# DECIPHERING THE 2007-0? LIQUIDITY AND CREDIT CRUNCH

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# Overview of Talk



1. Run-up
   - Originate and distribute banking model
   - Shadow banking system (SIVs, Conduits)
   - Increased leverage/maturity mismatch (on/off balance sheet)
   - Lax lending standards

   ⇨ "Credit bubble:" buy-out bonanza, house price frenzy
2. Unfolding of crisis
   - Subprime, ABCP, banking crisis
   - Hedge fund quant crisis
3. Mechanisms at work
4. Difference to previous crises

# 1.1 Securitization – Shorten Maturity



- **Originate-distribute banking model**
- **Securitization**
  - Insuring — CDS
  - Pooling
  - Tranching — CDOs
- **Shortening maturity**
  - Off-balance sheet: SIVs et al.
    - Buy long-maturity assets
    - Sell and roll over short-term assets (ABCP)
      - + liquidity enhancement (credit line)
    - Traditional business of banks
      - New aspects:
  - On-balance sheet: overnight Repo

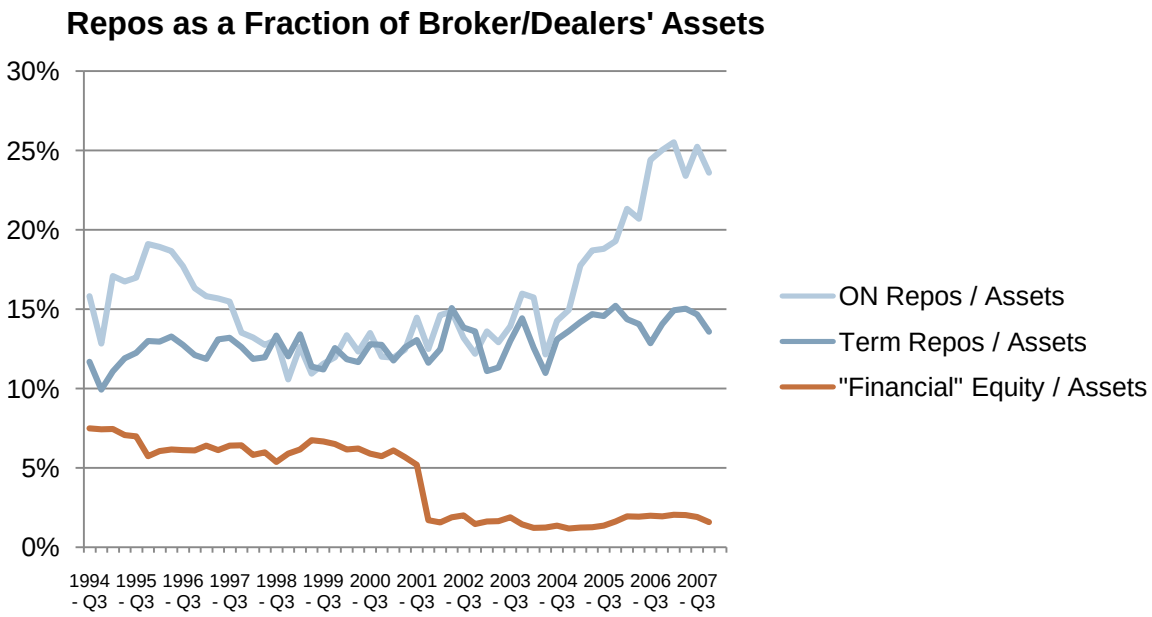
| Bond Tranches | Thickness | "Loss Support" |
|---|---|---|
| AAA | 80% | 20% |
| AA | 5% | 15% |
| A | 5% | 10% |
| BBB+ | 2% | 8% |
| BBB | 1% | 7% |
| BBB- | 2% | 5% |
| BB | 1% | 4% |
| Overcollateralization (Equity) | 4% | 0% |

# 1.2 Shortening Maturity: I-Banks



- Investment banks' main financing in 2007
  - Repos 1150.9bn
  - Security credit (subject to Reg T)
    - Margin accounts from HH or non-profit 853.5bn
    - From banks 335.7bn
  - "Financial" equity 49.3bn

- Increase in repo is due to overnight repos!




See also Adrian and Fleming (2005)

# 1.3 Why Structured Products?



- Good reasons
  - Credit risk transfer risk who can best bear it
    - Banks: hold equity tranch to ensure monitoring
    - Pension funds: hold AAA rated assets due to restriction by their charter
    - Hedge funds: focus on more risky pieces
    - *Problem:* risks stayed mostly within banking system
      banks held leveraged AAA assets – tail risk
- Bad reasons - supply
  - Regulatory Arbitrage – Outmaneuver Basel I (SIVs)
    - esp. reputational liquidity enhancements
  - Rating Arbitrage
    - Transfer assets to SIV and issue AAA rated papers
    - instead of issuing A- minus rated papers
    - + banks' own rating was unaffected by this practice
    - ++ buy back AAA has lower capital charge (Basel II)
  - …

# 1.3 Why Structured Products?



- Bad reasons - demand
  - Naiveté – Reliance on
    - past low correlation among regional housing markets
      - Overestimates value of top tranches
      - explains why even investment banks held many mortgage products on their books
    - rating agencies - rating structured products is different
      - Quant-skills are needed instead of cash flow skills
      - Rating at the edge – AAA tranch just made it to be AAA
  - Trick your own fund investors – own firm (in case of UBS)
    - "Enhance" portfolio returns e.g. leveraged AAA positions – extreme tail risk
      - searching for yield (mean)
      - track record building (skewness: picking up nickels before the steamroller)
    - Attraction of illiquidity (no price exists) (fraction of "level 3 assets" went up a lot)
      + difficulty to value CDOs (correlation risk)
      - "mark-to-model": Mark "up", but not "down"
      - smooth volatility, increase Sharpe ratio, lower $\beta$, increase $\alpha$
    - Implicit (hidden) leverage

# 1.4 Consequences of "originate and distribute banking model"



- Banks focus only on **"pipeline/warehouse risk"**
- Deterioration of lending standards
  - Housing Frenzy
  - Private equity bonanza – "going private trend"
    LBO acquisition spree

# 2. Unfolding of Crisis



Slow down in house-price increase

1. Subprime — early 2007 …

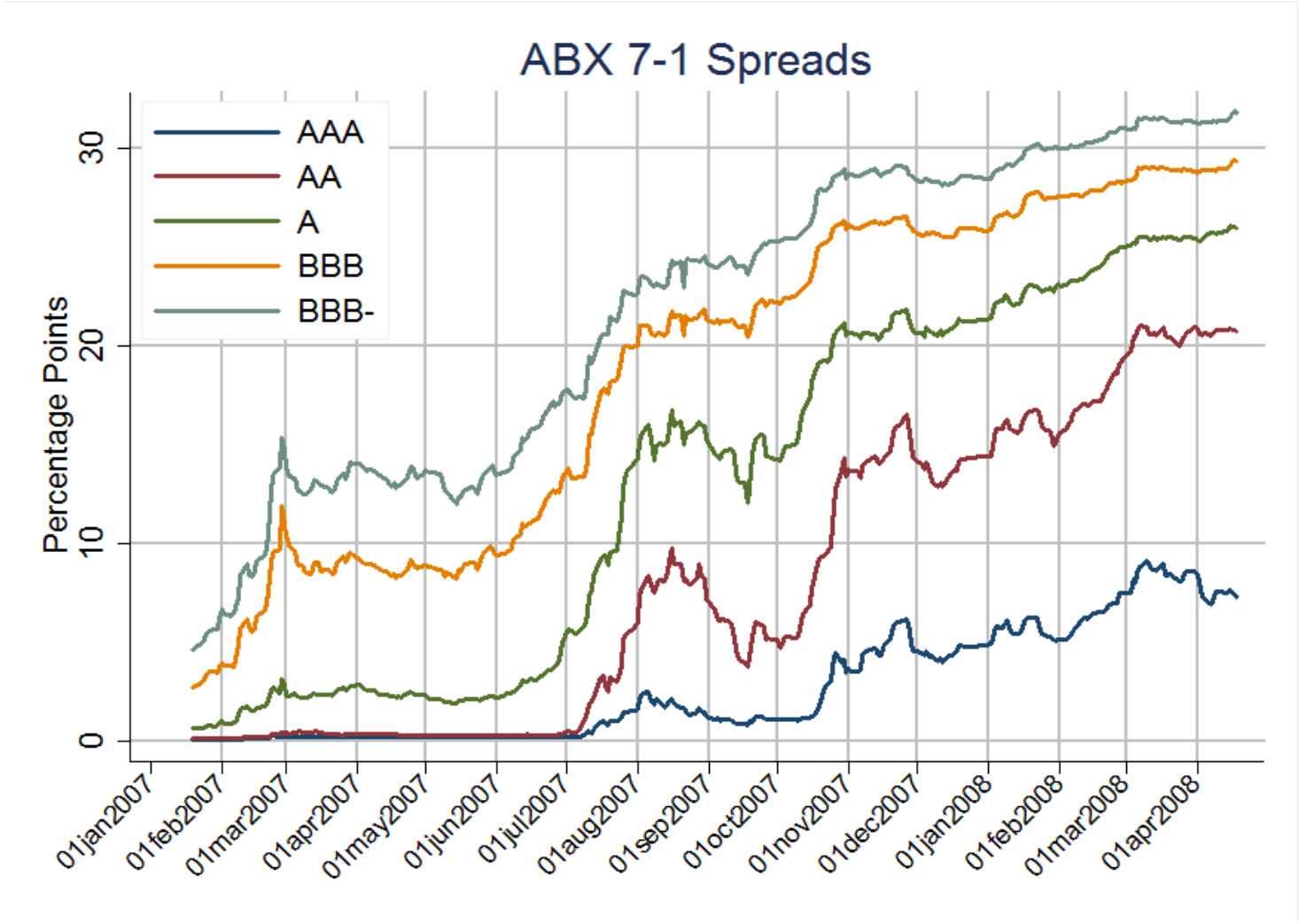
   ABCP, banking crisis — July/Aug. 2007 …


   Spillover to corporate credit

2. Hedge fund (quant) crisis — July/Aug.2007

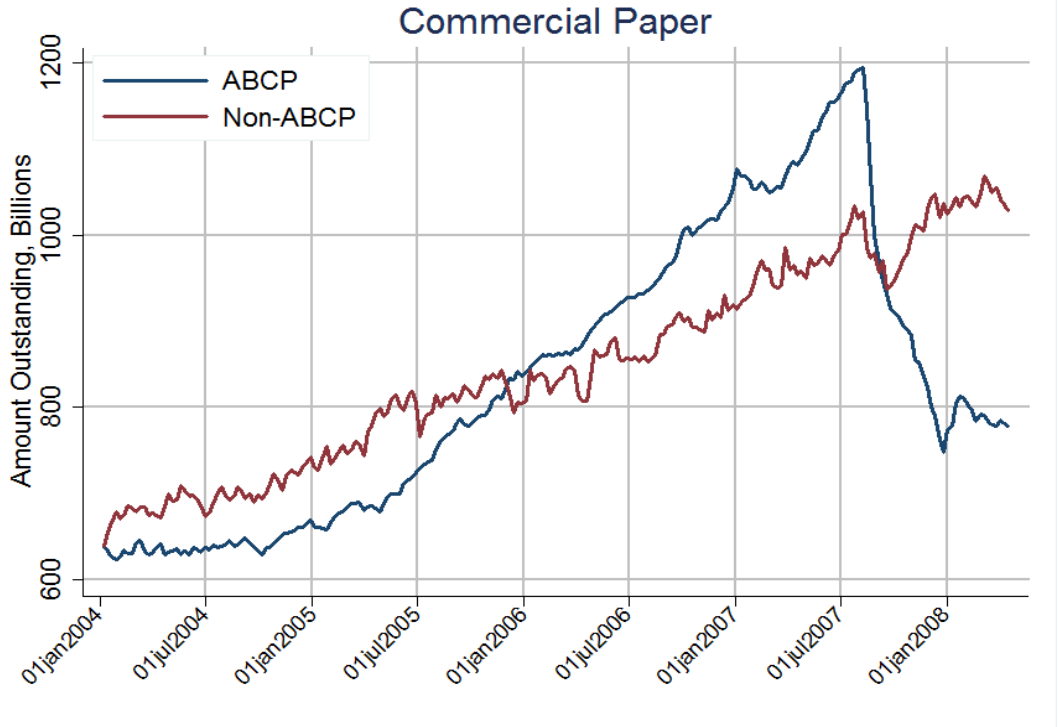
# 2.1 Subprime Crisis





# 2.2 ABCP – Banking Crisis

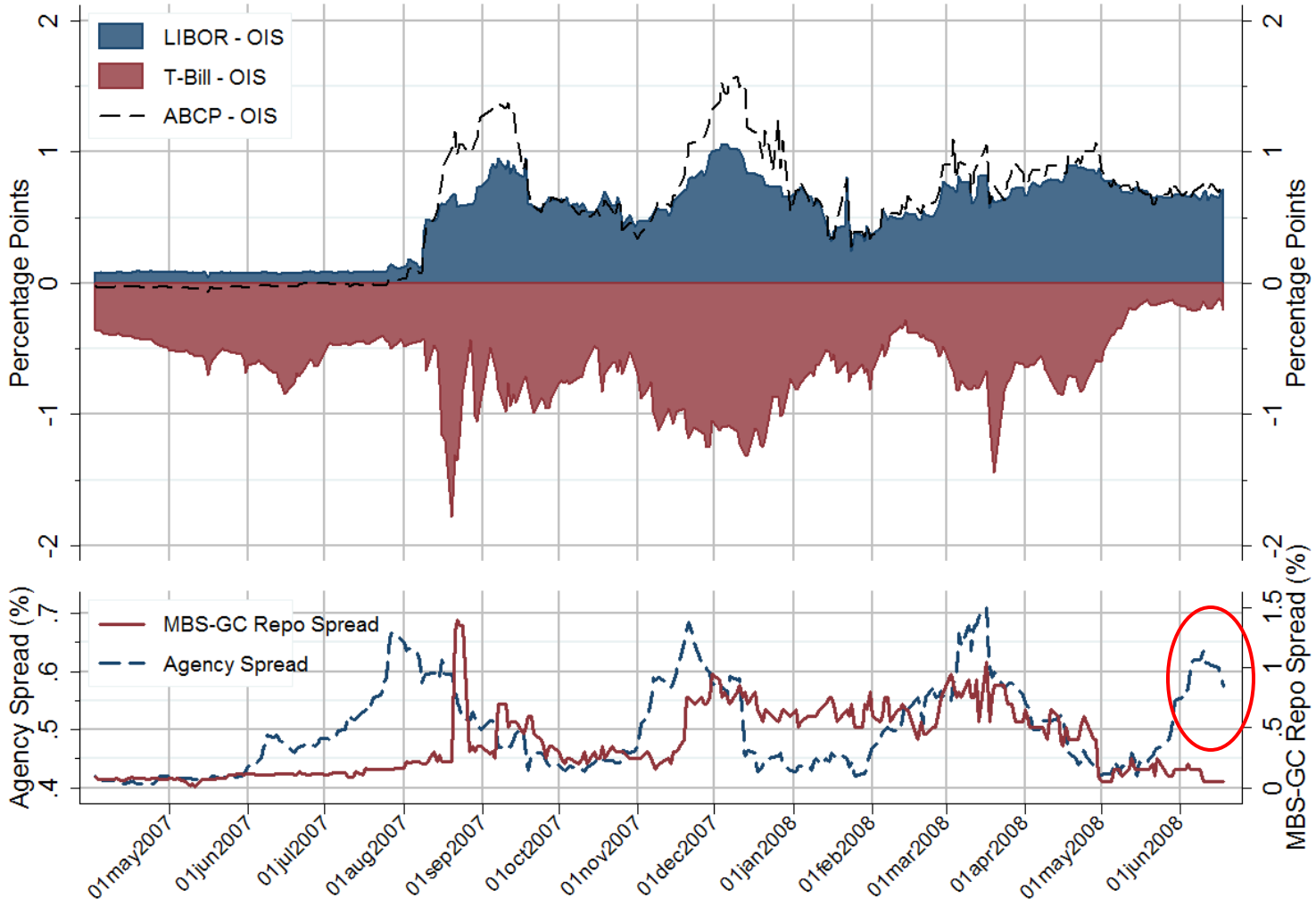





- ABCP dries up
  - no rollover, esp. by money market funds (“Break the Buck” Rule 2a-7)
- SIVs draw on credit lines of sponsoring bank
- Banking Crisis: IKB, SachsenLB, Northern Rock, IndyMac, …

# 2.2 The Waves






## Default risk

## Treasury special

- T-Bill – OIS
- Repo spread

## Agency spread leads TED

## New lending facilities

- 08/17 TermDW
- 12/12 TAF + Swap
- 03/16 PDCF
- 03/27 TSLF

## Interest rate cuts

- 08/17 -.5 (DW)
- 09/18 -.5
- 10/31 -.25,
- 12/11 -.25,
- 01/22 -.75
- 01/30 -.5

# 2.3 Hedge Fund Quant Crisis

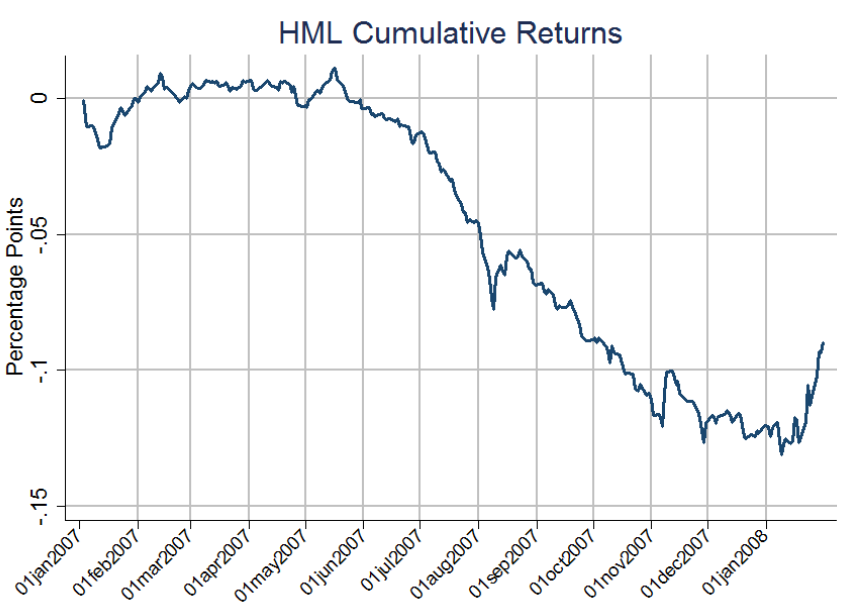


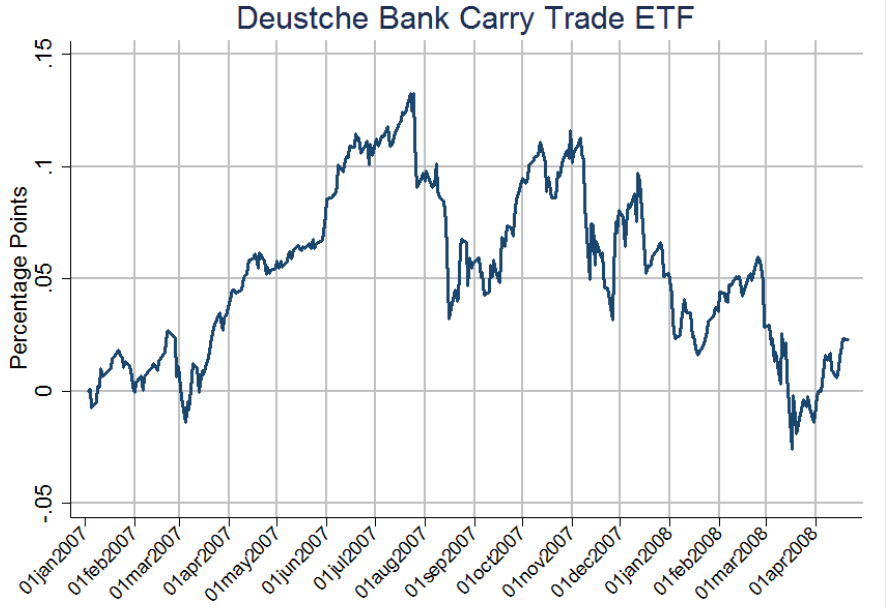
1. High frequency stat arbs
   - High frequency, IT driven, short-term reversal strategies
   - e.g. Renaissance's Medallion fund
   - Aug 1st to Aug 9th - price declines seven days in a row
2. Low frequency quant funds
   - Value-growth (HML) strategy, momentum strategy, earning/sale-ratio, accruals-total assets ratio, …
     - Orthogonalize (diversification)
   - FX carry trades
   - e.g. Goldman Sachs' Global Alpha, AQR, …

$\Rightarrow$ became very popular/crowded

# 2.3 Hedge Fund Quant Crisis






- Why? Many (not only quant) funds liquidate "relatively" liquid positions first – "liquid HML" suffered even more
- Quant funds focus on same few "quant strategies"
- Almost all quant strategies *comoved* – "crowded trades"
  - US from 08/05/07 + sharp (correlated) rebound on 08/10/07
  - Europe/Japan from 08/08/07 onwards

# 2.4 Size of trigger: subprime



- Envelope Calculation
  - Subprime mortgage: 15% of US$ 10tr = US$ 1.5tr
  - Say: 50 % default, only recoup 50%
  - Total loss: US$ 375bn, incl. Alt-A say, US$ 500bn
  - 2%-3% change in stock market ≈ US$ 500bn

➢ Amplifying mechanism needed!

# 3. Two Concepts of Liquidity



- Market liquidity
  - Ease with which one can raise money by selling the asset
- Funding liquidity
  - Ease with which one can raise money by borrowing using the asset as collateral

Each asset has two values/prices

1. price
2. collateral value

# 3. Flavors of Funding Liquidity



- Margin funding risk — *Prime broker*
  - Margin has to be covered by HF's own capital
  - Margins increase at times of crisis
- Rollover risk — *ABCP*
  - Inability to roll over short-term commercial paper
- Redemption risk — *Depositors, HF-investors*
  - Outflow of funds for HFs and banks

Essentially the same!

Maturity mismatch:

Long-term assets (with low market liquidity)
Short-term borrowing

*Maturity structure – **not** capital structure (leverage)!*

# 3. Amplification Mechanisms

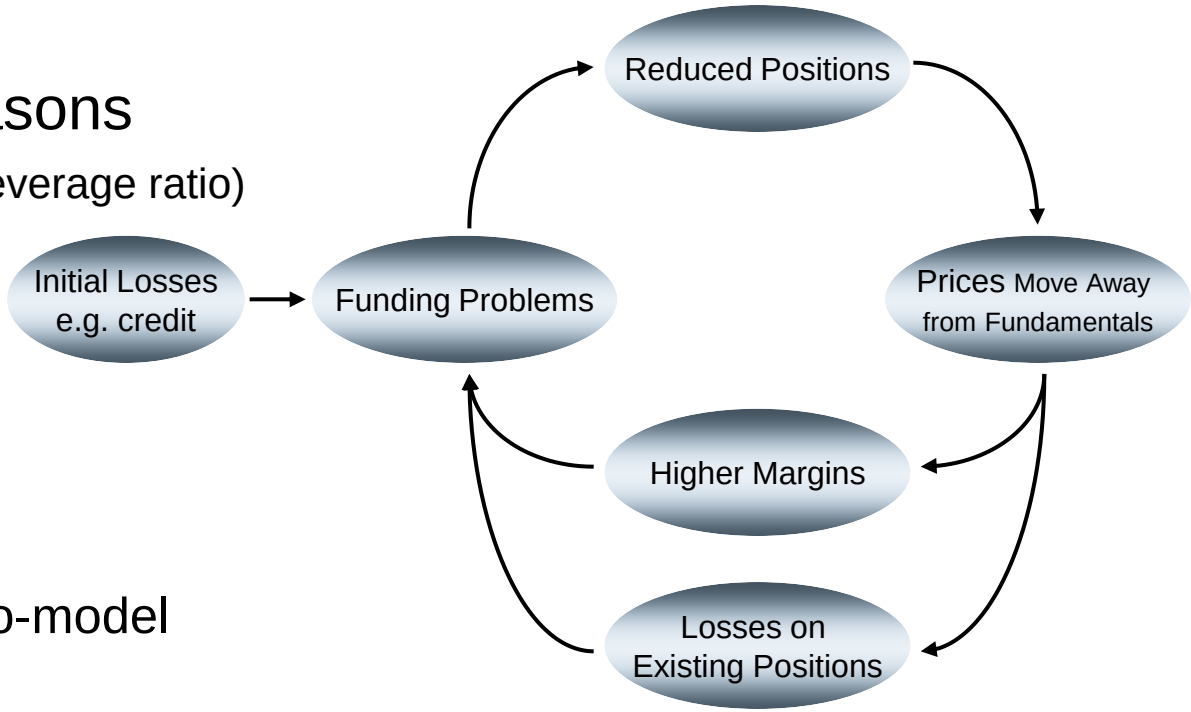


1. Borrowers' Balance Sheet Effects
   - Loss Spiral
   - Margin Spiral ⇨ de-leveraging
2. Lending Channel Effects
   - static
   - dynamic: precautionary hoarding
3. Run on Financial Institutions
4. Network Effects: Gridlock Risk

# 3.1 Balance Sheet Channel



- Borrowers' balance sheet
  - Loss spiral
    - Net wealth > $\alpha$ x
      for asym. info reasons
      - (constant or increasing leverage ratio)
      - Bernanke-Gertler, …
  - Margin spiral
    - (forces to delever)




Source: Brunnermeier & Pedersen (2007)

- Mark-to-market vs. mark-to-model
  - worsens loss spiral
  - improves margin spiral

• Both spirals reinforce each other

# 3.1 Balance Sheet Channel



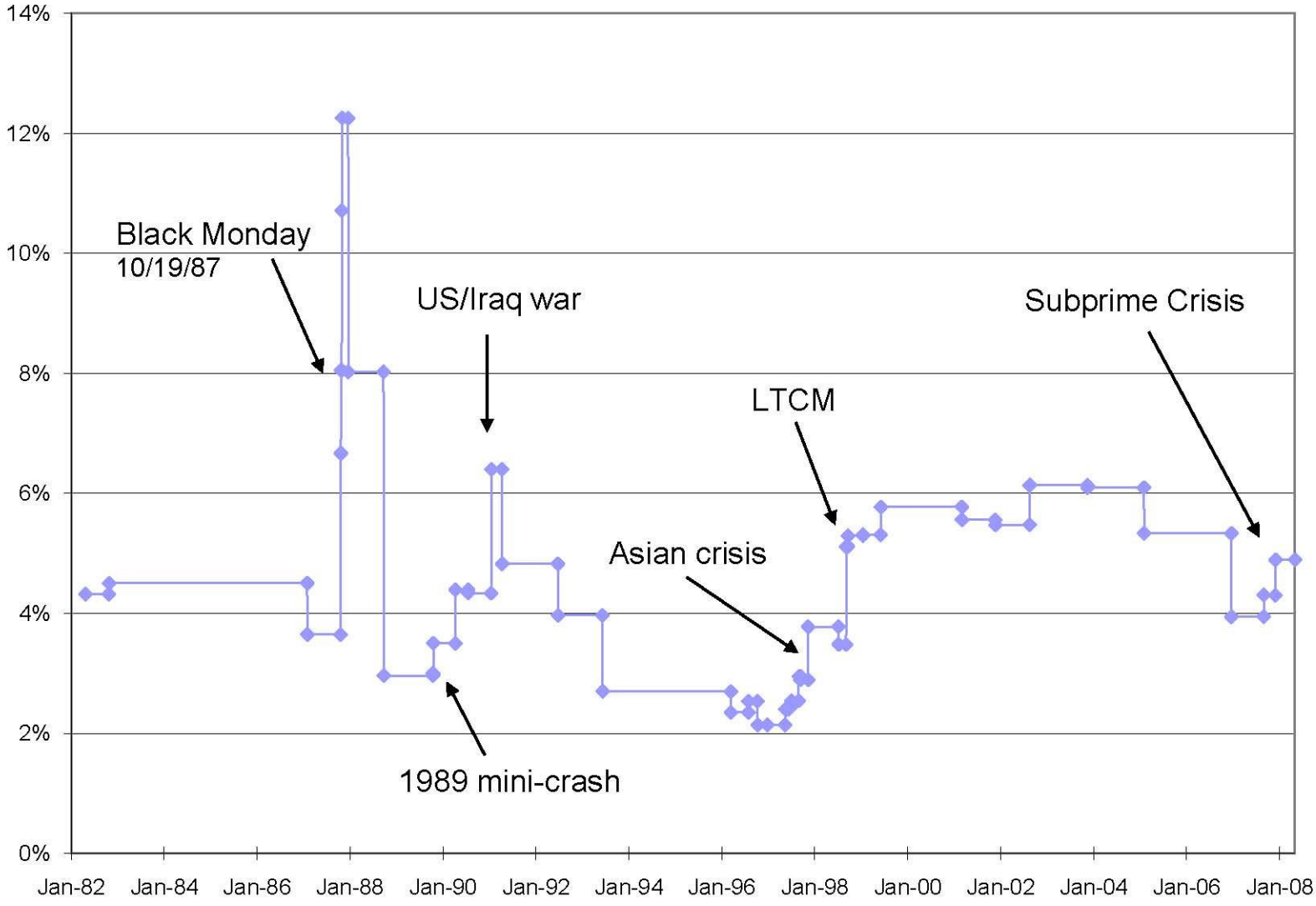
- Liquidity spiral
  - Loss spiral
  - Margin spiral

Margins/Haircuts:

| Rating | Jan-May 2007 | July-Aug 2007 |
|---|---|---|
| | **Bond** | |
| Investment grade | 0-3 | 3-7 |
| High yield | 0-5 | 10+ |
| | **Leveraged Loan** | |
| Senior | 10-12 | 15-20 |
| 2nd lien | 15-20 | 20-30 |
| Mezzanine | 18-25 | 30+ |
| | **ABS and CDO** | |
| AAA | 2-4 | 8-10 |
| AA | 4-7 | 20 |
| A | 8-15 | 30 |
| BBB | 10-20 | 50 |
| Equity | 50 | 100 |
| Source: Citigroup, IMF Stability report 2007 | | |

# 3.1 Balance Sheet - Margin Spiral





# 3.1 Margin Spiral – Why?



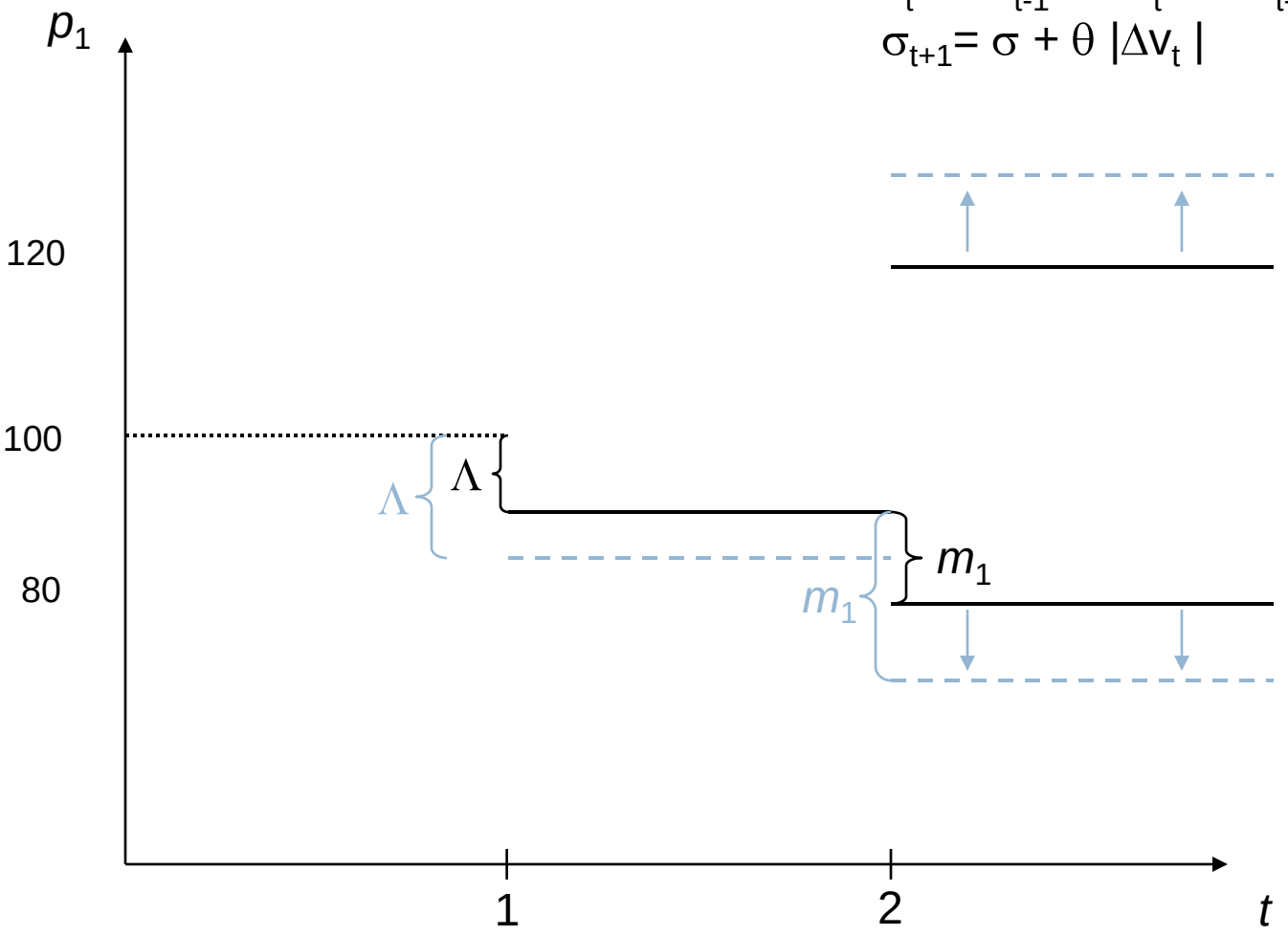
1. Volatility of collateral increases
   - Permanent price shock is accompanied by higher future volatility (e.g. ARCH)
     - Realization how difficult it is to value structured products
   - Value-at-Risk shoots up
   - Margins/haircuts increase = collateral value declines
   - Funding liquidity dries up
   - Note: all “expert buyers” are hit at the same time, SV 92
2. Adverse selection of collateral
   - As margins/ABCP rate increase, selection of collateral worsens
   - SIVs sell-off high quality assets first (empirical evidence)
   - Remaining collateral is of worse quality

# 3.1 Margin Spiral – Increased Vol.



$v_t = v_{t-1} + \Delta v_t = v_{t-1} + \sigma_t \varepsilon_t$

$\sigma_{t+1} = \sigma + \theta |\Delta v_t|$



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# 3.1 Example: ABCP



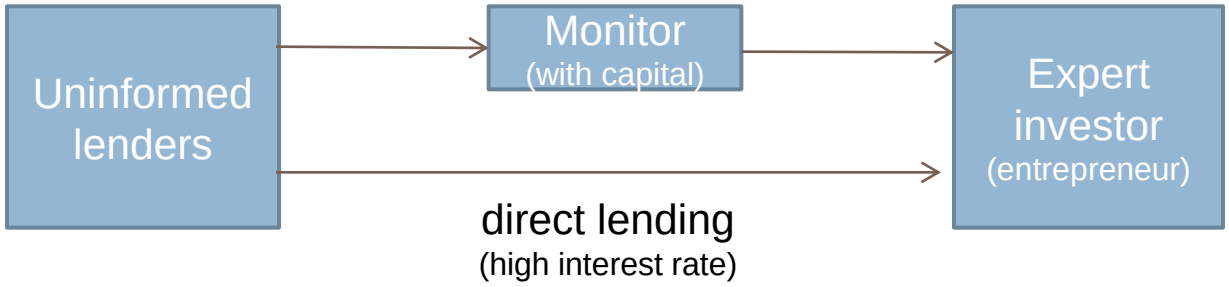
- *CP stops to be viewed as "cash substitute"*
  - Buyers of ABCP do not have expertise in credit quality evaluation
    – just use it to temporarily park funds
  1. Overcollateralization vanishes
     - Collateral is more volatile
  2. SIVs sell more liquid "sellable" assets
     - Quality of assets pool worsens

  ⇒ Withdrawal from ABCP market
  by firms and money market funds

# 3.2 Lending Channel - Hoarding



- Balance sheet of lenders/banks worsens
  - Cut down on lending
- Mechanisms
  1. Static - moral hazard in monitoring by lenders




  2. Dynamic - precautionary hoarding
     - Afraid of interim shock (state at which refinancing is difficult)
     - …

No deep pocket

# 3.2 Lending Channel - Hoarding



- Mechanisms (ctd.)
  2. Dynamic: Interim shock $\Rightarrow$ larger “funding cushion”
     - SIVs might draw on credit lines
     - Borrowing at interbank lending market might be more difficult/ volatile (since other banks might have SIV exposure then)
     - Increased counterparty credit risk
  - Asymmetric information worsens situation
    - Lemon’s problem
      “troubled” banks feel biggest urge to borrow
  - Example: Interbank market (LIBOR-OIS Spread)

# 3.3 Run on Financial Institutions



- *Run before others run* – racing b/c it's better to be among first
  ***first mover advantage*** - dynamic co-opetition
  - Balance sheet worsens
  - Other lenders face adverse shock
- Financial Institutions
  - On C-Banks: Classic bank-run by demand depositors
  - On I-Banks: "Client run" by margin account holders
    Bear Stearns' case
  - On HFs: "Margin run" by prime brokers
    Redemption run by investors
  - On SIVs: Rollover stop by money market investors

- Note: "Liquidation policy" of SIVs favors early withdrawals!
- (Aside: Similar problem for mutual due to tax-treatment
  Mutual funds' NAV should take hidden taxes into account.)

# 3.4 Network – CPCR+Gridlock Risk



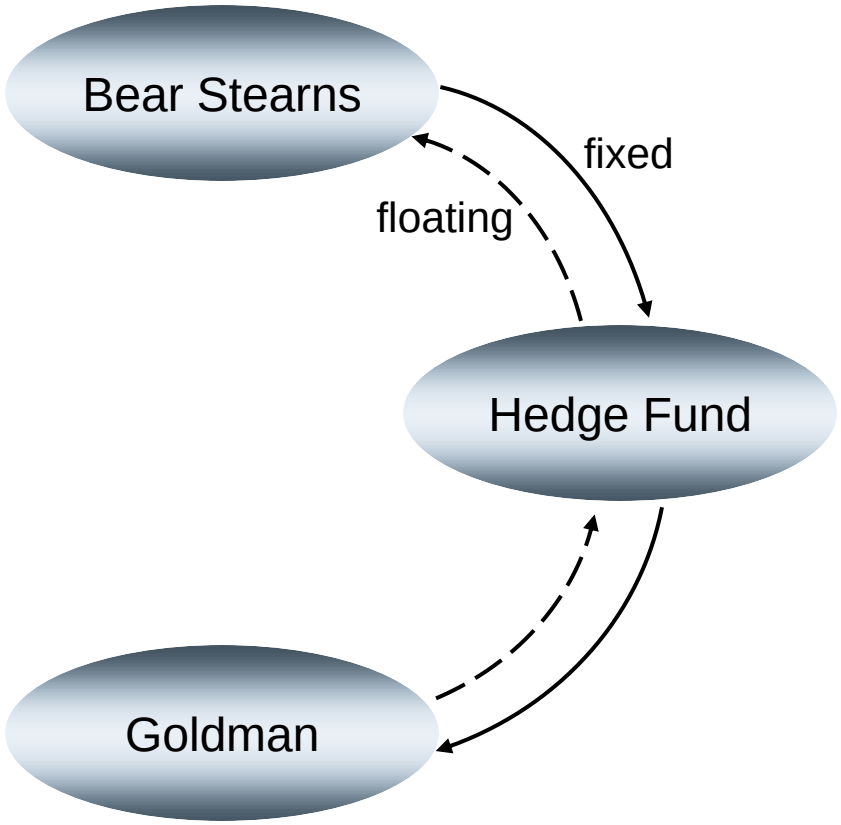
- Network:
  - Interweaved network of financial obligations
  - Lender and borrower at the same time
- Balance sheet and lending channel simultaneously at work

- Investors take on position that might partially cancel each other at some later point
  - Go long a swap with one party and short the swap a week later with some other party – asset need not be totally identical
  - Also explains why CDS US$ ≈45tr while corporate debt ≈US$ 5tr

- Counterparty Credit Risk & Gridlock Risk

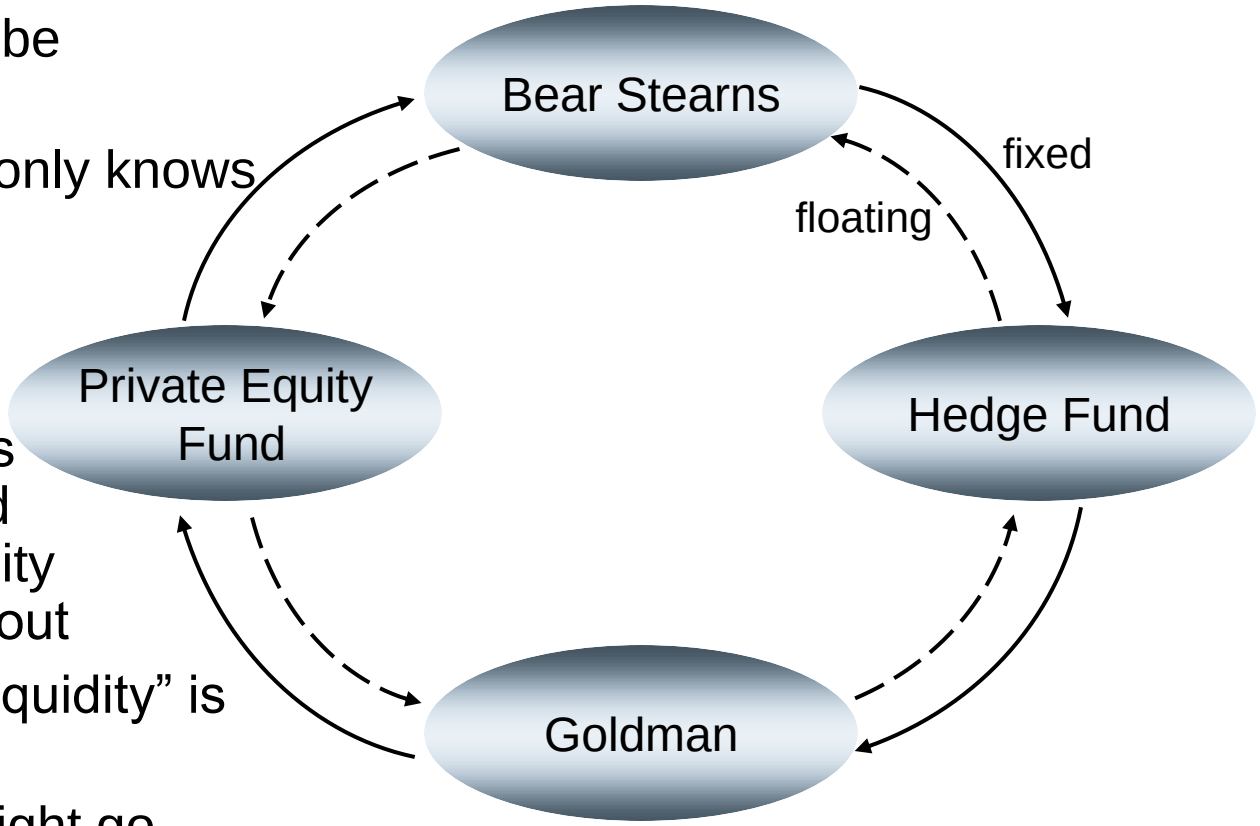
# 3.4 Network effects

- Example: Interest rate swap
  - Hedge fund can “step out” (by netting/novating)
  - March 11th evening, Goldman sent an e-mail to hedge fund: netting that directly exposes Goldman to Bear Stearns can only approved next morning
  - Question: Did misinterpretation led to hedge fund clients run?
- Let’s extend the example



# 3.4 Network effects

- Extended example:
  - Everything can be netted out
  - But each party only knows his obligations
  - After Goldman's call, hedge fund and private equity fund can't step out
  - More "funding liquidity" is necessary
  - Hedge funds might go under as well



# 4. Differences to Previous Crisis



- **Common theme:**
  interaction between funding and market liquidity.
- 1987 crash: culpritportfolio insurance trading + funding of m.m.
- 1990s Scandinavian crisis
- 1990s Japan's lost decade
- 1994 mortgage crisis: primarily prepayment risk
- 1998 LTCM crisis: specific convergence spread arbitrage
  - trades were well known
    e.g. on-the run and off-run spread (not much in 2007)
  - main player which needed to be bailed out were known
- 2000 Technology bubble – role of analysts
- 2007-0?:
  - misalignment of incentives for mortgage brokers
  - housing market correction – larger real economy effects
  - rating agencies
  - opaque shadow banking system

# 6. Conclusion



- Crisis with traditional elements:
  - mismatch of maturities – maturity + capital structure
  - Interaction between funding and market liquidity
- New aspects
  - Structured products are difficult to value - complexity
  - off-balance sheet vehicles (SIVs)
  - Reliance on short-term money funds
- Several mechanism/“liquidity spirals” are at work
  - Balance Sheet Channel
    - Loss spiral
    - Margin spiral
  - Lending Channel: Hoarding
  - Run on financial institutions (first mover advantage problem)
  - Network effects: Counterparty credit risk