Lecture notes on risk management, public policy, and the financial system

Financial market impact of crises and policy responses

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Behavior of asset prices during crises

Anomalies in markets since the crisis
Behavior of asset prices during crises

- Shifts in asset prices
- Liquidity and credit risk in crises
- Extreme volatility
- Correlations

Anomalies in markets since the crisis

- Reduced size and growth of markets
- Market liquidity since the crisis
- Impact on wholesale funding and money markets
Decline in risky asset prices

- Typical asset price behaviors during and in anticipation of “ordinary” recessions
  - Equity markets decline sharply
  - Credit spreads widen
The senior bond spread over Libor (z-spread) is blended from spreads on the 4.7% maturing May 29, 2015 (CUSIP 172967CY5) and the 5.85% maturing August 2, 2016 (CUSIP 172967DQ1). The subordinated bond yields are for the 4.875% issue maturing May 7, 2015. *Source: Bloomberg Financial L.P.*
Rise in prices of safer assets

- U.S. dollar appreciation
- Compounding longer-term increase in demand for safe assets
- U.S. dollar-denominated interest-rate swaps since crisis
  - Negative spreads
  - Demand for duration
  - Markets need balance sheet to force a re-widening
- Credit discrimination becomes extreme in crisis: risk-free rates fall, increasing credit spreads
U.S. dollar index 2006–2012

Source: Bloomberg Financial L.P.
U.S. dollar swap spreads 1989–2012

Spread between fixed rate on 10-year plain vanilla interest-rate Libor swap and the yield to maturity of the on-the-run 10-year U.S. Treasury note, daily. Source: Bloomberg Financial L.P.
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Liquidity and credit risk in crises

Solvency and liquidity

- **Solvency** refers to two conditions:
  - Ability to meet liabilities as they fall due: going-concern perspective
  - Having assets in excess of liabilities (**balance-sheet solvency**)
- Leverage and illiquidity both increase risk of insolvency
- Liquidity and solvency closely related, but not identical
  - Firm may be balance-sheet solvent but illiquid; **example:** bank experiencing run
  - Firm may be liquid but insolvent; **example:** underpriced insurance policies
- May be difficult to discern solvency, doubts of firm’s insolvency can impair liquidity

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Liquidity contraction in financial crises

- Intense increase in liquidity preference
- Diminution of market liquidity for all but safest assets
- Diminution of funding liquidity →
  - Actual difficulty rolling over or extending term of short-term debt
  - Fear of difficulty rolling over short-term debt leads to **liquidity hoarding**: reluctance to lend and desire to extend term of own borrowing
- Liquidity as well as credit and counterparty risk affect money market spreads
 Runs and panics

- Withdrawal of short-term funding from banks, more recently MMMFs, securitization funding vehicles
- “Daisy chains” of intermediary failure and “fire sales”
- Impairment of market functioning
- Classic runs: Mass withdrawal of retail bank deposits
- Contemporary runs: Mass withdrawal of wholesale short-term funding
  - Examples: Northern Rock 2007, Bear Stearns 2008
- Scarcity and devaluation of collateral (the “run on repo”)
  - Amplified by rehypothecation fears: where’s my collateral?

Prime brokers face withdrawal of cash balances
- Cash not held as collateral against shorts or OTC derivatives can be withdrawn on short notice
- Held largely by hedge fund customers, but used to finance entire broker-dealer
U.S. bank failures 1934–2016

Number of commercial and savings banks, 2016 through mid-year. Vertically shaded intervals denote NBER recessions. *Source:* Federal Deposit Insurance Corporation (FDIC), Historical Statistics on Banking, Table BF02.
Illiquidity and insolvency in stress conditions

- Illiquidity: difficulty funding assets
- Insolvency: asset value falls below liabilities
  - In normal times, illiquidity of balance-sheet solvent firm often survivable
- Asymmetric information problem
  - Difficult to distinguish intermediary liquidity from solvency in real time under stress conditions
  - Asset values dropping rapidly, high volatility
  - Complexity and opacity of large intermediaries’ balance sheets
  - Collective action problems in funding: no lender wants to step ahead of others, but no lender wants to see large-intermediary failure
- Illiquidity can become insolvency via market illiquidity
  - Vicious circle: Fear of insolvency $\rightarrow$ illiquidity $\rightarrow$ asset “fire sales” and runs
  - Higher likelihood of illiquidity tipping into insolvency with reliance on short-term wholesale funding
Money market spreads in the global financial crisis

- Interpreting extremely sharp spread widening among money market rates after August 2007; may be due to
  - **Increased liquidity risk** and liquidity hoarding
  - **Increased credit/counterparty risk** → contagion
  - Changes in term structure on economic fundamentals, interest-rate policy changes

- **TED spread**: Eurodollar or LIBOR rate minus rate on T-bills of same maturity
  - Interbank rates higher because of credit risk, T-bill rates lower on desire for safety

- **Libor-OIS** or **LOIS spread**:
  - OIS a relatively risk-free rate indicator of term structure expectations (but some counterparty risk)
  - Spread may be driven by liquidity premium or credit spread

- Compare Libor with other credit-risky rates, e.g. on wholesale-market **certificates of deposit** (CDs)
  - CD and Libor rates very close, suggesting credit/counterparty risk largely responsible for LOIS spread
TED spread 1986–2016

Three-month USD BBA Libor minus the 3-month Treasury bill yield, basis points, daily. Source: FRED.
Libor-OIS spread 2006–2016

USD BBA Libor minus OIS of like maturity, basis points, daily. Purple plot: 1-month; orange plot: 3-month. Source: Bloomberg Financial L.P.
Libor and CD rates 2007–2009

Left panel: 3-month USD BBA Libor (gray plot) and 3-month OIS (purple plot).
Right panel: 3-month USD BBA Libor (gray plot) and 3-month CD rate (purple plot).
All data in percent, daily. Sources: Bloomberg Financial L.P., FRED.
Typical volatility patterns

- Realized volatility
- Implied volatility
- Volatility of volatility
  - Market participants expect arrival of important news
S&P 500 volatility dispersion

Cross-sectional variance of the implied volatilities of the largest S&P 500 constituents. Data source: Bloomberg Financial L.P.
Correlation observables

- Radicalization of historical correlations
  - Misleadingly summarized as “all correlations → 1"
  - Caution warranted: sampling during high-volatility periods

- Implied return correlations
  - Equity: derived from prices of index and single-stock options
  - Rates: derived from prices of options on different points on the term structure and on the term spread

- Default correlations
  - Derived from prices of standard tranches of credit default index swaps
Correlation breakdowns

**European currency crisis 1992–1993**

*Left panel:* daily correlation between logarithmic changes in the USD-DEM and USD-FRF exchange rates, computed using EWMA model with decay factor 0.94, October 5, 1990, to May 31, 1995. *Right panel:* correlation coefficient of daily changes in (solid line, left axis) and spread between (in basis points, dotted line, right axis) yields to maturity of the on-the-run and first off-the-run 30-year Treasury bond. Correlation computed using EWMA model with decay factor 0.94, May 7, 1995, to December 31, 1999. *Data source:* Bloomberg Financial L.P.
S&P 500 option-implied correlation 2006–2012

Percent. Data source: Bloomberg Financial L.P.
Base correlation 2004–2012

Black line (left axis) plots the equity base correlation. Red line (right axis) plots the 5-year IG CDX spread. Source: JPMorgan.
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Anomalies in markets since the crisis
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Policy changes and interest rates since the crisis

- Identification problem: specific changes in markets hard to trace back to specific policy change
- Two major categories of policy change
  - Monetary and debt management policies
  - Regulatory policies
- And acceleration of a pre-crisis trend
  - Low interest rates and demand for safe assets
Arbitrage in normal times and after the crisis

- Slow arbitrage
  - Arbitrage never perfect, but unusually slow since crisis
- “Balance sheet”
  - Low return and low risk trades may require large positions
  - In turn requiring debt or equity funding
Slowing growth of U.S. commercial banks

- Overall growth in financial assets lower than pre-crisis
- Reduction in net interest margin (NIM)
  - Below 3 percent for first time since recovery from long-term interest rate control policies imposed during Second World War
- Reduction in lending activity
- Increase in share of cash and reserves
  - Composed in large part of excess reserves, counterpart of liability on Federal Reserve balance sheet
Top panel: share of each asset type in total financial assets of U.S.-chartered depository institutions. Lower panel: annual growth rate of financial assets. Annual data. Source: Federal Reserve Board, Financial Accounts of the United States (Z.1), Table L.111.
Low real interest rates

- Real rates down $\approx 200$ basis points since crisis
- Potential explanations indicate risk aversion
  - Demand for safe assets
  - Low prospective returns
- Fed keeping real rate artificially low?
  - Rising asset prices an intended element of monetary policy transmission
  - Fed placing market rate near natural rate or market rate below natural rate?
  - But low capital spending and bank lending in spite of low rates
- Are yields low/prices high due to low risk-seeking?
  - High real dividend yields
  - Credit spreads wider than before crisis
Credit spreads and equity prices

- Are yields low/prices high due to low risk-seeking?
  - High real dividend yields

- Equity prices by some measures not that high *given low interest rates*
  - Shiller CAPE is currently 31, highest since 2000-01 decline
  - But dividend yield at record high relative to real interest rates

- Credit spreads are not at pre-crisis lows
  - U.S. lows in 1997 and 2005
  - Euro lows in 2005 and 2007; Bloomberg Barclays Agg now 3 times wider
Dividend-real rate yield spread 1970–2017

Trading costs steady but flexibility impaired?

- Focus on U.S. corporate bond market
- Bid-ask spreads appear steady
- But dealers withdrawing, trading volumes down
- Leads to deterioration in
  - Ability to trade in size
  - Speed of executing desired trades
- “Tantrums”
- Liquidity evaporates for issues of troubled firms
Dealer assets and bond trading volume 1996–2017

The shrunken money market: overview

- **Short-term wholesale funding** markets grew dramatically up to crisis
- Trading and issuance volumes much lower since crisis
- Yet money markets awash in liquidity
- Declining integration: different money market rates track each other less closely
  - E.g. lower correlation of daily changes
  - Largely, but not completely, integrated → incomplete “arbitrage”
  - Integration crucial for transmission of policy rates to market rates
- Profound regulatory changes post-crisis
- Shifts in market participants
  - Greater MMMF role in short-term intermediation, e.g. eurodollars
  - Declining and “broken model” of broker-dealer role
  - Short-term borrowing less attractive to banks
- New tools introduced by Federal Reserve
Decline in money fund assets

- Reduction in total MMMF assets of about 25 percent from pre-crisis peak
- Shift from commercial paper to repos in asset mix
- As compliance deadline for money fund reforms approaches
  - Shift from prime to government-only funds
Money market fund assets 1985–2016

Top panel: share of each asset type in total financial assets of U.S. money market mutual funds. Lower panel: total financial assets of money market mutual funds, $ trillions. Quarterly data, Q1 1985 to Q2 2016. Source: Federal Reserve Board, Financial Accounts of the United States (Z.1), Table L.121.
Three-month U.S. money market rates 2014–2016

Secondary market rates on highly-rated three-month commercial paper and on U.S. Treasury bills, daily, percent. *Source:* Bloomberg LP.
Repo markets

- Higher capital and new liquidity standards decrease profitability of repo dealing
  - Repo dealing has low profit margin, low risk
  - Leverage ratio—if binding—disincentivizes use of "balance-sheet capacity"
  - Liquidity standards: Liquidity Coverage Ratio (LCR) → less attractive to supply high-quality liquid assets (HQLA) as collateral
    - Treasury repo has zero run-off assumption

- Impact on repo markets
  - During the crisis, desire for safety dominant: need for collateral, safe assets → Repo rates falling well below funds rate
  - Although secured, dealer-intermediated GC repo higher than unsecured fed funds rate
  - Increase in incidence of fails, failure to deliver collateral at conclusion of repo transaction

- Implications for → exit from extraordinary accommodation: changes in market functioning, transmission mechanism
Incomplete arbitrage in money markets

- Fed funds below comparable money market rates
  - Trades lower than repo, a secured rate
  - IOER has not acted as floor for funds rate, becomes ceiling during normalization
- Repo “bid-ask spread” wide and volatile
- GCF repo: dealer-to-dealer, dealers to hedge funds
  - Matched books
- Triparty repo: dealers source cash and securities
  - Provided by MMMFs, institutional investors
Triparty and GCF repo rates 2012–2017

Regulatory changes and collateral shortage

- Regulatory changes
  - Clearing mandates (but clearing→increase in netting, possible offset)
  - Basel liquidity ratio
  - **Financial repression**: reduction in yield resulting from increased demand imposed by regulation

- Responses include **collateral swaps**, swap lower- for higher-quality collateral for a fee

- Restraints on rehypothecation leads to ↓supply of collateral

- For European banks in particular, additional pressure from **encumbrance** of assets
  - Assets pledged or otherwise committed→subordination of remaining debt
  - **Covered bonds**: bonds secured by specific assets, usually mortgage loans
  - **Long Term Refinancing Operations** (LTROs): European Central bank program provides 3-year loans against eligible collateral
Treasury fails 2010–2016

Count of fails to receive and to deliver, 1000’s. Source: Bloomberg LP. Average of Bloomberg tickers FAILTRED Index and FAILTRER Index, divided by 1000.
Impact of post-crisis regulation on swap markets

- Normal relationship: swaps somewhat higher than Treasuries
  - Swaps have some credit/counterparty risk
  - Risk of financing component: floating short-term rate
- Occasionally very wide: shortage of Treasuries on budget surplus, termination of 30-year issuance
- Clearing mandates diminish credit risk component
- Negative swap spreads: swap rates below Treasury yield
  - Unprecedented prior to global financial crisis
  - 30-year swap spread negative since 2008
  - 10-year swap spread negative since 2015
- Repo market changes→higher cost to keeping Treasuries on balance sheet
Swap spreads 1994–2018

Spread of plain-vanilla interest-rate swaps over yield of Treasury of like maturity, basis points, daily, 05May1994–09Feb2018. Source: Bloomberg LP.