Credit Freeze

IMF – Training Seminar

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Credit Freeze

- The recent financial crisis started with a shock in the financial sector and spread to the real economy due to a **credit freeze**.
  - Banks were hoarding cash and not lending to firms and households.
- Governments have used various policy measures aimed at obtaining a **credit thaw**.
- What causes a credit freeze? Do we need government policy to stop it? If so, what are the optimal policies?
- In this lecture, I will review evidence and theories to shed light on some of these questions.

- Using data on **syndicated lending** in the US, they demonstrate a sharp decrease in lending during the financial crisis of 2008.
  - Lending volume in the fourth quarter of 2008 is 47% lower than the prior quarter and 79% lower than the peak of the credit boom.
- But, commercial and industrial loans reported on balance sheets of US banks in the fourth quarter of 2008 have increased.
  - These are just **drawdowns** of existing revolving credit facilities. **New loan issuances** have decreased.
Total amount of loans issued in billion USD (from Ivashina and Scharfstein, 2010):
Identification Issues: Supply or Demand

- Does decrease in loans originate from the demand side or the supply side?
  - Only the latter indicates a potential real effect of the financial crisis.
- Ivashina and Scharfstein identify a supply effect by showing:
  - Banks that were financed with more insured deposits (relative to short-term debt) had a lower decrease in lending.
    - But, these banks may face borrowers with different demand.
  - Banks that co-syndicated credit lines with Lehman (exposed to more drawdowns) decreased lending more.

- To identify a real effect, the authors analyze capital expenditure decisions of firms and how they were affected by the financial shock of fall 2007.
- They compare the behavior of firms with maturing long-term debt vs. firms with non-maturing long-term debt.
  - Arguably, these firms are similar, but the financial shock affected the former more than the latter.
• The authors show that firms with maturing long-term debt reduced their investment rates from 7.8% of capital to 5.7% of capital following the financial shock.

• Firms with non-maturing long-term debt hardly change their investment.

• Such effects are strong for firms that rely a lot on long-term debt.

• Such effects do not exist outside the crisis period.

• The need to refinance in time of crisis affected firms’ policies on cash balances, inventories, and also generated large value implications.

• The effects were not long-lasting, and as the crisis deepens, all firms start cutting their investments, as is shown in the graph in the next slide:
Theoretical Underpinnings

• In the credit freeze, banks were under stress, and so had fewer funds to lend.

• But, on top of that, they didn’t lend funds that they had. They were hoarding cash.

• What is the reason for a lower level of lending? Is there inefficiency involved?

• Can this be addressed with government policy, and if so, how policy should be designed?
A Model of Coordination Failures: Bebchuk and Goldstein (Review of Financial Studies, 2011)

- We describe an economy, where firms are interdependent:
  - Firm A buys inputs from firm B, whose employees are customers of firm C, who buys inputs from firm A, etc.
- In such an economy, the success of a firm depends on the success of other firms, and hence lending by a bank is worthwhile if other banks lend.
- Then, credit freezes arise as a self-fulfilling belief. They are inefficient and so there is role for government policy to alleviate the problem.
Setup

- Continuum $[0,K]$ of banks, each one holds $1$.

- Need to decide whether to invest in a risk free asset, generating $1$, or lend to operating firms.

- Operating firms generate $1+R$ if projects succeed. Specifically, return is:

$$
\begin{cases}
1 + R & \text{if} \quad aL + \theta \geq b \\
0 & \text{if} \quad aL + \theta < b
\end{cases}
$$

  - $\theta$ is fundamental of the economy.
  - $L$ is mass of operating firms obtaining financing. $L = nK$, where $n$ is proportion of banks deciding to lend.
Multiple Equilibria

- Three ranges of fundamentals ($\theta$):
  
  - **Below $b - aK$** (lower dominance region):
    - Unique equilibrium: (efficient) credit freeze.
  
  - **Between $b - aK$ and $b$** (intermediate region):
    - Multiple equilibria: either lending or (inefficient) credit freeze.
  
  - **Above $b$** (upper dominance region):
    - Unique equilibrium: lending.
Equilibrium Outcomes for Common Knowledge

No-Lending Equilibrium

Multiple Equilibria

Lending Equilibrium

\[ b - aK \quad b \quad \theta \]
Source and Nature of Inefficient Credit Freeze

- In the intermediate range of fundamentals, an inefficient credit freeze may occur because of strategic complementarities among banks. They want to do what other banks do.
  - When other banks do not lend, the economy gets into a recession, and thus lending is expected to fail.

- As a result, a credit freeze is panic-based: It occurs as a result of the self-fulfilling beliefs that other banks are not going to lend.

- Moreover, here, a freeze is unrelated to fundamentals.
  - Some tend to attribute bad equilibria to sunspots.
Comments on Basic Framework

- The basic framework is a bit unsatisfactory, as it cannot pin down what will ultimately happen. This is an obstacle for:
  
  o **Policy analysis**: which policy tools are desirable to overcome crises?
  
  o **Empirical analysis**: what constitutes sufficient evidence for the relevance (or lack of) of strategic complementarities in fragility?

  ▪ Large body of empirical research (e.g., Gorton, 1985; Demirguc-Kunt and Detragiache, 1998; Kaminsky and Reinhart, 1999; Martinez-Peria and Schmukler, 2001) associates crises with weak fundamentals. Is this evidence against the panic-based approach?
Global-Games Approach

- The global-games approach – based on Carlsson and van Damme (1993) – enables us to derive a unique equilibrium in a model with strategic complementarities and thus overcome the problems associated with multiplicity of equilibria (discussed above).

- The approach assumes lack of common knowledge obtained by assuming that agents observe slightly noisy signals of the fundamentals of the economy.

- The classic illustration is by Morris and Shin (1998). I will illustrate using credit-freeze model.
Unique Equilibrium

• Suppose that fundamental $\theta$ is normally distributed with mean $y$ (public news) and standard deviation $\sigma_\theta$ (precision, $\tau_\theta = \frac{1}{(\sigma_\theta)^2}$).

• Banks obtain signals: $x_i = \theta + \epsilon_i$, where $\epsilon_i$ is normally distributed with mean 0 and standard deviation $\sigma_\epsilon$ (precision, $\tau_\epsilon = \frac{1}{(\sigma_\epsilon)^2}$).

• As long as private information is sufficiently precise relative to public information (formally, $\frac{\tau_\theta}{\sqrt{\tau_\epsilon}} \leq \frac{\sqrt{2\pi}}{aK}$), there is a unique equilibrium, where

  o Banks lend if and only if their signals are above $x^*$.  
  o Real projects succeed if and only if the fundamentals are above $\theta^*$:
**Intuition** (see board illustration)

- Banks choose whether to lend or not based on their signals.
- Because they only observe imperfect signals, they must take into account what other banks will do at other signals.
- This ‘connects’ the behavior of banks at different fundamentals, and ultimately links it to the known behavior at the extreme dominance regions.
- The outcome is unique determination of banks’ behavior.
Equilibrium Characterization (limit case)

- When banks observe very precise signals, i.e., $\tau_p$ approaches infinity, $x^*$ and $\theta^*$ converge to the same value:

$$\theta^* = b - aK + aK \frac{1}{1 + R}$$

- Three ranges of fundamentals:
  
  - Below $b - aK$: **Efficient credit freeze**.
  
  - Between $b - aK$ and $b - aK + aK \frac{1}{1+R}$: **Inefficient credit freeze**.
  
  - Above $b - aK + aK \frac{1}{1+R}$: **No credit freeze**.
Equilibrium Outcomes

- Efficient No-Lending Equilibrium
- Inefficient Credit Freeze
- Efficient Lending Equilibrium

\[ \theta \quad \theta^* \quad \theta \]
What determines the threshold?

- When observing $\theta^*$, a bank is indifferent between lending and not lending.
  - The bank is (almost) certain about the level of the fundamentals.
  - But, faces a strategic risk about what other banks are going to do. He expects a uniform distribution about the proportion of other banks that receive a signal above his and decide to lend.

- This gives the following indifference condition, which can be rearranged to express $\theta^*$:

$$1 = \left(1 - \frac{b - \theta^*}{aK}\right)(1 + R)$$
Why Is This Equilibrium Interesting?

- **First**, reconciles panic-based approach with empirical evidence that fundamentals are linked to crises.
- **Second**, panic-based approach generates empirical implications.
  - The probability of a crisis is pinned down by the value of $\theta^*$, which depends on parameters in the model.
- **Third**, once the probability of crises is known, one can use the model for policy implications.
- **Fourth**, captures the notion of strategic risk, which is missing from the perfect-information version.
Working with the Model to Analyze Policy Responses

- First, what may trigger a credit freeze?

  o A downward shift in fundamentals:
    - Fundamentals drop to a level below $\theta^*$.  

  o A decrease in banks’ capital:
    - Suppose that banks lost a fraction $l$ of their capital, the threshold for a credit freeze would increase to:
      
      $$
      \theta^* = b - aK(1 - l) + aK(1 - l) \frac{1}{1 + R}
      $$


Capital Infusion to Banks

- Suppose that the government has total capital of $\alpha lK$.
- What is the effect of infusing that capital to the banking system?
- This will reduce the likelihood of a freeze to:

$$\theta^*_{Bank} = b - aK(1 - (1 - \alpha)l) + aK(1 - (1 - \alpha)l) \frac{1}{1 + R}$$

- But, there are still inefficient credit freezes that occur just because banks believe that other banks are not going to lend to operating firms.
- What is the mechanism at work?
• The additional capital available to banks gives other banks confidence that operating firms will do well if they receive financing, and may induce them to lend capital they already have.
  
  o Recall the indifference condition behind the threshold $\theta^*$: with additional capital available to banks, a uniform distribution for the proportion of lending banks implies more capital being lent and higher likelihood of success. This reduces the fundamental $\theta^*$ that makes banks indifferent.

• But, coordination failures still arise, as banks choose not to lend if they expect other banks will not lend.
The Effect of Capital Infusion to Banks

- Inefficient Freeze Sustained
- Inefficient Freeze Eliminated

\[ \theta \quad \theta_{Bank}^{*} \quad \theta^{*} \quad \theta \]
Is Direct Lending to Operating Firms Better?

• A traditional LOLR policy would be to provide capital directly to operating firms.

• This is indeed more efficient in getting the economy out of a credit freeze and inducing banks to lend, yielding the threshold:

\[
\theta^*_{Direct} = b - aK(1 - (1 - \alpha)l) + aK(1 - l) \frac{1}{1 + R}
\]

  ○ Recall that: \[\theta^*_{Bank} = b - aK(1 - (1 - \alpha)l) + aK(1 - (1 - \alpha)l) \frac{1}{1 + R}\]

• The fact that the government provides the capital directly to operating firms makes banks even more confident that real projects will succeed.
• But, suppose that the government does not have the skill of banks to identify good borrowers, and lends to proportion \( \beta \) of firms who always generate zero return.

• Then, comparing capital infusion to banks with direct lending yields:

\[
(1 - (1 - \alpha)l)K - (1 - l)K > 0 \text{ below } \theta^*_\text{Direct}.
\]

- Here, credit freeze occurs in both regimes; under direct lending, government ends up making bad loans (to good and bad firms).

\[
(1 - (1 - \alpha)l)K - (1 - l + \alpha l(1 - \beta))K(1 + R) \text{ between } \theta^*_\text{Direct and } \theta^*_\text{Bank}.
\]
Here, direct lending prevents a credit freeze, but generates waste due to lending to bad firms. Sign is ambiguous.

\[(1 - (1 - \alpha)l)K(1 + R) - (1 - l + \alpha l(1 - \beta))K(1 + R) > 0\]

above \(\theta^{*}_{Bank}\).

Here, credit freeze does not occur in both regimes; under direct lending, government ends up making bad loans (to bad firms).

Overall, formal comparison yields:

- Direct lending is preferred when \(y\) (known fundamental) is in an intermediate range, \(\beta\) is low, and \(R\) is high.
Comparing Capital Infusion to Banks with Direct Lending to Firms

Capital Infusion to Banks Dominates  Direct Lending to Firms May Dominate  Capital Infusion to Banks Dominates

$\theta_{Direct}^*$  $\theta_{Bank}^*$  $\theta$
‘Best’ Government Policy: Government Funds with Private Equity Participation

- Suppose that the government gives \( aL \) to private funds, such that if they lend, they get net return of \( \gamma R \) in case of success and are penalized by \( c \) in case of failure.

- Banks (holding \( 1-L \)) still face the same payoffs as before, receiving net return of \( R \) in case of success and \(-L\) in case of failure.

- The new equilibrium is such that lending occurs below:
\[
\theta_{\text{Risky Funds}}^* = b - aK \left( \frac{R}{\frac{c}{\gamma} + R} \alpha l + \frac{R}{1 + R} (1 - l) \right)
\]

- We control the incentives of the fund managers, by changing the ratio \( \frac{c}{\gamma} \).
  Reducing this ratio, we increase the proportion of them that invest, and reduce the likelihood of a freeze.

- Taking \( c \) to zero, we approach \( \theta_{\text{Direct}}^* \).

- There is a disadvantage in reducing \( c \), which is that banks face lower incentive not to lend in a credit freeze. But, this is a very small effect when their information is close to perfect.
Detecting the Link between Complementarities and Fragility in the Data: Chen, Goldstein, and Jiang (Journal of Financial Economics, 2010)

- Ample empirical evidence link crises episodes to weak fundamentals.

- However, as demonstrated by the theoretical framework above, this does not say much about whether or not strategic complementarities play a role.

- To assess relevance of models, it is important to know if strategic complementarities are important in the data.

- Using mutual-fund data, we present an empirical test that relies on cross-sectional differences in the level of strategic complementarities.
Institutional Background

- In mutual funds, investors can redeem their shares every day at the market value of that day.

- Their redemptions might lead the fund to trade later in order to rebalance the portfolio.

- If the fund holds illiquid assets, this will generate costs that will be imposed on the investors who stay in the fund.

- Hence, in mutual funds that hold illiquid assets (illiquid funds), there are strategic complementarities in the redemption decision, more so than in funds that hold liquid assets (liquid funds).
Hypotheses

- Using a global-games models, we develop the following predictions:
  - Illiquid funds exhibit stronger sensitivity of outflow to bad performance than liquid funds.
    - The complementarities amplify response to fundamental shocks.
  - This pattern will be weaker in funds that are held mostly by large/institutional investors.
    - These investors can better internalize the externalities, and thus respond less to complementarities.
- These hypotheses are confirmed in the data, while alternative explanations are refuted.

- In a recent paper, Hertzberg, Liberti, and Paravisini (2010) use a natural experiment, based on the expansion of the Public Credit Registry in Argentina in 1998, to test for strategic complementarities in lending.
  - Prior to 1998, the registry only provided information about borrowers, whose total debt was above $200,000.
  - In 1998, the need for the threshold was eliminated, leading to the disclosure of information about 540,000 borrowers, for which credit assessments were previously only known privately.
• They identify the presence of complementarities in lending by studying the difference in lenders’ behavior following the announcement of the expansion.
• Consider a lender who had negative information about a borrower, for whom the information was not initially disclosed.
• From the point of view of this lender, no new information has arrived between the two periods.
• The only difference is that in the intermediate period, he realizes that the information will become available publicly.
• The authors show that for these borrowers, the amount of credit has decreased following the announcement of expansion.
• This is supposedly because the lenders realized that making this information public will make other lenders reduce credit.

• Moreover, using a differences-in-differences approach, they show that the decrease in debt following the announcement is not observed for:
  o Firms that were slightly above the threshold (for whom the information was always available).
  o Firms who borrow from only one lender (for whom there is no coordination problem).

• Overall, above approaches can be used to assess the relevance of strategic complementarities in other settings and guide policy.
A Model of Debt Overhang: Philippon and Schnabl (Journal of Finance, forthcoming)

- An important reason for why banks do not lend is the debt overhang problem, going back to Myers (1977).
- If banks have existing debt, then investing new capital to make new loans is costly because the profits from the new loans are used to pay old creditors. Hence, banks are making fewer loans than optimal.
- The problem can be solved with renegotiation with existing debt holders. But, this can be difficult for various reasons.
- Also, there may be an externality, as reduction in loans by one bank makes debt overhang problem for other banks more severe.
Simple Illustration

- Bank can lend money, generating a payoff of $v$ at a cost $x$.
- Optimally, loan is made when $v > x$.
- But, bank has existing debt at face value of $D$.
- Suppose bank has existing assets in place that yield $A$ with probability $p$ and 0 with probability $1-p$.
- Suppose that $v < D < A$. That is, existing debt is paid when asset in place is good, but there is not enough to pay existing debt otherwise.
- New loan has to be made with new debt, which is junior to old debt.
- New debt holders require a face value of $\frac{x}{p}$.
Lending Decision

- Bank is making the lending decision to maximize shareholder value:
  - In case it lends: \( p \left( A - D + \frac{v}{p} \right) \).
  - In case it doesn’t lend: \( p(A - D) \).
  - Hence, bank lends whenever \( v - \frac{x}{p} > 0 \).

- Hence, banks lend only when \( vp \) is high enough. Good lending opportunities are being wasted due to the debt overhang problem, since optimal decision does not involve the quality of the asset in place (captured by \( p \)).

- This is illustrated in figure in the next page.
Investment with debt overhang

$L^o = 0$

$I^o$

$V$

$x$

$p$

$0$

$l$
Government Intervention via Asset Purchase

- The government can intervene in this model by injecting cash to banks and hence alleviating the debt overhang problem.
- The form of intervention matters. First consider asset purchase.
  - The government gets a claim on $Z$ of the asset in case it yields a return.
  - The government pays a price of $Zq$.
- Suppose that the government does not know the type of the bank ($p$ and $v$), but this is known by the bank and other market participants.
- Suppose that participation in the asset-purchase program is voluntary.
• Effectively, the government provides a subsidy to the bank at the amount of 
\((q - p)Z\).
• Clearly, only banks for which \(q > p\) will participate.
• For these banks, participation and investment is worthwhile if
  \[ v_p - x + (q - p)Z > 0. \]
• The injection of capital to the bank via asset-purchase program alleviates the debt overhang problem, allowing more banks to lend.
• However, the negative side of this is that banks who would lend without government intervention also participate: “opportunistic participation”.
• This is illustrated in the following figure:
The Role of Equity

- The problem of opportunistic participation can be alleviated to some extent if the government takes an equity position in the bank.
  - Here the government injects $m$ to the bank and takes claim of a portion $\alpha$ of the equity return.
  - Now, the bank may decide not to participate, not only when $p$ is high, but also when $v$ is high.
- This mechanism can be perfected to eliminate all opportunistic participation by giving the government warrants that shift the entire increase in equity value due to the investment to the government.
A Model Based on Collateral Values: Benmelech and Bergman (American Economic Review, forthcoming)

- A long line of literature (e.g., Holmstrom and Tirole, 1997) studies frictions in credit markets due to a moral hazard problem between borrowers and lenders.

- Borrowers can either steal funds or take actions that generate private benefits, and so lenders will provide them limited funds that ensure they will be repaid their reservation value.

- Borrowers are thus constrained in how much they can borrow. They can borrow more when they have more capital in the project or when they can offer enough collateral.
Endogenous Collateral Values and Externalities

- Benmelech and Bergman analyze a model where collateral values are determined endogenously in an industry equilibrium.
- When a bank wants to sell the collateral, he has to sell it to another firm in the industry.
- Then, the value of the collateral depends on the liquidity held by other firms in the industry.
- When firms have more funds and invest more, the market for the collateral will be more active, generating more room for lending, amplifying the effect. But, this is not always the case.
Monetary Policy

- The authors study the effect of monetary policy that increases the amounts of funds available to banks for lending. They show three outcomes:
  - **Conventional outcome**: monetary policy increases lending and this is amplified by the externality mentioned above.
  - **Credit trap**: the capital injection by the central bank is not sufficient to boost collateral values, and so the funds get trapped in the banks.
  - **Jump start**: the policy can jump start a frozen credit market generating the positive feedback loop.
- For monetary policy to work, there needs to be sufficient liquidity in the market.
Conclusions

• The credit freeze has been an important element of the financial crisis, leading to transmission of the shock in the financial system to the real economy.

• Empirical evidence suggests that there was indeed a causal effect from the financial sector to the real economy.

• Government policies tried to alleviate the problem by providing capital to the financial sector and to the real sector.

• Different sources for the credit freeze generate different tradeoffs and implications with regard to the optimal form of intervention.