Liquidity and Financial Cycles*

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*The views expressed in this presentation are those of the authors and do not necessarily represent those of the Federal Reserve Bank of New York or the Federal Reserve System.

Marking to Market and Changes in Net Worth

- Consider world where balance sheets are continuously marked to market.
  - Price changes show up immediately as changes in net worth
- What are the reactions to changes in net worth?
- What are the aggregate consequences to such reactions?

Three Objectives of This Paper

- Document evidence on the behavior of financial intermediaries
  - Leverage is strongly pro-cyclical
  - Margin of adjustment is in collateralized borrowing/lending (repos and reverse repos)
- Show that such behavior has aggregate consequences for risk appetite
  - Balance sheet changes forecast shifts in risk appetite (VIX index)
- Shed light on "liquidity" as change in aggregate balance sheets

Shedding Light on "Liquidity"

- Asset price booms often linked to "liquidity" in financial system
- Suggestive metaphors, such as
  - *"Awash with liquidity", The Economist, February 3rd 2005.*
  - *"Liquidity sloshing around", Reuters, July 26th 2006.*

We propose a definition of liquidity in this context in terms of balance sheets of financial intermediaries.

Basic Balance Sheet Arithmetic: Passive Investor

- Household balance sheet

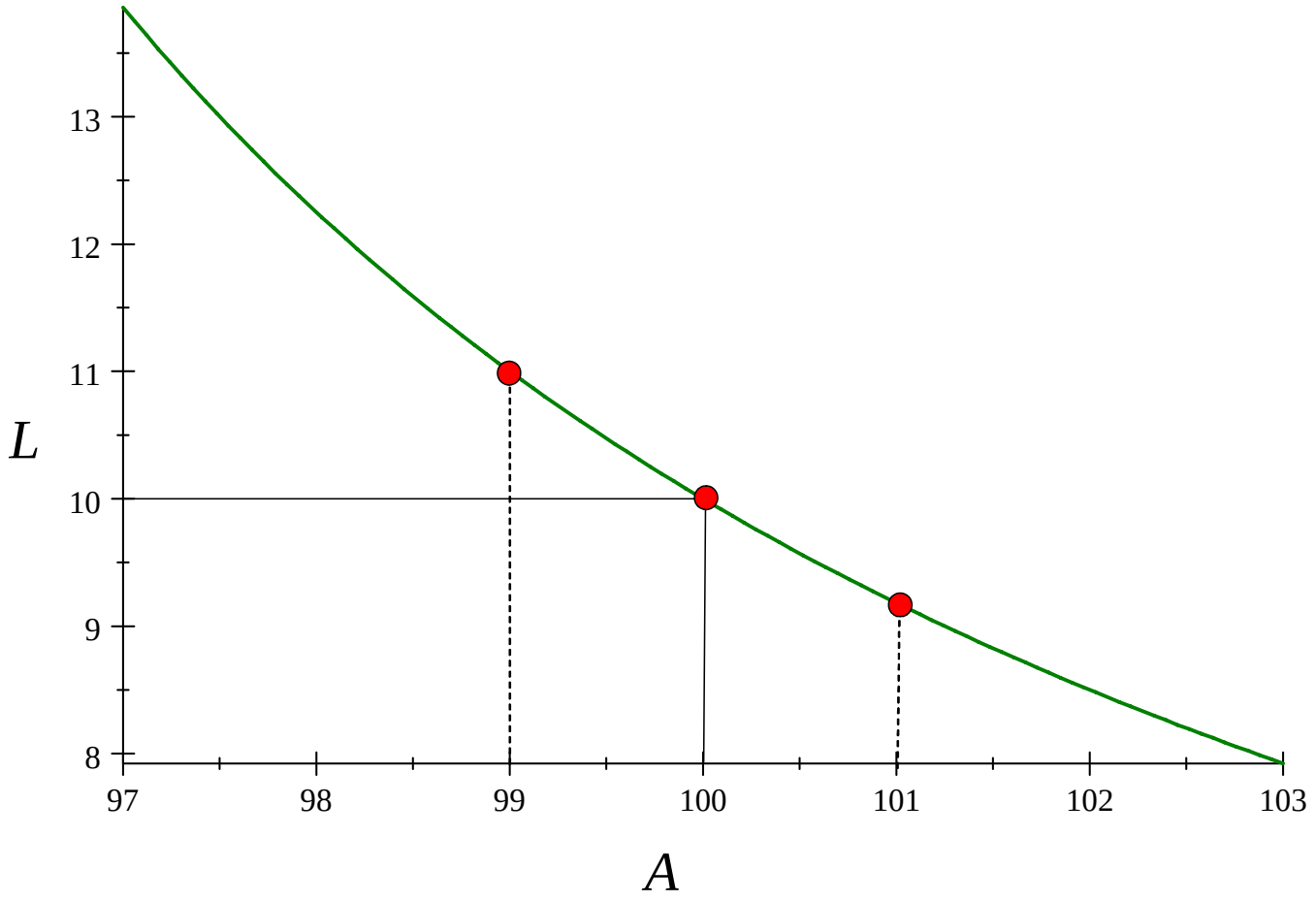
Assets	Liabilities
House, 100	Equity, 10 Mortgage, 90

$$\text{Leverage} = \frac{\text{Assets}}{\text{Equity}} = 10$$

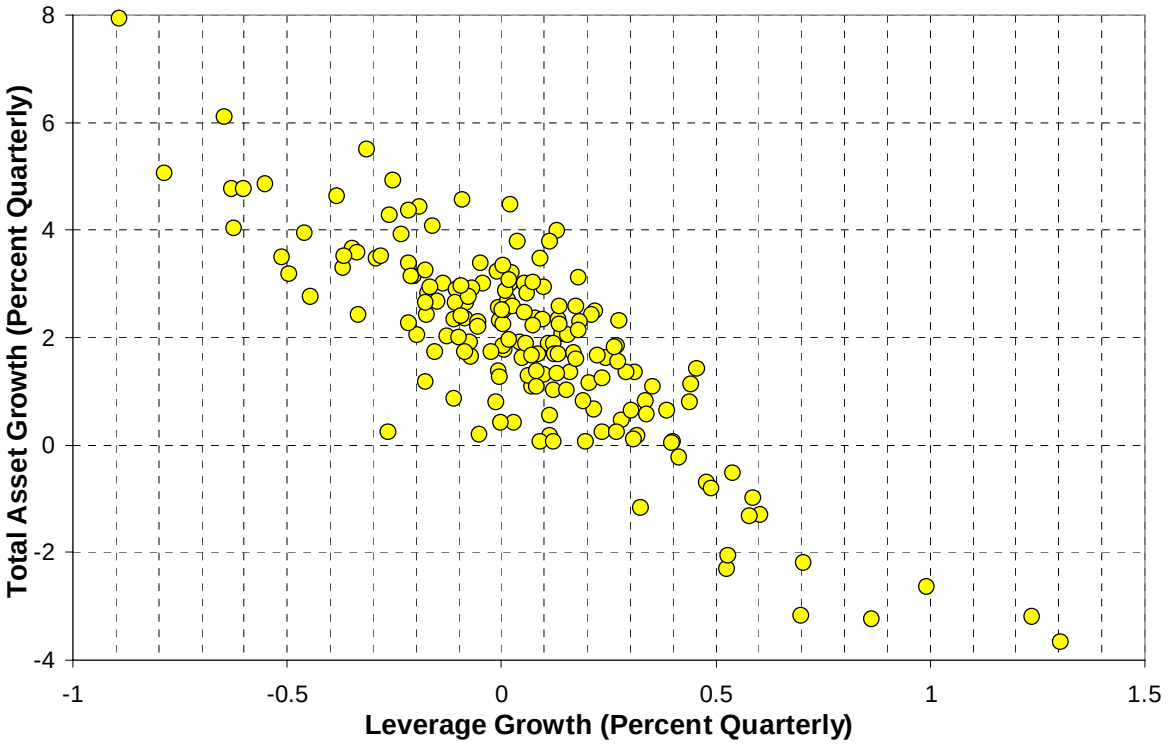
- Assume that the market value of debt is constant at 90.

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

- Leverage is inversely related to total assets:

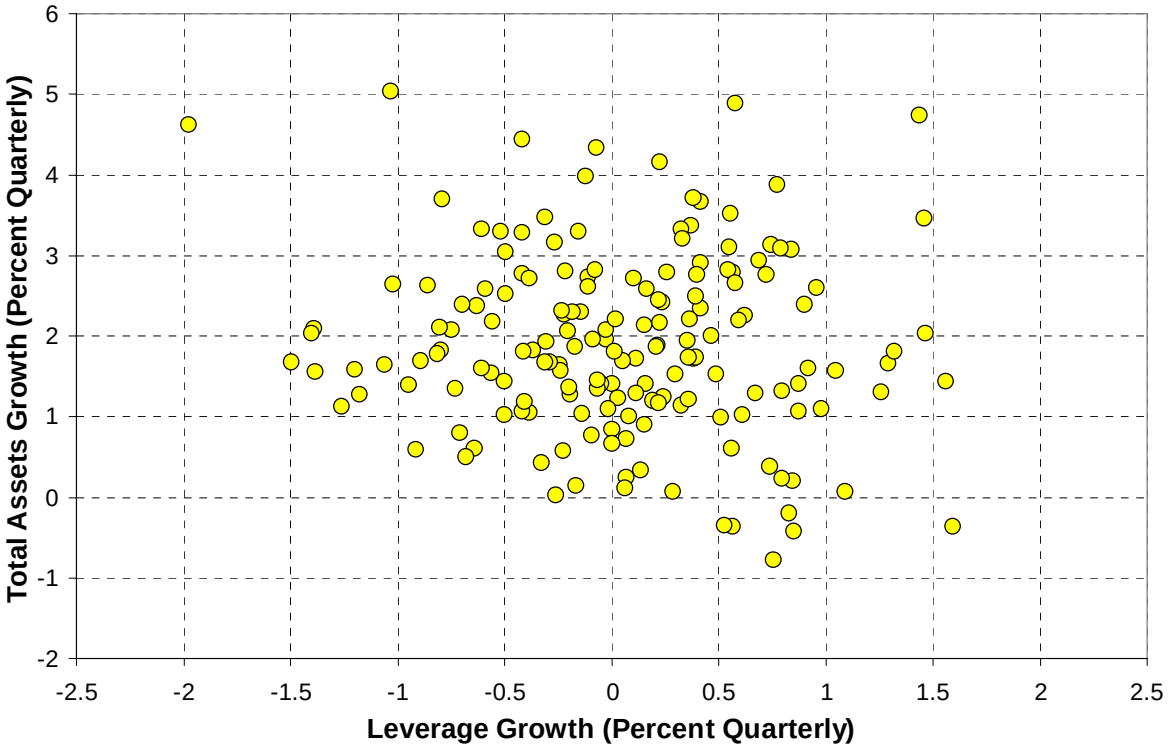


Balance Sheet Size and Leverage: Households



U.S. Flow of Funds (1963 - 2006)

Non-Financial, Non-Farm Corporations



U.S. Flow of Funds, 1963 - 2006

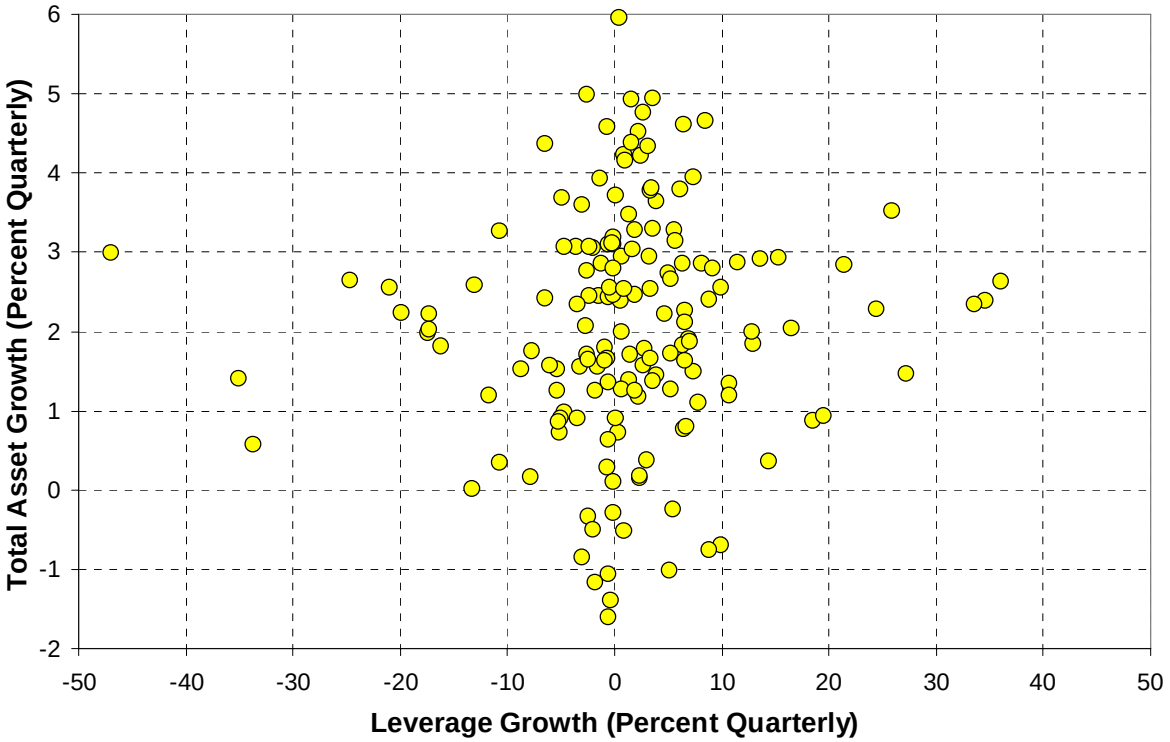
Financial Institutions

Financial institutions *actively manage balance sheets* so as

- to meet value at risk or economic capital targets
- to meet performance measures such as return on equity (ROE).
- to hit desired credit ratings
- meet regulatory requirements

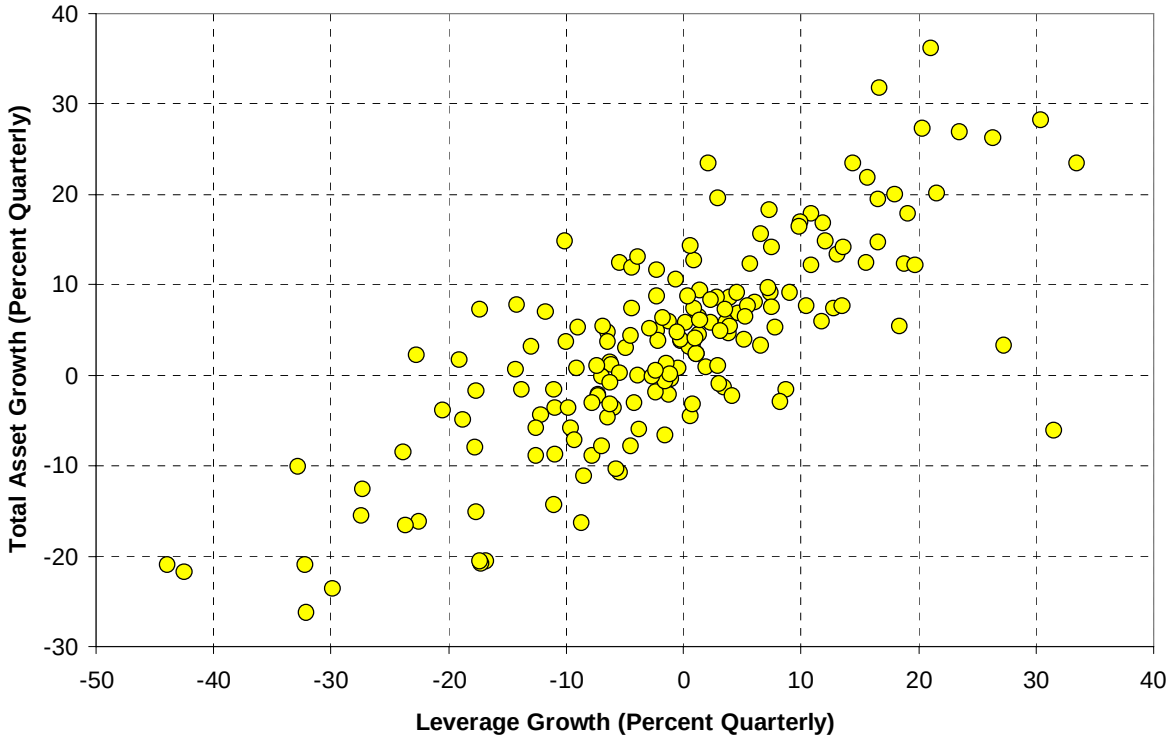
What are the consequences?

Commercial Banks



U.S. Flow of Funds (1963 - 2006)

Security Dealers and Brokers



U.S. Flow of Funds (1963 - 2006)

Targeting Constant Leverage

Initial balance sheet

Assets	Liabilities
Securities, 100	Equity, 10
	Debt, 90

Assume price of debt approximately constant. Suppose the security price increases by 1% to 101.

Assets	Liabilities
Securities, 101	Equity, 11
	Debt, 90

Leverage falls to

$$\frac{101}{11} = 9.18$$

If bank targets **constant leverage**, 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 $D = 9$. In other words, the bank takes on additional debt worth 9, and with this money purchases securities worth 9.

The demand curve is upward-sloping.

The new balance sheet looks like this.

Assets	Liabilities
Securities, 110	Equity, 11
	Debt, 99

The leverage is now back up to 10.

The mechanism works in reverse, too. Suppose there is shock to the security price so that

Assets	Liabilities
Securities, 109	Equity, 10
	Debt, 99

Leverage is too high $(109/10 = 10.9)$.

Sell securities worth 9, paydown debt of 9.

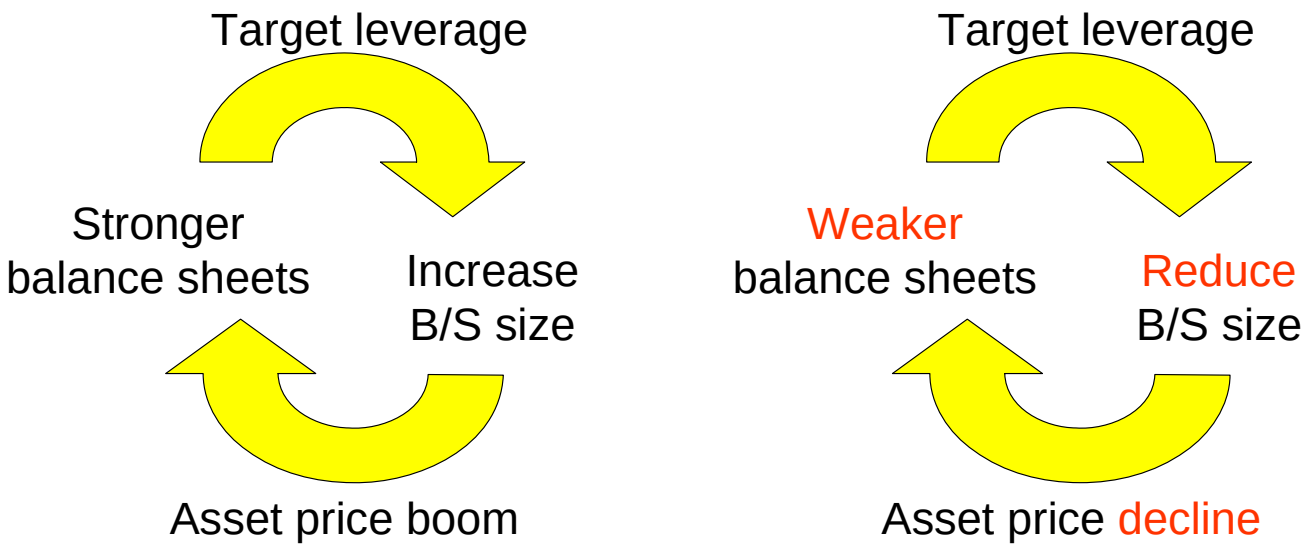
Assets	Liabilities
Securities, 100	Equity, 10
	Debt, 90

Back to leverage of 10.

Supply curve is downward-sloping.

What is the aggregate impact of perverse demand and supply curves?

Aggregate Impact



If leverage is procyclical, then amplifying effect is that much larger.

Wall Street Investment Banks

Why investment banks?

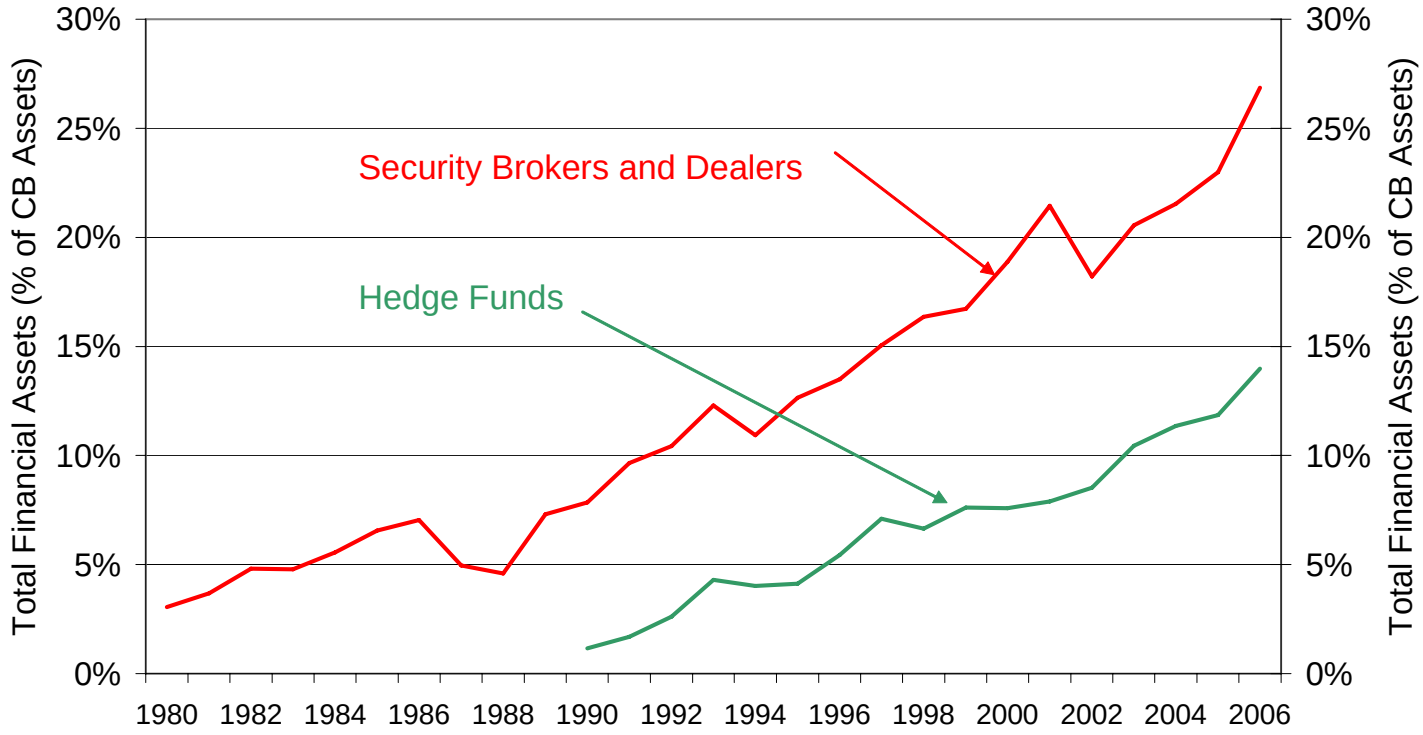
- Their balance sheet is very close to the ideal of being continuously marked to market.
  - Stylized balance sheet of an investment bank:

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

- They are a significant part of financial system, both in quantities and impact through prices

Total Financial Assets of Financial Intermediaries

as % of Commercial Bank Total Assets



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.

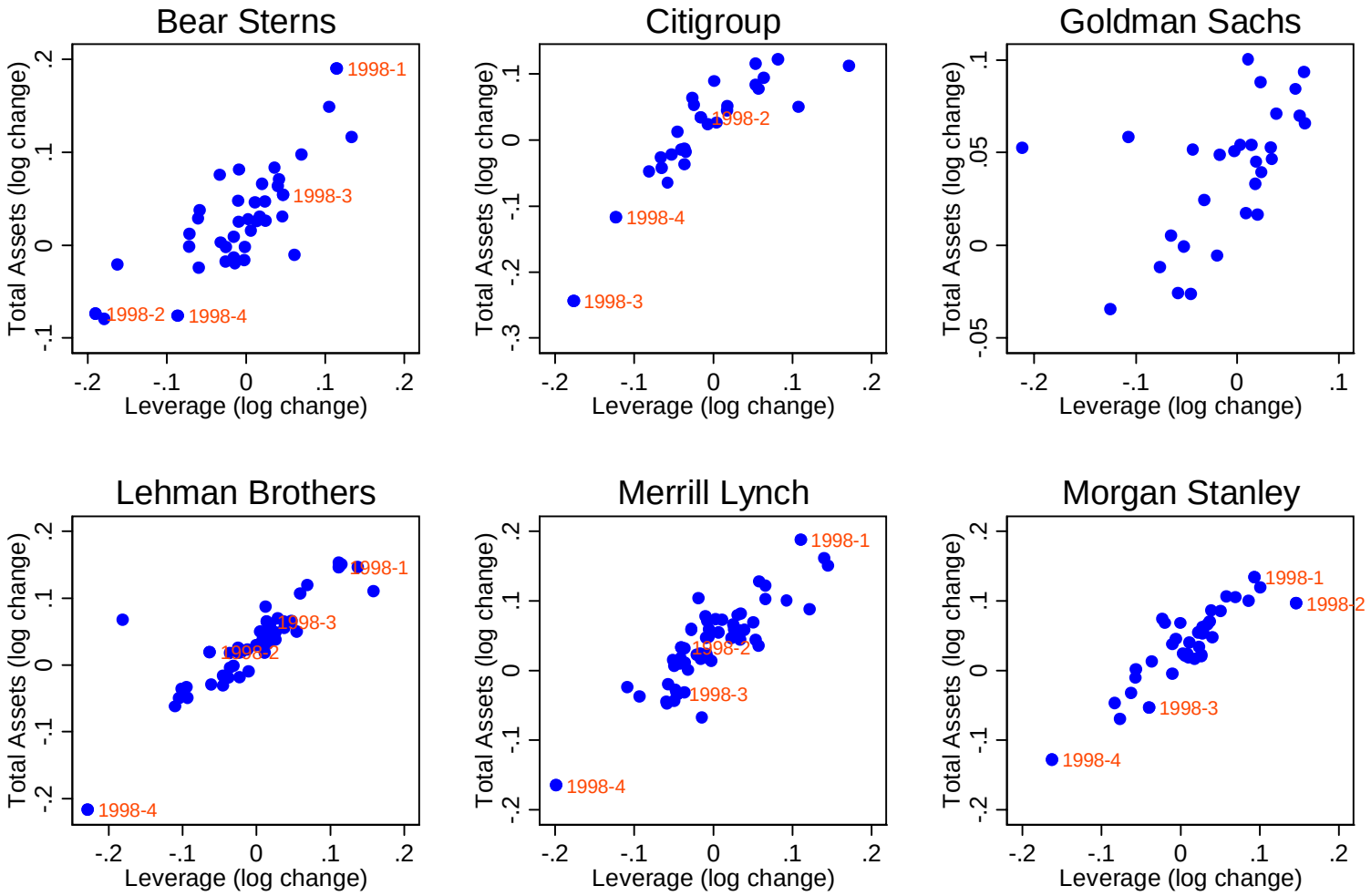
Sample

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

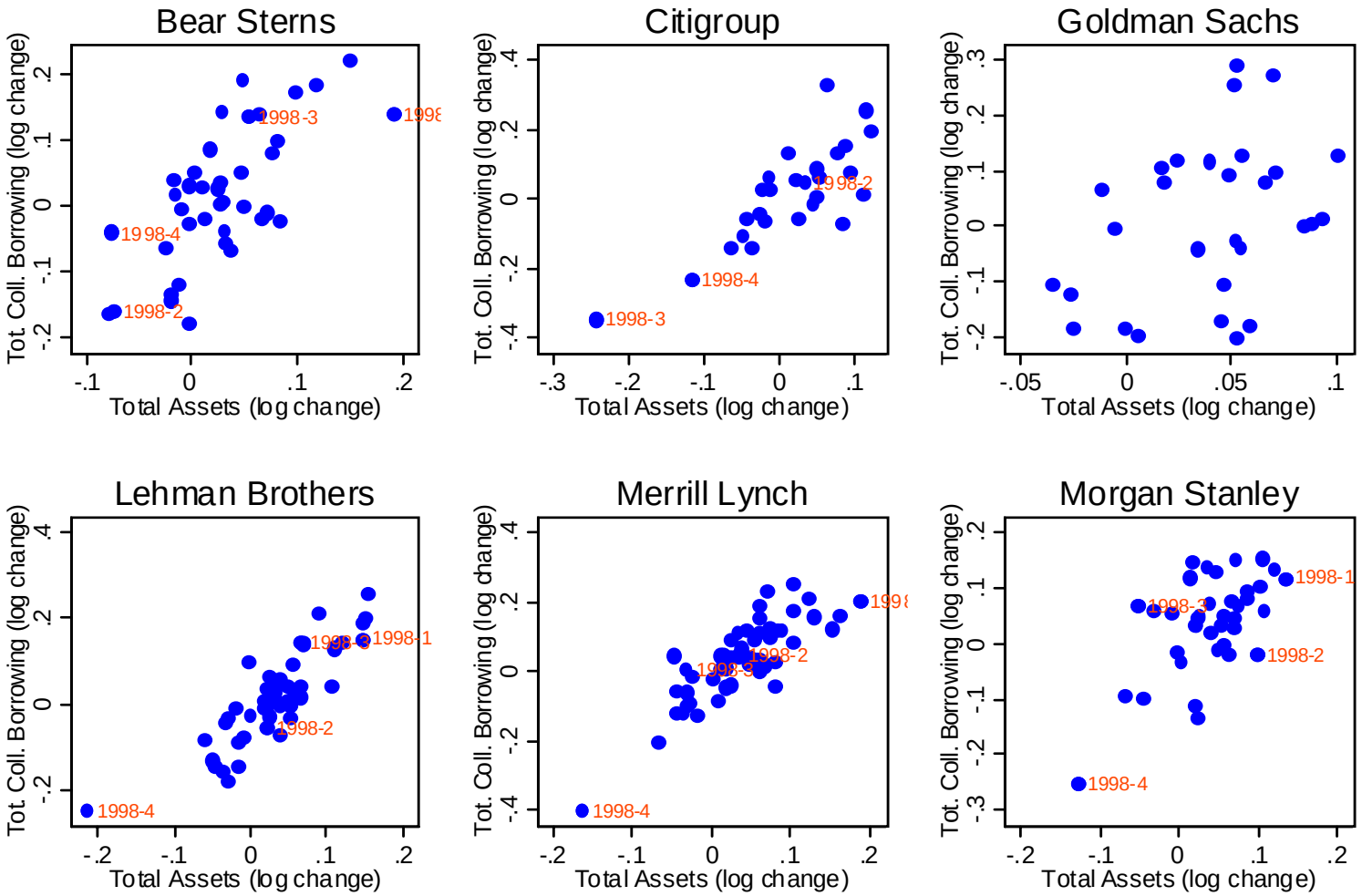
These banks are "pure play" stand alone investment banks, not part of larger commercial banking group.

Panel regressions use these five banks.

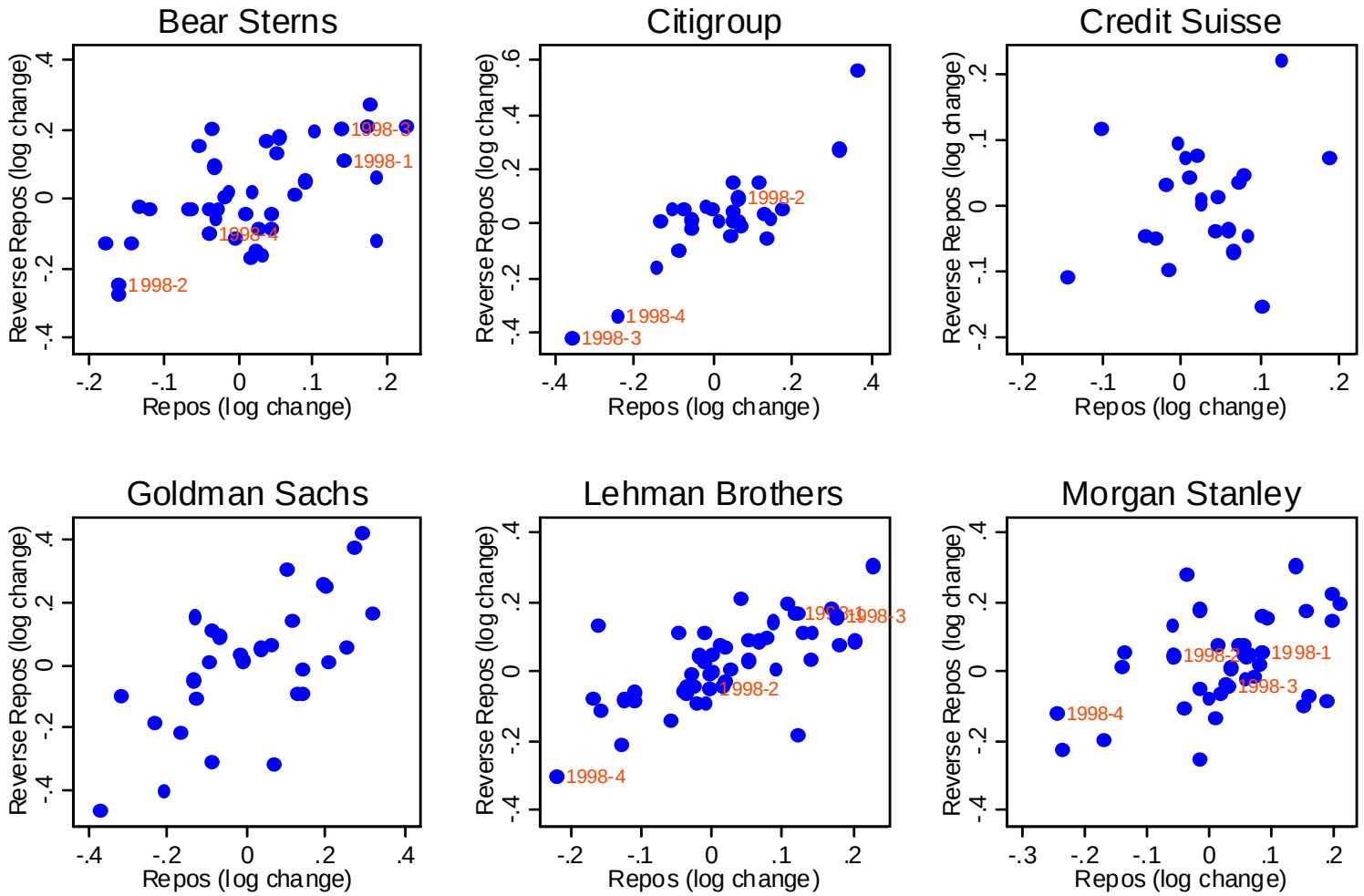
Total Assets and Leverage

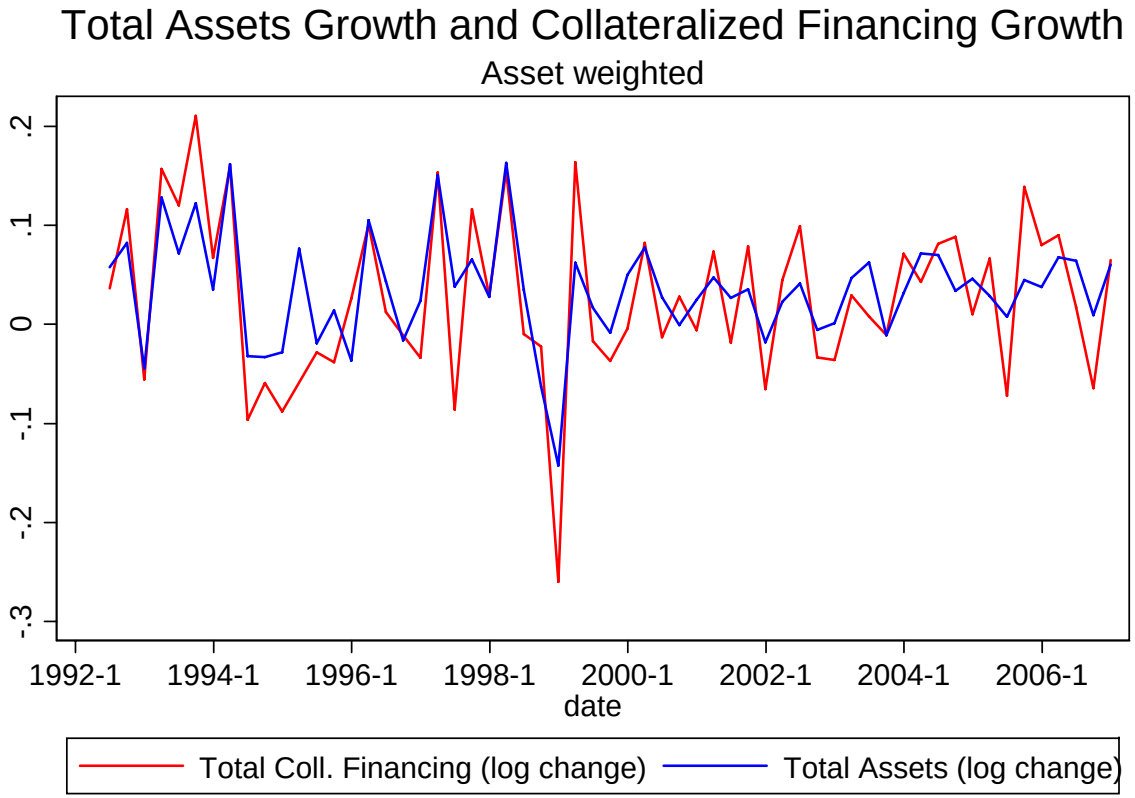


Total Repos and Total Assets



Total Repos and Reverse Repos




Total Assets Growth and Collateralized Financing Growth
Asset weighted
.2
.1
0
-.1
-.2
-.3
1992-1
1994-1
1996-1
1998-1
2000-1
2002-1
2004-1
2006-1
date
Total Coll. Financing (log change)
Total Assets (log change)

Value at Risk

Economic capital K meets total value at risk

$$K = V \times A$$

A is total assets

V is value at risk per dollar of assets.

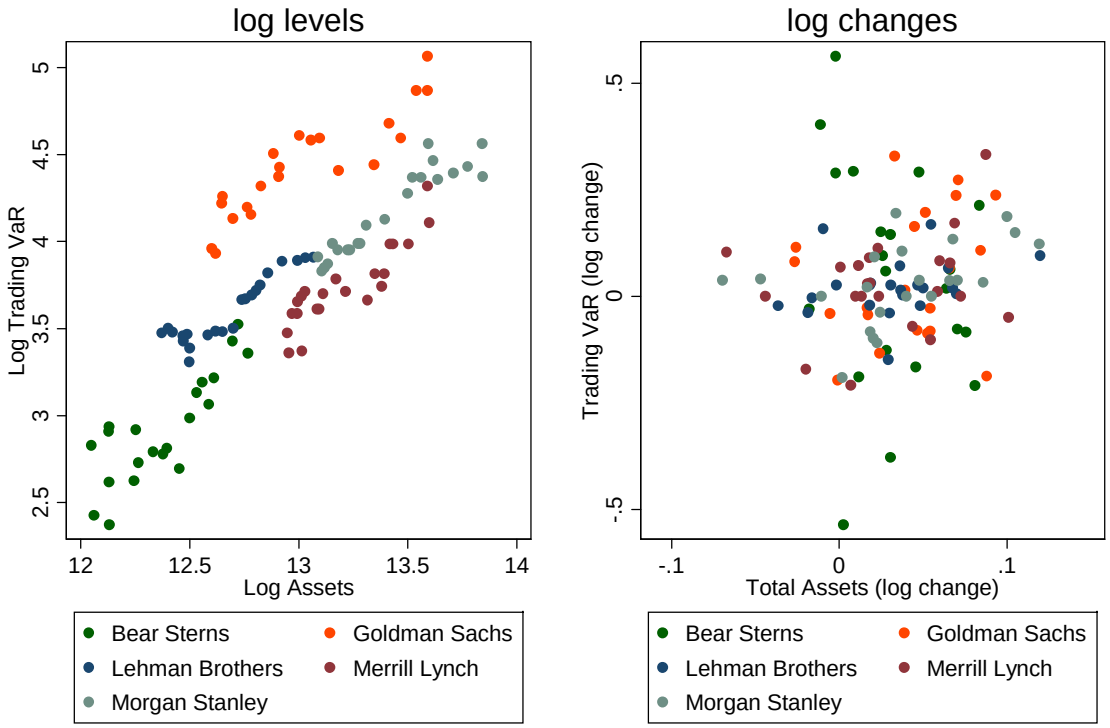
Leverage L satisfies

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

Procyclical leverage arise from *counter*-cyclical nature of value at risk.

Measured risk is low during booms and high during busts.

Trading VaR and Total Assets



Aggregate Impact on Risk Appetite

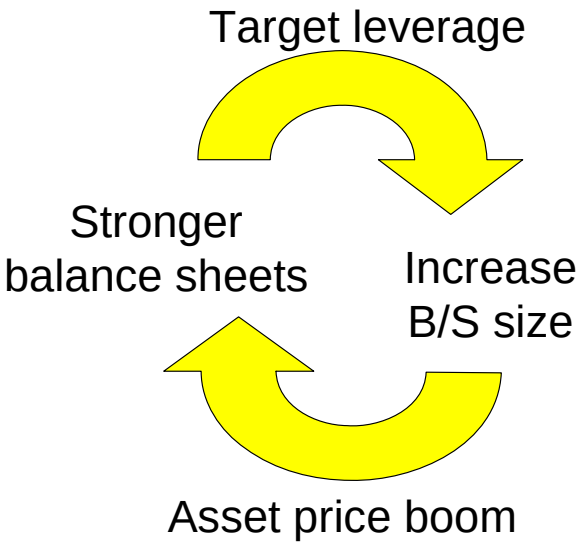
- Weekly data on primary dealers with the Federal Reserve, published every Thursday
- VIX index: weighted average of implied volatilities of S&P 500 index options
- Volatility risk premium: VIX index – realized volatility of S&P
- Averages over the week (Thursday - Wednesday)

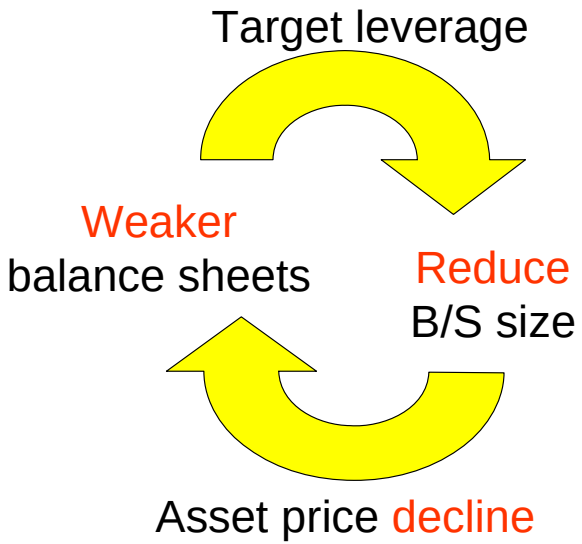
Forecasting Risk Appetite

Table 5: Forecasting Volatility Risk Premium

		Volatility Risk Premium					
		(i)	(ii)	(iii)	(iv)	(v)	(vi)
Volatility Risk Premium (lag)	coef		0.704		0.703		0.700
	p-value		0.000***		0.000***		0.000***
Repos (lagged growth rate)	coef	-0.146	-0.196				
	p-value	0.009***	0.000***				
Reverse Repos (lagged growth rate)	coef			-0.091	-0.130		
	p-value			0.047**	0.000***		
Net Repos (lagged growth rate)	coef					-0.061	-0.068
	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%

Completing the Circle





Aggregate Liquidity

Liquidity is the rate of growth of aggregate balance sheets.

Strong balance sheets $\Rightarrow$ surplus marked-to-market capital
$\Rightarrow$ "surplus capacity" in banking system

- For surplus capacity to be utilized, intermediaries expand their balance sheets.
  - On the liabilities side, take on more short-term debt.
  - On the asset side, search for potential borrowers

- How hard do financial intermediaries search for borrowers?
  - Sub-prime mortgage market
  - Debt financing of private equity

Liquidity and Money Stock?

What is the link between **liquidity** and the **money stock**?

- Broad money is liability of deposit-taking banks.
- In financial systems dominated by deposit-taking banks, money stock tracks aggregate balance sheets.
  - 19th and early 20th centuries, developing countries today
  - but poor indicator of aggregate liquidity for market-oriented financial system
- Focus on the right analogies for classical notion of money.
  - Forget "money" as means of exchange
  - **Repos are the rightful successors of "money"**