Shadow Banking and Systemic Risk

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Shadow Banking and the 2007-2008 Crisis

- Near consensus that the shadow banking sector played a key role in the genesis and transmission of the crisis

- Pooling and tranching of risky mortgages, financing of MBS with commercial paper, etc., caused the financial sector to grow and eventually led to its demise

- But what caused the system to be so fragile?
Liquidity View

• Fragility was due to short-term financing. Diamond Dybvig type of run (Gorton and Metrick)
  • A small fundamental shock caused a large crisis due to runs and adverse selection

• Merits:
  • Summer of 2007: news of relatively small losses in subprime, dry up of ABCP
  • Success of the FED in calming markets with liquidity provision

• Problems: Events of 2008, the real crisis
  • Here bank losses were large, insolvency threat for highly leveraged institutions
  • Relatively inexpensive liquidity provisions was no longer enough
IMF Updates on Bank Losses

• October of 2007: projected $200 billion of total losses for ABS holders

• March of 2008: projected $720 billion of losses in securities, of which about half accrue to banks, about $200 billion to US banks
  • See also Greenlaw et al. (2008)

• October of 2008: $980 billion total losses, $500 of which for banks
  • Write down of bank loans: $300 billions

• April 2009: total write down of $1.06 trillions on loans, $1.64 on securities

• These are very large shocks for highly levered institutions
Errors in Expectations

• Before 2007, but also between 2007 and 2008, markets did not seem to be aware of the possibility of a large negative shock

• Coval Jurek and Stafford (2009, 2010): investment banks and rating agencies used incorrect models, neglecting the systematic component in the risks of individual mortgages

• Cheng, Raina and Xiong (2014): securitization specialists at bought homes in the mid 2000s and suffered large losses from the collapse
an aggressive scenario, in which HPA is 11 percent over the life of the pool (with an assigned probability of 15 percent)

—a modestly aggressive scenario, with 8 percent HPA over the life of the pool (15 percent)

—a base scenario, in which HPA slows to 5 percent by the end of 2005 (50 percent)

—a pessimistic scenario, with 0 percent HPA for the next three years and 5 percent HPA thereafter (15 percent), and

—a meltdown scenario, with −5 percent HPA for the next three years and 5 percent HPA thereafter (5 percent).
Credit Spread forecasts (Blue Chip)
Expectations of Stock Returns (Gallup)
Expectations of Corporate Earnings Growth

- CFO Expectations of Next 12m Earnings Growth
- Analyst Expectations of Next 12m Earnings Growth
Errors in Expectations

• After the liquidity problems in the summer of 2007, market players were still quite optimistic about GDP growth also
  • SPF consensus GDP growth remains is positive in the summer of 2007 and remains positive until the summer of 2008
  • FED real growth forecasts stay positive until the third quarter of 2008

• It is hard to believe that at the time most market participants had figured out the existential threat the banking sector and the economy
A Neglected Risk Account

• I will now outline an account of financial fragility based on the idea that markets neglect the risk of large, unlikely, bank losses
  • Gennaioli, Shleifer and Vishny (2012, 2013)

• Centrality of expectational errors for thinking not only about the crisis, but about financial instability in general
  • Greenwood and Hanson (2013), Stein et al. (2017), Baron and Xiong (2017), Mian and Sufi (2017), Bordalo, Gennaioli and Shleifer (2017)
Model Setup

• Two periods: \( t = 0, 1 \)
  - Assume away short term debt problems

• Two types of agents:

  - Intermediaries: they own a stochastic and collateralizable cash flow that repays at \( t = 1 \). They can issue debt against it

  - Investors: they are patient, they wish to buy debt, but have a strong preference for safe debt
Intermediaries and Investors

- **Intermediaries**
  - Risk neutral, discount future profits: $C_{0,i} + \beta_l C_{1,i}$
  - Stochastic cash flow $\tilde{X} \geq 0$ distributed according to cdf $f(\tilde{X})$

- **Investors**
  - Receive large endowment $W$ at $t = 0$
  - Low required return $1/\beta_h < 1/\beta_l$ for debt defaulting with prob. less than $\delta^*$
  - High required return $1/\epsilon \gg 1/\beta_l$ for debt riskier than $\delta^*$
Rational Expectations

• To cater to investors, intermediaries must manufacture debt whose default is less frequent than $\delta^*$. Issuance of $N$ debt claims each promising one unit must respect the AAA constraint:

$$\int_0^N f(\tilde{X})d\tilde{X} \leq \delta^*$$

• Given large investor wealth $W$, equilibrium price of each debt claim is:

$$p(N) = \beta_h \left[ 1 - \int_0^N \left( 1 - \frac{\tilde{X}}{N} \right) f(\tilde{X})d\tilde{X} \right]$$
Profit Maximization by Intermediary

\[
\max_N (\beta_h - \beta_l) \left[ N - \int_0^N (N - \tilde{X}) f(\tilde{X}) d\tilde{X} \right] + \beta_l \int_0^{+\infty} \tilde{X} f(\tilde{X}) d\tilde{X}
\]

s.t.:

\[
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Profits from issuance of safe debt
Debt Issuance under Rational Expectations

- Equilibrium debt issuance $N^*$: binding AAA constraint

\[ \int_0^{N^*} f(\bar{X})d\bar{X} = \delta^*. \]

- Gains from trade are maximized
Neglected Downside Risk

- **Definition**  Agents neglect downside risk $X$ when their believed cash flow distribution $f^\theta(\tilde{X})$ underestimates the tail to the left of $X$:

$$\int_0^X f^\theta(\tilde{X})d\tilde{X} < \int_0^X f(\tilde{X})d\tilde{X}, \quad \text{for all } X \leq \_.$$

- For $X \rightarrow \infty$ this coincides with FOSD
Neglected risk and Debt Issuance

• Under neglected risk, equilibrium debt issuance $N^\theta$, where:

\[ \int_{0}^{N^\theta} f^\theta(\tilde{X})d\tilde{X} = \delta^* \]

⇒ If risk neglect is severe enough, $X > N^*$, debt issuance expands relative to rational expectations, namely $N^\theta > N^*$
Neglected Risk and Financial Fragility

- Due to over-issuance of debt, the true riskiness of bonds is above investors’ tolerance level

\[ \Pr(\tilde{X} < N^\theta) = \delta^* + \int_{N^*}^{N^\theta} f(\tilde{X})d\tilde{X} \]

- Fragility: endogenous response of safe debt issuance to risk neglect

- What happens if neglect of risk disappears and market participants’ beliefs get corrected from \( f^{\theta}(\tilde{X}) \) to the true density \( f(\tilde{X}) \)?
Secondary Markets

• Investors’ reservation value for the debt they own collapses to:

\[ p_{inv}^{crisis} = \epsilon \left[ 1 - \int_{0}^{N^\theta} \left( 1 - \frac{\tilde{X}}{N^\theta} \right) f(\tilde{X}) d\tilde{X} \right] \]

• Intermediaries’ reservation value for the same debt:

\[ p_{int}^{crisis} = \beta_l \left[ 1 - \int_{0}^{N^\theta} \left( 1 - \frac{\tilde{X}}{N^\theta} \right) f(\tilde{X}) d\tilde{X} \right] \]

• How much wealth have intermediaries carried over from \( t = 0 \)?
Fire Sales and Risk Misallocation

• Denote by $E$ the wealth that intermediaries have carried over from $t = 0$

i) If $E \geq p_{\text{inv}}^{\text{crisis}} \times N^\theta$, intermediaries buy back all debt, whose equilibrium price may be equal to $p_{\text{int}}^{\text{crisis}}$.

ii) If $E < p_{\text{inv}}^{\text{crisis}} \times N^\theta$, the price of debt collapses to $p_{\text{inv}}^{\text{crisis}}$ and investors are stuck with some risky debt
Fire Sales and Risk Misallocation

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In ii) there is a crisis with depressed prices and a socially costly risk misallocation.
Neglected Risk \rightarrow \text{Excess Debt Issuance} \rightarrow \text{Fire Sales and Crisis (low liquid wealth)}
Neglected Risk $\rightarrow$ Excess Debt Issuance $\rightarrow$ Fire Sales and Crisis (low liquid wealth)

Need that intermediaries have no liquid wealth in the interim period
Assets and Liabilities

• So far, we only considered bank liabilities. But bank assets are crucial. Invest in risky loans or keep some cash?

• Investment $I$ in loans is transformed into cash flow $\tilde{A} q(I)$ at $t = 1$.

• $\tilde{A}$ is distributed according to $h(\tilde{A})$. Neglected risk is $h^\theta(\tilde{A})$ that satisfies previous definition.

• Bank finances $I$ with bond sales $pN$ but can keep $pN - I$ in cash
Optimal Lending and Debt Issuance

- Now debt is repaid in full provided $N < \tilde{A}q(I)$ or equivalently $\tilde{A} > N/q(I)$:

$$\max_{N,I} (\beta_h - \beta_l) \left[ N - \int_0^{N/q(I)} (N - \tilde{A}q(I)) h^\theta(\tilde{A}) d\tilde{A} \right] + \beta_lq(I) \int_0^{+\infty} \tilde{A} h^\theta(\tilde{A}) d\tilde{A} - I.$$  

s.t.:

$$\int_0^{N/q(I)} h^\theta(\tilde{A}) d\tilde{A} \leq \delta^*$$  

$$p(N,I)N - I \geq 0$$
Optimal Lending and Debt Issuance

• At the optimum:
  - The AAA constraint is binding
  - If expected productivity \( \int_{0}^{\infty} \tilde{A} h^\theta (\tilde{A}) d\tilde{A} \) is high enough, the intermediary invests everything, namely \( I^\theta = p(N^\theta, I^\theta)N^\theta \)

\[
q'(I^\theta) \left[ (\beta_h - \beta_i) \left( \int_{0}^{A^\theta} \tilde{A} h^\theta (\tilde{A}) d\tilde{A} + A^\theta \delta^* \right) + \beta_i \int_{0}^{+\infty} \tilde{A} h^\theta (\tilde{A}) d\tilde{A} \right]
\]

Due to excess-optimism, banks keep their assets illiquid.
Neglected Risk

Excess Debt Issuance

Excess Lending

illiquid wealth

Fire Sales and Crisis
Securitization: Pooling and Tranching

• Thus far, we left out this aspect. To introduce it, just need to allow for idiosyncratic risk in bank-level cash flows:

\[ \tilde{X}_i = \tilde{X}\epsilon_i, \]

- \( \tilde{X} \) systematic risk distributed according to \( f(\tilde{X}) \)
- \( \epsilon_i \) is i.i.d in \([\epsilon, \bar{\epsilon}]\) with pdf \( g(\epsilon) \) featuring \( \int \epsilon g(\epsilon) d\epsilon = 1 \)

• And to assume that each bank \( i \) can sell a share \( \alpha_i \) of own cash flow and buy a diversified pool of \( \alpha_i \) cash flows from all banks
The Effect of Idiosyncratic Bank Risk

Lemma 1 If the density $f(\tilde{X})$ of the common cash flow factor $\tilde{X}$ decreases toward the left tail, then idiosyncratic risk induces a fatter left tail.

- As a result, idiosyncratic risk reduces issuance along the AAA constraint:

$$\int_{0}^{N_i^\theta} f_i^\theta(\tilde{X})d\tilde{X} = \delta^*$$

$N_i^\theta < N^\theta$, the level prevailing without idiosyncratic risk
Pooling of Risks and Debt Issuance

• If the intermediary sells share $\alpha_i$ of cash flow and buys the same amount of a diversified pool, its cash flow becomes:

$$\tilde{X}_i(\alpha_i) = (1 - \alpha_i)\tilde{X}\epsilon_i + \alpha_i\tilde{X} = \tilde{X}[1 + (1 - \alpha_i)(\epsilon_i - 1)]$$

• In equilibrium banks sell their entire cash flow and diversify $\alpha_i = 1$

• The equilibrium debt issuance is $N^\theta$, which is the same prevailing in the absence of idiosyncratic risk
• **Proposition 5** Under some technical conditions, cash flow pooling boosts over-issuance:

\[
N^\theta - N^* \bigg|_{pooling} > N^\theta - N^* \bigg|_{no~pooling}.
\]

• Combination of insurance and safe debt issuance greatly expands the financial sector. Diversification myth.
We can summarize the analysis of this chapter with the diagram below.

Neglected Risk → Excess Debt Issuance → Fire Sales and Crisis

Neglected Risk → Excess Lending → illiquid wealth → Fire Sales and Crisis

Securitization
To Conclude

• Important feature of the recent financial crisis: neglect of the possibility that banks could incur large losses

• In the presence of risk neglect, beneficial mechanisms like pooling and tranching cause overexpansion, becoming a source of fragility
Takeaways

• The psychology of beliefs is promising to think about financial instability, evidence of systematic errors also in other domains/episodes

• In ongoing work, we are developing psychologically founded models of non-rational beliefs

• Explore the interaction of non-rational beliefs with financial contracts, markets, and regulation