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

Gerardi, Lehnert, Sherlund, Willen: Five Scenarios Considered by Analysts in 2005

—an *aggressive* scenario, in which HPA is 11 percent over the life of the pool (with an assigned probability of 15 percent)

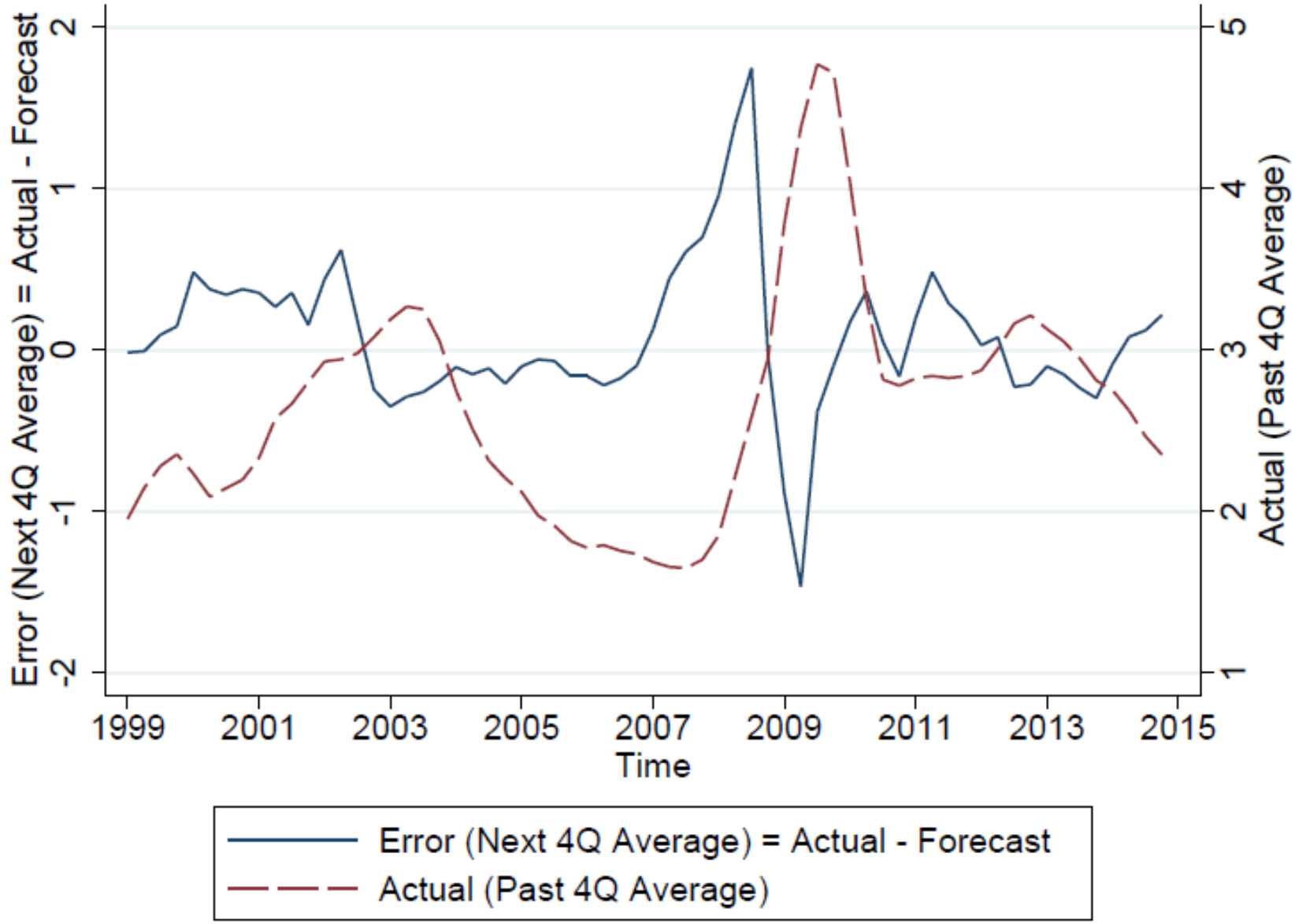
—a *modestly aggressive* scenario, with 8 percent HPA over the life of the pool (15 percent)

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

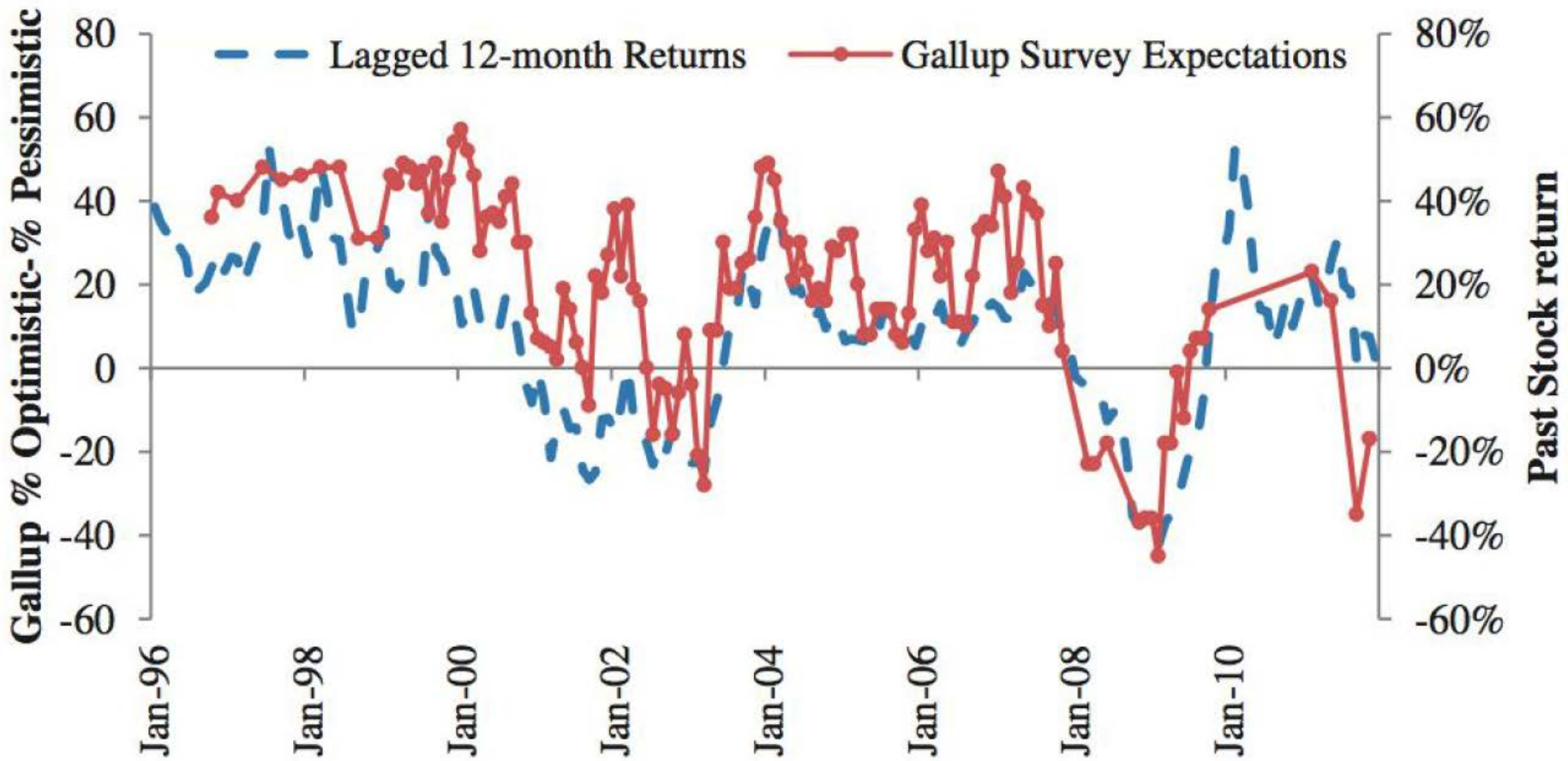
—a *pessimistic* scenario, with 0 percent HPA for the next three years and 5 percent HPA thereafter (15 percent), and

—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

Errors in Expectations

- After the liquidity problems in the summer of 2007, market players were still quite optimistic about GDP growh 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 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 δ^*
- High required return $1/\epsilon \gg 1/\beta_l$ for debt riskier than δ^*

Rational Expectations

- To cater to investors, intermediaries must manufacture debt whose default is less frequent than δ^*. 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.:

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

Profit Maximization by Intermediary

Profits from issuance of safe debt

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

s.t.:

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

Debt Issuance under Rational Expectations

- Equilibrium debt issuance N^*: binding AAA constraint

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

- Gains from trade are maximized

Neglected Downside Risk

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

$$\int_0^X f^{\theta}(\tilde{X})d\tilde{X} < \int_0^X f(\tilde{X})d\tilde{X}\,, \qquad for\ all\ X \leq \underline{X}.$$

- For $\underline{X} \to \infty$ this coincides with FOSD

Neglected risk and Debt Issuance

- Under neglected risk, equilibrium debt issuance N^{θ}, where:

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

$\Rightarrow$ If risk neglect is severe enough, $\underline{X} > N^*$, 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

$$\Pr\left(\tilde{X} < N^{\theta}\right) = \delta^{*} + \int_{N^{*}}^{N^{\theta}} f\left(\tilde{X}\right) d\tilde{X}$$

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

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

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 inermediaries have carried over from $t = 0$

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

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

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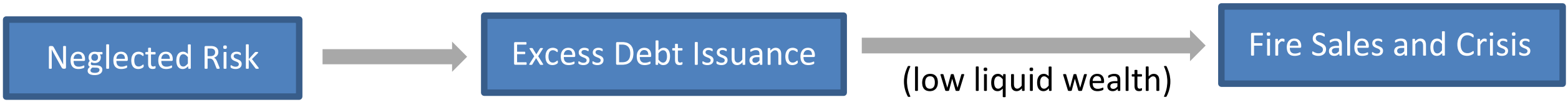
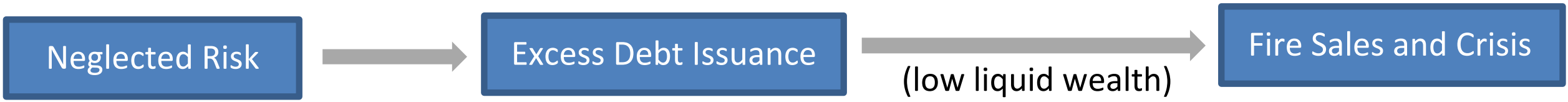
In ii) there is a crisis with depressed prices and a socially costly risk misallocation


Neglected Risk
Excess Debt Issuance
(low liquid wealth)
Fire Sales and Crisis



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 $\tilde{A} > N/q(I)$:

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

s.t.:

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

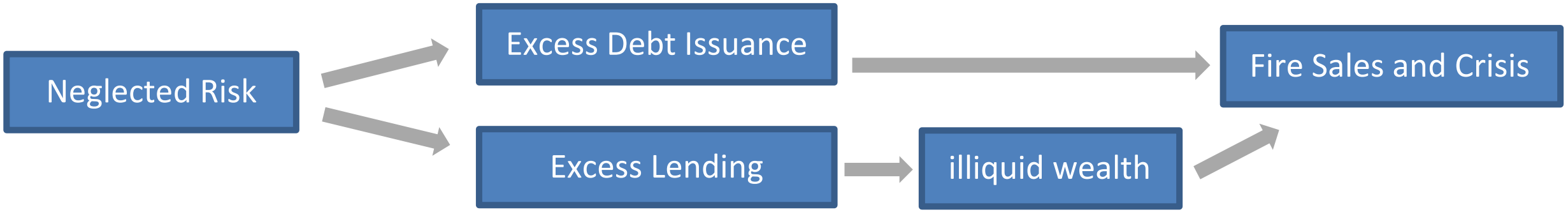
$$p(N, I)N - I \geq 0$$

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 $I^{\theta} = p(N^{\theta}, I^{\theta}) N^{\theta}$

$$q'(I^{\theta}) \left[(\beta_h - \beta_l) \left(\int_0^{A^{\theta}} \tilde{A} h^{\theta}(\tilde{A}) d\tilde{A} + A^{\theta} \delta^* \right) + \beta_l \int_0^{+\infty} \tilde{A}\, h^{\theta}(\tilde{A}) d\tilde{A} \right]$$

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 $f(\tilde{X})$
- ϵ_i is i.i.d in $[\underline{\epsilon}, \overline{\epsilon}]$ with pdf $g(\epsilon)$ featuring $\int \epsilon g(\epsilon) d\epsilon = 1$

- And to assume that each bank i can sell a share α_i of own cash flow and buy a diversified pool of α_i cash flows from all banks

The Effect of Idiosycnratic 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 idiosycnratic risk

Pooling of Risks and Debt Issuance

- If the intermediary sells share α_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 $\alpha_i = 1$

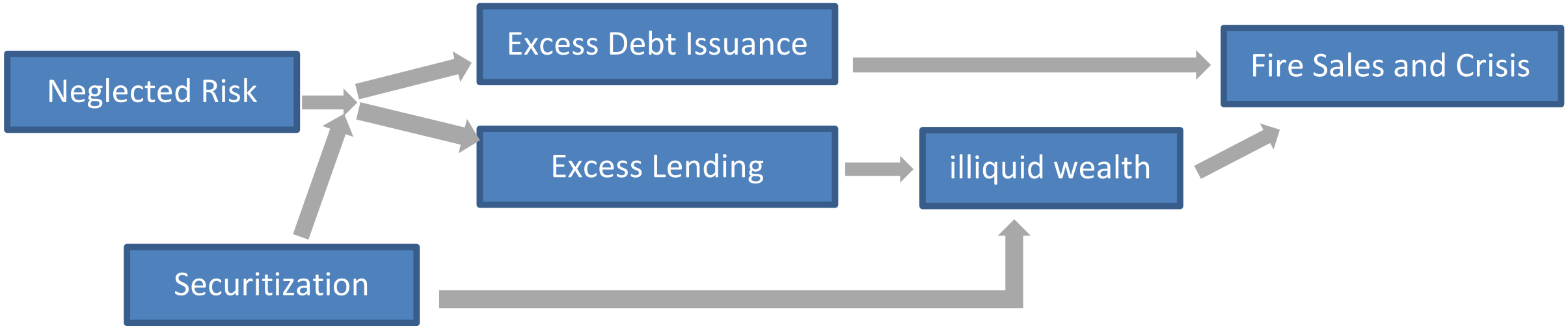
- The equilibrium debt issuance is N^{θ}, which is the same prevailing in the absence of idiosyncratic risk

Pooling and Financial Fragility

- **Proposition 5** *Under some technical conditions, cash flow pooling boosts over-issuance:*

$$N^{\theta} - N^{*}\Big|_{pooling} > N^{\theta} - N^{*}\Big|_{no\ pooling}.$$

- Combination of insurance and safe debt issuance greatly expands the financial sector. Diversification myth.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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