

Seminar 2
Balance Sheet Management and the Price of Risk

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Case for Marking to Market

- Market price reflects current terms of trade between willing parties
- Market price gives better indication of current risk profile
 - Market discipline
 - Informs investors, better allocation of resources
- Cautionary tales: US Savings and Loans crisis, Japan's lost decade

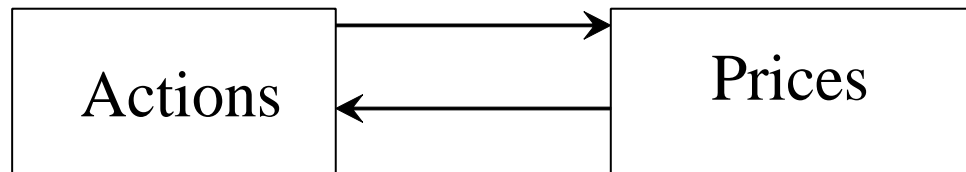
Theory of the Second Best

- When there is more than one imperfection in an economy, removing one of them need not improve welfare.
- In the presence of other imperfections (illiquidity, forced selling, bubbles, etc.) marking to market may not always be desirable.

Dual Role of Market Prices

Market prices play two roles

- Reflection of fundamentals
- Imperative for actions



Sometimes, reliance on market prices can distort market prices

Millennium Bridge

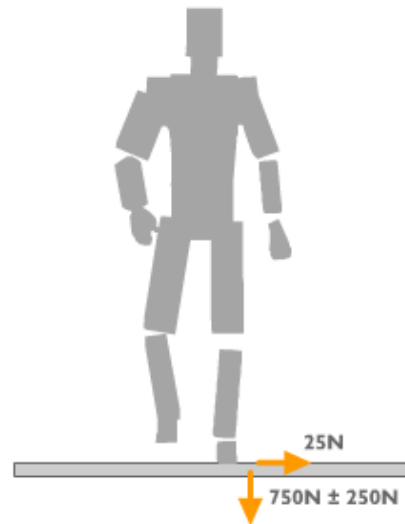


Diagnosis

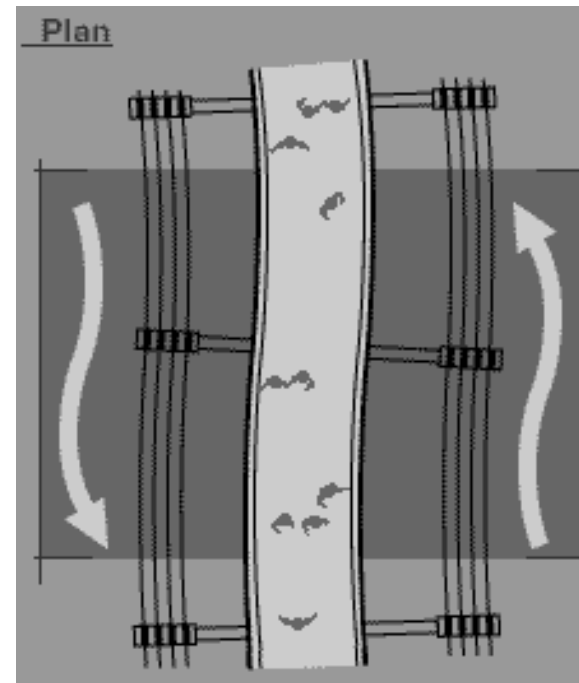
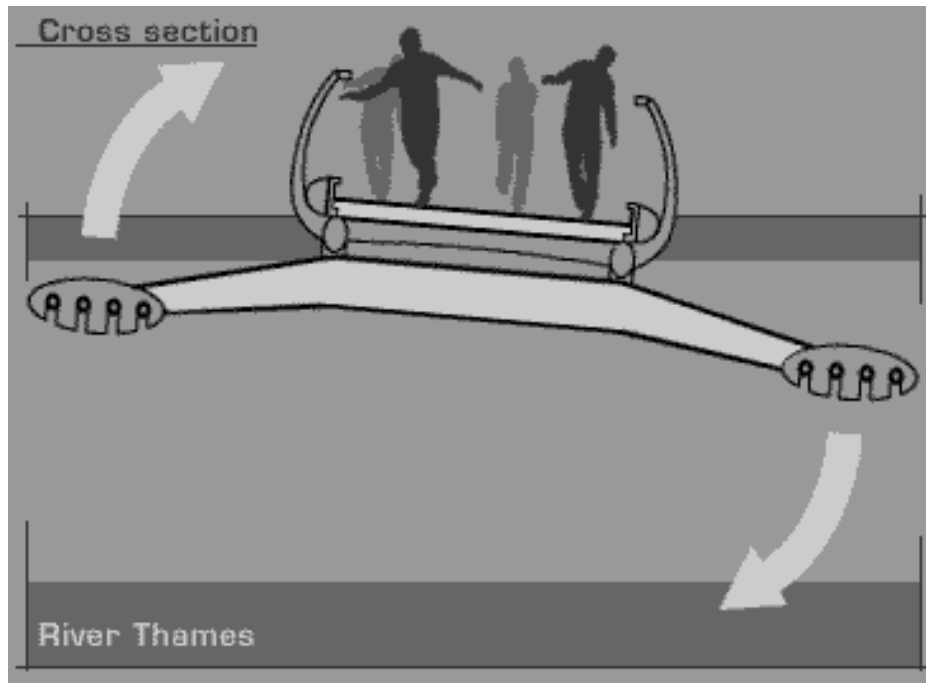
Trouble was at 1 hertz (one complete cycle per second)

Walking pace is approximately two steps per second (2 hertz)

Although most force exerts down when walking, there is small sideways force every two steps (1 hertz)



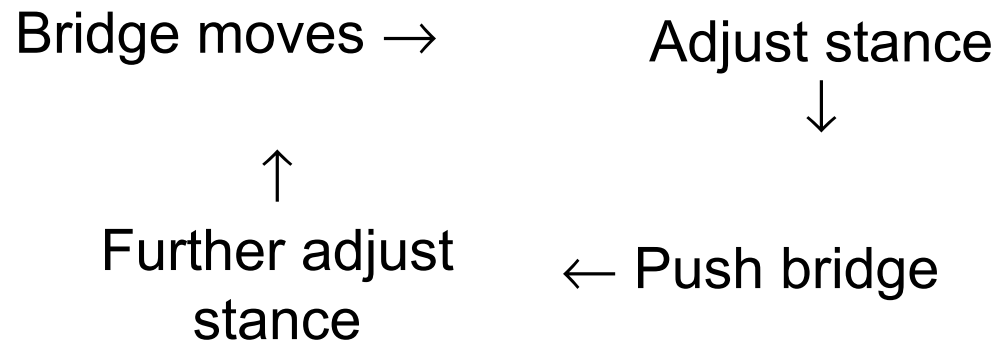
Diagnosis



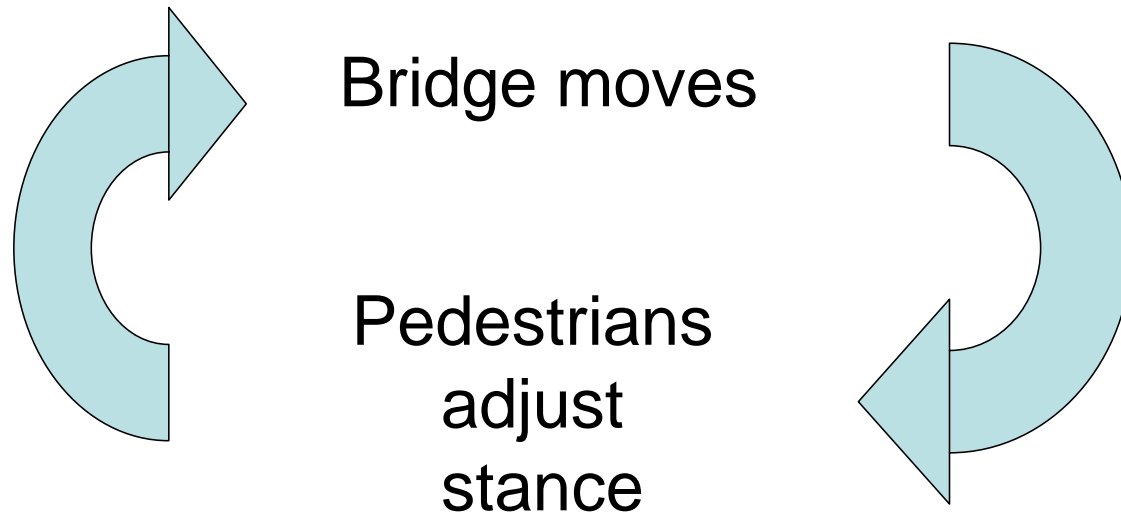
Probability of Coordination

What is the probability that a thousand people walking at random end up walking exactly in step, and remain in lock step thereafter?

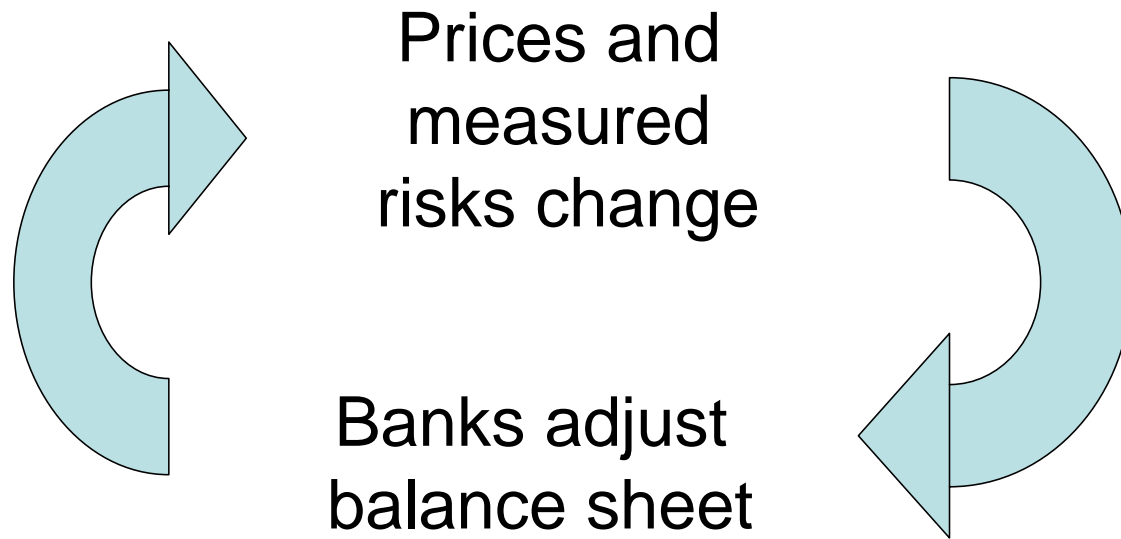
- If individual steps are independent, then probability is close to zero.
- But if there is a coordination mechanism, the probability is close to 1 under the right conditions.



Millennium Bridge Analogy



Millennium Bridge Analogy



Role of Accounting

When balance sheets are marked to market, asset price changes show up immediately on the balance sheet, and elicit responses from market participants - especially leveraged entities.

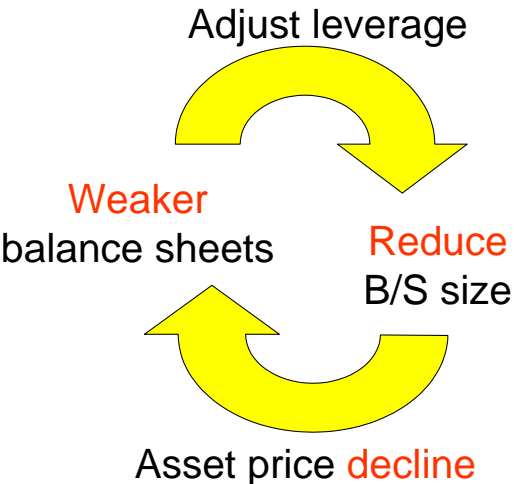
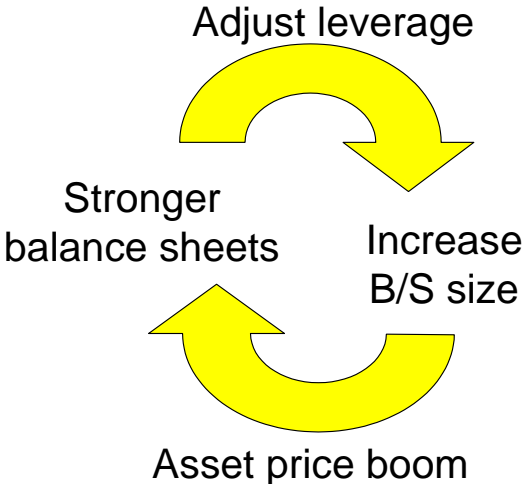
Diversity of positions aids stability of financial system. But market prices are a lightning rod that imposes uniformity.

Reliance on market prices may distort market prices.

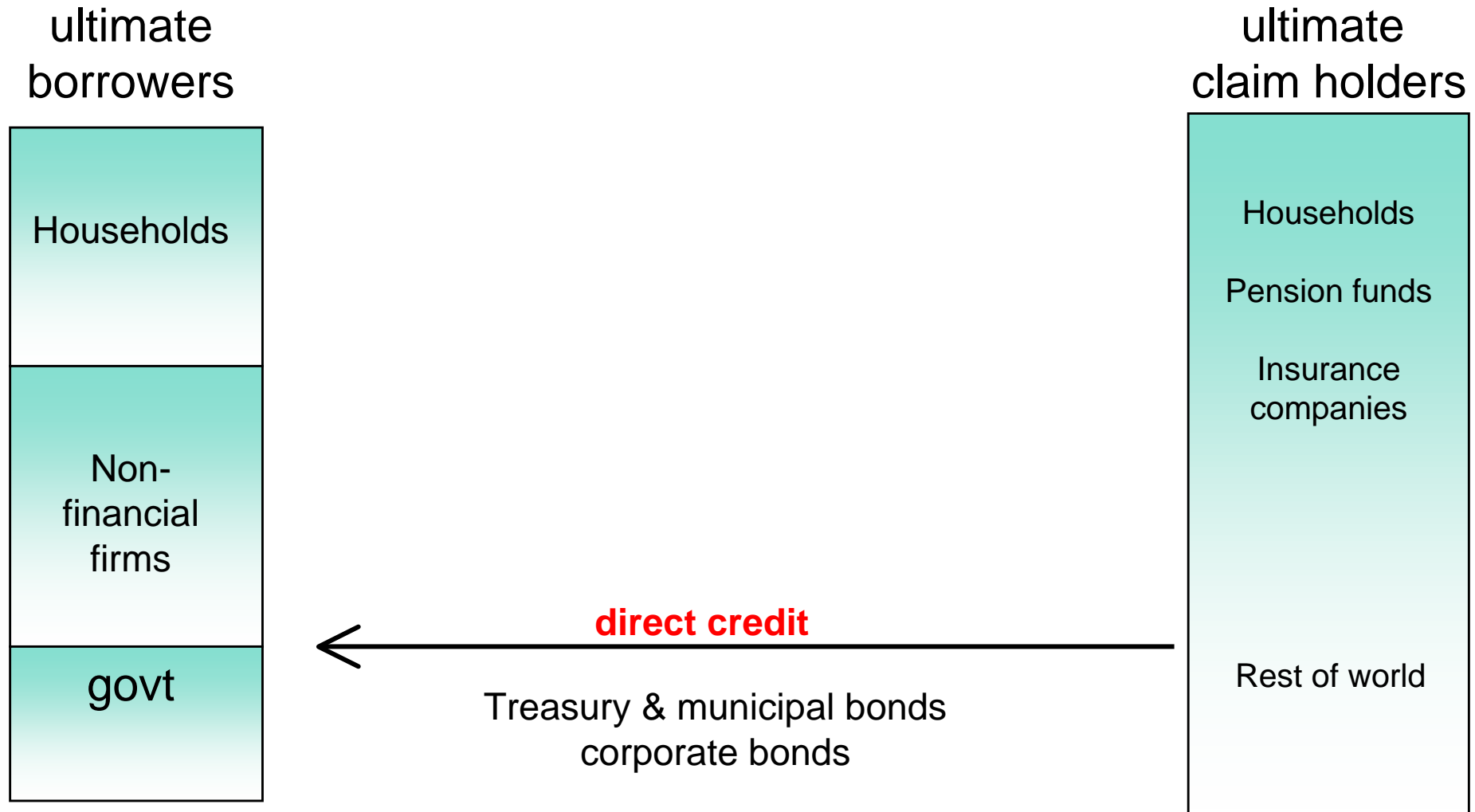
The choice is between:

- Relying on degraded market signals
- Using valuation rules that filter out some price information

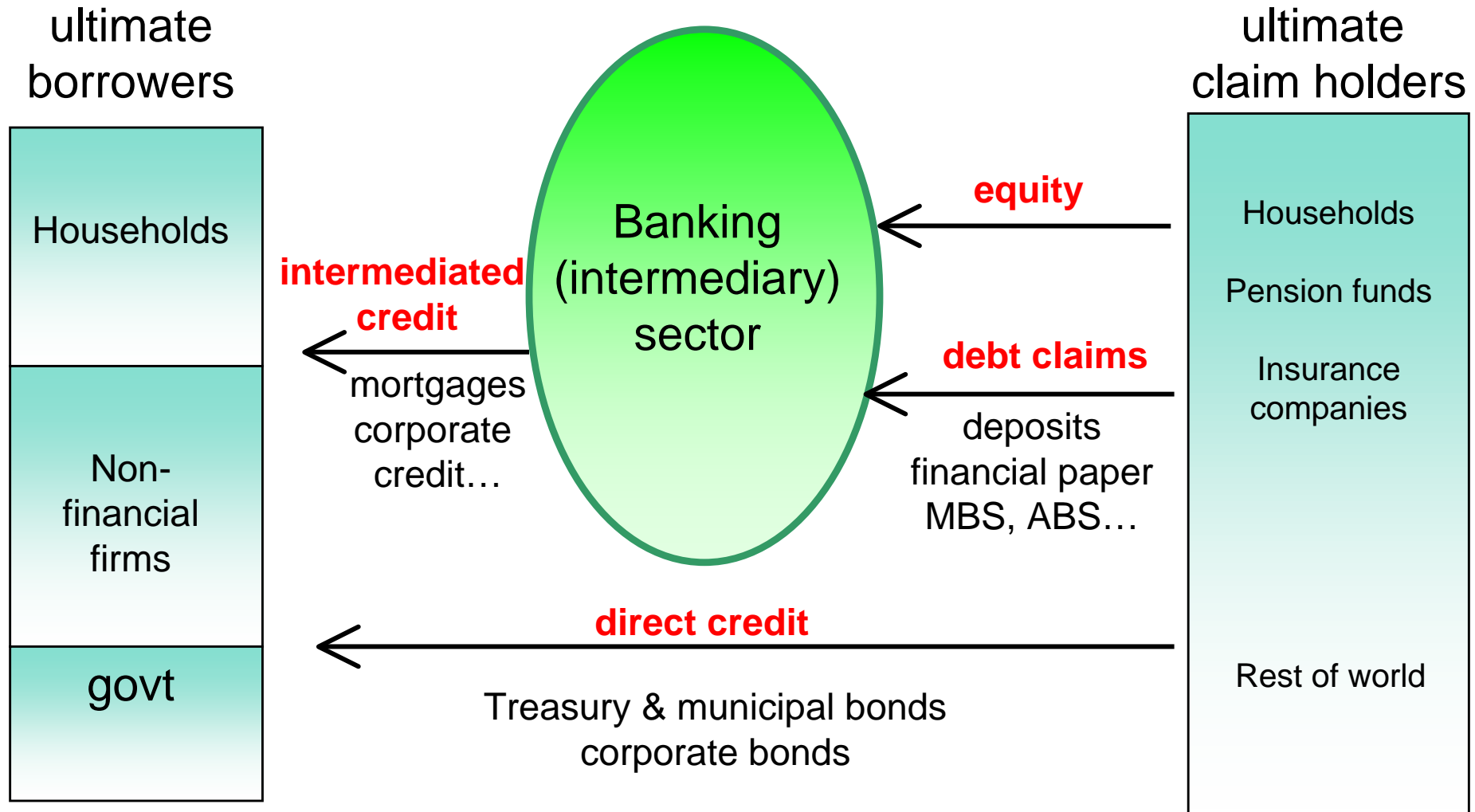
Amplification



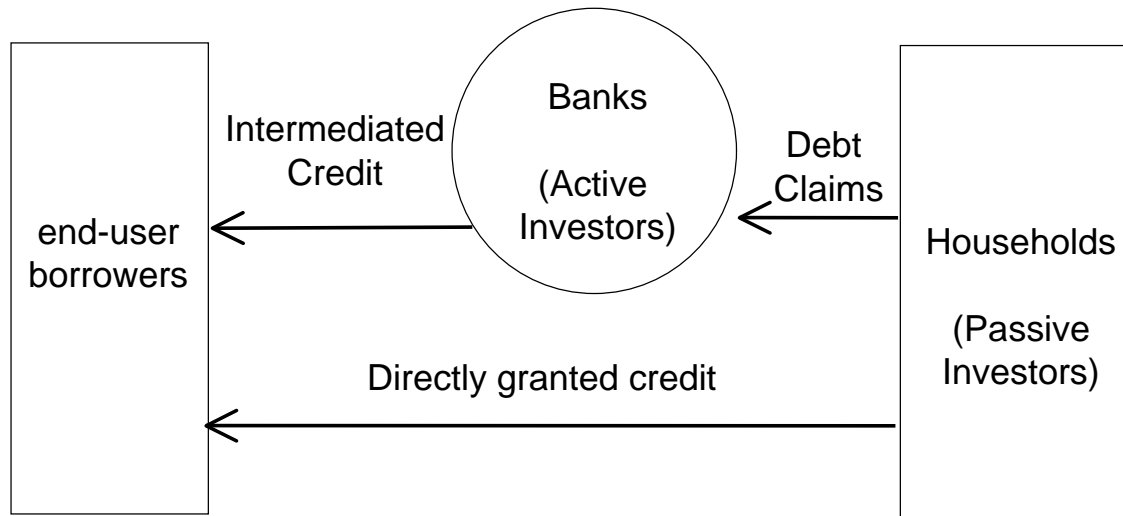
Stylized Financial System



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*.

Interpretation

- 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

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

$\tau > 0$ 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

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

Optimal holding of risky security satisfies first order condition:

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

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

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

Aggregation. Linear demands can be summed to give the aggregate demand. If τ_i is the risk tolerance of the i th 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:

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

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

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

Optimal holding of the risky securities for the leveraged investor is

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

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

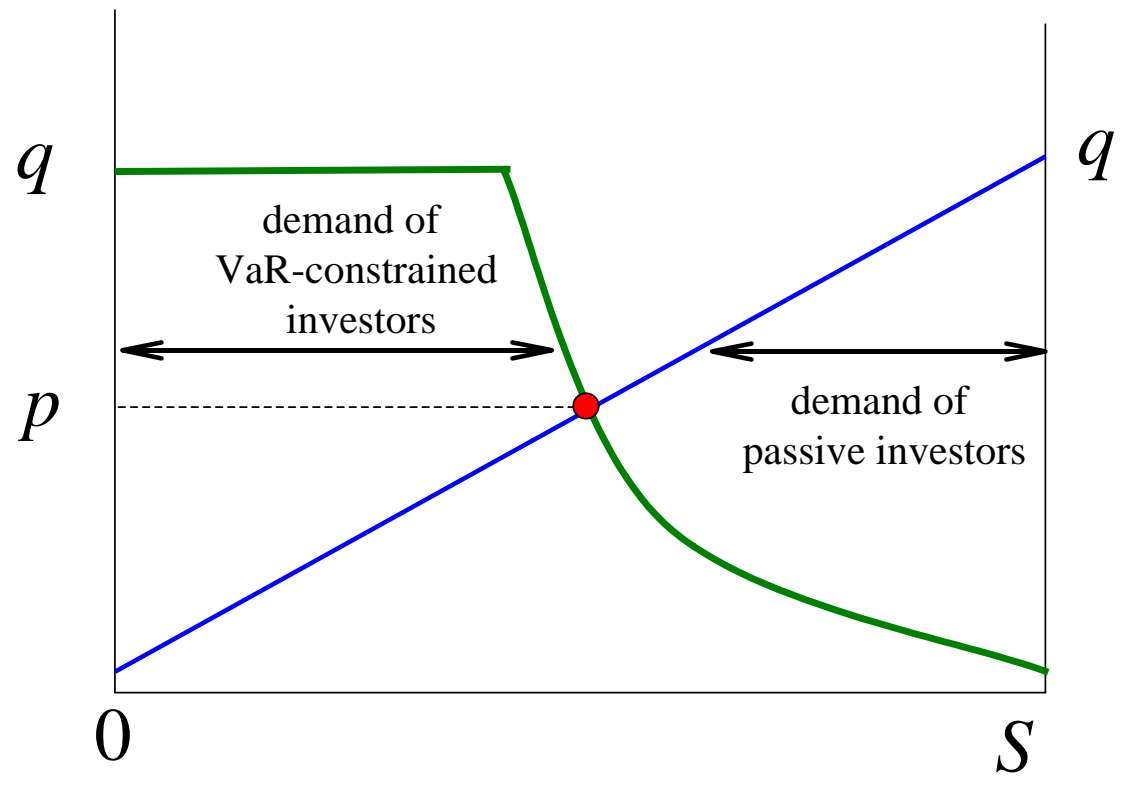
y_P the holding by the passive investors.

S is the total endowment of the risky securities.

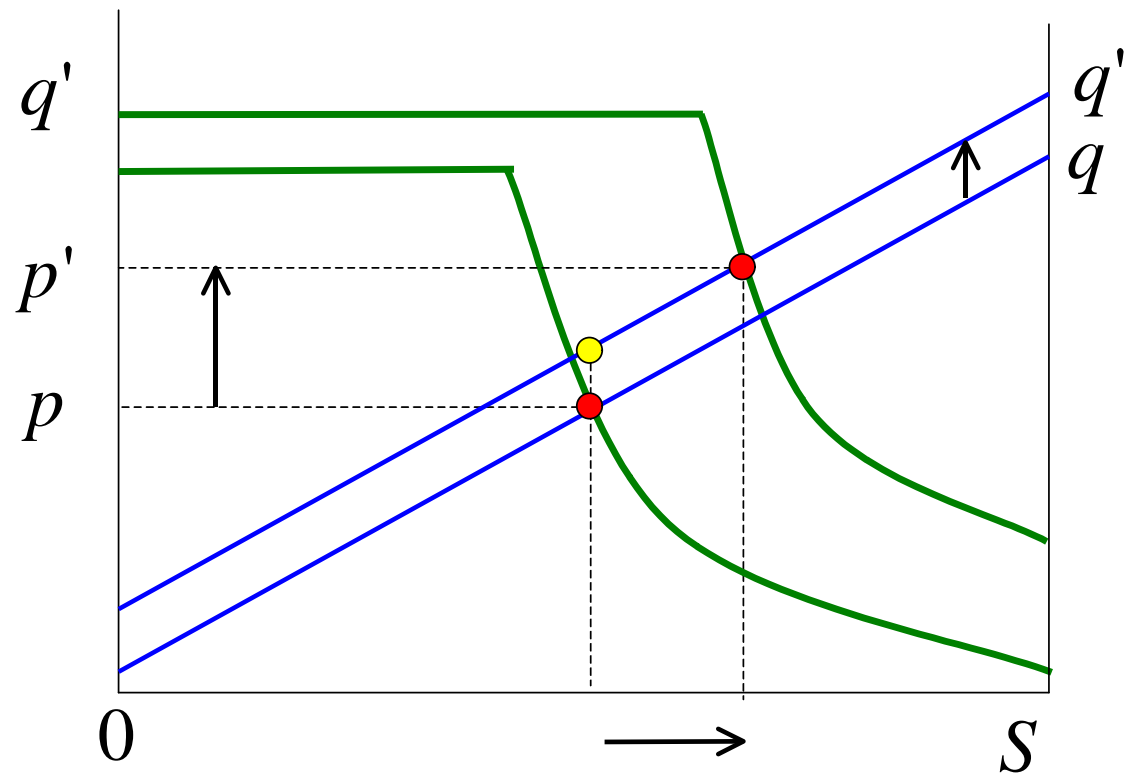
Market clearing condition is

$$y_A + y_P = S \quad (10)$$

The solution is fully determined as a function of e .



Market Clearing Price



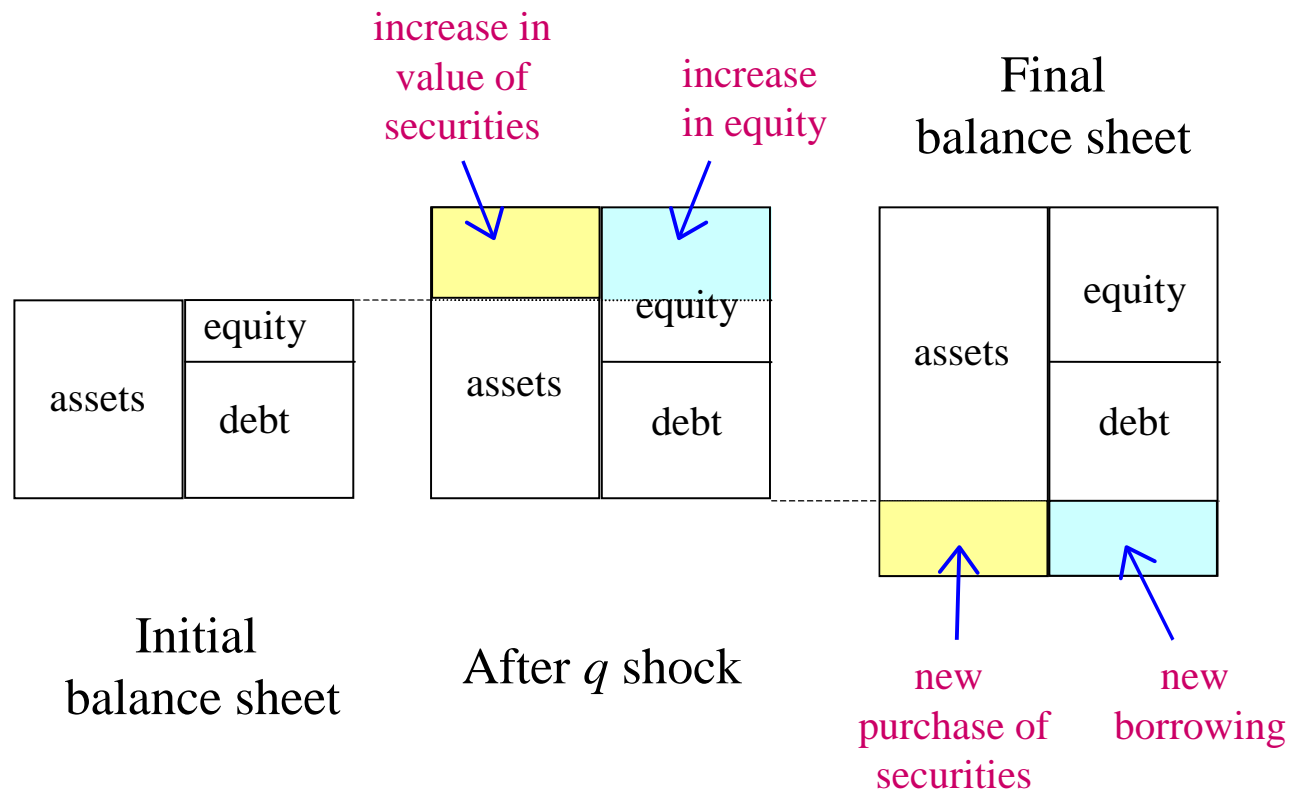
Amplified response to improvement in fundamentals q

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

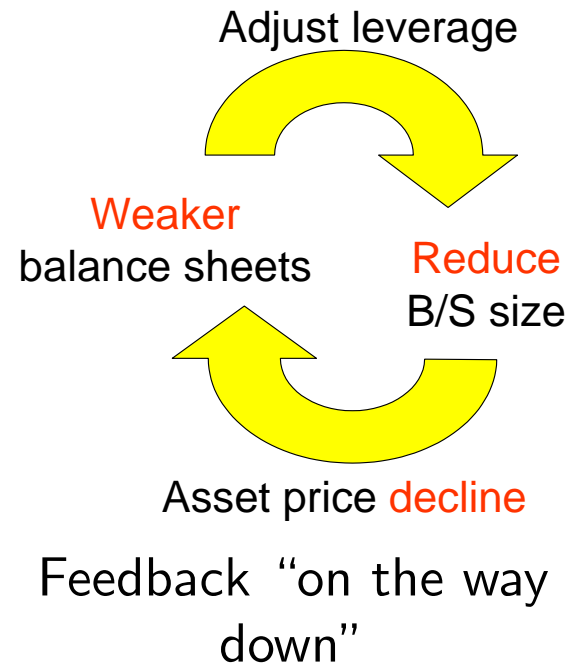
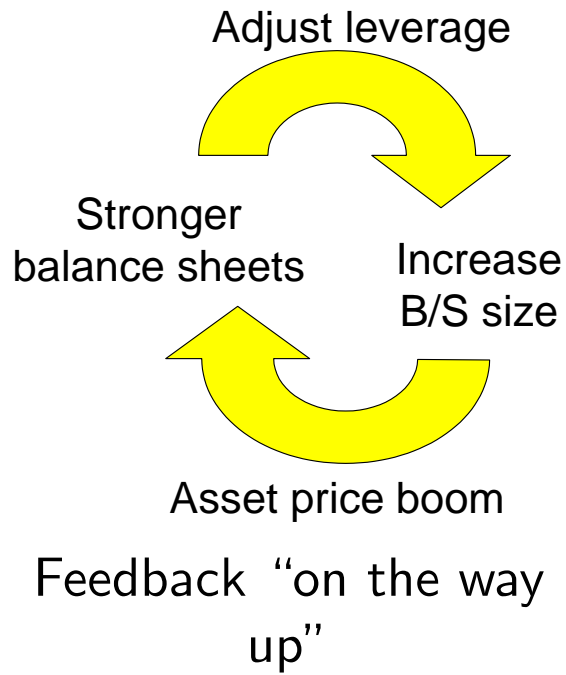
$$y' = y \left(1 + \frac{q' - q}{z + p' - q'} \right) \quad (13)$$

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

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

Substituting into (13),

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



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*

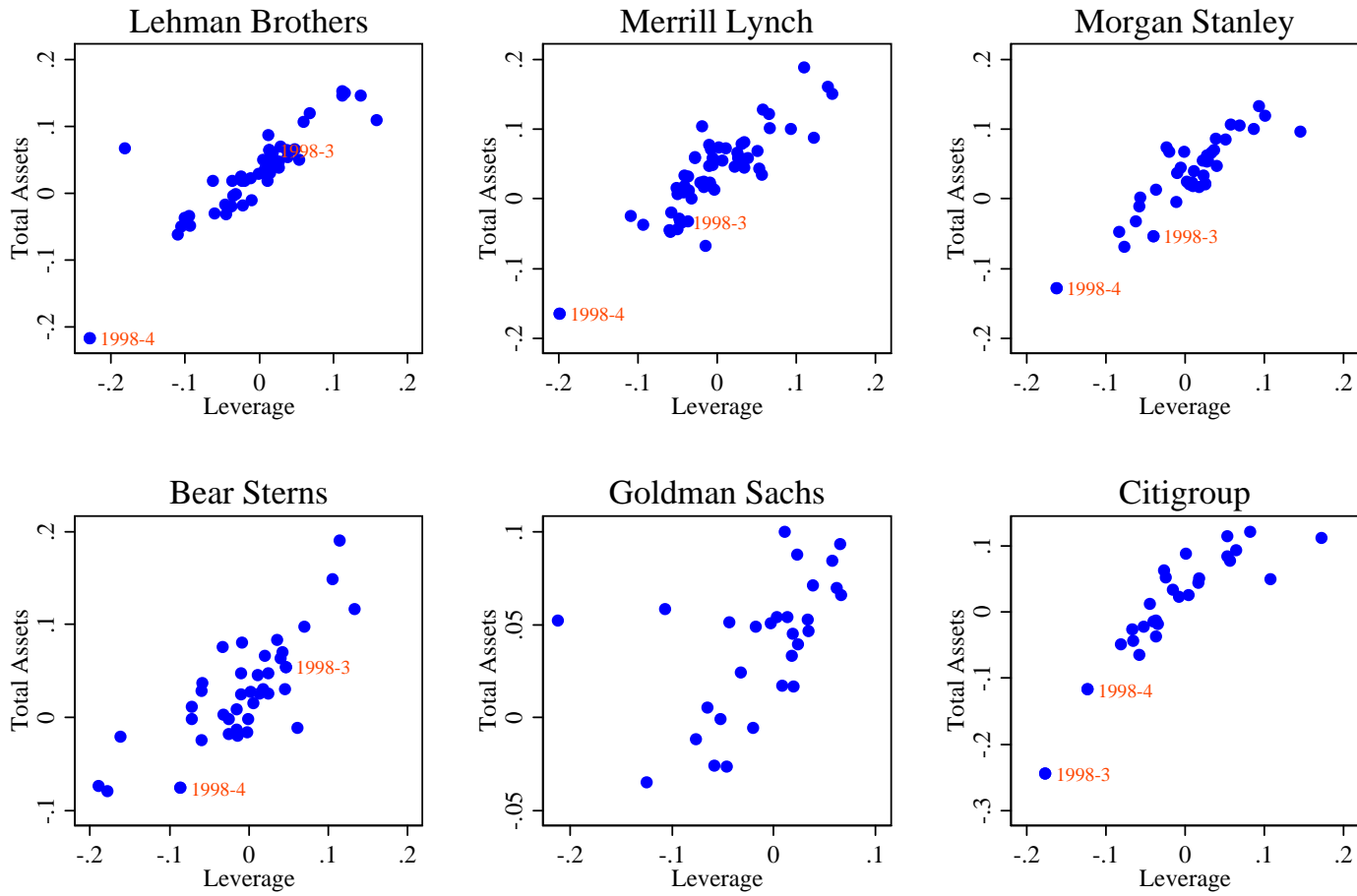
“The shadow value of bank capital is low when balance sheets are large”

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

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

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

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,

$$\pi \geq \pi_0 \quad (17)$$

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

Alternative Approaches to Policy

- Extreme choices are:
 - Using degraded market signals (marking to market)
 - Using obsolete historical information (historical cost accounting)
- But the spillover effects are different
 - Marking to market amplifies price moves
 - Historical cost accounting dampens price moves (e.g. “gains trading”)
- What should be the target of policy?
 - Price signals?
 - Incentives?
 - Are quantitative restrictions sufficient?

Governance Issues

- Accounting rules have economic impact, but accounting standard setters do not see it as part of their remit to consider wider economic impact
- Accounting is a public policy issue, as much as prudential regulation or monetary policy.
- Is accounting too important to be left solely to the accountants?