilities of a bank as its liabilities to the nonbank domestic creditors (such as through deposits). Then, the noncore liability of a bank is either (*a*) a liability to another bank, or (*b*) a liability to a foreign creditor.

In a boom when credit is growing very rapidly, the growth of bank balance sheets outstrips the growth in the pool of retail deposits. As a result, the growth of bank lending results in greater lending and borrowing between the intermediaries themselves, or results in the sucking in of foreign debt.

INTERCONNECTEDNESS AND SYSTEMIC RISK

Rapid asset growth and greater reliance on noncore liabilities are closely related to systemic risk and interconnectedness between banks. In booms credit grows rapidly, the growth of bank balance sheets outstrips available core funding, and asset growth is mirrored in the greater cross-exposures across banks. Consider the stylized banking system in **Figure 11** with two banks: Bank 1 and Bank 2. Both banks draw on retail deposits to lend to ultimate borrowers. They also hold claims against each other.

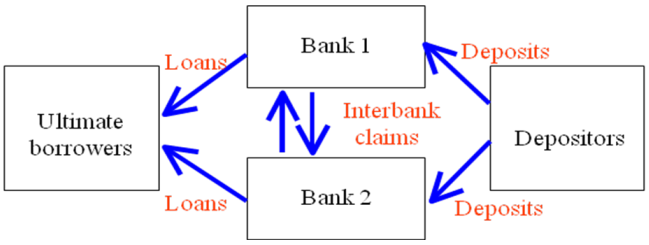

Figure 11: Stylized Financial System

Imagine a boom where the assets of both banks double in size, but the pool of retail deposits stays fixed. Then, the proportion of banking sector liabilities in the form of retail deposits must fall, and there must be increased cross-claims across banks. In this sense, the growth in bank assets and increased interconnectedness are two sides of the same coin.

The relationship between banking sector assets and increased cross-exposures across banks holds more generally as an accounting identity. Define the core liabilities of a bank as its liabilities to claimholders who are not financial intermediaries themselves. Retail deposits would be the best example of core liabilities. Covered bonds held by a pension fund would also count as a core liability. However, any liability of an intermediary held by another intermediary would be a noncore liability. Under this definition, we have the following accounting identity for the total core liabilities of the banking sector:

$$\text{Total Core Liabilities} = \sum_{i=1}^{n} e_i z_i (\lambda_i - 1),$$

where e_i is the equity of bank i, λ_i is the leverage of bank i, z_i is the ratio of bank i's core liabilities to its total liabilities, and *n* is the number of banks in the banking system. Because total core liabilities (retail deposits) are slow-moving, a rapid increase in total bank assets (equity times leverage) must result in lower z_i values, implying a greater reliance on noncore funding.

In this way, there are close conceptual links between procyclicality, interconnectedness, and the stock of noncore liabilities of the banking system. In a boom, we have the conjunction of three features:

1. Total lending increases rapidly.
2. Noncore (including foreign currency) liabilities increase as a proportion of total liabilities.
3. Systemic risk increases through greater cross-holdings between intermediaries.

In this respect, systemic risk is procyclical and excessive asset growth lies at the heart of the increase in bank interconnectedness. Therefore, addressing excessive asset growth in booms will go a long way toward mitigating systemic risks and the cross-exposure across banks.

The prevalence of short-maturity liabilities is a consequence of longer intermediation chains and the need to maintain a lending spread for each link in the chain. **Figure 12** depicts a traditional deposit-taking bank that collects deposits and holds mortgages. All banking liabilities are core liabilities in such a system.

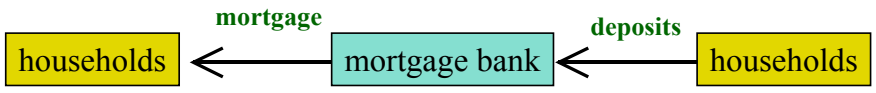

Figure 12: Short Intermediation Chain

However, lengthening intermediation chains increases cross-exposures across intermediaries. In **Figure 13**, mortgage assets are held in a mortgage pool, but mortgage-backed securities (MBSs) are owned by an asset-backed security (ABS) issuer who pools and tranches the MBSs into another layer of claims, such as collateralized mortgage obligations (CMOs). Then, a securities firm might hold CMOs and finances them by pledging them as collateral to a commercial bank through repos. The commercial bank in turn funds its lending to the securities firm by issuing short-term liabilities such as financial commercial paper. Money market mutual funds complete the circle, and household savers own shares to these funds.

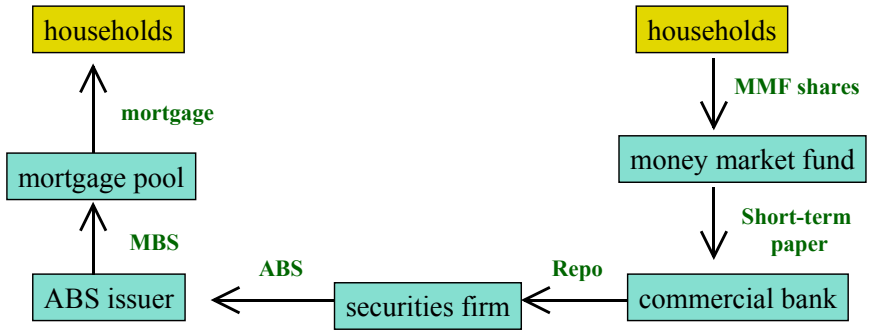

Figure 13: Long Intermediation Chain

The illustration in **Figure 13** is a simple example of potentially much more complex and intertwined relationships. At each stage of the intermediation chain, the funding interest rate must be lower than the asset interest rate. As the intermediation chain becomes longer, more short-term funding must be used to support the chain, as short-term funding tends to be the cheapest. In this way, the prevalence of short-term debt is a natural consequence of the increased weight of noncore liabilities in the intermediary sector.

Understanding the role of noncore funding in the financial cycle gives some insights into the role of securitization. Securitization can be seen as a way for intermediaries to tap non-deposit funding by creating securities that can be pledged as collateral. The demand for collateral assets is therefore a demand for leverage.

SHADOW BANKING

Pozsar et al. (2010) provide a detailed overview of the shadow banking system. Shadow banks are financial entities that conduct either all three or any one of the classic bank functions: *a*) credit transformation, *b*) maturity transformation, *c*) liquidity transformation. However, these bank functions are conducted without the liquidity and credit puts provided by the discount window and deposit insurance. Much of the interaction between financial intermediaries and financial markets is conducted by these shadow banks. Pozsar et al. (2010) provide a breakdown of a typical intermediation chain into seven steps:

1. Loan origination: finance companies, industrial loan companies, and commercial banks.
2. Loan warehousing: single and multiseller conduits.
3. ABS issuance: residential and commercial private label mortgage-backed securities, and other asset-backed securities.
4. ABS warehousing: broker-dealer warehousing.
5. ABS, CDO, and synthetic CDO issuance.
6. ABS intermediation: structured investment vehicles, tender option bonds, credit hedge funds.
7. Wholesale funding: 2(a)-7 fund, enhanced cash fund, offshore money funds.

In the first step of the intermediation chain, loans or mortgages are originated by institutions such as finance companies or commercial banks. These loans are then warehoused temporarily in conduits, which are bankruptcy remote special purpose vehicles with primary funding in the asset-backed commercial paper (ABCP) market. Such conduits are typically not endowed with any equity, but instead are able to issue commercial paper due to credit lines provided by sponsoring commercial banks. The third step of the shadow banking intermediation chain consists in the issuance of asset-backed securities. ABSs are pools of loans or mortgages that issue tranches of debt that are rated according to the seniority of cash flows to which each of the tranches corresponds. Different tranches of the ABS are then potentially resecuritized in CDOs. The resecuritization necessitates ABS warehousing by the broker dealers that engineer

the CDOs. CDOs are tranches of ABSs, particularly the mezzanine tranches. The sixth step in the shadow banking intermediation chain consists of maturity transformation that is conducted by structured investment vehicles or credit hedge funds. Finally, the seventh step consists of the funding by money market mutual funds that hold repo, commercial paper, and other short-term debt of the maturity transformation vehicles. The entirety of the shadow banking system intermediates between the ultimate savers and ultimate borrowers, much like a traditional commercial bank does.

SUMMARY POINTS

1. Textbook discussions of balance sheet management by nonfinancial firms take the set of positive NPV projects as given, which in turns determines the size of the assets of the firm. The focus is on the funding of such assets between debt and equity, where the relative mix is determined by the trade-off between the tax advantages of debt and the potential for costs of financial distress when debt is too high.

2. In contrast, the balance sheet management of financial intermediaries reveal that equity behaves as the predetermined variable, and the asset size of the bank or financial intermediary is determined by the degree of leverage that is permitted by market conditions. Leverage of financial intermediaries is procyclical, where the procyclicality comes from expansions of the balance sheet during booms when intermediaries take on new assets, make new loans, and purchase securities funded with new debt issuance.

3. Equity is sticky in the sense that even during the booms, banks do not fund their expanding balance sheet by raising new equity. The relative stickiness of equity reveals possible non-pecuniary benefits to bank owners so that they are reluctant to raise new equity, lest the new equity dilutes the inside owners' non-pecuniary benefits.

4. We explore the empirical evidence for both market-based financial intermediaries such as the Wall Street investment banks, as well as the commercial bank subsidiaries of the large U.S. BHCs. We find that the procyclical leverage of commercial banks results in scatter charts of change in assets and leverage that are similar in shape to those for securities firms.

5. We further explore the aggregate consequences of such behavior by the banking sector for the propagation of the financial cycle and securitization. The fluctuations in intermediary balance sheets are closely associated with funding conditions and the perceived liquidity of financial markets.

FUTURE ISSUES

1. Determine the aggregate effects of balance sheet behavior of financial institutions for the financial system and the determination of the risk premium.

2. Analyze the role of the length of intermediation chains for financial stability.

3. Investigate the corporate finance motivation for balance sheet adjustment by banks and other financial intermediaries.

4. Investigate empirically the new issuance of the debt and the relationship between new issuance activity and the maturity structure of debt.

5. Analyze the relationship between new issuance of debt by banks and other financial intermediaries and the funding of housing investment.

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Glossary

Asset-backed commercial paper (ABCP): form of commercial paper that is collateralized by other financial assets

Asset-backed security (ABS): security whose value and income payments are derived from and collateralized by a specified pool of underlying assets, such as credit cards, auto loans, or mortgages

Bank holding company (BHC): any company that has control over one or more banks; all are required to register with the Board of Governors of the Federal Reserve System

Collateralized debt obligation (CDO): type of structured asset-backed security whose value and payments are derived from a portfolio of underlying fixed-income assets and that is split into different risk classes

Federal Reserve: central banking system of the United States

Government-sponsored enterprise: financial service corporation to enhance the flow of credit to targeted sectors of the economy, particularly housing

Money Market Fund (MMF): mutual fund that holds short-term fixed income securities and whose shares are redeemable at short notice at par value

Mortgage-backed security (MBS): asset-backed security or debt obligation that represents a claim on the cash flows from mortgage loans, most commonly on residential property

Repurchase agreement (repo): transaction in which the borrower sells a security to a lender while also agreeing to buy back the same security from the lender at a fixed price at some later date

Value at risk (VaR): widely used risk measure of the risk of loss on a specific portfolio of financial assets; for a given portfolio, probability, and time horizon, VaR is defined as a threshold value such that the probability that the mark-to-market loss on the portfolio over the given time horizon exceeds this value is the given probability level

BASEL III

The financial crisis of 2007–2009 gave rise to concerted international efforts under the G20 process to arrive at strengthened capital requirements for banks. The international efforts resulted in a new capital regime known as Basel III, which was agreed upon by the 27 member countries of the Basel Committee for Banking Supervision. The main elements of the new accord are a strengthening of required minimum regulatory capital of 7% of common equity relative to risk-weighted assets. The emphasis on common equity represents a strengthening of standards relative to the previous rules that allowed capital requirements to be met with capital instruments such as preferred equity that had attributes of debt as well as that of equity.

Basel III envisages the introduction of a leverage ratio, which sets minimum capital requirements as a proportion of total assets—that is, without risk weights. Basel III also introduces liquidity rules that govern the holding of cash-like assets to deal with short-term funding problems in a crisis, and with rules, that restrict the degree of maturity mismatch between assets and liabilities. Basel III also has macroprudential features that attempt to mitigate the procyclicality of the financial system. For example, there is a countercyclical capital charge that may be imposed at the discretion of the national regulator.