Financial Intermediaries and Monetary Policy

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Presentation at ECB Conference:
Key Developments in Monetary Economics

29 – 30 October 2009

Motivation

- Monetary economics models at central banks do not highlight financial intermediaries

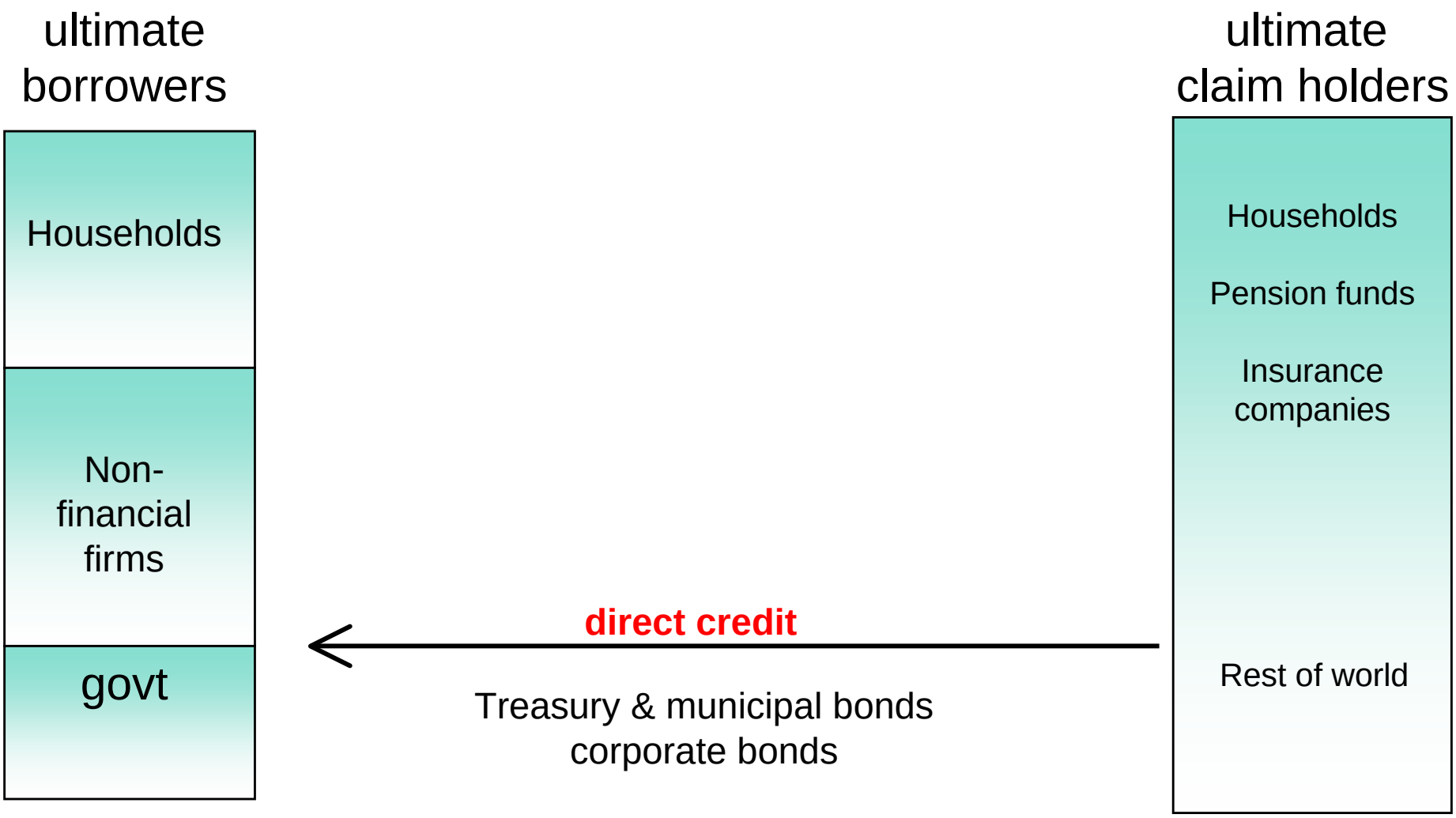
- Instead, explore hypothesis that financial intermediaries are the ***engine*** of the boom-bust cycle

"Risk-Taking Channel" of Monetary Policy

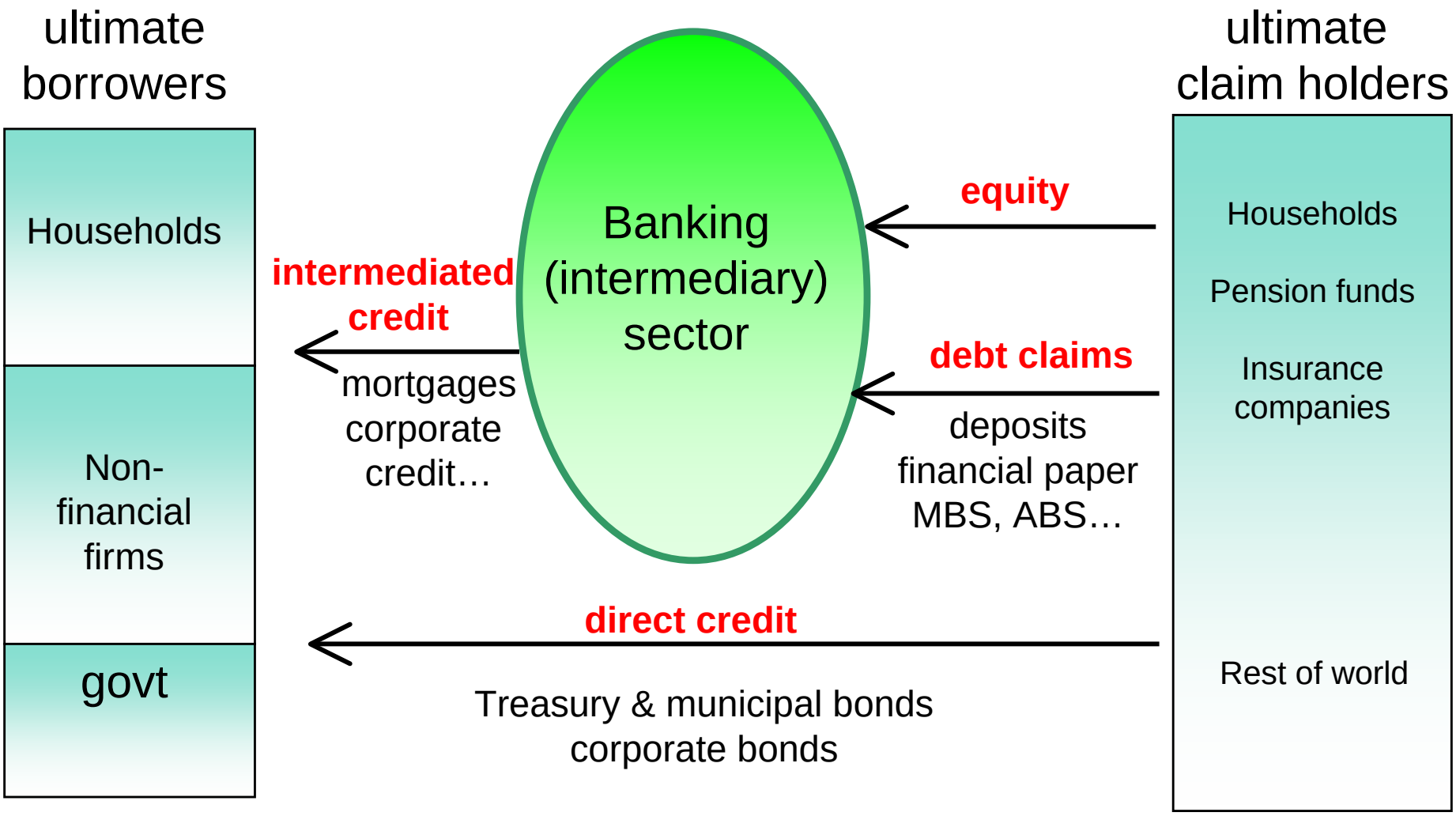
- Term coined by Borio and Zhu (2008), but refers to older set of ideas to do with
  - ***Supply*** of credit
  - Capital market conditions
  - Works through intermediary balance sheets
  - "Liquidity"

Static Model of Risk Premium

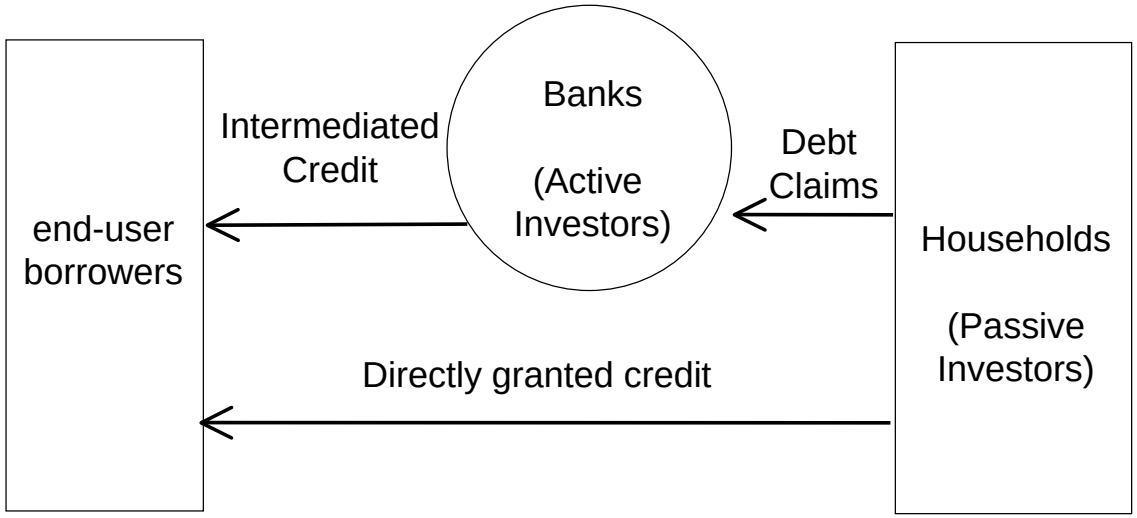
Stylized Financial System



Stylized Financial System



Simplified Financial System



Intermediated and Directly Granted Credit

General Equilibrium with Value-at-Risk

Two initial ingredients:

- No defaults
- No chains among banks

In practice, both defaults and chains are important.

Purpose of these assumptions is to show fundamental source of financial fluctuations as balance sheet dynamics.

General Equilibrium with Value-at-Risk

Two dates, 0 and 1.

Single risky security (loan) and cash

Risky security's payoff is random variable $\tilde{w}$, with expected value $q > 0$.

Random variable $\tilde{w}$ is uniformly distributed over the interval:

$$[q - z, q + z]$$

$z > 0$ is a known constant.

Mean and variance of $\tilde{w}$ are

$$\begin{aligned} E(\tilde{w}) &= q \\ \sigma^2 &= \frac{z^2}{3} \end{aligned}$$

Cash pays interest rate of zero.

p is price of the risky security.

For investor with equity e who holds y units of the risky security, payoff of the portfolio is the random variable:

$$W \equiv \tilde{w}y + (e - py) \tag{1}$$

Two groups of investors - *passive investors* and *active investors*.

Interpetation

- Risky securities are *loans* granted to ultimate borrowers
- Market value risky security is market value of loans.
- Passive investors' holding of risky security is credit granted *directly* by the household sector (e.g. holding of corporate bonds)
- Active investors's holding of risky security is *intermediated finance*: active investors are banks who borrow from the households in order to lend to the ultimate borrowers.

Passive Investors (Households, Long-Only Institutions)

Passive investors have mean-variance preferences over the payoff from the portfolio. They maximise

$$U = E(W) - \frac{1}{2\tau}\sigma_W^2 \tag{2}$$

$\tau > 0$ is constant called the investor's "risk tolerance" and σ_W^2 is the variance of W. In terms of the decision variable y, passive investor's objective function is

$$U(y) = qy + (e - py) - \frac{1}{6\tau}y^2 z^2 \tag{3}$$

Optimal holding of risky security satisfies first order condtion:

$$q - p - \frac{1}{3\tau} z^2 y = 0 \tag{4}$$

Optimal risky security holding of the passive investor (denoted by y_P) is

$$y_P = \begin{cases} \dfrac{3\tau}{z^2}(q-p) & \text{if } q > p \\ \\ 0 & \text{otherwise} \end{cases} \tag{5}$$

Aggregation. Linear demands can be summed to give the aggregate demand. If τ_i is the risk tolerance of the ith investor and $\tau = \sum_i \tau_i$, then (5) gives the aggregate demand of the passive investor sector as a whole.

Active Investors (Banks, Leveraged Institutions)

- Risk-neutral

- Value-at-Risk (VaR) constraint.

VaR is **worst possible loss**, where anything worse than VaR has probability α.

Special case where $\alpha = 0$. Value-at-Risk constraint stipulates that the debt issued by the investor be risk-free.

So **bank debt** and **cash** are perfect substitutes - simplifies analysis.

The optimization problem for an active investor is:

$$\max_{y} E(W) \quad \text{subject to VaR} \leq e \tag{6}$$

$E(W)$ is strictly increasing in y provided $p < q$, and so the Value-at-Risk constraint binds.

$$\underbrace{py - (q - z)\, y}_{\text{worst possible loss}} = \underbrace{e}_{\text{equity}} \tag{7}$$

Optimal holding of the risky securities for the leveraged investor is

$$y = \frac{e}{z - (q - p)} \tag{8}$$

Balance sheet is

Assets	Liabilities
securities, py	equity, e debt, $(q-z)\,y$

(9)

Aggregation.

Since (8) is linear in e, the aggregate demand of the leveraged sector has the same form as (8) when e is the *aggregate capital* of the leveraged sector as a whole.

Market Clearing

y_A is holding of risky securities by active investors

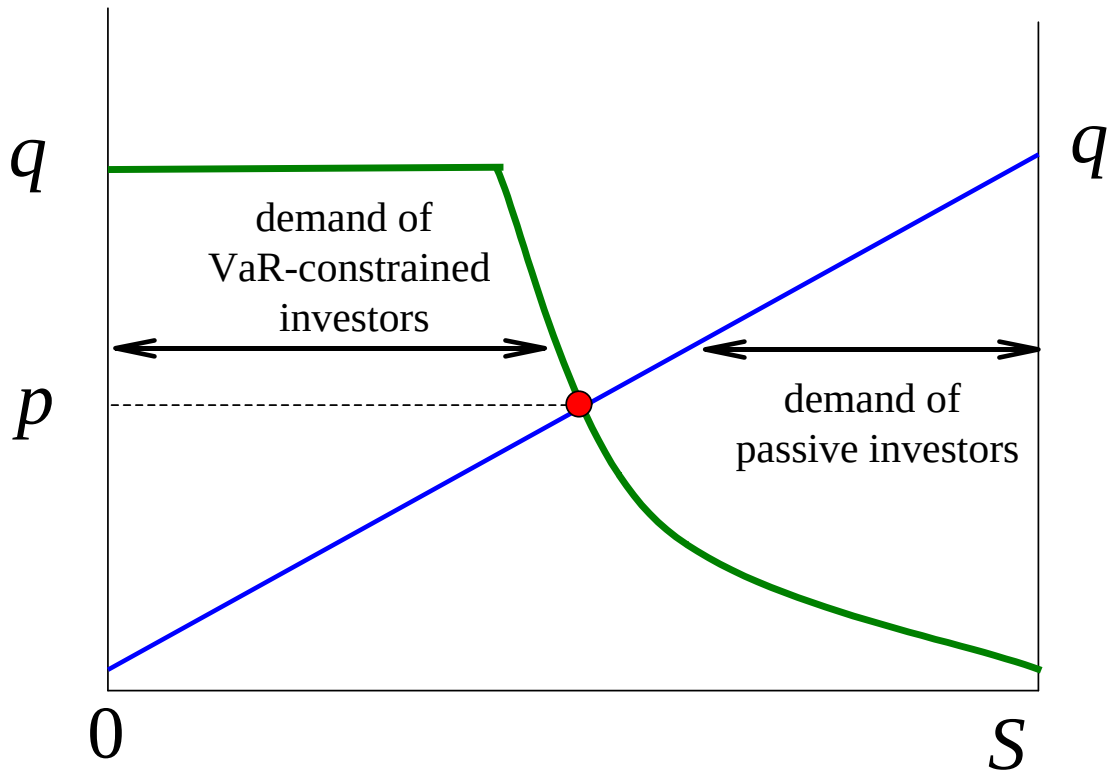
y_P the holding by the passive investors.

S is the total endowment of the risky securities.

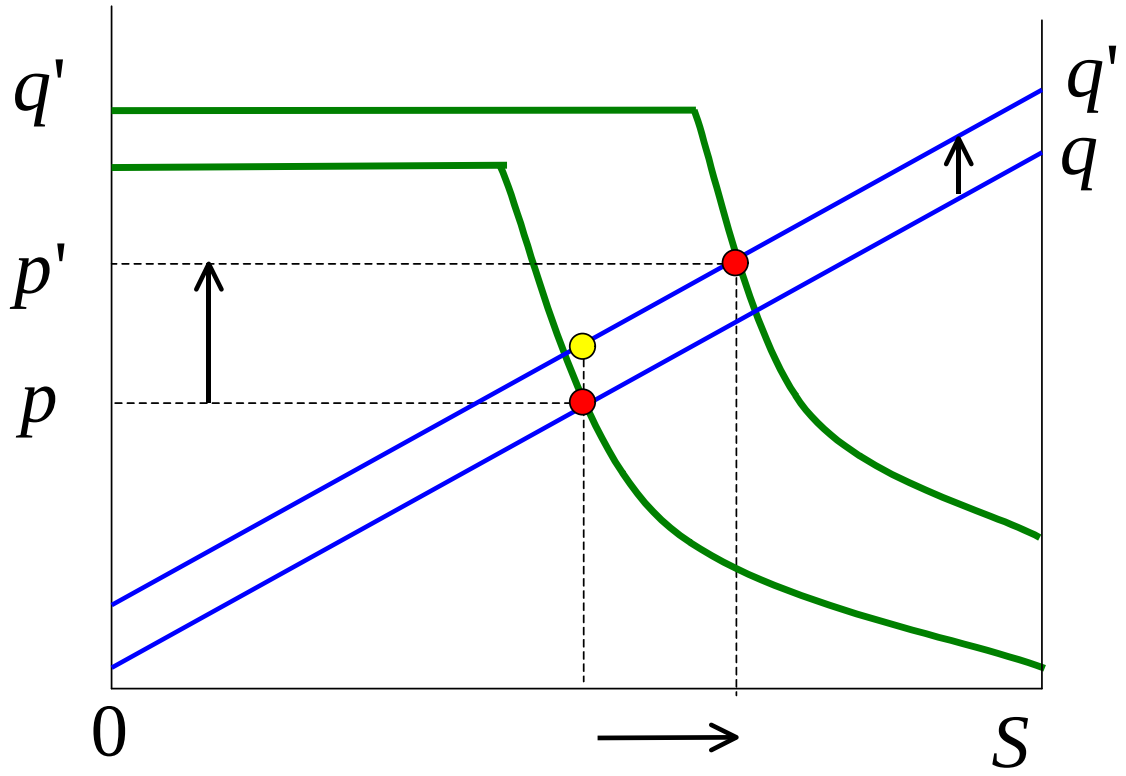
Market clearing condition is

$$y_A + y_P = S \tag{10}$$

The solution is fully determined as a function of e.



Market Clearing Price



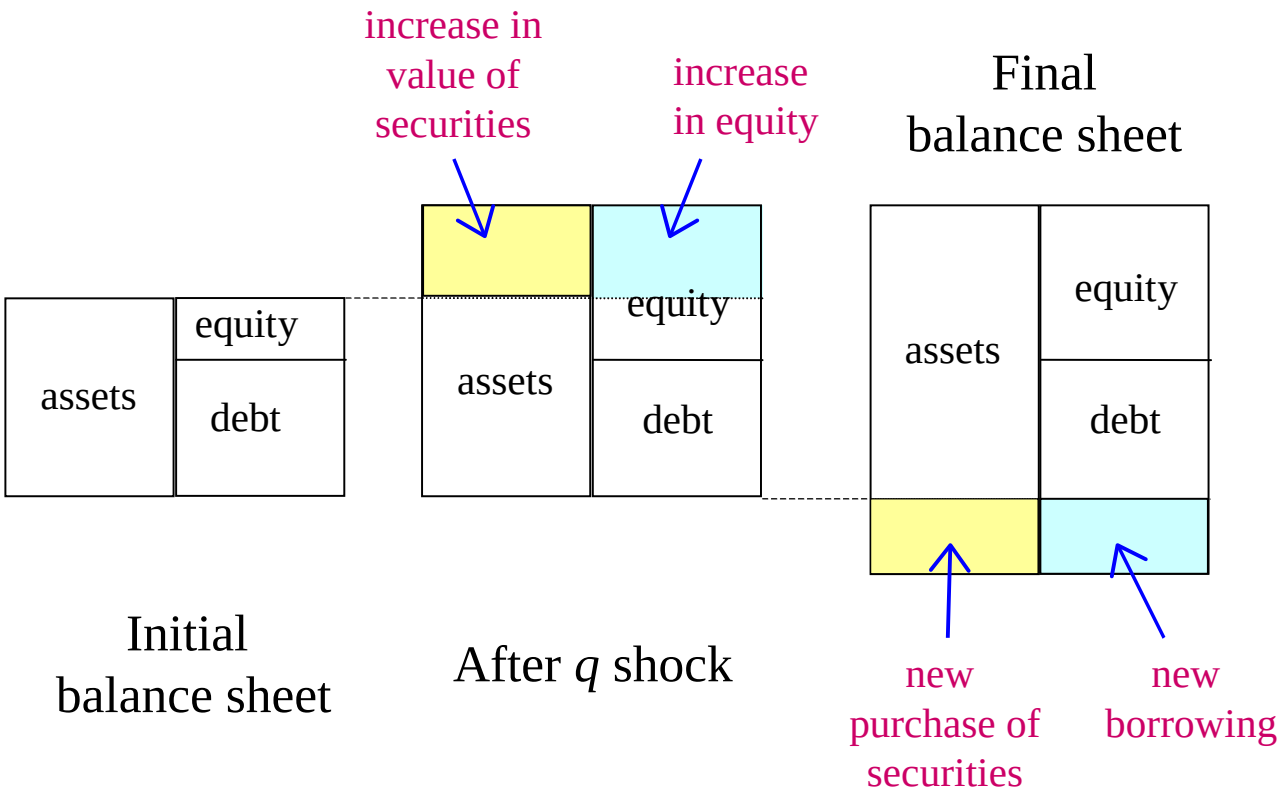
Amplified response to improvement in fundamentals q

Risk-Taking Channel of Monetary Policy

Consider rise in value of loans from q to q'.

Possible cause is looser monetary policy:

- Borrower cashflows safer
- Mark-to-market effects on duration mismatch



Balance sheet expansion from q shock

New equity e'

New price p'

Debt value remains same at $(q - z)\, y$.

$$\begin{aligned} e' &= p'y - (q - z)\, y \\ &= (z + p' - q)\, y \end{aligned} \tag{11}$$

New lending y' satisfies Value-at-Risk constraint.

$$\begin{aligned} e' &= p'y' - (q' - z)\, y' \\ &= (z + p' - q')\, y' \end{aligned} \tag{12}$$

New loan supply y' is

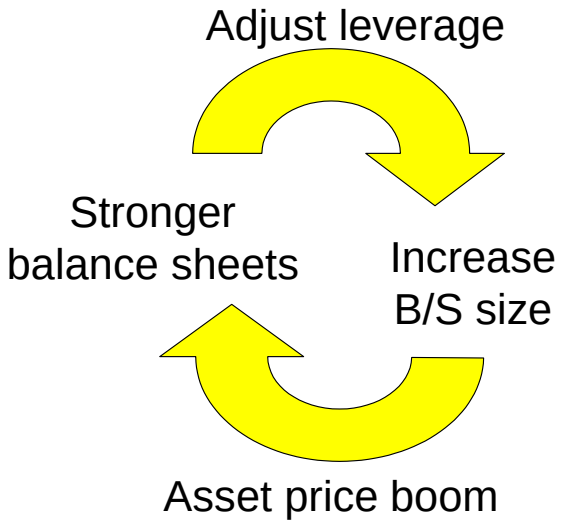
$$y' = y\left(1 + \frac{q' - q}{z + p' - q'}\right) \tag{13}$$

From the demand of passive investors (5) and market clearing,

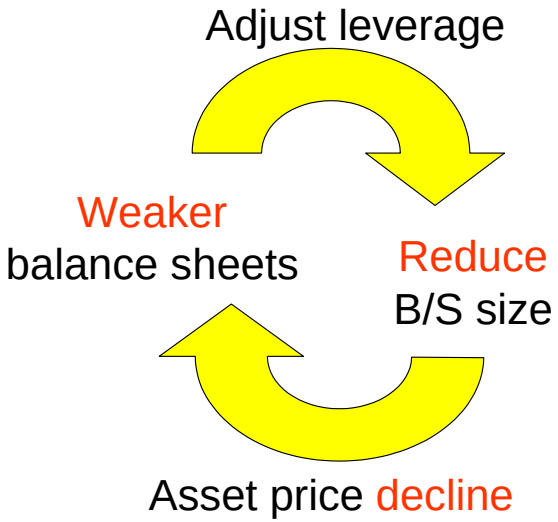
$$p' - q' = \frac{z^2}{3\tau}\left(y' - S\right)$$

Substituting into (13),

$$y' = y\left(1 + \frac{q' - q}{z + \frac{z^2}{3\tau}\left(y' - S\right)}\right) \tag{14}$$



Feedback "on the way up"



Feedback "on the way down"

Pricing of Risk and Credit Supply

For exogenous S,

Proposition 1. *Risk premium* $(q/p) - 1$ *is decreasing in aggregate bank balance sheet size.*

Proposition 2. *Risk premium* $(q/p) - 1$ *is decreasing in fundamental payoff* q*.*

Proposition 3. *Lagrange multiplier of the VaR constraint is decreasing in aggregate bank balance sheet size*

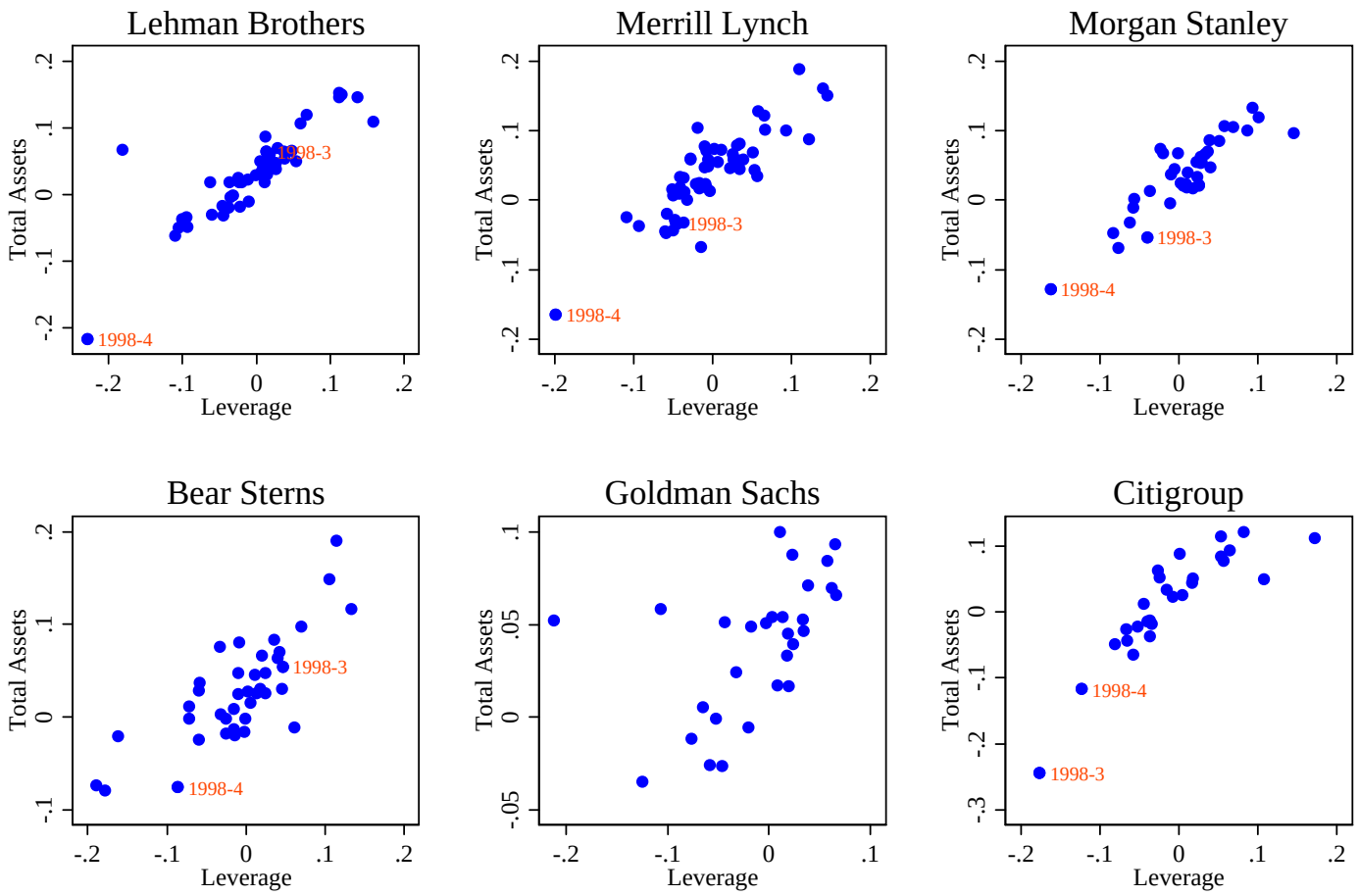
"The shadow value of bank capital is low when balance sheets are large"

$$\lambda = \frac{z\left(S - y_A\right)}{3\tau + z\left(y_A - S\right)} \tag{15}$$

Proposition 4. *For* $q \in [\bar{q}, \infty)$ *bank leverage is* procyclical

$$\frac{py}{e} = \frac{p(q)}{z - (q - p(q))} \tag{16}$$

Total Assets and Leverage



Mechanism for Subprime

Stronger balance sheets imply **surplus capital**.

Banks attempt to remedy surplus capital.

Analogy with manufacturing firms: financial system as having "surplus capacity".

For such surplus capacity to be utilized, the intermediaries must expand their balance sheets. On the liability side, they take on more debt. On the asset side, they search for potential borrowers.

When the set of potential borrowers is fixed, the greater willingness to lend leads to an erosion in risk premium from lending, and spreads become compressed.

Supply of Credit

Endogenous S allows analysis of **loan supply.**

Assume pool of potential borrowers, each with risky project with return π_0.

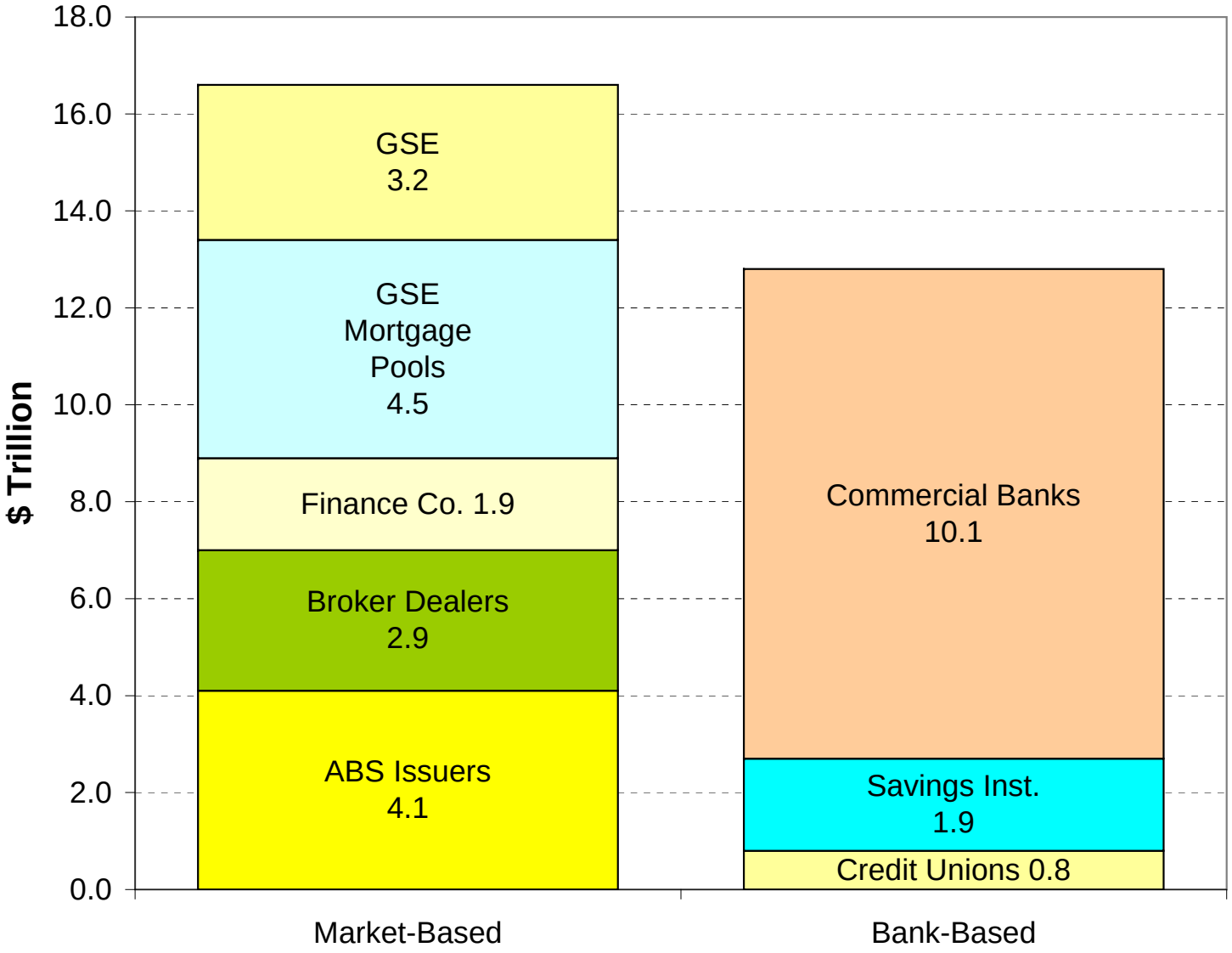
Market premium cannot fall below π_0, so that in any equilibrium with endogenous credit supply,

$$\pi \geq \pi_0 \tag{17}$$

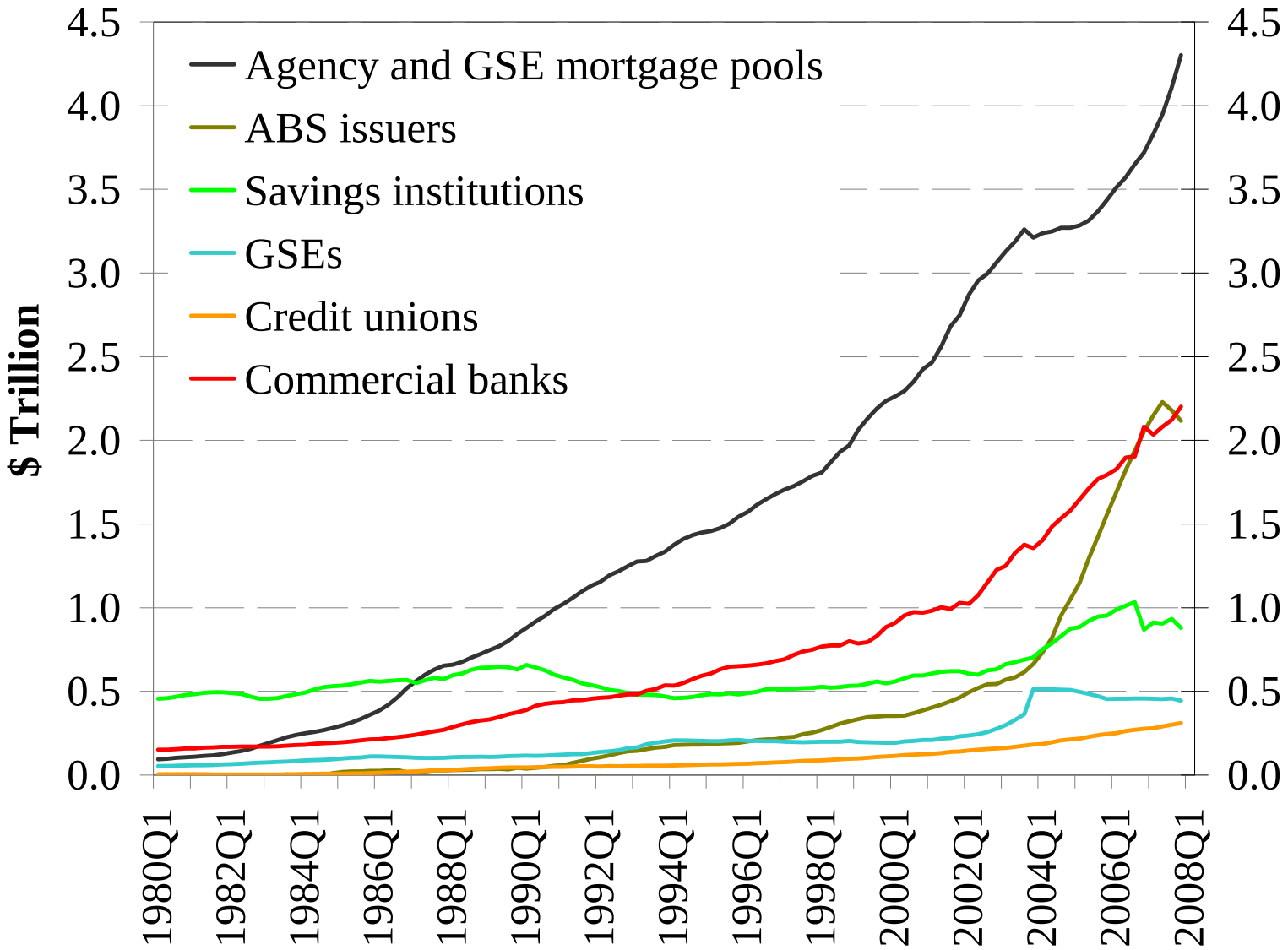
Proposition 5. *The supply of credit S is strictly increasing in q when $q > \pi^{-1}(\pi_0)$.*

Changing Nature of Financial Intermediation

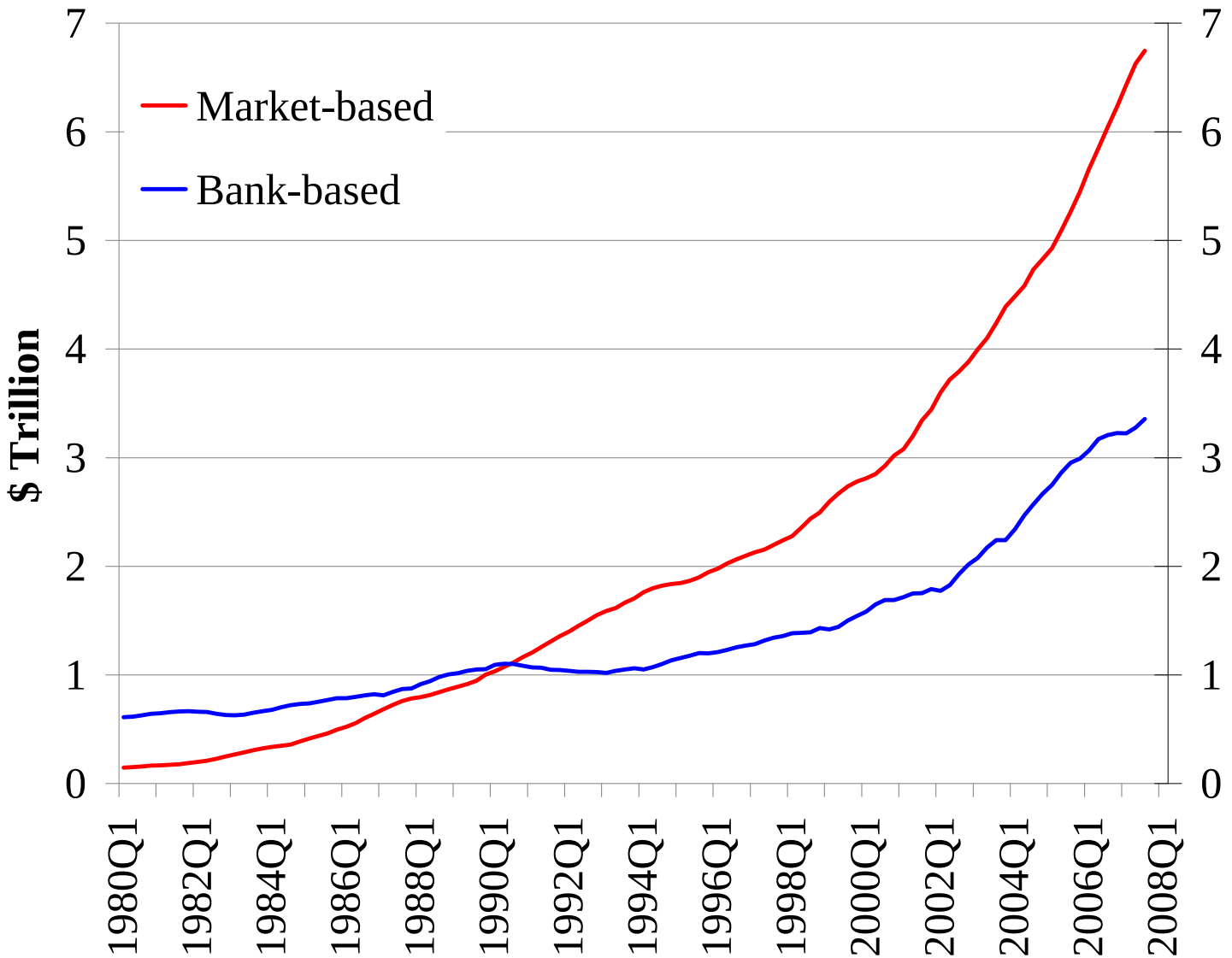
US Financial Intermediaries Total Assets (2007Q2)



Holding of US Home Mortgages by Type of Financial Institution

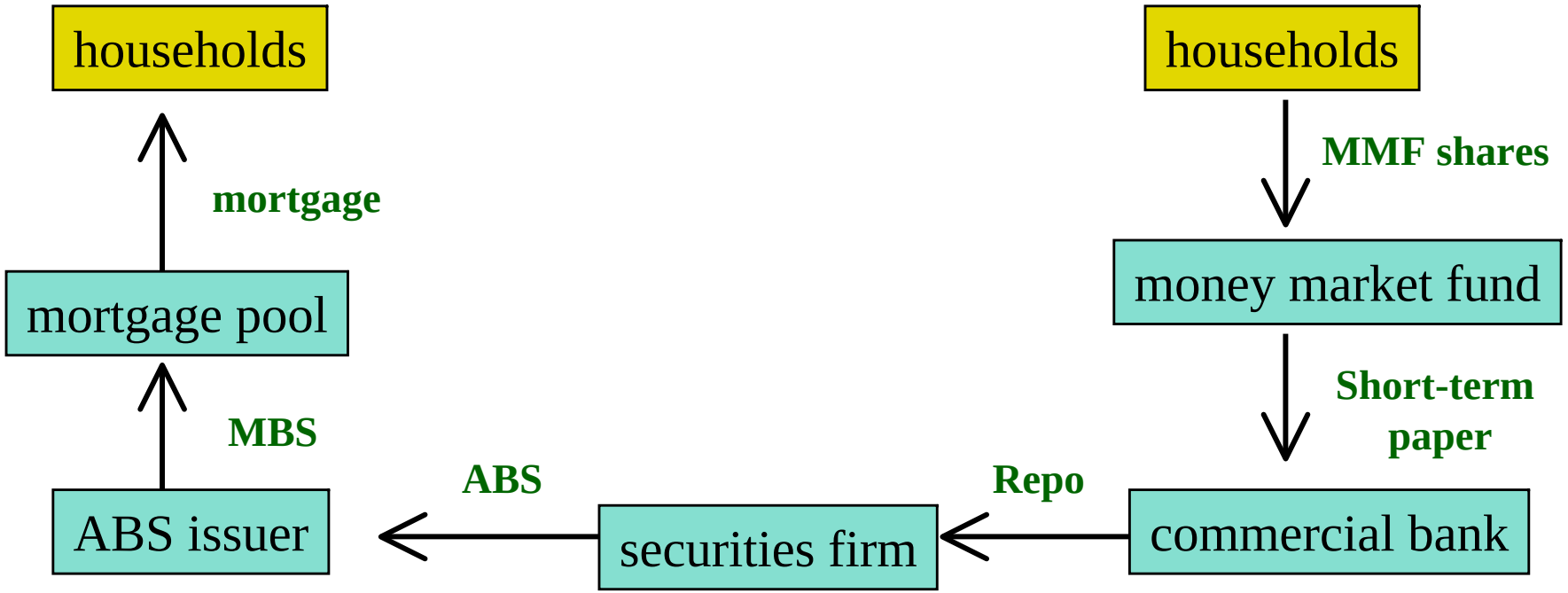


Market-Based and Bank-Based Holding of Home Mortgages

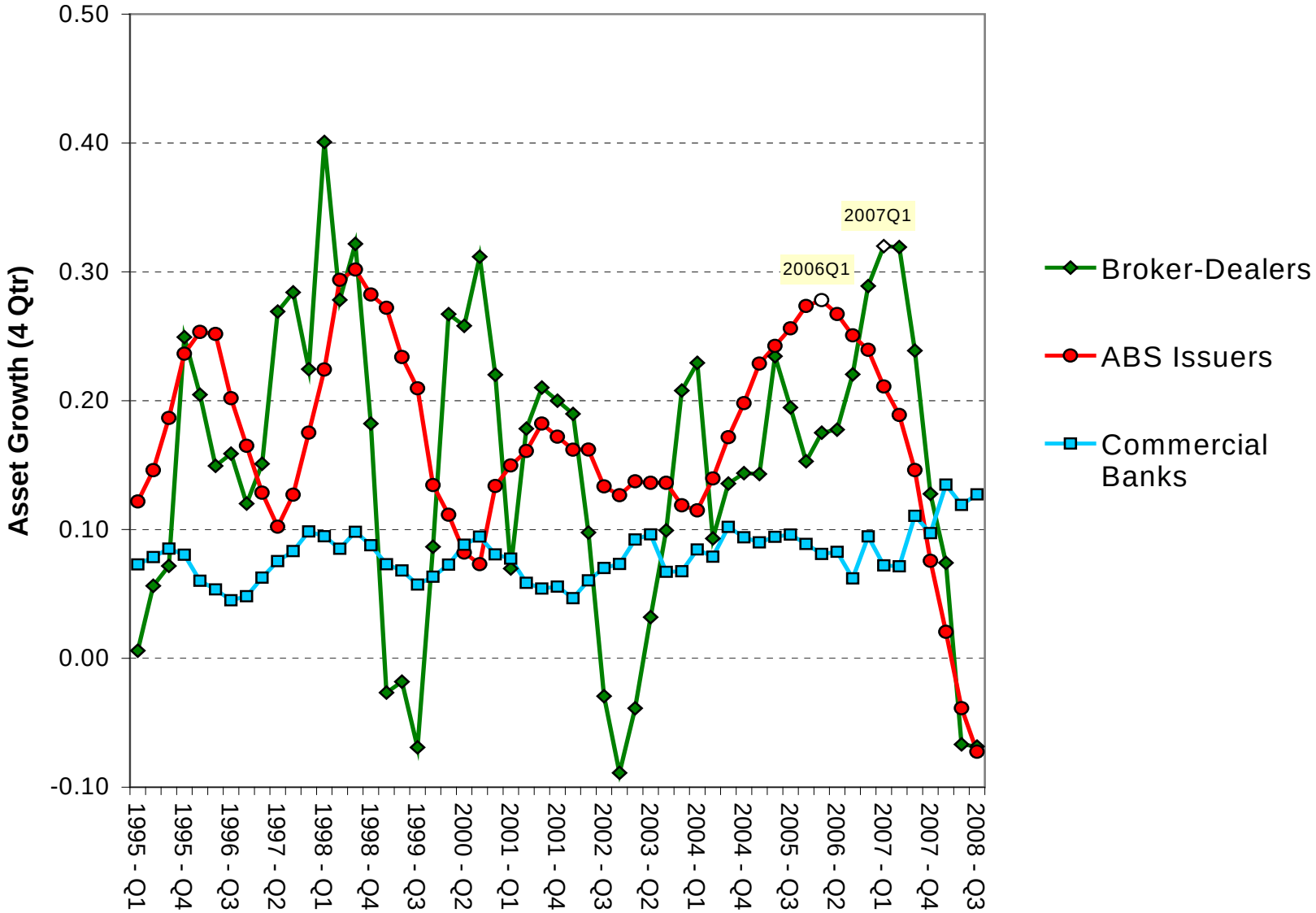


Short Intermediation Chain

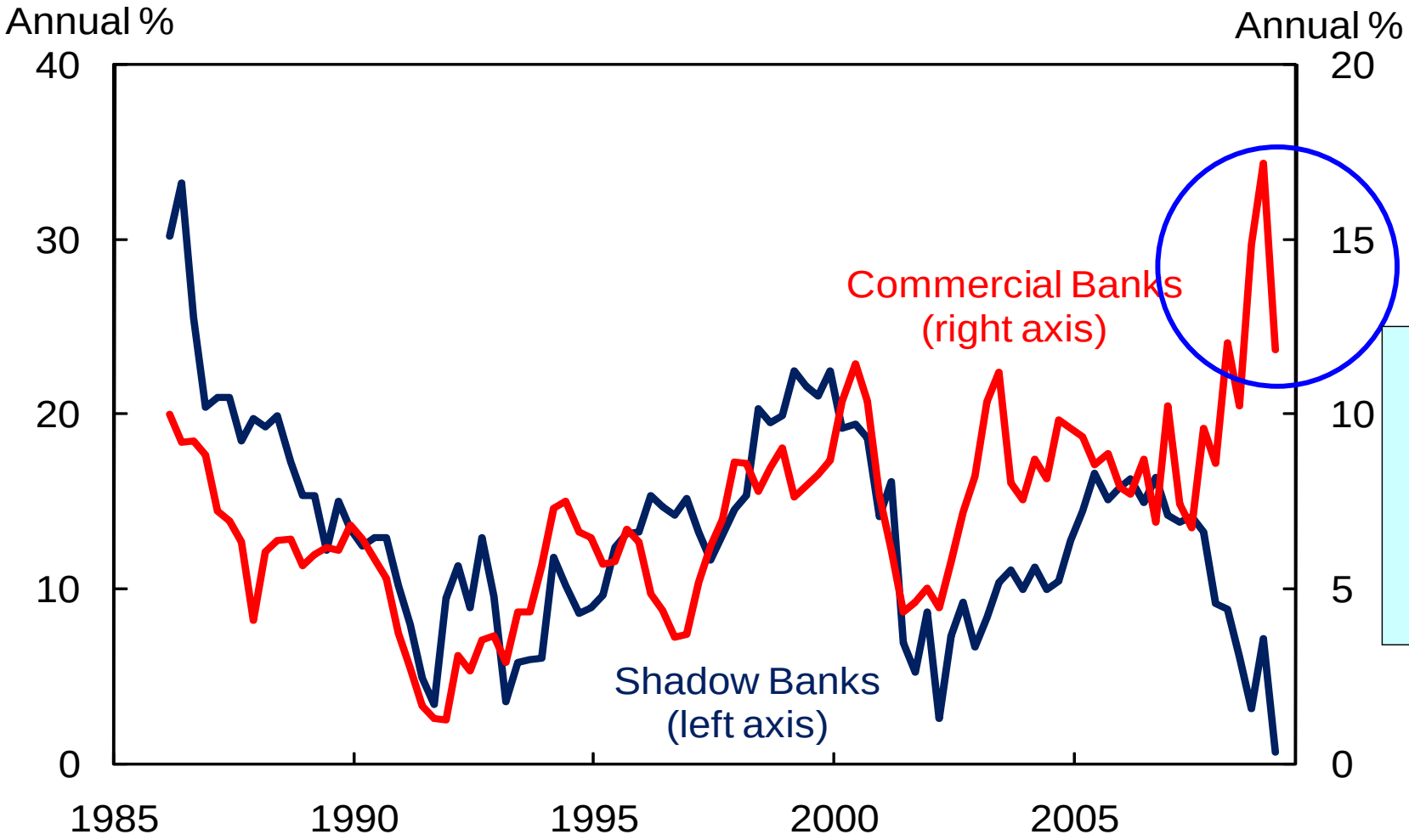
Long Intermediation Chain



Focusing on bank lending only would be a mistake…



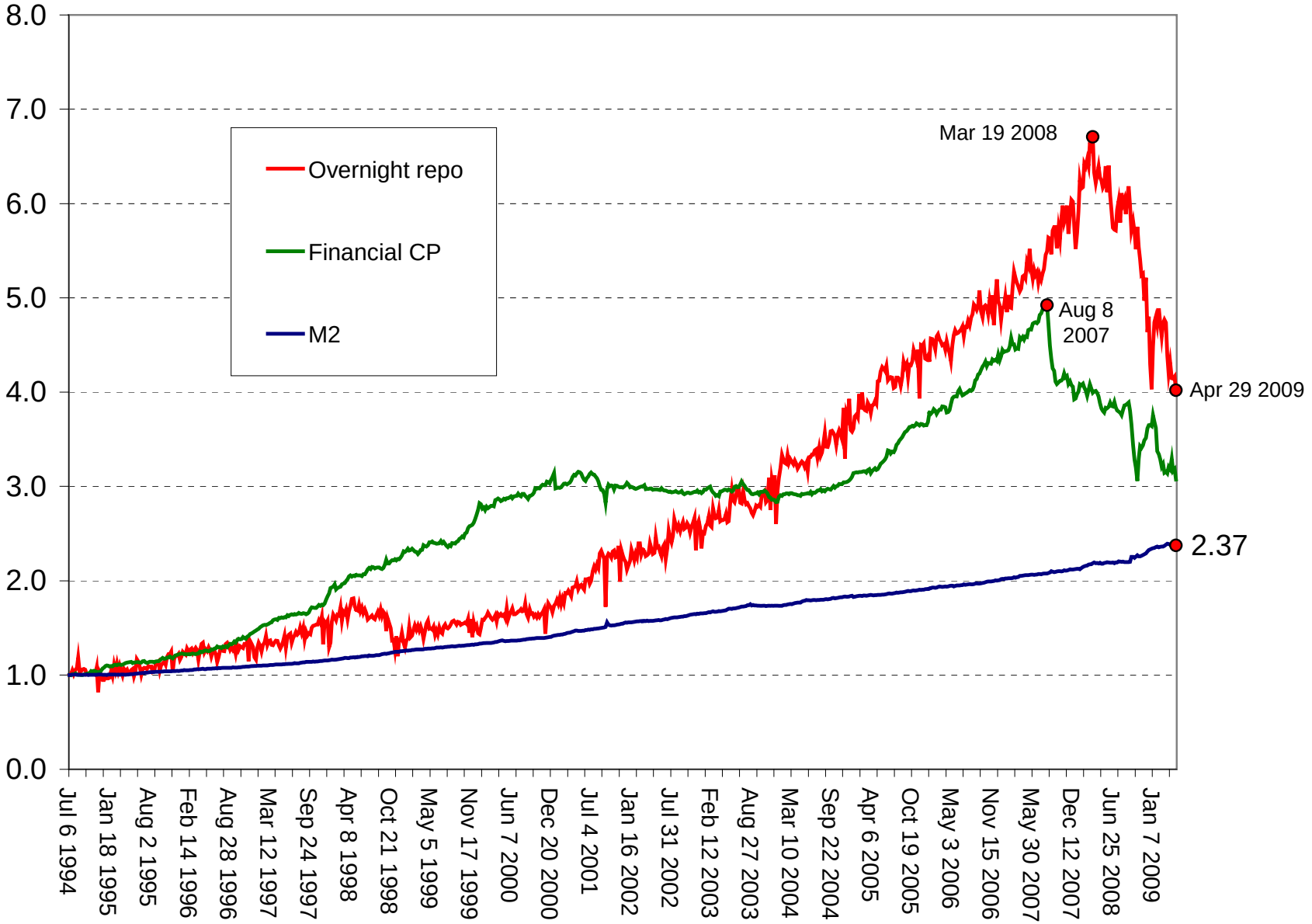
Shadow Bank and Commercial Bank Asset Growth



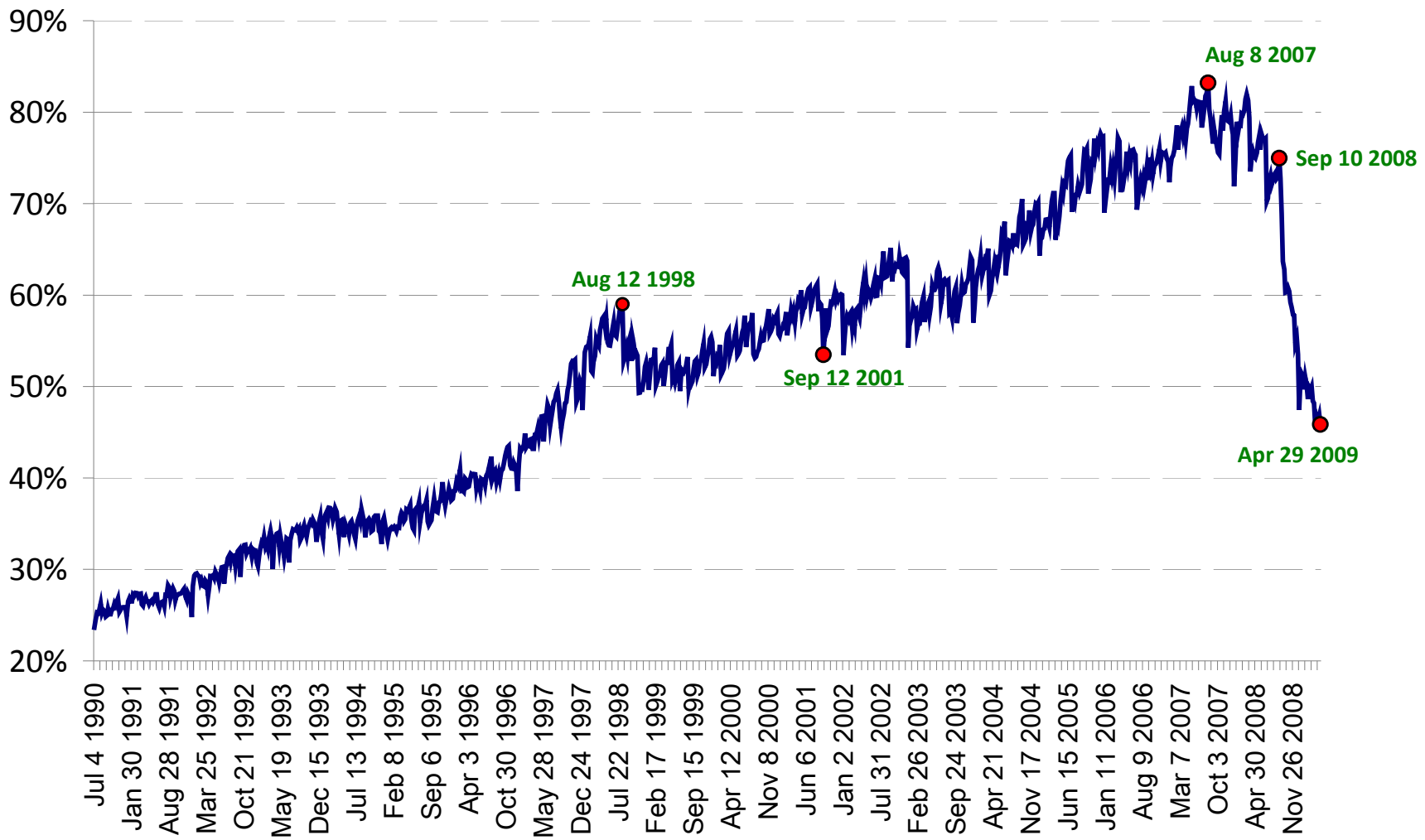
Commercial banks have at last begun to shrink assets

Note: Shadow banks are ABS issuers, finance companies, and funding corporations.
Source: Board of Governors of the Federal Reserve

Overnight repos, Financial CP and M2 (weekly, July 6 1994 as base date)

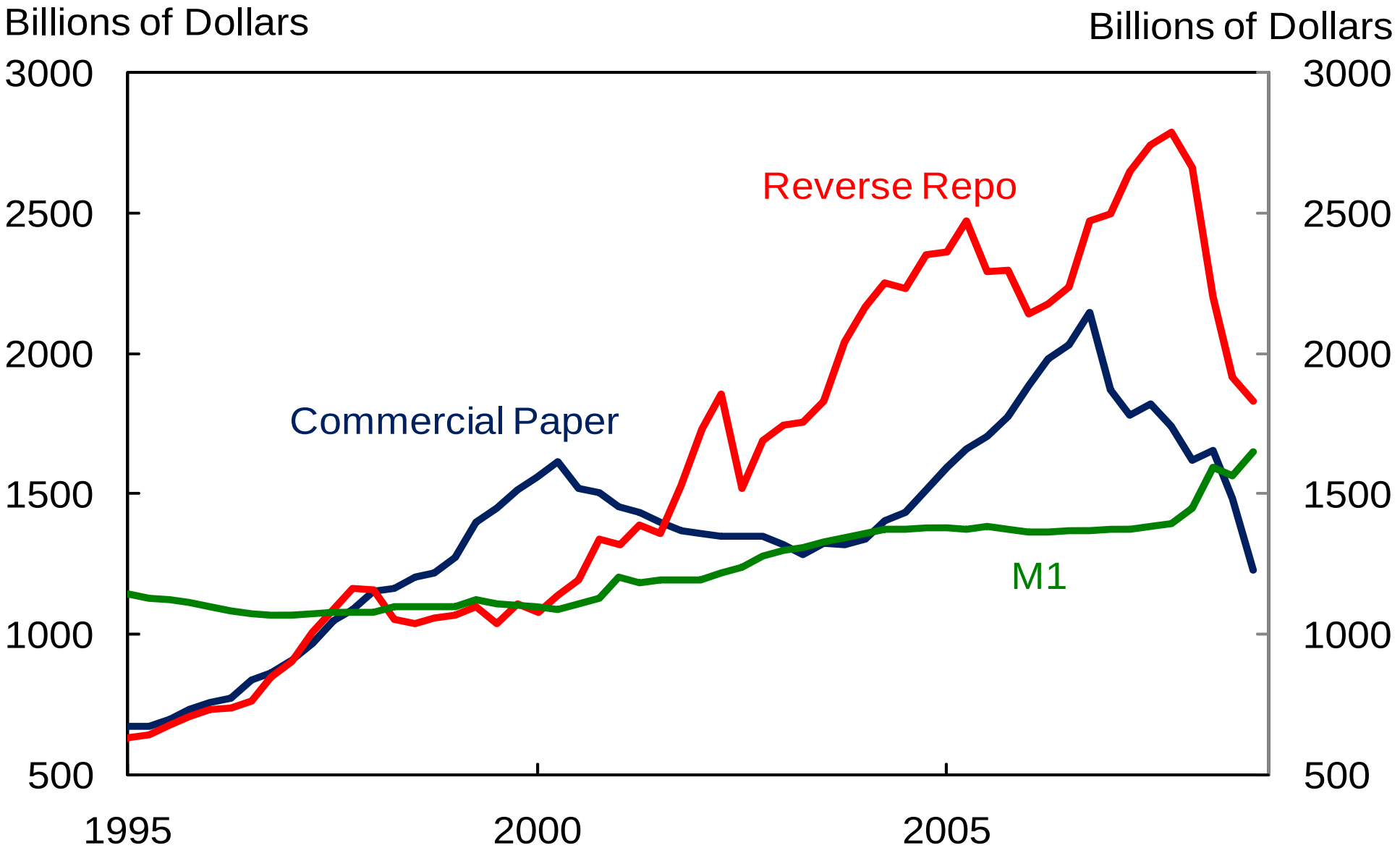


Repos and Financial CP as Fraction of M2 (weekly)



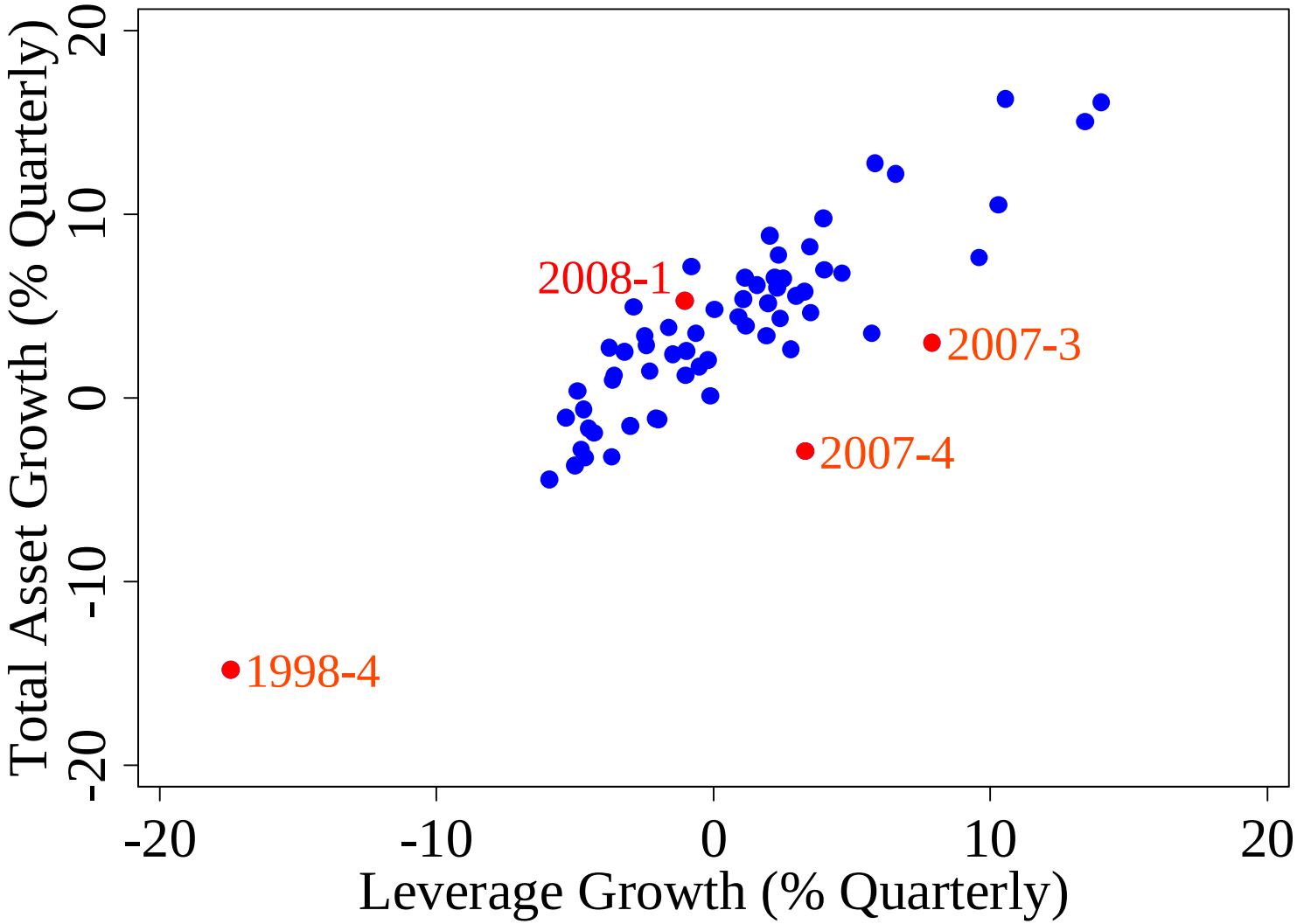
Source: Adrian and Shin (2009)

Short Term Funding: CP, Repo, M1

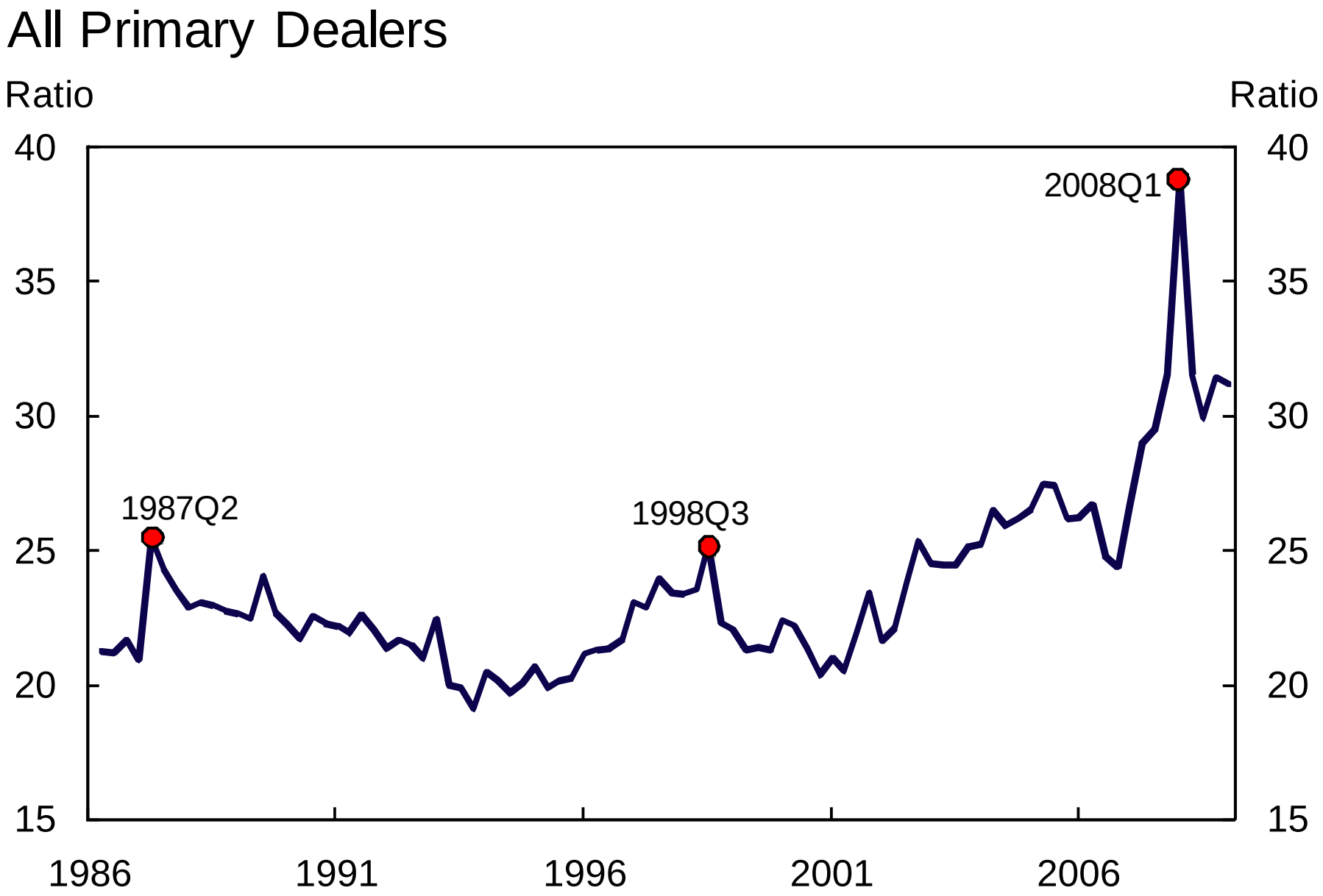


Source: Federal Reserve Board

Procyclical Leverage of Five US Investment Banks



Primary Dealer Leverage



Empirical Findings

Table 1: **Impact of Balance Sheets on GDP**

	(1) GDP Growth	(2) GDP Growth	(3) GDP Growth
Broker-Dealer Asset Growth (lag)	0.01*		
Shadow Banks Asset Growth (lag)		0.06***	
Commercial Bank Asset Growth (lag)			-0.05
GDP Growth (lag)	0.85***	0.69***	0.89***
PCE Inflation (lag)	-0.18	-0.25*	-0.15
VIX (lag)	0.03	0.02	0.02
Credit Spread (lag)	-0.63***	-0.83***	-0.50**
Term spread (lag)	0.25**	0.31***	0.13
Fed Funds (lag)	0.02	-0.02	-0.02
Constant	1.06*	1.68***	1.66***
Observations	92	93	93
R^2	0.865	0.878	0.862

Impulse Response of B/S Growth on GDP

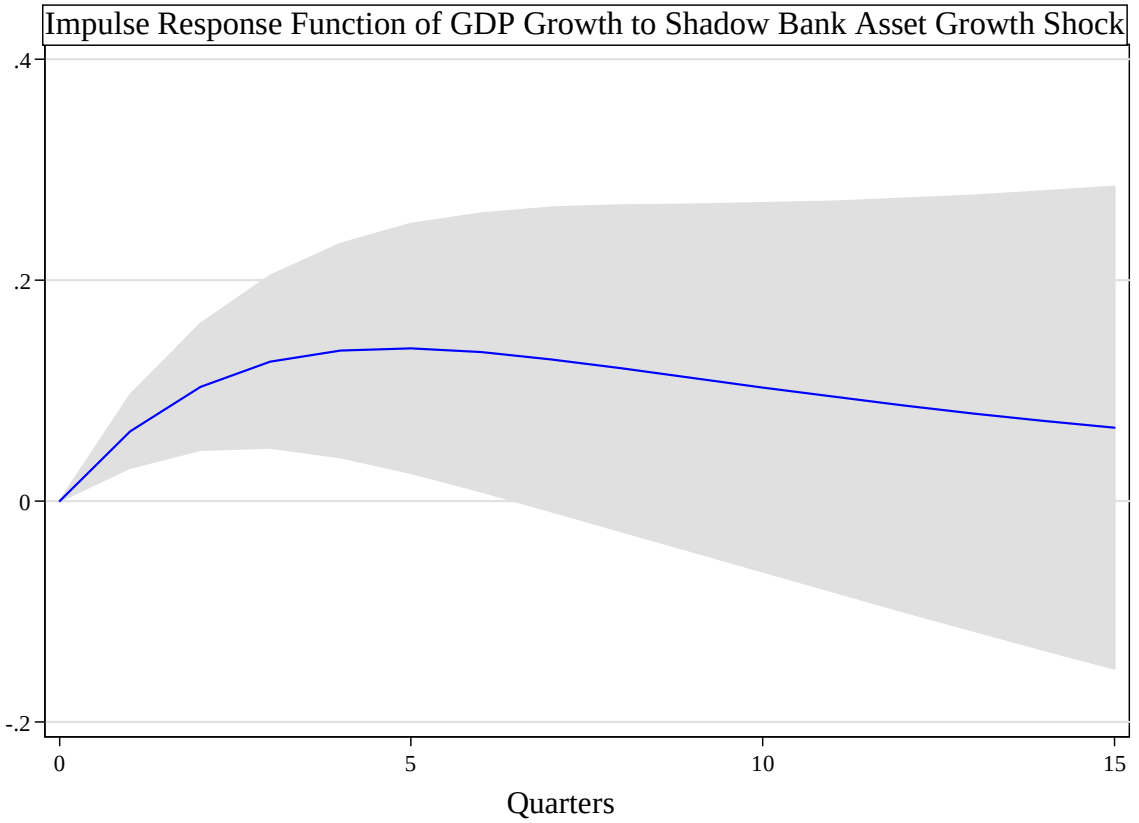


Table 2: **Impact of Balance Sheets on Housing Investment.**

	(1) Housing Growth	(2) Housing Growth	(3) Housing Growth
Broker-Dealer Asset Growth (lag)	0.08***		
Shadow Banks Asset Growth (lag)		0.00	
Commercial Bank Asset Growth (lag)			-0.44**
Housing Growth (lag)	0.90***	0.94***	0.95***
PCE Inflation (lag)	-0.30	-0.11	-0.07
VIX (lag)	0.11	0.02	0.02
Credit Spread (lag)	-1.03	-0.64	0.13
Term spread (lag)	1.09**	0.57	-0.07
Fed Funds (lag)	-0.07	-0.07	-0.28
Constant	-2.23	0.33	3.67
Observations	93	93	93
R^2	0.911	0.891	0.898

Impulse Response of B/S Growth on Housing Investment

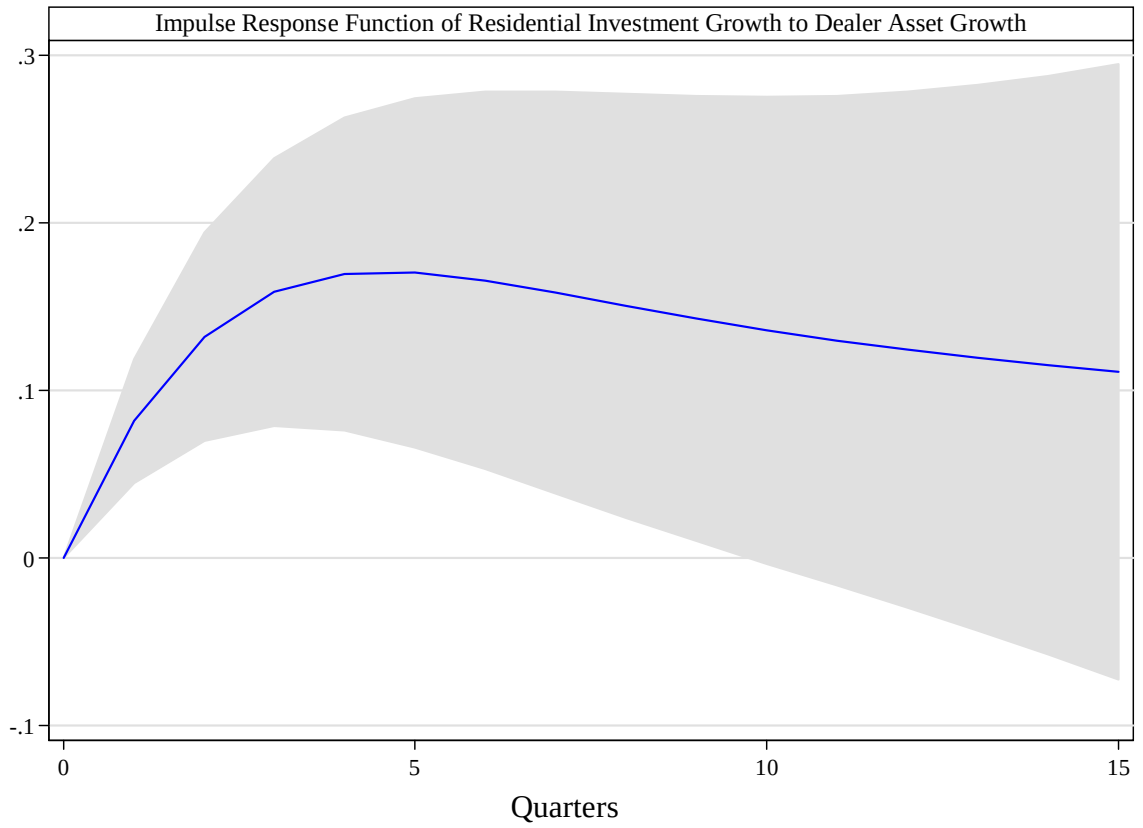


Table 3: **Impact of Short Rates on Balance Sheets**

	(1) Repo Growth	(2) Repo+CP Growth	(3) M2 Growth
Fed Funds (change)	-0.048***	-0.024**	-0.013***
Fed Funds (lag)	0.054***	0.023***	-0.010***
Equity Return	0.002***	0.001***	-0.000
Equity Index (lag)	0.025***	0.015***	-0.001*
VIX (change)	-0.001	-0.001	0.001***
VIX (lag)	-0.010***	-0.003*	0.002***
Term spread (change)	0.059***	0.019	-0.003
Term spread (lag)	0.124***	0.060***	-0.021***
Credit Spread (change)	-0.084**	-0.078***	0.013***
Credit Spread (lag)	-0.075***	-0.137***	-0.002
Repo Growth (lag)	-0.141***	-0.079***	0.017***
CP Growth (lag)	0.014	-0.033	0.016**
M2 Growth (lag)	1.246***	0.685***	-0.160***
Constant	-0.241**	0.072	0.089***
Observations	972	972	965
R^2	0.250	0.360	0.637

Role of Short Rates

Short Rates and q

- Lower short rates make borrower's cash flow less risky

- Marked-to-market increase in bank equity
  - Long duration of assets
  - Short duration of liabilities

Two Recent Papers

- Ioannidou, Ongena and Peydro (2009) "Monetary Policy, Risk-Taking and Pricing: Evidence from a Quasi-Natural Experiment" paper presented at NBER Summer Institute
  - in a dollarized system (Bolivia) that banks take more credit risk and reduce the loan spreads when rates are low

- Jimenez, Ongena, Peydró and Saurina (2008) find that lower short-term rates prior to loan origination imply loans with higher hazard rate, whereas higher rates during the life of the loan increase hazard rate
  - Working paper, Bank of Spain and ECB

Main Findings

- Decrease in Fed Funds rate
  - Increases hazard rate of default for *new loans*
  - Decreases hazard rate of default for *existing loans*
- Increases in lending
  - to *lower-rated borrowers*
  - at *lower spreads*

Possible Clue

Decrease in Fed Funds rate

- Increases hazard rate of default for *new loans*
- Decreases hazard rate of default for *existing loans*

Possible Clue

Decrease in Fed Funds rate

- Increases hazard rate of default for *new loans*
- Decreases hazard rate of default for *existing loans* [increases market value of assets]

Possible Clue

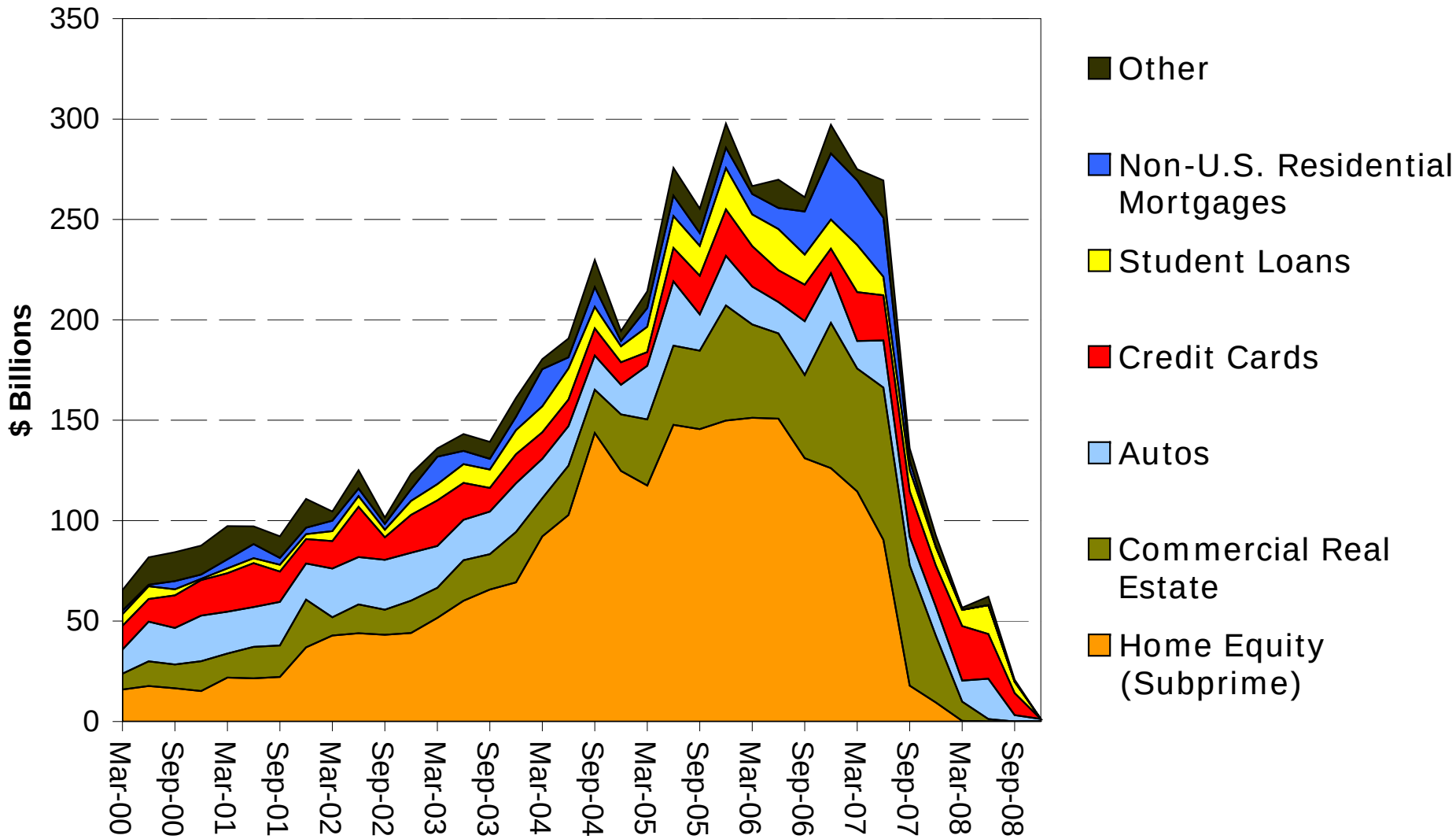
Decrease in Fed Funds rate

- Increases hazard rate of default for *new loans* [greater balance sheet capacity, take on marginal loans]
- Decreases hazard rate of default for *existing loans* [increases market value of assets]

Crisis Intervention and Monetary Policy

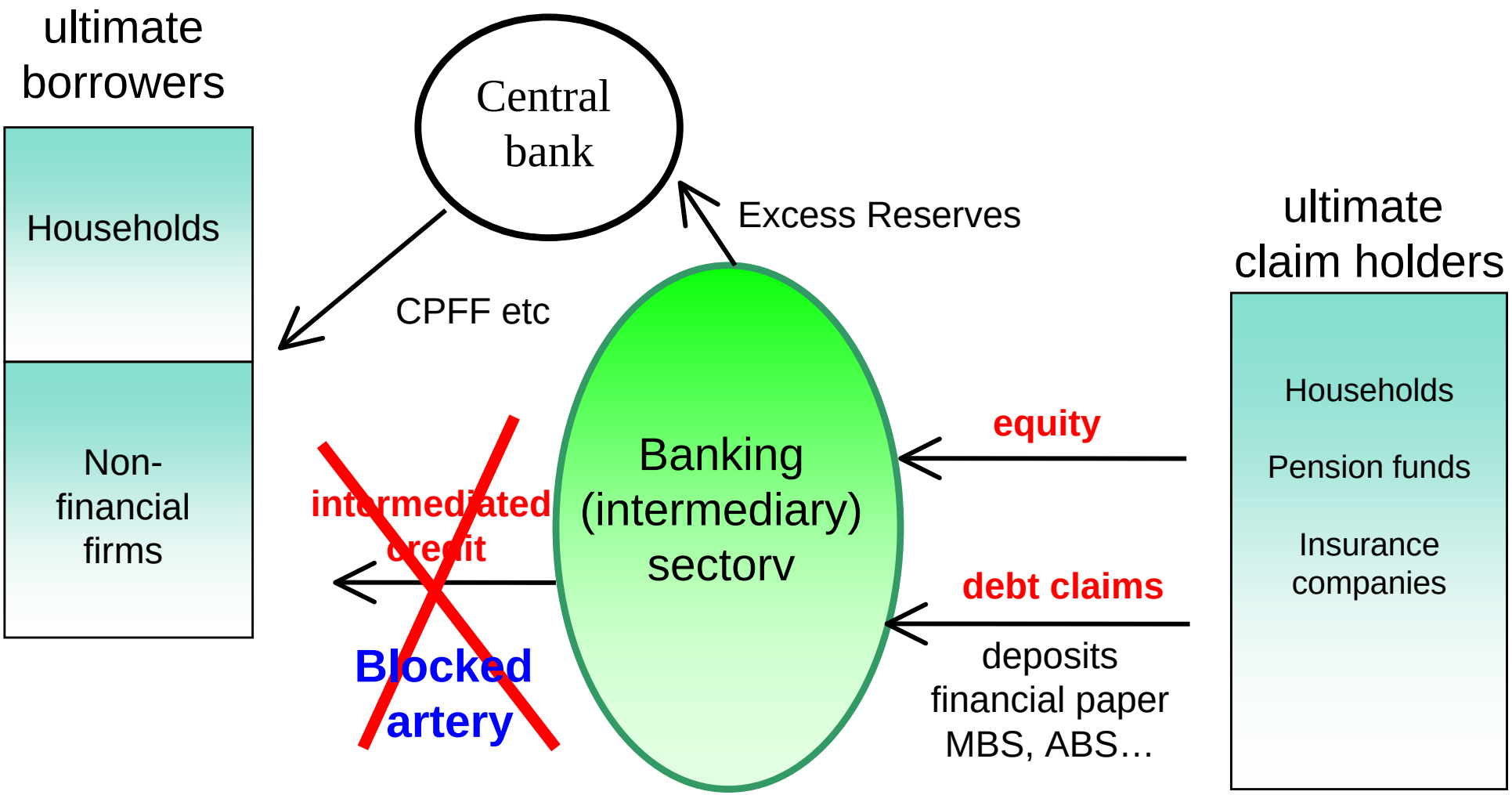
Asset Backed Securities Issuance

Three Months Sum

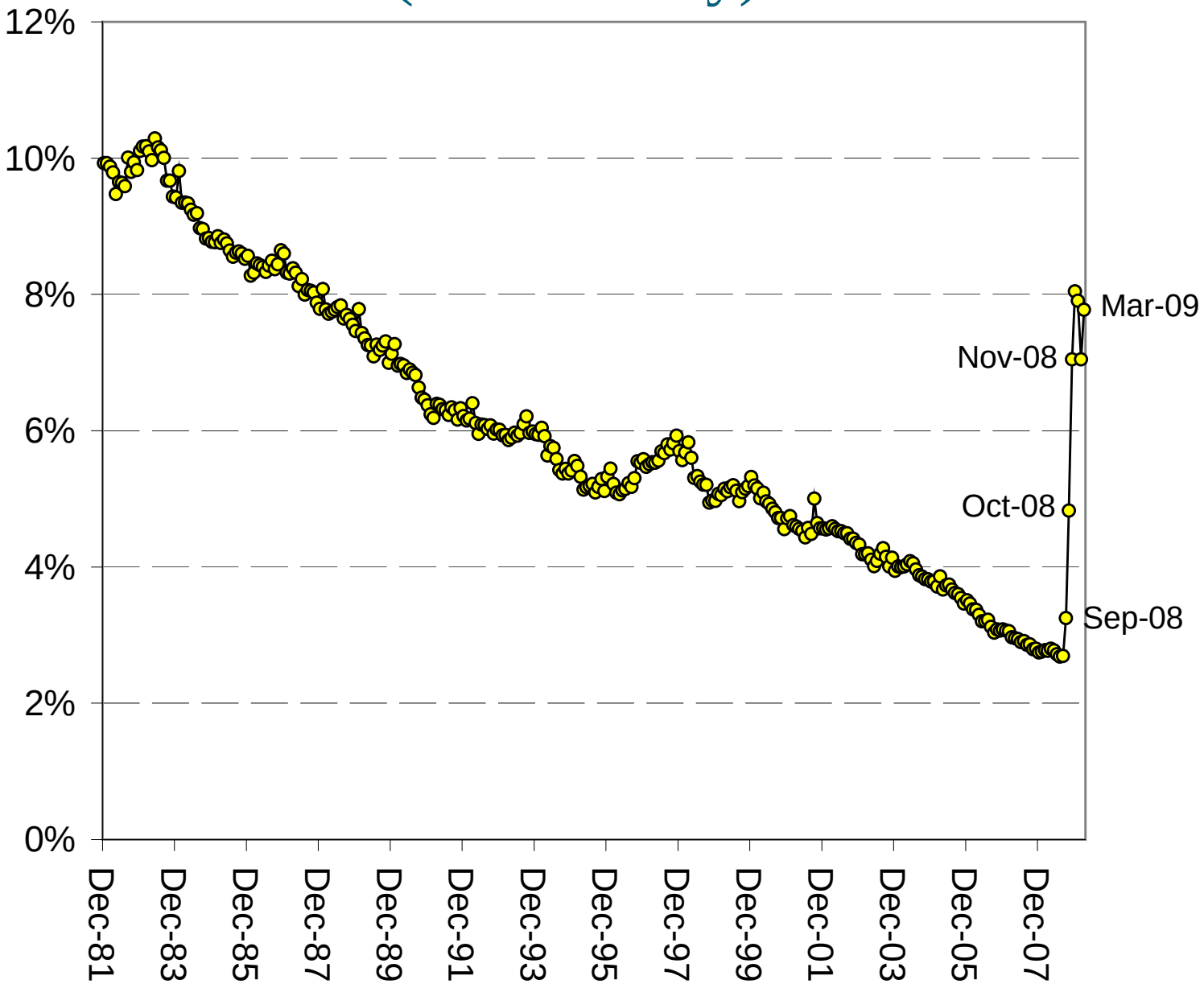


Source: JP Morgan

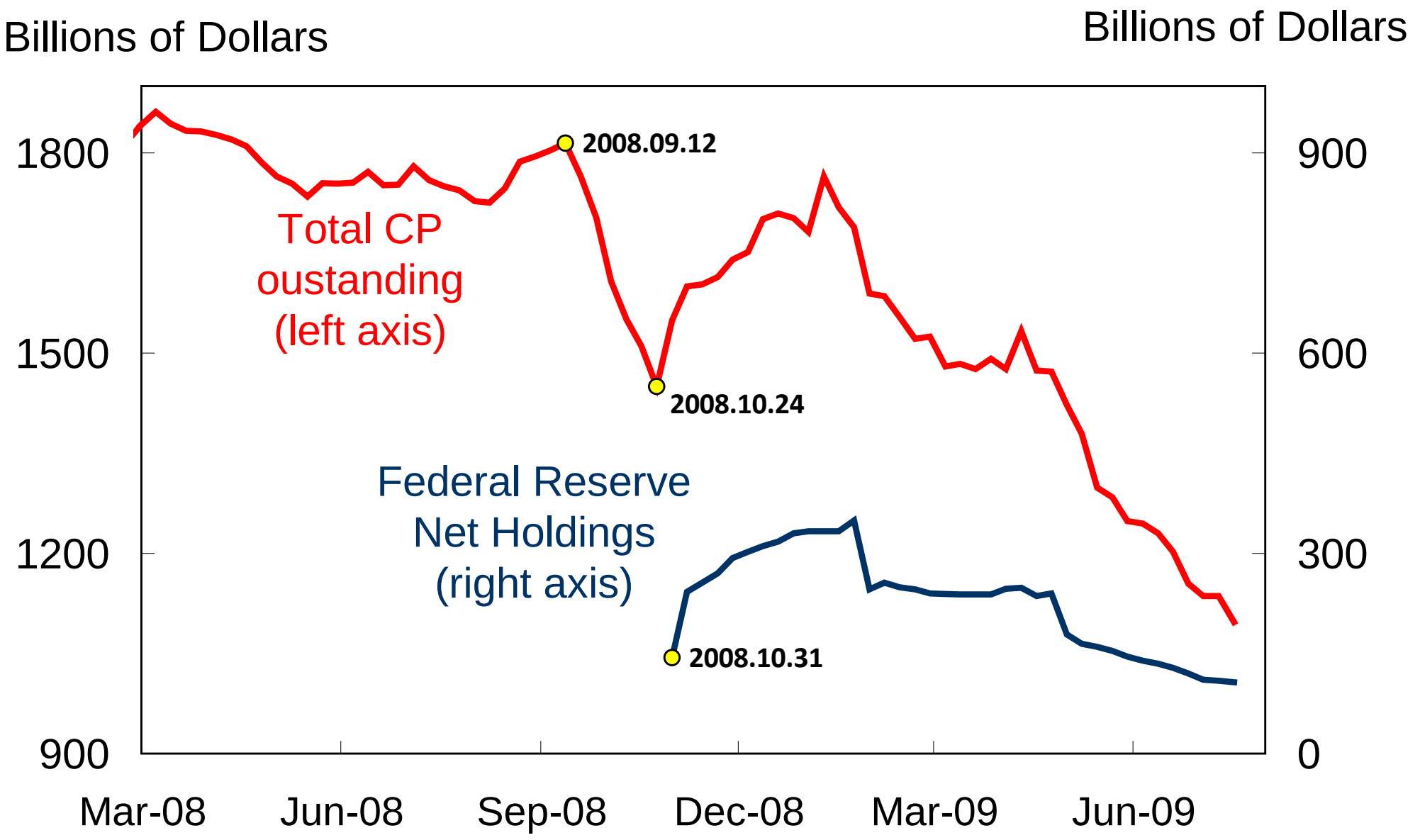
By-pass Surgery



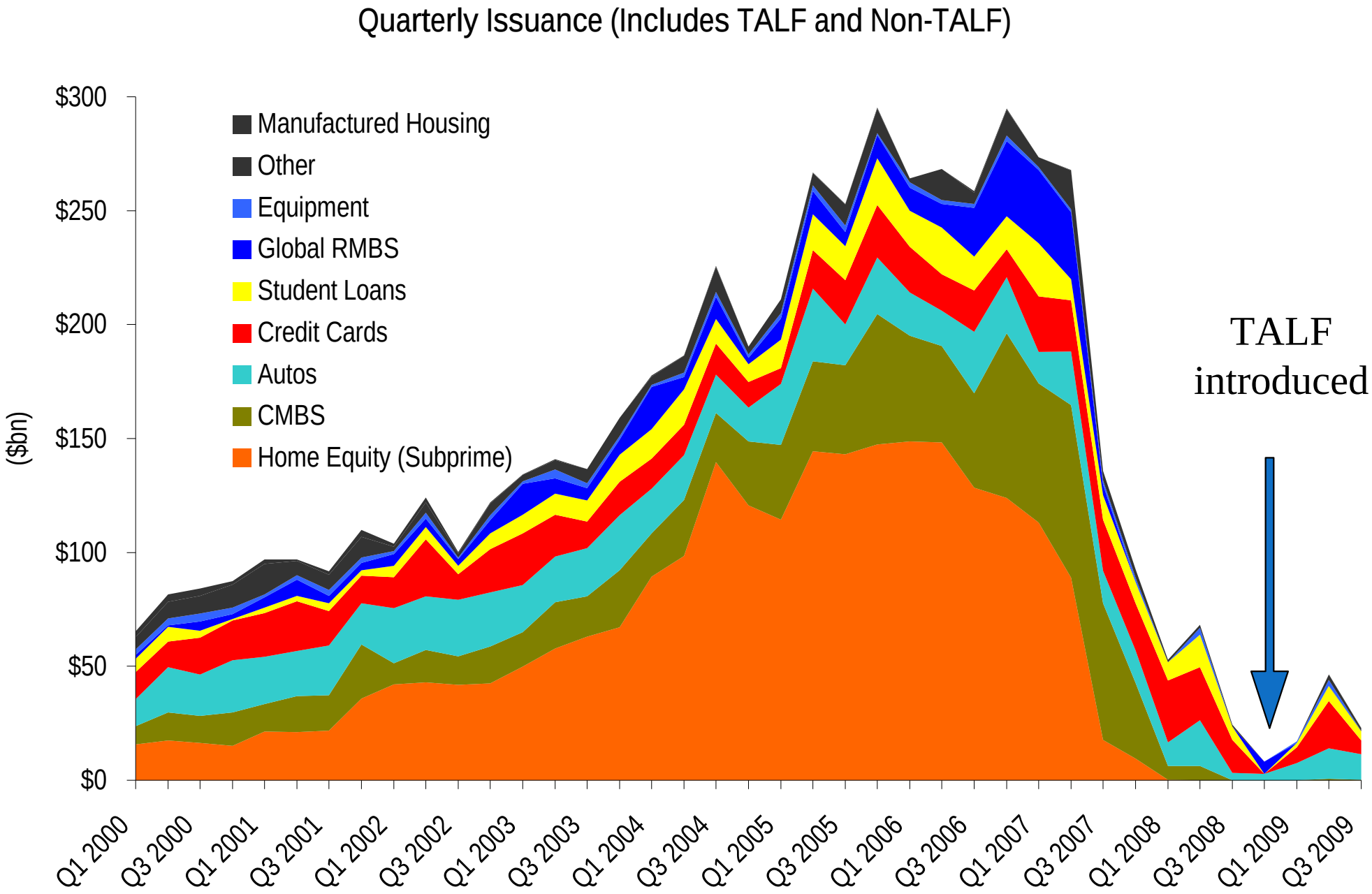
US Commercial Bank Cash/Assets Ratio (H8 Monthly)



CPFF and Commercial Paper Outstanding

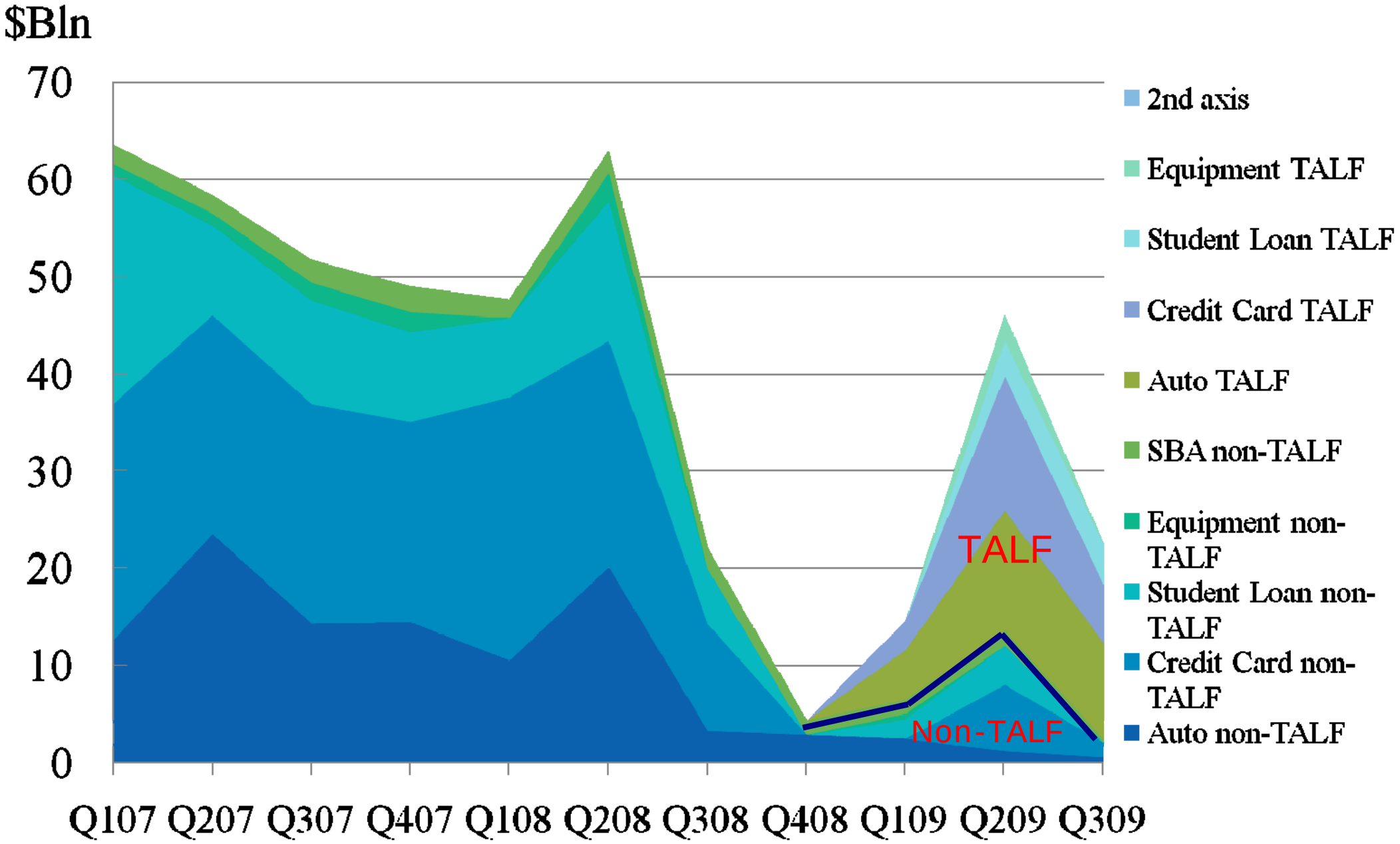


Source: Federal Reserve Board, Haver


Quarterly Issuance (Includes TALF and Non-TALF)
($bn)
$300
$250
$200
$150
$100
$50
$0
Manufactured Housing
Other
Equipment
Global RMBS
Student Loans
Credit Cards
Autos
CMBS
Home Equity (Subprime)
TALF introduced
Q1 2000
Q3 2000
Q1 2001
Q3 2001
Q1 2002
Q3 2002
Q1 2003
Q3 2003
Q1 2004
Q3 2004
Q1 2005
Q3 2005
Q1 2006
Q3 2006
Q1 2007
Q3 2007
Q1 2008
Q3 2008
Q1 2009
Q3 2009

ABS Issuance and TALF

(2009Q3 incomplete)



Source: JPMorgan

Monetary Policy Lessons

- Overnight interest rate matters in its own right, not just through expectations channel
  - Balance sheet growth & liquidity conditions
- Case for rehabilitating some role for balance sheet quantities
  - Not money, but repos, commercial CP, etc.
- Monetary policy and policies for financial stability are two sides of same coin