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Liquidity and financial cycles

by Tobias Adrian and Hyun Shin

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Foreword

On 18–19 June 2007, the BIS held its Sixth Annual Conference on “Financial systems and macroeconomic resilience”, in Brunnen, Switzerland. The event brought together senior representatives of central banks, academic institutions and the private sector to exchange views on this topic. BIS Paper 41 contains the opening address by William R White (Economic Adviser, BIS), the contributions to the policy panel on “Coping with financial distress in a more markets-oriented environment” and the prepared remarks of the participants at the overview panel of the conference. The participants in the policy panel discussion were Donald Kohn (Board of Governors of the Federal Reserve), Armínio Fraga (Gávea Investimentos) and John Gieve (Bank of England). Yi Gang (People’s Bank of China), Stanley Fischer (Bank of Israel) and Lucas Papademos (European Central Bank) participated in the overview panel, which was chaired by Malcolm Knight (BIS). The present Working Paper includes a paper presented at the conference and the discussant comments.

Conference programme

Sunday 17 June

17:30	Conference registration
19:00	Cocktail reception and informal dinner

Monday 18 June

09:00	Opening remarks:	William White (Bank for International Settlements)
	Chair:	YV Reddy (Reserve Bank of India)
09:15	**Session 1:**	**Financial intermediation through institutions or markets?**
	Paper title:	"Financial intermediaries and financial markets"
	Author:	Martin Hellwig (Max Planck Institute for Research on Collective Goods)
	Discussants:	Bengt Holmström (Massachusetts Institute of Technology) Martín Redrado (Central Bank of Argentina)
10:45	Coffee break	
11:15	**Session 2:**	**Towards market completeness**
	Paper title:	"Innovations in credit risk transfer: implications for financial stability"
	Author:	Darrell Duffie (Stanford University)
	Discussants:	Mohamed El-Erian (Harvard Management Company) Kenneth Froot (Harvard Business School)
12:45	Lunch	
	Chair:	Alan Bollard (Reserve Bank of New Zealand)
14:15	**Session 3:**	**Accounting and financial system behaviour**
	Paper title:	"Liquidity and financial cycles"
	Author:	Hyun Song Shin (Princeton University) and Tobias Adrian (Federal Reserve Bank of New York)
	Discussants:	Philipp Hildebrand (Swiss National Bank) Mary Barth (Stanford University)
15:45	Coffee break	

Monday 18 June (cont)

16:15	**Session 4:**	**Policy panel discussion on "Coping with financial distress in a more markets-oriented environment"**
	Panellists:	Donald Kohn (Board of Governors of the Federal Reserve System) Armínio Fraga (Gávea Investimentos) John Gieve (Bank of England)
18:00	Adjournment	
19:00	Reception followed by formal dinner	
	Keynote lecture by Robert Merton (Harvard University)	

Tuesday 19 June

	Chair:	Kazumasa Iwata (Bank of Japan)
09:00	**Session 5:**	**Risk transfer to households and macroeconomic resilience**
	Paper title:	"Risk management for households – the democratization of finance"
	Author:	Robert Shiller (Yale University)
	Discussants:	John Campbell (Harvard University) Jaime Caruana (International Monetary Fund)
10:30	Coffee break	
11:00	**Session 6:**	**Financial system: shock absorber or amplifier?**
	Paper title:	"Financial system: shock absorber or amplifier?"
	Author:	Franklin Allen (Wharton School of the University of Pennsylvania) and Elena Carletti (Center for Financial Studies)
	Discussants:	Raghuram Rajan (University of Chicago) Yung Chul Park (Seoul National University)
12:30	Lunch	
14:00	**Overview panel**	
	Chair:	Malcolm Knight (Bank for International Settlements)
	Panellists:	Yi Gang (People's Bank of China) Stanley Fischer (Bank of Israel) Lucas Papademos (European Central Bank)
15:30	Close of conference	

Contents

Liquidity and financial cycles[1]

Tobias Adrian (Federal Reserve Bank of New York) and

Hyun Song Shin (Princeton University)

Abstract

In a financial system where balance sheets are continuously marked to market, asset price changes show up immediately in changes in net worth, and elicit responses from financial intermediaries, who adjust the size of their balance sheets. We document evidence that marked to market leverage is strongly procyclical. Such behaviour has aggregate consequences. Changes in aggregate balance sheets for intermediaries forecast changes in risk appetite in financial markets, as measured by the innovations in the VIX index. Aggregate liquidity can be seen as the rate of change of the aggregate balance sheet of the financial intermediaries.

1. Introduction

In a financial system where balance sheets are continuously marked to market, changes in asset prices show up immediately on the balance sheet, and so have an immediate impact on the net worth of all constituents of the financial system. The net worth of leveraged financial intermediaries is especially sensitive to fluctuations in asset prices given the highly leveraged nature of such intermediaries' balance sheets.

Our focus in this paper is on the reactions of the financial intermediaries to changes in their net worth, and the market-wide consequences of such reactions. If the financial intermediaries were passive and did not adjust their balance sheets to changes in net worth, then leverage would fall when total assets rise. Change in leverage and change in balance sheet size would then be negatively related.

However, as we will see below, the evidence points to a strongly *positive* relationship between changes in leverage and changes in balance sheet size. Far from being passive, the evidence points to financial intermediaries adjusting their balance sheets actively, and doing so in such a way that leverage is high during booms and low during busts.

Procyclical leverage can be seen as a consequence of the active management of balance sheets by financial intermediaries, who respond to changes in prices and measured risk. For financial intermediaries, their models of risk and economic capital dictate active management

[1] E-mails: tobias.adrian@ny.frb.org and hsshin@princeton.edu. Paper prepared for the 6th BIS Annual Conference, "Financial System and Macroeconomic Resilience", 18–19 June 2007, Brunnen, Switzerland. We thank John Kambhu, Ken Garbade, Anil Kashyap, Raghu Rajan, Franklin Allen and our discussants Mary Barth and Philipp Hildebrand for their comments. The views expressed in this paper are those of the authors and do not necessarily represent those of the Federal Reserve Bank of New York or the Federal Reserve System.

of their overall value at risk (VaR) through adjustments of their balance sheets. Credit ratings are a key determinant of their cost of funding, and they will attempt to manage key financial ratios so as to hit their credit rating targets.

From the point of view of each financial intermediary, decision rules that result in procyclical leverage are readily understandable. However, there are aggregate consequences of such behaviour for the financial system as a whole that are not taken into consideration by an individual financial intermediary. We give evidence that such behaviour has aggregate consequences on overall financial conditions, risk appetite and the amplification of financial cycles.

Our paper has three objectives. The first is to document evidence on the relationship between balance sheet size and leverage for a group of financial intermediaries – the major Wall Street investment banks – for whom the ideal of balance sheets that are continuously marked to market is a good approximation of reality. We show that leverage is strongly procyclical for these banks, and that the margin of adjustment on the balance sheet is through repos and reverse repos (and other collateralised borrowing and lending).

Our second objective is to outline the aggregate consequences of procyclical leverage, and document evidence that expansions and contractions of balance sheets have important asset pricing consequences through shifts in market-wide risk appetite. In particular, we show that changes in aggregate intermediary balance sheet size can forecast innovations in market-wide risk premiums as measured by the difference between the VIX index and realised volatility. We see this result as being very significant. Previous work in asset pricing has shown that innovations in the VIX index capture key components of asset pricing that conventional empirical models have been unable to address fully. By being able to forecast shifts in risk appetite, we hope to inject a new element into thinking about risk appetite and asset prices. The shift in risk appetite is closely related to other notions of market and funding liquidity, as used by Gromb and Vayanos (2002) and Brunnermeier and Pedersen (2005b). One of our contributions is to explain the origins of funding liquidity in terms of financial intermediary behaviour.

Our third objective is to shed light on the concept of “liquidity” as used in common discourse about financial market conditions. In the financial press and other market commentary, asset price booms are sometimes attributed to “excess liquidity” in the financial system. Financial commentators are fond of using the associated metaphors, such as the financial markets being “awash with liquidity”, or liquidity “sloshing around”. However, the precise sense in which “liquidity” is being used in such contexts is often unclear. We propose an economic counterpart to the notion of the market being “awash with liquidity”. Aggregate liquidity can be understood as the rate of growth of aggregate balance sheets. When financial intermediaries’ balance sheets are generally strong, their leverage is too low. The financial intermediaries hold surplus capital, and they will attempt to find ways in which they can employ their surplus capital. In a loose analogy with manufacturing firms, we may see the financial system as having “surplus capacity”. For such surplus capacity to be utilised, the intermediaries must expand their balance sheets. On the liabilities side, they take on more short-term debt. On the asset side, they search for potential borrowers to whom they can lend. Aggregate liquidity is intimately tied to how hard the financial intermediaries search for borrowers.

The outline of our paper is as follows. We begin with a review of some very basic balance sheet arithmetic on the relationship between leverage and total assets. The purpose of this initial exercise is to motivate our empirical investigation of the balance sheet changes of financial intermediaries in Section 3. Having outlined the facts, in Section 5, we show that changes in aggregate repo positions of the major financial intermediaries can forecast innovations in the volatility risk premium, where the volatility risk premium is defined as the difference between the VIX index and realised volatility. We conclude with discussions of the implications of our findings for financial cycles.

2. Some basic balance sheet arithmetic

What is the relationship between *leverage* and *balance sheet size*? This question raises important issues, both conceptually and empirically. We begin with some very elementary balance sheet arithmetic, so as to focus ideas.

Before looking at the evidence for financial intermediaries, let us think about the relationship between balance sheet size and leverage for a household. The household owns a house financed by a mortgage. The balance sheet looks like this.

Assets	Liabilities
House	Equity
	Mortgage

For concreteness, suppose the house is worth 100, the mortgage value is 90, and so the household has net worth (equity) of 10.

Assets	Liabilities
100	10
	90

Leverage is defined as the ratio of total assets to equity, and is given by 100/10 = 10. What happens to leverage as total assets fluctuate? Denote by A the market value of total assets; E is the market value of equity. We make the simplifying assumption that the market value of debt stays roughly constant at 90 with small shifts in the value of total assets. Total leverage is then

$$L = \frac{A}{A - 90}$$

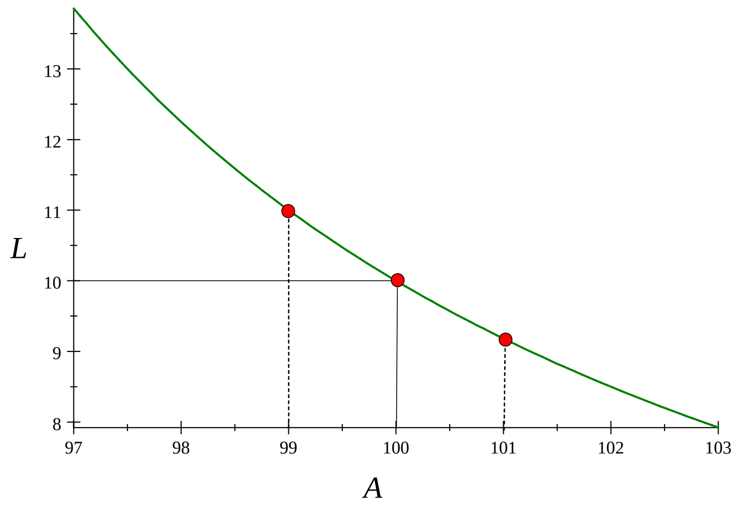
Leverage is inversely related to total assets. This is just saying that when the price of my house goes up, my net worth increases, and so my leverage goes down. Figure 1 illustrates the negative relationship between total assets and leverage.

Indeed, for households, the negative relationship between total assets and leverage is clearly borne out in the aggregate data. Figure 2 plots the quarterly changes in total assets to quarterly changes in leverage as given in the flow of funds account for the United States. The data are from 1963 to 2006. The scatter chart shows a strongly negative relationship, as suggested by Figure 1.

We can ask the same question for firms, and we will address this question for three different types of firm.

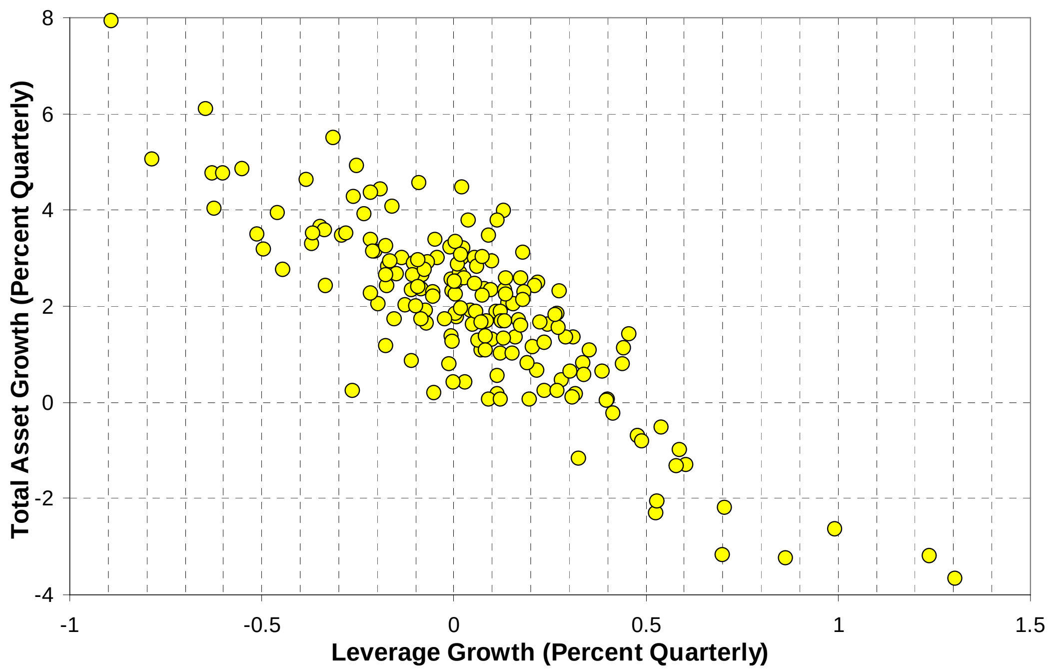
Graph 1

Leverage for passive investor



Graph 2

Households: total assets and leverage



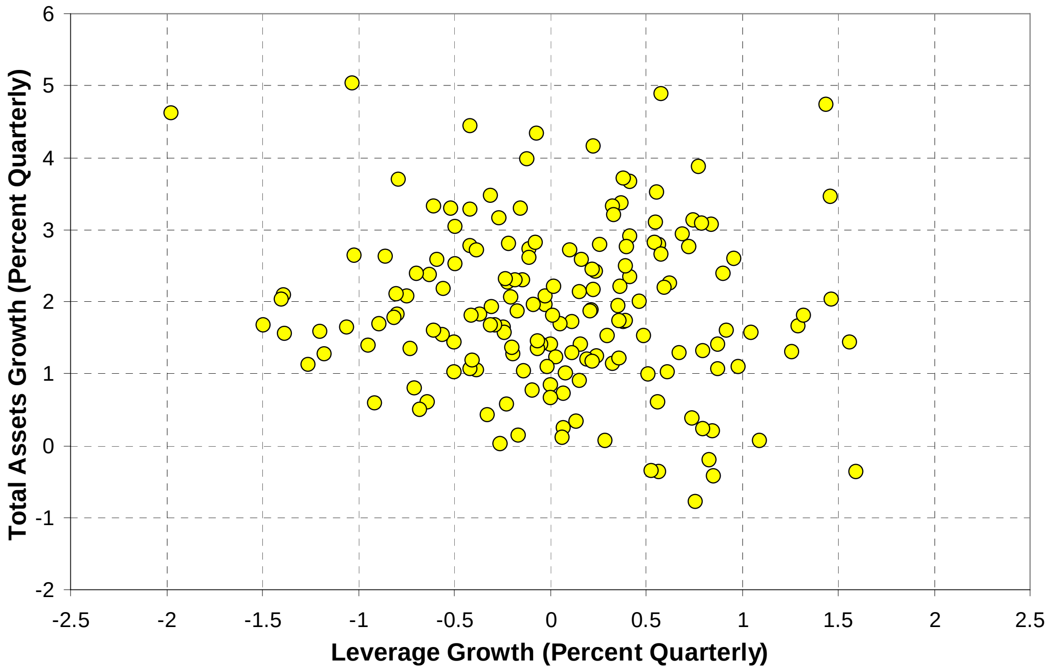
Source: Board of Governors, Federal Reserve, flow of funds, 1963 Q1–2006 Q4.

- Non-financial firms
- Commercial banks
- Security dealers and brokers (including investment banks).

If a firm were passive in the face of fluctuating asset prices, then leverage would vary inversely with total assets. However, the evidence points to a more active management of balance sheets.

Graph 3

Non-financial, non-farm corporates



Source: Board of Governors, Federal Reserve, flow of funds, 1963 Q1–2006 Q4.

Figure 3 is a scatter chart of the change in leverage and change in total assets of non-financial, non-farm corporations drawn from the US flow of funds data (1963–2006). The scatter chart shows much less of a negative pattern, suggesting that companies react to changes in assets by shifting their leverage stance.

More striking still is the analogous chart for US commercial banks, again drawn from the US flow of funds accounts.

Figure 4 is the scatter chart plotting changes in leverage against changes in total assets for US commercial banks. A large number of the observations line up along the vertical line that passes through zero change in leverage. In other words, the data show the outward signs of commercial banks targeting a fixed leverage ratio.

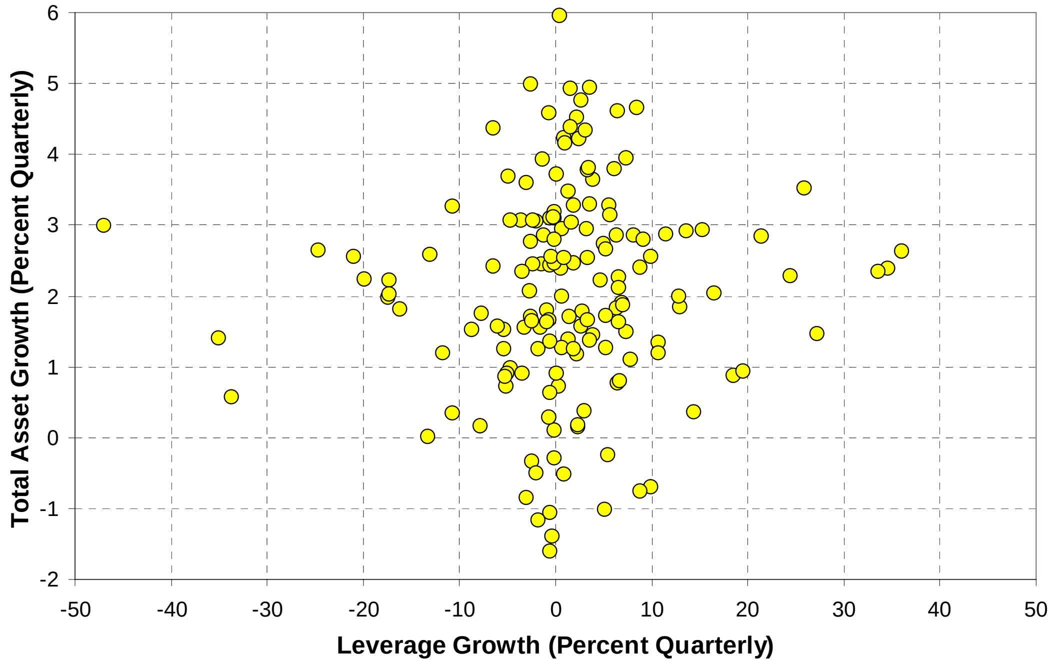
Financial institutions manage their balance sheets actively for several reasons. They attempt to manage the key financial ratios so as to hit credit rating targets and the cost of capital. Their models of risk and economic capital also demand active management of their balance sheets. Economic capital is also closely related to performance measures such as return on equity (ROE).

However, even more striking than the scatter chart for commercial banks is that for security dealers and brokers, including the major Wall Street investment banks.

Figure 5 is the scatter chart for US security dealers and brokers, again drawn from the flow of funds accounts (1963–2006). The alignment of the observations is now the reverse of that for households. There is a strongly *positive* relationship between changes in total assets and changes in leverage. In this sense, leverage is procyclical. Ayuso et al (2004) exhibit similar evidence on regulatory capital over the cycle using panel data from Spanish banks.

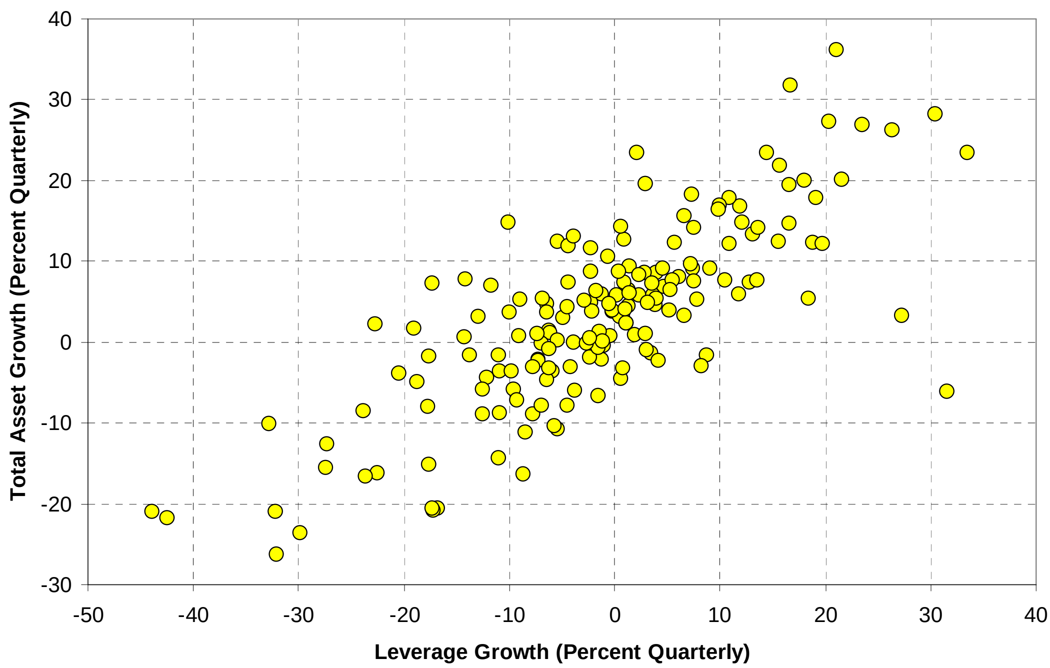
In order to appreciate the aggregate consequences of procyclical leverage, let us first consider the behaviour of a financial intermediary that manages its balance sheet actively so as to

Graph 4
Commercial banks



Source: Board of Governors, Federal Reserve, flow of funds, 1963 Q1–2006 Q4.

Graph 5
Security dealers and brokers



Source: Board of Governors, Federal Reserve, flow of funds, 1963 Q1–2006 Q4.

maintain a *constant* leverage ratio of 10. Suppose the initial balance sheet is as follows. The financial intermediary holds 100 worth of securities, and has funded this holding with debt worth 90.

Assets	Liabilities
Securities, 100	Equity, 10
	Debt, 90

Assume that the price of debt is approximately constant for small changes in total assets. Suppose the price of securities increases by 1% to 101.

Assets	Liabilities
Securities, 101	Equity, 11
	Debt, 90

Leverage then falls to 101/11 = 9.18. If the bank targets leverage of 10, then it must take on additional debt of *D* to purchase *D* worth of securities on the asset side so that

$$\frac{\text{assets}}{\text{equity}} = \frac{101 + D}{11} = 10$$

The solution is D = 9. The bank takes on additional debt worth 9, and with this money purchases securities worth 9. Thus, an increase in the price of the security of 1 leads to an increased holding worth 9. The demand curve is *upward-sloping*. After the purchase, leverage is now back up to 10.

Assets	Liabilities
Securities, 110	Equity, 11
	Debt, 99

The mechanism works in reverse, too. Suppose there is shock to the securities price so that the value of security holdings falls to 109. On the liabilities side, it is equity that bears the burden of adjustment, since the value of debt stays approximately constant.

Assets	Liabilities
Securities, 109	Equity, 10
	Debt, 99

Leverage is now too high (109/10 = 10.9). The bank can adjust down its leverage by selling securities worth 9, and paying down 9 worth of debt. Thus, a *fall* in the price of securities of leads to *sales* of securities. The supply curve is *downward*-sloping. The new balance sheet then looks as follows.

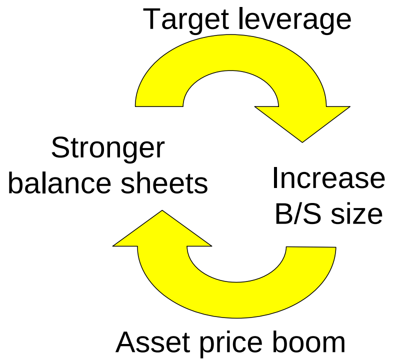
Assets	Liabilities
Securities, 100	Equity, 10
	Debt, 90

The balance sheet is now back to where it was before the price changes. Leverage is back down to the target level of 10.

Leverage targeting entails upward-sloping demands and downward-sloping supplies. The perverse nature of the demand and supply curves is even stronger when the leverage of the financial intermediary is procyclical – that is, when leverage is high during booms and low during busts. When the securities price goes up, the upward adjustment of leverage entails purchases of securities that are even larger than that for the case of constant leverage. If, in addition, there is the possibility of feedback, then the adjustment of leverage and price changes will reinforce each other in an amplification of the financial cycle.

Graph 6

Target leverage in booms

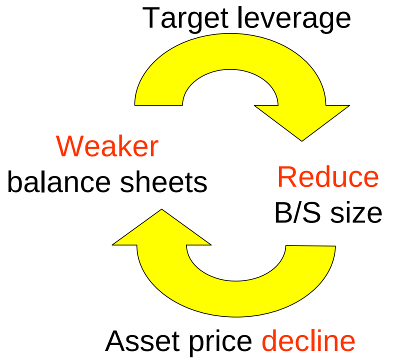


If we hypothesise that greater demand for the asset tends to put upward pressure on its price (a plausible hypothesis, it would seem), then there is the potential for a feedback effect in which stronger balance sheets feed greater demand for the asset, which in turn raises the asset's price and leads to stronger balance sheets. Figure 6 illustrates feedback during a boom.

The mechanism works exactly in reverse in downturns.

Graph 7

Target leverage in busts



If we hypothesise that greater supply of the asset tends to put downward pressure on its price, then there is the potential for a feedback effect in which weaker balance sheets lead to greater sales of the asset, which depresses the asset's price and leads to even weaker balance sheets. Figure 7 illustrates feedback during a downturn.

When the feedback between price and leverage is taken into account, the financial cycle may be amplified due to the procyclical leverage of financial intermediaries. We now turn to the empirical evidence to ascertain how the leverage of financial intermediaries varies with balance sheet size.

3. Evidence from investment bank balance sheets

We examine the quarterly changes in the balance sheets of five large investment banks, listed below in Table 1. The data is drawn from the Mergent database, which in turn is based on regulatory filings with the US Securities and Exchange Commission (SEC) on their 10-Q forms.

Table 1
Sample of investment banks

Name	**Sample**
Morgan Stanley	1997 Q2–2006 Q4
Merrill Lynch	1991 Q1–2006 Q4
Lehman Brothers	1993 Q2–2006 Q4
Goldman Sachs	1999 Q2–2006 Q4
Bear Stearns	1997 Q1–2006 Q4

Investment banks are closest to the ideal of having balance sheets that are continuously marked to market. Our choice of these five banks is motivated by our concern to examine "pure play" investment banks that are not part of a larger commercial banking group so as to focus attention on their behaviour with respect to the capital markets.[2] The stylised balance sheet of an investment bank is as follows.

Assets	Liabilities
Trading assets	Short positions
Reverse repos	Repos
Other assets	Long-term debt
	Shareholder equity

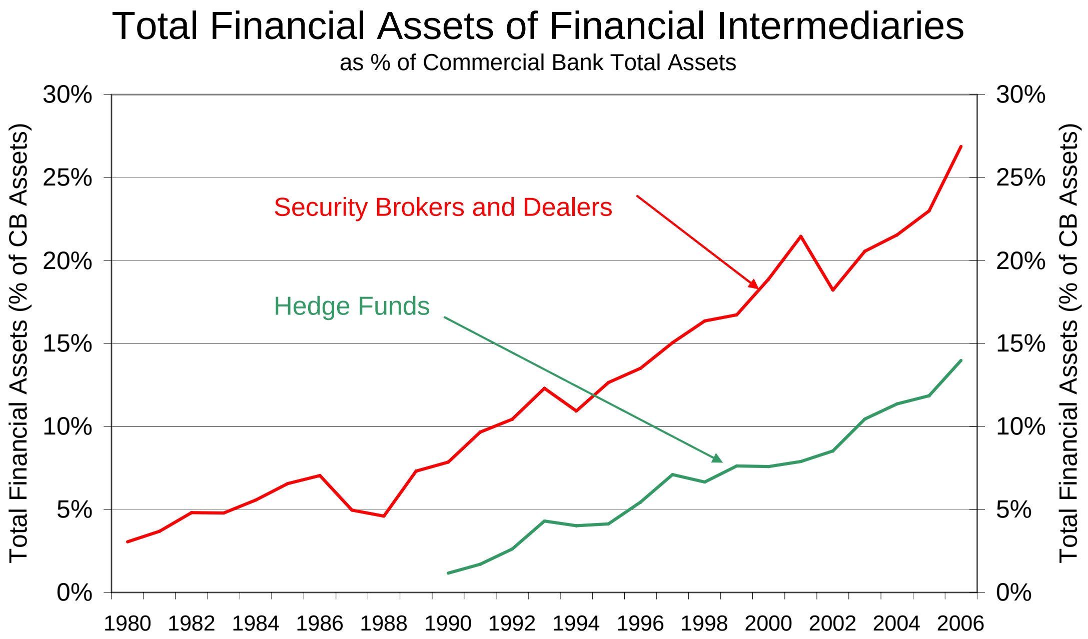
On the asset side, traded assets are valued at market prices or are short-term collateralised loans (such as reverse repos), for which the discrepancy between face value and market value

2 Hence, we do not include Citigroup, JP Morgan Chase, Credit Suisse, Deutsche Bank and other banking groups that have major investment banking operations.

are very small due to the very short-term nature of the loans. On the liabilities side, short positions are at market values, and repos are very short-term borrowing. We give more detailed descriptions of repos and reverse repos below. Long-term debt is typically a very small fraction of the balance sheet.[3] For these reasons, investment banks provide a good approximation of a balance sheet that is continuously marked to market, and hence provide insights into how leverage changes with balance sheet size. The second reason for our study of investment banks lies in their significance for the financial system.

Graph 8

Balance sheet size as proportion of commercial banks' balance sheets



Source:
Total financial assets of Security Brokers and Dealers are from table L.129 of the Flow of Funds, Board of Governors of the Federal Reserve.
Total financial assets of Bank Holding Companies are from table L.112 of the Flow of Funds, Board of Governors of the Federal Reserve.
Total Assets Under Management of Hedge Funds are from HFR.

Figure 8 plots the size of securities firms' balance sheets relative to that of commercial banks. We also plot the assets under management for hedge funds, although we should be mindful that "assets under management" refers to total shareholder equity, rather than the size of the balance sheet. To obtain total balance sheet size, we should multiply by leverage (which is estimated at approximately 2). Figure 8 shows that when expressed as a proportion of commercial banks' balance sheets, securities firms have been increasing their balance sheets very rapidly. Note that when hedge funds' assets under management are converted to balance sheet size by multiplying by the leverage of 2, the combined balance sheet of investment banks and hedge funds is over 50% of commercial banks balance sheets.

Size is not the only issue. When balance sheets are marked to market, the responses to price changes will entail responses that may be disproportionately large. LTCM's balance sheet was small relative to the total financial sector, but its impact would have been underestimated if only

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[3] The balance sheet of Lehman Brothers as of November 2005 shows that short positions are around a quarter of total assets, and long-term debt is an even smaller fraction. Shareholder equity is around 4% of total assets (implying leverage of around 25). Short-term borrowing in terms of repurchase agreements and other collateralised borrowing makes up the remainder.

size had been taken into account. Table 2 gives the summary statistics of the investment banks over the sample period.

Table 2
Summary statistics

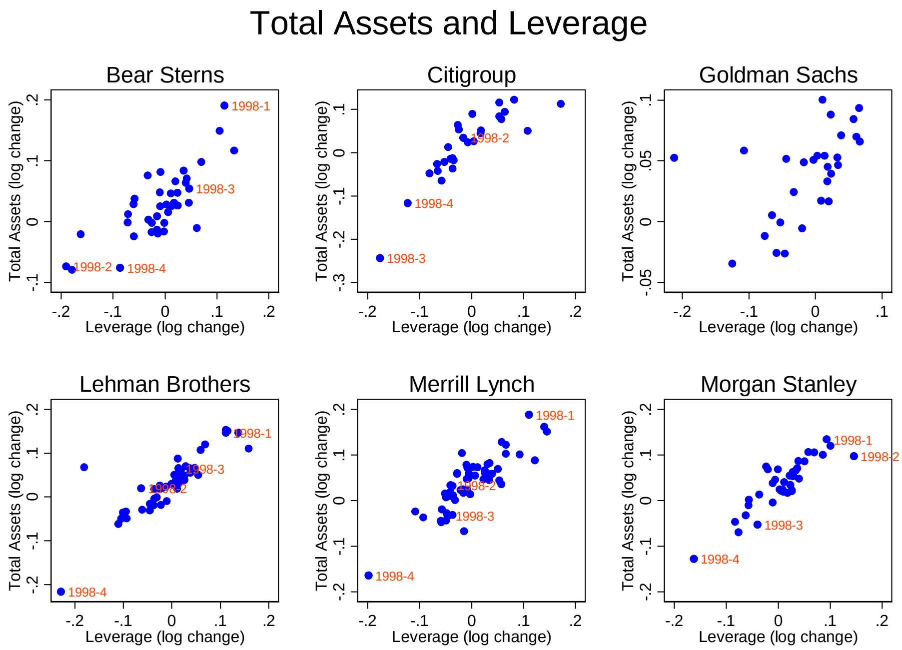
Panel A: US$ millions	Mean	Std dev	Min	Median	Max	Obs
Total assets	355,881	209,046	97,302	302,410	1,120,645	217
Assets (log lag)	341,771	200,254	93,111	2,903,11	1,085,215	216
Equity	14,412	9,381	2,979	12,003	39,038	216
Total collateralised lending	108,730	727,46	29,423	85,323	417,823	216
Total collateralised borrowing	141,853	82,278	34,216	119,362	474,497	217
Repos	96,196	52,806	27,476	89,625	267,566	178
Reverse repos	66,347	37,252	19,097	55,873	210,268	205
Trading VaR	50	28	11	43	159	114
Panel B: log changes	**Mean**	**Std dev**	**Min**	**Median**	**Max**	**Obs**
Total assets	3%	6%	–22%	4%	19%	213
Total liabilities	3%	6%	–22%	4%	19%	211
Equity	4%	4%	–7%	3%	26%	211
Total collateralised lending	3%	11%	–40%	3%	29%	211
Total collateralised borrowing	3%	9%	–30%	3%	25%	213
Repos	2%	12%	–37%	2%	31%	174
Reverse repos	2%	15%	–47%	2%	43%	200
Trading VaR	3%	15%	–54%	3%	56%	108

We begin with the key question left hanging in the previous section. What is the relationship between leverage and total assets? The answer is provided in the scatter charts in Figure 9. Note that we have included the scatter chart for Citigroup Global Markets (1998 Q1–2004 Q4) for comparison, although Citigroup is not included in the panel regressions reported below. The scatter chart shows the growth in assets and leverage at a quarterly frequency. In all cases, leverage is large when total assets are large. Leverage is procyclical.

There are some notable common patterns in the scatter charts, but also some notable differences. The events of 1998 are clearly evident in the scatter charts. The early part of the year saw strong growth in total assets, with the attendant increase in leverage. However, the third and fourth quarters of 1998 show all the hallmarks of financial distress and the attendant retrenchment in the balance sheet. For most banks, there were very large contractions in balance sheet size in 1998 Q4, accompanied by large falls in leverage. These points are on the bottom left-hand corners of the respective scatter charts, showing large contractions in the balance sheet and a decrease in leverage. Lehman Brothers and Merrill Lynch seem especially hard hit in 1998 Q4. However, there are also some notable differences.For instance, the major retrenchment for Citigroup Global Markets seems to have happened in the third quarter of 1998, rather than the final quarter of 1998. Such a retrenchment would be consistent with the closing-down of the former Salomon Brothers fixed income arbitrage desk on 6 July 1998 following the

Graph 9

Procyclical leverage



acquisition of the operation by Travelers Group (later, Citigroup). Many commentators see this event as the catalyst for the sequence of events that eventually led to the demise of Long Term Capital Management (LTCM) and the associated financial distress in the summer and early autumn of 1998.[4]

Table 3 shows the results of a panel regression for change in leverage. The negative relationship between the change in leverage and change in total assets is confirmed in the final column (column (v)) of Table 3. The coefficient on lagged leverage (ie previous quarter's leverage) is negative, suggesting that there is mean reversion in the leverage ratio for the banks. Leverage is positively related to short-term debt, repos and collateralised borrowing. Notice, however, that there is no relationship between leverage and *net* collateralised financing.

More interestingly, the regressions reveal which items on the balance sheet are adjusting when balance sheets expand and contract. In particular, the regressions show that the margin of adjustment in the expansion and contraction of balance sheets is through repos and reverse repos. In a repurchase agreement (repo), an institution sells a security while simultaneously agreeing to buy it back at a pre-agreed price on a fixed future date. Such an agreement is tantamount to a collateralised loan, with the interest on the loan being the excess of the repurchase price over the sale price. From the perspective of the funds lender – the party who buys the security with the undertaking to resell it later – such agreements are called reverse repos. For the buyer, the transaction is equivalent to granting a loan, secured on collateral.

Repos and reverse repos are important financing activities that provide the funds and securities needed by investment banks to take positions in financial markets. For example, a bank taking a long position by buying a security needs to deliver funds to the seller when the security is received on settlement day. If the dealer does not fully finance the security out of its own capital,

4 The official account (BIS (1999)) is given in the report of the CGFS of the Bank for International Settlements (the so-called "Johnson Report"). Popular accounts, such as Lowenstein (2000), give a description of the background and personalities.

Table 3

Regressions for the quarterly change in leverage

		Leverage (log change)				
		(i)	(ii)	(iii)	(iv)	(v)
Leverage (log lag)	coef p-value	–0.086 0.001***	–0.1 0.008***	–0.106 0.000***	–0.041 0.026**	–0.042 0.001***
Trading VaR (log change)	coef p-value		0.068 0.015**			
Repos (log change)	coef p-value			0.264 0.000***		
Collateralised financing (log change)	coef p-value				0.37 0.000***	
Total assets (log change)	coef p-value					0.904 0.000***
Constant	coef p-value	0.279 0.001***	0.319 0.008***	0.336 0.000***	0.12 0.043**	0.104 0.014**
Observations		211	108	174	211	211
Number of i		5	5	5	5	5
R-squared		5%	12%	33%	43%	66%
Fixed effects		yes	yes	yes	yes	yes

then it needs to borrow funds. The purchased security is typically used as collateral for the cash borrowing. When the bank sells the security, the sale proceeds can be used to repay the lender.

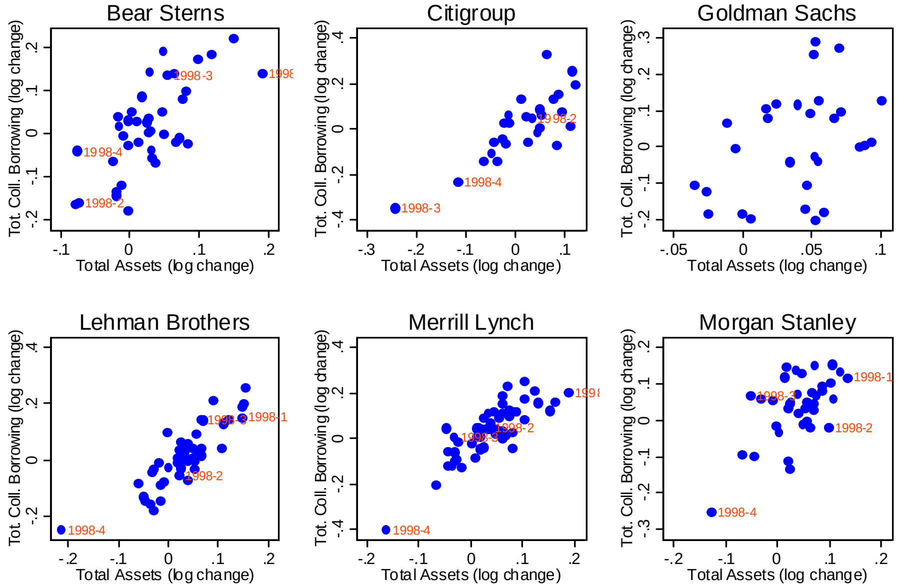
Reverse repos are loans made by the investment bank against collateral. The bank's prime brokerage business vis-à-vis hedge funds will figure prominently in the reverse repo numbers. The scatter chart gives an insight into the way in which changes in leverage are achieved through expansions and contractions in collateralised borrowing and lending. We saw in our section illustrating elementary balance sheet arithmetic that when a bank wishes to expand its balance sheet, it takes on additional debt, and with the proceeds of this borrowing it takes on more assets.

Figure 10 plots the change in assets against the change in collateralised borrowing. The positive relationship in the scatter plot confirms our panel regression finding that balance sheet changes are accompanied by changes in short-term borrowing.

Figure 11 plots the change in repos against the change in reverse repos. A dealer taking a short position by selling a security it does not own needs to deliver the security to the buyer on the settlement date. This can be done by borrowing the needed security, and providing cash or other securities as collateral. When the dealer closes out the short position by buying the security, the borrowed security can be returned to the securities lender. The scatter plot in Figure 11 suggests that repos and reverse repos play such a role as counterparts in the balance sheet.

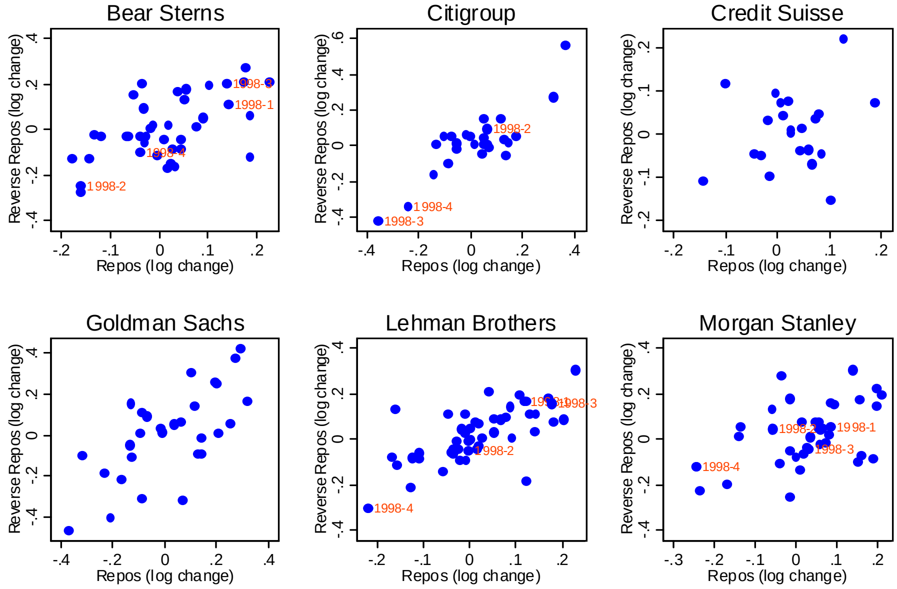
Graph 10

Collateralised borrowing growth and asset growth



Graph 11

Repos and reverse repos



4. Value-at-risk

Procyclical leverage is not a term that the banks themselves are likely to use in describing what they do, although this is in fact what they are doing. To get a better handle on what motivates the banks in their actions, we explore the role of value-at-risk (VaR) in explaining the banks' balance sheet decisions.

For a random variable W, the *value-at-risk* at confidence level c relative to some base level W_0 is defined as the smallest non-negative number x such that

$$\text{Prob}\,(W < W_0 - x) \leq 1 - c$$

For instance, W could be the total marked to market assets of the firm at some given time horizon. Then the value-at-risk is the equity capital that the firm must hold in order to stay solvent with probability c. Financial intermediaries publish their value-at-risk numbers as part of their regulatory filings, and also regularly disclose such numbers through their annual reports. Their *economic capital* is tied to the overall value-at-risk of the whole firm, where the confidence level is set at a level high enough (99.98%) to target a given credit rating (typically A or AA).

If financial intermediaries adjust their balance sheets to target economic capital, then we may conjecture that their disclosed value-at-risk figures would help to reconstruct their actions. Denote by V the value-at-risk per dollar of assets held by a bank. If the bank maintains capital K to meet total value-at-risk, then we have

$$K = V \times A \qquad (1)$$

where A is total assets. Hence, leverage L satisfies

$$L = \frac{A}{K} = \frac{1}{V}$$

Procyclical leverage then translates directly to *counter*cyclical nature of value-at-risk. Measured risk is low during booms and high during busts.

We explore the way in which the ratio of total value-at-risk to equity varies over time. Equation (1) suggests that it would be informative to track the ratio of value-at-risk to shareholder equity over time. The naive hypothesis would be that this ratio is kept constant over time by the bank. The naive hypothesis also ties in neatly with the regulatory capital requirements under the 1996 Market Risk Amendment of the Basel capital accord. Under this rule, the regulatory capital is 3 times the 10-day, 99% value-at-risk. If total value-at-risk is homogeneous of degree 1, then (1) also describes the *required* capital for the bank.

Table 4 presents the regressions for the quarterly change in the ratio of value-at-risk to equity. Value-at-risk numbers are those numbers that the banks themselves have reported in their 10-Q filings. For the reasons outlined above, the firm's self-assessed value-at-risk is closely tied to its assessment of economic capital, and we would expect behaviour to be heavily influenced by changes in value-at-risk.

We focus on the ratio of value-at-risk to equity. In the panel regressions, the lagged value-at-risk to equity ratio is strongly negative, with coefficients in the range of -0.5 to -0.6, suggesting rapid reversion to the mean. We take these as evidence that the banks use value-at-risk as a cue for how they adjust their balance sheets. However, the naive hypothesis that banks maintain a fixed ratio of value-at-risk to equity does not seem to be supported by the data. Column (ii) of Table 4 suggests that an increase in the value-at-risk to equity ratio coincides with periods when the bank increases its leverage. Value-at-risk to equity is procyclical, when measured relative to leverage. However, total assets have a negative sign in column (iv). It appears that value-at-risk to equity is procyclical, but total assets adjust down some of the effects captured in leverage.

The evidence points to an additional, procyclical risk appetite component to banks' exposures that goes beyond the simple hypothesis of targeting a normalised value-at-risk measure. Perhaps we should not be too surprised at the positive relationship between risk appetite and leverage. For an individual bank, such behaviour in the face of market movements may be an entirely natural and rational response. However, if large swathes of the financial system behave in this way, the spillover effects will be considerable. We now turn to the asset pricing consequences of such procyclical behaviour.

Table 4

Regressions for the change in value-at-risk to equity ratio

		Trading VaR/equity (log change)			
		(i)	(ii)	(iii)	(iv)
Trading VaR/equity (log lag)	coef	– – 0.614	– – 0.555	– – 0.615	– – 0.542
	p-value	0.000***	0.000***	0.000***	0.000***
Leverage (log change)	coef		0.913		1.645
	p-value		0.002***		0.000***
Total assets (log change)	coef			– – 0.044	– – 1.291
	p-value			0.9	0.009***
Constant	coef	– – 3.673	– – 3.323	– – 3.679	– – 3.204
	p-value	0.000***	0.000***	0.000***	0.000***
Observations		107	107	107	107
Number of i		5	5	5	5
R-squared		33%	39%	33%	44%
Fixed effects		yes	yes	yes	yes

5. Forecasting risk appetite

We now turn to the asset pricing consequences of balance sheet expansion and contraction. We have already noted how the demand and supply responses to price changes can become perverse when financial intermediaries' actions result in leverage that covary positively with the financial cycle. We exhibit empirical evidence that the waxing and waning of balance sheets have a direct impact on asset prices through the ease with which traders, hedge funds and other users of credit can obtain funding for trades.

So far, we have used quarterly data drawn either from the balance sheets of individual financial intermediaries or the aggregate balance sheet items from the flow of funds accounts. However, for the purpose of tracking the financial market consequences of balance sheet adjustments, data at a higher frequency is more likely to be useful. For this reason, we use the weekly data on the primary dealer repo and reverse repo positions compiled by the Federal Reserve Bank of New York.

Primary dealers are the dealers with whom the Federal Reserve has an ongoing trading relationship in the course of daily business. The Federal Reserve collects data that cover transactions, positions, financing, and settlement activities in US Treasury securities, agency debt securities, mortgage-backed securities (MBS), and corporate debt securities for the primary dealers. The data are used by the Fed to monitor dealer performance and market conditions, and are also consolidated and released publicly on the Federal Reserve Bank of New York website.[5] The dealers supply market information to the Fed as one of several responsibilities to maintain their primary dealer designation and hence their trading relationship with the Fed. It is worth noting that the dealers comprise an important but limited subset of the overall market.

5 www.newyorkfed.org/markets/primarydealers.html

Moreover, dealer reporting entities may not reflect all positions of the larger organisations. Nevertheless, the primary dealer data provide a valuable window on the overall market, at a frequency (every week) that is much higher than the usual quarterly reporting cycle.

At the close of buseness each Wednesday, dealers gather information on their transactions, positions, financing and settlement activities in the previous week. They report on US Treasury securities, agency debt securities, MBSs and corporate debt securities. Data are then submitted on the following day (that is, Thursday) via the Federal Reserve System's Internet Electronic Submission System. Summary data are released publicly by the Fed each Thursday, one week after they are collected. The data are aggregated across all dealers, and are only available by asset class (that is, Treasuries, agencies etc). Individual issue data, and individual dealer data, are not released publicly.

Repos and reverse repos are an important subset of the security financing data. The financing is reported on a gross basis, distinguishing between "securities in" and "securities out" for each asset class. "Securities in" refer to securities received by a dealer in a financing arrangement (be it against other securities or cash), whereas "securities out" refer to securities delivered by a dealer in a financing arrangement (be it against securities or cash). For example, if a dealer enters into a repo in which it borrows funds and provides securities as collateral, it would report securities out. Repos and reverse repos are reported across all sectors. The actual financing numbers reported are the funds paid or received. In the case of a repo, for example, a dealer reports the actual funds received on the settlement of the starting leg of the repo, and not the value of the pledged securities. In cases where only securities are exchanged, the market value of the pledged securities is reported.

We use the weekly repo and reverse repo data to forecast financial market conditions in the following week. Our measure of financial market conditions is the VIX index of the weighted average of the implied volatility in the S&P 500 index options. The VIX index has found widespread application in empirical work as a proxy for market risk appetite. Ang et al (2006) show that VIX innovations are significant pricing factors for the cross section of equity returns, and Bollerslev and Zhou (2007) show that the volatility risk premium – the difference between the VIX and realised volatility of the S&P 500 index – forecasts equity returns better than other commonly used forecasting variables (such as the P/E ratio or the term spread).

We use the daily VIX data from the website of the Chicago Board Options Exchange (www.cboe.com/micro/vix), and compute the S&P 500 volatility from daily data over 21 trading day windows, corresponding to the maturity of the options that are used for the VIX calculation. We compute the volatility risk premium as the difference between implied volatility and current volatility. This risk premium is closely linked to the payoff to volatility swaps, which are zero investment derivatives that return the difference between realised future volatility and implied volatility over the maturity of the swap (see Carr and Wu (2004) for an analysis of variance and volatility swaps). We then compute averages of the VIX and the variance risk premium over each week (from the close of Wednesday to the close of the following Tuesday).

We are able to forecast both the *level* of the volatility risk premium, as well as the *change* in the volatility risk premium from one week to the next. We believe the latter result (the ability to forecast the innovation in the volatility risk premium) to be very significant.

Our results are summarised in Table 5 and Table 6. Table 5 shows the forecast regressions for the level of the volatility risk premium at the weekly frequency. In columns (i) and (ii) of Table 5, we can see that when the level of the volatility risk premium is regressed on the growth in repos from week $t-1$ to week t, we obtain high significance, especially when the lagged level of volatility risk premium is included in the regression. Columns (iii) and (iv) of Table 5 show that the change in *reverse repos* plays a similarly informative role in forecasting the level of

Table 5

Forecasting volatility risk premium

		Volatility risk premium					
		(i)	(ii)	(iii)	(iv)	(v)	(vi)
Volatility risk premium	coef		0.704		0.703		0.700
(lag)	p-value		0.000***		0.000***		0.000***
Repos	coef	–0.146	–0.196				
(lagged growth rate)	p-value	0.009***	0.000***				
Reverse repos	coef			–0.091	–0.130		
(lagged growth rate)	p-value			0.047**	0.000***		
Net repos	coef					–0.061	–0.068
(lagged growth rate)	p-value					0.035**	0.001***
Constant	coef	4.788	1.428	4.778	1.422	4.782	1.437
	p-value	0.000***	0.000***	0.000***	0.000***	0.000***	0.000***
Observations		862	862	862	862	862	862
R-squared		0.8%	50.0%	0.5%	49.5%	0.5%	49.2%

the volatility risk premium. The R^2 of the forecasting regressions is low when either the repo or reverse repos are used in isolation, but reaches a level of 50% when used in conjunction with the lagged value of the volatility risk premium.

Table 6

Forecasting innovations in volatility risk premium

		Volatility risk premium (change)					
		(i)	(ii)	(iii)	(iv)	(v)	(vi)
Volatility risk premium	coef		-0.296		-0.297		-0.300
(lag)	p-value		0.000***		0.000***		0.000***
Repos	coef	-0.217	-0.196				
(lagged growth rate)	p-value	0.000***	0.000***				
Reverse repos	coef		-0.147	-0.130			
(lagged growth rate)	p-value		0.000***	0.000***			
Net repos	coef				-0.071	-0.068	
(lagged growth rate)	p-value				0.002***	0.001***	
Constant	coef	0.017	1.428	0.004	1.422	0.004	1.437
	p-value	0.855	0.000***	0.964	0.000***	0.965	0.000
Observations		862	862	862	862	862	862
R-squared		2.9%	17.3%	1.9%	16.4%	1.2%	16.0%

Table 6 shows the forecasting regressions for the *innovations* in the volatility risk premium. It demonstrates that the hypothesis of balance sheet expansions leading to asset pricing consequences are borne out by the data. Changes in repo and reverse repo positions are highly significant in forecasting the innovations in the volatility risk premium. In particular, when the lagged level in the volatility risk premium is included in the forecasting regression, the R^2 jumps to around 16%. Although 16% is much lower than the 50% or so for R^2 in the forecasting regression for *levels* of the volatility risk premium, it is notable that innovations in the volatility risk premium can be forecast with such a high level of significance. The economic rationale for the forecasting regressions presented here is that when balance sheets expand through the increased collateralised lending and borrowing by financial intermediaries, the newly released funding resources then chase available assets for purchase. More capital is deployed in increasing trading positions through the chasing of yield, and the selling of the "tails", as in the selling of out-of-the-money puts. If the increased funding for asset purchases results in the generalised increase in prices and risk appetite in the financial system, then the expansion of balance sheets will eventually be reflected in the asset price changes in the financial system – hence, the ability of changes in repo positions to forecast future risk appetite.

6. Related literature

The targeting of leverage seems intimately tied to the bank's attempt to target a particular credit rating. To the extent that the "passive" credit rating ought to fluctuate with the financial cycle, the fact that a bank's credit rating remains constant through the cycle suggests that banks manage their leverage actively, so as to shed exposures during downturns. Kashyap and Stein (2003) draw implications from such behaviour for the procyclical impact of the Basel II bank capital requirements.

Since balance sheets play a central role in our paper, our discussion here is related to the large literature on the amplification of financial shocks. The literature has identified two distinct channels. The first is the increased credit that operates through the *borrower's* balance sheet, where increased lending comes from the greater creditworthiness of the borrower (Bernanke and Gertler (1989), Kiyotaki and Moore (1998, 2001)). The second is the channel that operates through the *banks'* balance sheets, either through the liquidity structure of the banks' balance sheets (Bernanke and Blinder (1988), Kashyap and Stein (2000)), or the cushioning effect of the banks' capital (Van den Heuvel (2002)). Our discussion is closer to the latter group in that we also focus on the intermediaries' balance sheets. However, our discussions provided added insight into the way that marking to market enhances the role of market prices, and the responses that price changes elicit from intermediaries.

Our results also relate to the developing theoretical literature on the role of liquidity in asset pricing (Allen and Gale (2004), Acharya and Pedersen (2005), Brunnermeier and Pedersen (2005a, 2005b), Morris and Shin (2004), Acharya et al (2007)). The common thread is the relationship between funding conditions and the resulting market prices of assets. The theme of financial distress examined here is also closely related to the literature on liquidity drains, dealing with events such as the stock market crash of 1987 and the LTCM crisis in the summer of 1998. Gennotte and Leland (1990) and Geanakoplos (2003) provide analyses that are based on competitive equilibrium.

The impact of remuneration schemes on the amplifications of the financial cycle were addressed recently by Rajan (2005). The agency problem within a financial institution holds important clues to how we may explain procyclical behaviour. Stein (1997) and Scharfstein and Stein (2000) present analyses of the capital budgeting problem within banks in the presence of agency problems.

The possibility that a market populated with value-at-risk constrained traders may have more pronounced fluctuations has been examined by Danielsson et al (2004). Mark to market accounting may at first appear to be an esoteric question of measurement, but we have seen that it has potentially important implications for financial cycles. Plantin et al (2005) present a microeconomic model that compares the performance of marking to market and historical cost accounting systems.

7. Concluding remarks on aggregate liquidity

Aggregate liquidity can be understood as the rate of growth of aggregate balance sheets. When financial intermediaries' balance sheets are generally strong, their leverage is too low. The financial intermediaries hold surplus capital, and they will attempt to find ways in which they can employ their surplus capital. In a loose analogy with manufacturing firms, we may see the financial system as having "surplus capacity". For such surplus capacity to be utilised, the intermediaries must expand their balance sheets. On the liabilities side, they take on more short-term debt. On the asset side, they search for potential borrowers to whom they can lend. Aggregate liquidity is intimately tied to how hard the financial intermediaries search for borrowers. In the sub-prime mortgage markets in the United States we have seen that when balance sheets are expanding fast enough, even borrowers that do not have the means to repay are granted credit – so intense is the urge to employ surplus capital. The seeds of the subsequent downturn in the credit cycle are thus sown. In their study of Spanish banks, Jimenez and Saurina (2006) show that the loans granted during booms have higher default rates than those granted during leaner times.

In what sense is our notion of aggregate liquidity related to the traditional notion of liquidity as the money stock? In a financial system where deposit-taking banks are the only leveraged institutions, their liabilities can be identified with broad money. As such, the broad money stock would be a good indicator of the aggregate size of the balance sheets of leveraged institutions. To this extent, the growth of the money stock would play a useful role in signalling changes in the size of aggregate balance sheets.

Such a picture may have been a reasonably good description of the financial system in the first half of the 20th century, or in developing countries today. However, for market-oriented financial systems such as in the United States, we cannot so readily identify the money stock with the aggregate size of the liabilities of leveraged institutions. This is so for two reasons. First, many of the leveraged institutions (investment banks, hedge funds and others) do not conform to the textbook ideal of the deposit-funded bank. Hence, their liabilities are not counted as "money". Even for deposit-taking banks, not all items of liabilities qualify as money.

These points seem especially important for financial systems that rely on the capital market, rather than on the banking system. Perhaps the divergent empirical results between the United States and some European countries in terms of the role of money in financial cycles can be attributed to the much bigger role that the capital markets play in the United States.

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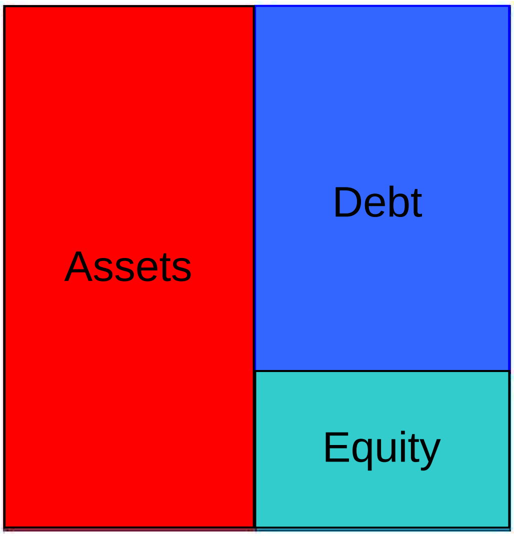
Comments on "Liquidity and financial cycles" by Tobias Adrian and Hyun Song Shin

Philipp M Hildebrand[1]

The paper presents some intriguing stylised facts about the behaviour of leverage and balance sheet size for households and various types of firms. By definition, the total value of assets is, of course, always equal to the total value of liabilities. Liabilities in turn are the sum of debt and equity (Figure 1). Given these relationships, the paper looks at the way these variables interact. Essentially, it poses the following question: if the value of total assets, ie the balance sheet size, changes, how does the composition of debt and equity change? Or, to put it differently, how does leverage, ie the ratio of debt to equity, change if total assets change?

Figure 1

Stylised balance sheet



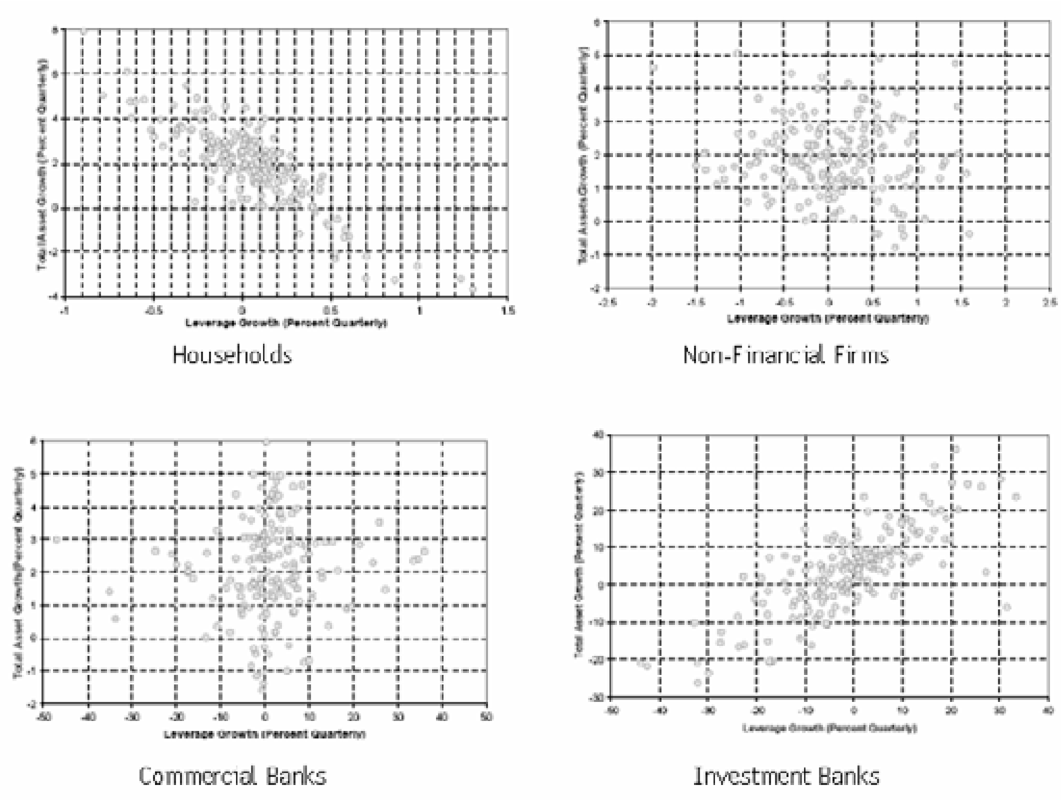
As it turns out, there appear to be a number of systematic relationships between the total value of assets and the degree of leverage. As you can see, this relationship is strikingly different for households and for various types of firms (Figure 2).

For households, leverage tends to decrease as total assets increase. For non-financial firms, no clear picture emerges. For banks, there is an interesting distinction between commercial and investment banks. For commercial banks, leverage is roughly independent of asset growth, ie independently of the change in the balance sheet size, leverage remains constant. For investment banks, however, the total values of assets and leverage increase and decrease together.

[1] Vice-Chairman, Swiss National Bank.

Figure 2

Relationship between changes in assets and changes in leverage



These stylised facts are surprising in the light of one of the most fundamental results in corporate finance, the Modigliani-Miller theorem, which tells us that the capital structure of firms is irrelevant.[2] In perfect markets, the composition of liabilities does not affect the value of a firm. Going back to my previous description of balance sheets, the mix between debt and equity and hence leverage are of no particular importance. Since the composition of liabilities is irrelevant, firms and households are said to be indifferent regarding the level of leverage, and no particular preference for either high or low leverage should be expected. By the same token, we would not expect any systematic relationships between changes in total assets and changes in leverage.

The data, however, clearly refute Modigliani and Miller's theorem. As Modigliani and Miller have pointed out themselves, markets aren't perfect.[3] There are at least two important imperfections: taxes, and costs of financial distress. Debt provides a "tax shield". Unlike dividends paid to equity holders, interest paid to lenders is a tax-deductible expense. Therefore, increasing the level of debt lowers the taxes paid by a firm and increases its after-tax payout to debt and equity holders. On the other hand, increasing the level of debt raises the probability of default and thereby the expected bankruptcy costs. In this simple trade-off

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[2] See Modigliani and Miller, "The cost of capital, corporation finance, and the theory of investment", *American Economic Review*, 1958, vol 53, pp 443–53.

[3] See also the seminal paper on the trade-off between debt and equity by Jensen and Meckling, "Theory of the firm: managerial behaviour, agency cost and ownership structure", *Journal of Financial Economics*, 1976, vol 3, pp 305–60. And for an extensive survey of the literature on capital structure, see Harris and Raviv, "The theory of capital structure", *Journal of Finance*, vol 46, pp 297–355.

theory, a firm will borrow up to the point where the marginal benefit of tax shields is equal to the marginal expected cost of financial distress.

These arguments suggest that there may be some relevance to capital structure after all. However, they do not explain the drastic differences in capital structure decisions between non-financial firms and banks. After all, similar tax and financial distress considerations apply to all types of firms. We would therefore expect them to behave similarly.

So why do banks behave so differently? To my knowledge, there is no single convincing explanation. Nonetheless, two reasons come to mind. First, a considerable share of banks' debt consists of demand deposits and other very short-term liabilities. Since depositors and other short-term creditors value the high liquidity of these claims, they are willing to accept a lower interest rate than they could receive by investing in less liquid assets. Due to this "liquidity premium", the marginal costs of (short-term) debt are lower for banks than for other firms.

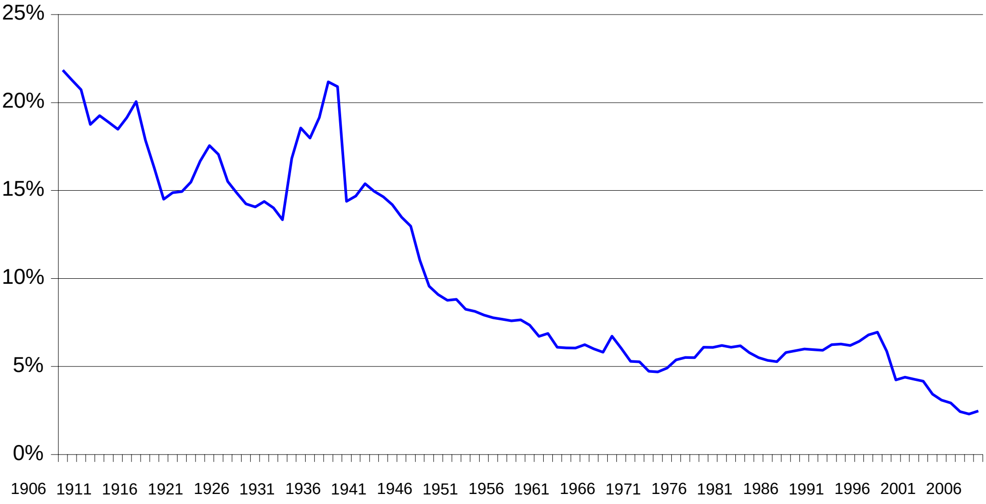
Second, banks' debt holders are protected with an extensive safety net. Thanks to (explicit) deposit insurance and (implicit) government guarantees, banks' debt is perceived to be relatively safe – independent of the banks' actual risk. This constitutes a sort of subsidy, which also contributes to a higher preference for debt by banks. Indeed, while there are obviously other factors that shape their capital structure, banks typically have very low capital ratios.

The ratio of capital to total assets for banks worldwide is typically well below 10%. For instance, the two big Swiss banks – which are well capitalised according to their risk-weighted capital ratios – have (unweighted) capital ratios below 3%. The following comparisons help to put these numbers into perspective:

- Typical capital ratios of firms that are listed on a stock exchange range between 30% and 40%.
- Historically, banks' (unweighted) capital ratios used to be much higher than they are now. Around 1900, for instance, the capital-to-total-assets ratios of the Swiss big banks were greater than 20% (Figure 3).
- Banks themselves usually consider their own borrowers creditworthy if these borrowers have minimal capital ratios in the order of 30%. Depending on other characteristics of borrowers, this limit may be higher or lower.

Figure 3

Capital ratio of big Swiss banks



These comparative figures illustrate that, as a percentage of their assets, banks' capital cushions are extraordinarily thin both from a historical perspective and when compared to other industries. In other words, capital appears to be much more expensive for banks than for other, non-financial firms. Obviously, given the low levels of leverage for non-financial firms, the cost of equity capital does not appear to be such a great concern for those firms.

By contrast, bank capital seems to be extremely expensive. Otherwise it would be difficult to explain the generally high leverage of internationally active banks, which typically ranges between 10 and 50.[4]

Why is bank capital apparently so expensive, in particular relative to the cost of capital for other, non-financial firms? One answer, to which I have already alluded, is that "banks are special". There may be some aspects of banking that in fact justify or even require banks to have very high leverage.

Another potential answer is less comforting. From an overall economic point of view, banks may tend to hold too little capital. Accordingly, their balance sheets may be characterised by an inefficiently high degree of leverage. Let me offer two explanations as to why this might be so.

First, banks fail to give attention to the negative externalities and costs to third parties that would occur if they went bankrupt. While this might be true for all firms, the bankruptcy externalities in banking are, arguably, particularly severe. These negative externalities include disruptions to the payments system and a general loss of confidence in the banking system (with possible contagious runs on other banks). The reduction of credit due to a banking crisis can slow economic growth and lead to costs in terms of reduced GDP.[5] It is true that banks themselves have an interest in holding capital in order to avoid bankruptcy and ensure their continued existence. Due to limited liability, however, they may neglect the consequences of their insolvency as described above, and therefore hold too little capital relative to the socially optimal amount that would take these costs into account.

Second, as I have mentioned before, banks have a preference for debt because they generally enjoy a quasi-subsidy on it. Deposit insurance and government guarantees tend to be underpriced. Part of the cost of these "safety nets" is typically borne by a deposit insurance company, the government, or ultimately the taxpayer. Since banks may therefore not take the true total cost of debt into account, they may have a tendency to borrow in excess of what is socially optimal.

Given the tendency of banks to opt for a high degree of leverage, it is particularly important for policymakers to remain vigilant now that "Basel II" is coming into effect: any reduction in banks' capital needs to be carefully monitored. Reductions in capital should accompany corresponding reductions in risk. Finally, policymakers should ensure that banks maintain capital cushions large enough to withstand a significant and sudden deterioration in financial and economic conditions.[6]

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[4] See Swiss National Bank, *Financial Stability Report 2007*, p 29.

[5] For some recent estimates of the costs of banking crises, see Boyd, Kwak and Smith, "The real output losses associated with modern banking crises", *Journal of Money, Credit, and Banking*, vol 37, pp 977–99.

[6] See also T Geithner, "Liquidity risk and the global economy", remarks at the Federal Reserve Bank of Atlanta's 2007 Financial Markets Conference, June 2007.

Discussion of “Liquidity and financial cycles”

Mary E Barth[1]

Introduction

It is my pleasure to discuss “Liquidity and financial cycles” by Tobias Adrian and Hyun Shin.[2] It is a very interesting paper and I learned much from reading it. The paper states three objectives. The first is to document the relationship between balance sheet size and procyclical leverage for financial intermediaries using mark to market accounting. The second is to outline aggregate consequences of procyclical leverage, and to document that expansions and contractions of balance sheets have asset pricing implications. The third is to shed light on the concept of liquidity. Because I am an accountant, my discussion focuses on the inferences the paper draws about accounting. That is, my focus is on the first and second of the paper’s objectives, and not the third.

Don’t blame the accountants

In my view, the paper makes a clear case that mark to market, ie economic, leverage is procyclical. It goes on to suggest that procyclical leverage is a problem for financial market regulators. I accept that as fact. However, the paper implies that mark to market accounting is at least in part the cause of procyclical leverage effects. For example, the paper states that even though mark to market accounting may at first appear to be an esoteric question of measurement, we have seen that it has potentially significant implications for financial cycles. As an accountant, I believe that accounting is important. But I feel compelled to object, on behalf of my professional colleagues, to being blamed for procyclical leverage.

The link in the paper between financial reporting leverage and economic leverage is the assumption that financial intermediaries have incentives to maintain constant financial reporting leverage. Unfortunately, the paper offers little support for this assumption. I accept that financial intermediaries probably aim for optimal capital structures, taking into consideration solvency and credit ratings. But it seems that economic, not accounting, factors would be the first-order determinants of these decisions. The paper does not test for determinants of procyclical effects either – the tests are only of associations. Thus, drawing causal inferences between financial reporting and procyclical leverage is beyond what the paper can do. I would conjecture that such causal inferences would be difficult to obtain. Thus, financial market regulators need to look beyond financial reporting to solve this problem.

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[1] Stanford University, International Accounting Standards Board. I thank Leslie Hodder for helpful comments and suggestions. The views expressed in this paper are those of the author. Official positions of the International Accounting Standards Board on accounting matters are determined only after extensive due process and deliberation

[2] This discussion is based on the 5 June 2007 conference version of the paper.

Questions on model assumptions

The paper's main message is that financial intermediaries' economic leverage is procyclical, which could be a problem for the financial system. This message is clear from the analysis. However, the paper would be stronger if the assumptions underlying the analysis were more clearly explained and supported.

The analysis seems to be based on a standard contracting argument. Financial intermediaries take real economic actions, ie changing economic leverage, to meet contractual targets, ie leverage ratios. These real actions are costly and bad for the economy. The link to accounting is that the contractual target is based on financial reporting leverage. Mark to market accounting decreases (increases) financial reporting leverage when the economy is contracting (expanding), relative to historical cost-based accounting. To maintain financial reporting leverage at its contractual optimum, financial intermediaries take actions to increase (decrease) leverage when the economy expands (contracts). These actions are procyclical. This is the sense in which the paper portrays mark to market accounting as a problem for the financial system.

The maintained assumption is that change in financial reporting leverage drives financial intermediaries' actions, rather than change in economic leverage. That is, the analysis assumes that without a change in financial reporting leverage, financial intermediaries would take no action when economic leverage changes. This is because financial intermediaries are focused on their credit ratings and credit rating agencies look to financial reporting leverage. This is similar to saying that in the absence of a contracting constraint, investors are not inclined to adjust their investment portfolio when price appreciation or depreciation changes their proportionate asset mix. It is unclear what set of economic circumstances would make this assumption descriptively valid.

The key question is why would financial intermediaries target a financial reporting, not economic, leverage ratio? One would hope that financial reporting reflects economics – that is what accountants strive to do. But, at present, we do not recognise all assets and liabilities at market value. Thus, financial reporting leverage differs from economic leverage. One would hope that financial intermediaries would manage economic leverage, not financial reporting leverage, unless there were specific incentives to do so. As noted above, I am not persuaded by the incentives specified in the paper. Also, why would changing accounting amounts be directly linked to managing value-at-risk, unless accounting amounts were stated at current value? Why would financial intermediaries care about accounting return on equity? If financial intermediaries target financial reporting leverage ratios and constantly adjust their actions to maintain the target, why do we observe yearly mean reversion in reported leverage ratios? Given the availability of short-term financial instruments, like repurchase agreements and reverse repurchase agreements, why is it that financial intermediaries' leverage ratios are not essentially always at the target? It is not clear that the value-at-risk findings in Table 4 are consistent with financial intermediaries managing to a target financial reporting leverage ratio. How do these findings relate to the assumption that they do?

There are three other assumptions that raise questions, although it is not clear whether these assumptions are key to the paper's inferences. The first is the assumption that financial intermediaries manage leverage by managing debt. Financial reporting leverage ratios depend on assets, equity and debt. Why wouldn't financial intermediaries adjust their investments in assets, or issue or repurchase equity? The second is the assumption that credit rating agencies do not alter their analysis if the data change. For example, the assumption does not permit credit rating agencies to adapt their analysis if financial reporting is based on historical cost or mark to market accounting – the assumption is that the agencies simply take the reported numbers as given. I suspect that credit rating agencies are more sophisticated than this. The third is the assumption is that asset supply does not change with a change in the economic cycle. Do we observe increases in mortgage originations to first-time homeowners when real estate prices rise? What happens if this assumption is relaxed?

Questions on empirical analyses

The paper offers a series of empirical results. However, they are difficult to interpret. I find it difficult to interpret plots, and some of the details of the regression analyses are unreported. For example, it is unclear how the analysis deals with the effects of non-comparable accounting amounts. The paper refers to book values and market values seemingly interchangeably. The example of the homeowner is in terms of market values, yet the data for non-financial firms are from their financial statements, which means they are primarily based on historical cost. This raises the question of whether the lack of relation in Figure 2.3 is attributable to using historical cost-based amounts instead of market values. Moreover, assets of commercial banks are primarily reported at market value, but their liabilities are primarily reported at amortised historical cost. Thus it is difficult to interpret Figure 2.4. It is also unclear how the analysis deals with the effects on test statistics of cross-sectional and intertemporal correlation of regression residuals. The paper notes that the regressions are based on panel data, estimated with fixed effects. But it does not specify which effects – firm or time? What about the effects of other correlations?

Interestingly, despite the fact that the paper implies that accounting is at least in part to blame for procyclical leverage, the empirical analysis leaves the impression that accounting is mostly irrelevant. This is due to the fact that the empirical analysis is based on firms selected intentionally because the difference between historical cost and market value at any balance sheet date is immaterial. If a concern is the role of accounting in procyclical leverage, why not compare firms for which the accounting is different? For example, we could compare investment banks, which primarily use mark to market accounting for their assets and liabilities, and non-financial firms, which primarily use historical cost-based amounts. If accounting plays a role, we should not observe procyclical leverage for the non-financial entities, but should observe it for investment banks. Alternatively, why not test for differences in leverage before and after a change to a fair value accounting standard? We should observe procyclical leverage after the implementation of the standard, but not before. Why not compare economic booms to economic busts? The accounting differs for economic upturns and economic downturns in a way that could be related to the paper's research question. In particular, we impair assets in downturns, but do not write them up in upturns. Thus, in downturns accounting amounts are much closer to mark to market amounts. This is not the case in upturns. If mark to market accounting plays a role in causing procyclical leverage, we would expect to observe procyclical leverage in downturns but not upturns.

What should financial market regulators do?

The key problem the paper identifies is that mark to market, ie economic, leverage is procyclical. However, procyclical leverage is not caused by mark to market accounting. Rather, mark to market accounting reveals it. Thus, if procyclical economic leverage is a problem for the financial system, financial market regulators need to focus on how to deal with the undesirable procyclical effects. I am not a financial market regulator and thus I will not attempt to advise them on what to do. However, the paper suggests some potential remedies.

First, regulators should ensure that financial intermediaries manage their economic capital structures. Doing so would eliminate any perverse effects stemming from managing financial reporting leverage when this is not the same as economic leverage. Second, regulators should support financial reporting based on mark to market accounting. Financial reporting can help regulators by requiring financial intermediaries to prepare financial statements using mark to market accounting. In that way, regulators have ready access to a measure of economic leverage. Without mark to market accounting, financial reporting could mask the information on which financial intermediaries and their regulators should focus. Third, regulators should specify different capital requirements depending on where we are in the economic cycle. To counteract procyclical leverage, this would mean increasing capital requirements during expansions and decreasing them during contractions. However, regulators might want a more general equilibrium analysis than that offered in the paper before being willing to take such actions. Undoubtedly, there are more possible remedies, but I will leave these to regulators to determine.

Concluding remarks

This is a very interesting paper. It makes clear that procyclical leverage is a potential concern for financial market regulators. It suggests some possible remedies. Although the paper implies that mark to market accounting is at least in part to blame for procyclical leverage, I take a different view. I submit that financial reporting is not an enemy; it can be an ally. By using mark to market accounting, financial reporting can better reveal financial intermediaries' economic financial position and leverage. Managers of financial intermediaries and financial market regulators can then focus on financial intermediaries' economic actions, not their financial reporting actions.