DECIPHERING THE 2007-0? LIQUIDITY AND CREDIT CRUNCH
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

<table>
<thead>
<tr>
<th>Bond Tranches</th>
<th>Thickness</th>
<th>“Loss Support”</th>
</tr>
</thead>
<tbody>
<tr>
<td>AAA</td>
<td>80%</td>
<td>20%</td>
</tr>
<tr>
<td>AA</td>
<td>5%</td>
<td>15%</td>
</tr>
<tr>
<td>A</td>
<td>5%</td>
<td>10%</td>
</tr>
<tr>
<td>BBB+</td>
<td>2%</td>
<td>8%</td>
</tr>
<tr>
<td>BBB</td>
<td>1%</td>
<td>7%</td>
</tr>
<tr>
<td>BBB-</td>
<td>2%</td>
<td>5%</td>
</tr>
<tr>
<td>BB</td>
<td>1%</td>
<td>4%</td>
</tr>
<tr>
<td>Overcollateralization (Equity)</td>
<td>4%</td>
<td>0%</td>
</tr>
</tbody>
</table>
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 tranche 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

- Naïveté – 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 tranche 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 β, increase α
  - 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
   ABCP, banking crisis

   early 2007 …
   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, …
   ⇒ 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%
  - 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**
  - Margin has to be covered by HF’s own capital
  - Margins increase at times of crisis

- **Rollover risk**
  - Inability to roll over short-term commercial paper

- **Redemption risk**
  - 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 > $\alpha \times x$
    - for asym. info reasons
    - (constant or increasing leverage ratio)
    - Bernanke-Gertler, …
  - **Margin spiral**
    - (forces to delever)

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

Source: Brunnermeier & Pedersen (2007)

- Both spirals reinforce each other
3.1 Balance Sheet Channel

- Liquidity spiral
- Loss spiral
- Margin spiral

Margins/Haircuts:

<table>
<thead>
<tr>
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<tbody>
<tr>
<td><strong>Bond</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Investment grade</td>
<td>0-3</td>
<td>3-7</td>
</tr>
<tr>
<td>High yield</td>
<td>0-5</td>
<td>10+</td>
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<tr>
<td><strong>Leveraged Loan</strong></td>
<td></td>
<td></td>
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<tr>
<td>Senior</td>
<td>10-12</td>
<td>15-20</td>
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<tr>
<td>2nd lien</td>
<td>15-20</td>
<td>20-30</td>
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<tr>
<td>Mezzanine</td>
<td>18-25</td>
<td>30+</td>
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<tr>
<td><strong>ABS and CDO</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>AAA</td>
<td>2-4</td>
<td>8-10</td>
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<tr>
<td>AA</td>
<td>4-7</td>
<td>20</td>
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<tr>
<td>A</td>
<td>8-15</td>
<td>30</td>
</tr>
<tr>
<td>BBB</td>
<td>10-20</td>
<td>50</td>
</tr>
<tr>
<td>Equity</td>
<td>50</td>
<td>100</td>
</tr>
</tbody>
</table>

Source: Citigroup, IMF Stability report 2007
3.1 Balance Sheet - Margin Spiral

- Black Monday
  10/19/87
- US/Iraq war
- Subprime Crisis
- LTTCM
- Asian crisis
- 1989 mini-crash
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)
    - ...
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: culprit portfolio 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