Topic 5

Financial Market Frictions and Real Activity:

Basic Concepts

Mark Gertler
NYU
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Credit spreads on senior unsecured bonds

- Nonfinancial firms
- Financial firms

Percentage points

NBER Peak

Sept.
Objective

Illustrate the following key concepts:

1. Asymmetric information and/or costly contract enforcement as foundations of financial market imperfections

2. Premium for external finance

3. Rationing vs. non-rationing equilibria

4. Balance sheets and the external finance premium

5. Relation between 4. and leverage constraints

6. Risk, balance sheets constraints and the external finance premium.
Objective (con’t)

Illustrate with two simple models:

1. Costly State Verification Model (CSV) (Townsend, 1979)

2. Costly Enforcement Model
Basic Environment

- Two Periods: 0 and 1.

- Risk Neutral Entrepreneur:
  Has project that requires funding in 0 and pays off in 1.

- Competitive Risk Neutral Lender:
  Has opportunity cost of funds $R$. 
Basic Environment (con’t)

Project Finance:

\[ QK = N + B \]

\( Q \equiv \) Market Price of a Unit of Capital
\( K \equiv \) Capital Input
\( N \equiv \) Entrepreneurs’s Net Worth (Equity Finance)
\( B \equiv \) Debt Finance
Basic Environment (con’t)

Period 1 Payoff

$$\tilde{\omega} R_k \cdot QK$$

$$R_k \equiv \text{Average Gross Return on Capital}$$

$$\tilde{\omega} \equiv \text{Idiosyncratic Shock}$$

Entrepreneur takes $$\tilde{\omega} R_k$$ and $$Q$$ as given, but $$K$$ is a choice variable.
Basic Environment (con’t)

Idiosyncratic Shock Distribution:

$$E\{\tilde{\omega}\} = 1$$

$$\tilde{\omega} \in [0, \bar{\omega}]$$

$$H(\omega) = \text{prob}(\tilde{\omega} \leq \omega)$$

$$h(\omega) = \frac{dH}{d\omega}$$
Perfect Information and Perfect Contract Enforcement

- Given $E\tilde{\omega}R_k = R_k$, entrepreneurs operates if

  $$R_k \geq R$$

  where $R$ is the opportunity cost.

- If $R_k > R$, entrepreneur’s demand for funds is infinite
  Competitive market forces $\Rightarrow R_k = R$ in equilibrium.

- Miller-Modigliani theorem applies:
  Real Investment Decision is independent of financial structure
  Financial Structure is indeterminate
Private Information and Limited Liability

- Private Information:
  Only entrepreneurs can costlessly observe returns.
  Lenders must pay a cost equal to a fixed fraction $\mu$ of the realized return $\omega R_k K$.
  Interpretable as a bankruptcy cost.

- Limited Liability:
  Entrepreneurs minimum payoff bounded at zero.
Private Information and Limited Liability (con’t)

Implications:

- Entrepreneur has incentive to misreport returns.

- Financial structure matters to real investment decisions, due to expected bankruptcy costs.

- Financial structure determinate: Designed to reduce expected bankruptcy costs.
Entrepreneur’s Optimization Problem:

1. Investment Decision (choice of $K$)

2. Financial contract: (i) payment schedule based on $\omega$ and (ii) decision to monitor

3. Constraint: Lender must receive opportunity cost in expectation.
Risky Debt as the Optimal Contract

1. Induce Truth-Telling (revelation principle)

2. Minimize Expected Monitoring Costs

⇒

- Optimal Contract is Standard Debt: i.e, Debt with bankruptcy
Risky Debt as the Optimal Contract (con’t)

Let $D \equiv$ face value of debt and $\omega^* \equiv$ the cutoff value of $\omega$

$$D = \omega^* R_k Q K$$

The contract then works as follows:

- If $\omega \geq \omega^*$:
  Lender’s payoff is $D = \omega^* R_k Q K$; Borrower’s payoff is $(\omega - \omega^*) R_k Q K$

- If $\omega < \omega^*$,
  The borrower announces default and then the lender monitors.
  Lender’s payoff is $(1 - \mu) \omega R_k K$; Borrower’s payoff is 0.

- Observe that the deadweight bankruptcy cost is $\mu \omega R_k Q K$. 

Risky Debt as the Optimal Contract (con’t)

Intuition for Optimal Contract

1. There is no incentive for the entrepreneur to lie:
   In non-default states the payment to lenders is fixed
   In default states there is monitoring.

2. Expected bankruptcy costs are minimized.
   Lender cares about expected return across default and non-default states. By giving the lender everything in the default state, borrower can minimize non-default payment $D$.

   Given $D = \omega^* R_k Q K$, the bankruptcy probability $H(\omega^*)$ is

   $$H(\omega^*) = H\left(\frac{D}{R_k Q K}\right)$$

   which is increasing in $D \rightarrow$ minimizing $D$ minimizes expected default costs.
Solving for the Optimal Debt Contract

Given the form of the optimal contract ⇒

Lender’s expected payment:

\[
[1 - H(\omega^*)]D + \int_0^{\omega^*} (1 - \mu)\omega R_k Q K dH = \int_0^{\omega^*} \omega^* R_k Q K dH + \int_0^{\omega^*} (1 - \mu)\omega R_k Q K dH = [\Gamma(\omega^*) - \mu G(\omega^*)] R_k Q K
\]

with

\[
\Gamma(\omega^*) \equiv \omega^*[1 - H(\omega^*)] + \int_0^{\omega^*} \omega dH
\]

\[
G(\omega^*) \equiv \int_0^{\omega^*} \omega dH
\]

\(\Gamma(\omega^*) \equiv \) Lender’s expected gross share of return;

\(\Gamma(\omega^*) - \mu G(\omega^*) \equiv \) expected net share
Optimal Contract (con’t)

- $\Gamma(\omega^*)$ is increasing and concave

$$
\Gamma'(\omega^*) = 1 - H(\omega^*) > 0 \\
\Gamma''(\omega^*) = -h(\omega^*) < 0
$$

- $G(\omega^*)$ is increasing and convex, assuming $\omega^* h(\omega^*)$ is increasing

$$
G'(\omega^*) = \omega^* h(\omega^*) > 0 \\
G''(\omega^*) > 0
$$

- $\rightarrow \Gamma(\omega^*) - \mu G(\omega^*)$ is concave

  - increasing so long as the default prob $H(\omega^*)$ is not too large

$$
\Gamma'(\omega^*) - \mu G'(\omega^*) = 1 - H(\omega^*) - \mu \omega^* h(\omega^*)
$$

which is positive under reasonable values for $H(\omega^*), \mu$ and $\omega^* h(\omega^*)$ becomes negative as $\omega^* \rightarrow \bar{\omega}$. 
Entrepreneur’s Decision Problem

• Objective:

$$\max_{\omega^*, K} \{ \max \{ [1 - \Gamma(\omega^*)] R_k Q_k, R N \} \}$$

• subject to lender’s voluntary participation constraint

$$[\Gamma(\omega^*) - \mu G(\omega^*)] R_k Q_k = R B$$

$$R (Q_k - N)$$

$$\lambda \equiv \text{constraint multiplier} = \text{shadow value of } N$$
Entrepreneur’s Decision Problem (con’t)

F.O.N.C:

- $\omega^*$

- $K$

- $\lambda$

\[
\lambda = \frac{\Gamma'(\omega^*)}{\Gamma'(\omega^*) - \mu G'(\omega^*)}
\]

\[
R_k - \frac{\lambda}{\{[1 - \Gamma(\omega^*)] + \lambda[\Gamma(\omega^*) - \mu G(\omega^*)]\}} R = 0
\]

\[
[\Gamma(\omega^*) - \mu G(\omega^*)]R_k = R\left(1 - \frac{N}{QK}\right)
\]
Entrepreneur’s Decision Problem (con’t)

Given $\Gamma'(\omega^*) - \mu'G(\omega^*) > 0 \Rightarrow$ three observations:

1. $\lambda > 1$ and increasing in $\omega^*$ (from FONC for $\omega^*$)
   (a) $\rightarrow$ Shadow value of net worth $\lambda > 1$ and increasing in $D/R_k QK = \omega^*$

2. $\omega^*$ increasing in $R_k/R$ (from FONC for $K$)
   (a) As $R_k/R \uparrow$, borrowing increases $K$
   (b) $\rightarrow D/R_k QK = \omega^* \uparrow$ since $K$ is financed at the margin by debt

3. \[
\frac{\lambda}{[[1-\Gamma(\omega^*)]+\lambda[\Gamma(\omega^*)-\mu G(\omega^*)]]} > 1
\] is the premium for external finance.
   (a) $\rightarrow R_k > R$
   (b) Premium is increasing in $D/R_k QK = \omega^*$.
   (c) $\rightarrow$ upward sloping supply curve for funds since $D/R_k QK$ increases with $K$. 
4. Optimal Choices of $\omega^*$ and $K$

The following two equations determine $\omega^*$ and $QK$:

- Lender’s voluntary participation constraint:

$$[\Gamma(\omega^*) - \mu G(\omega^*)] R_k = R \left(1 - \frac{N}{QK}\right)$$

- Optimal Choice of Capital

$$R_k - \chi(\omega^*) R = 0$$

with

$$\chi(\omega^*) = \frac{\lambda(\omega^*)}{\left\{ [1 - \Gamma(\omega^*)] + \lambda(\omega^*) [\Gamma(\omega^*) - \mu G(\omega^*)] \right\}} > 1; \quad \chi'(\omega^*) > 0$$
Non-Rationing Equilibrium

\[ R_k = \chi(\omega)R \]

\[ R \left(1 - \frac{N}{QK}\right) \]
The Demand for Capital and Net Worth

- Inverting the lender’s voluntary participation constraint:

\[
\frac{QK}{N} = \frac{1}{1 - [\Gamma(\omega^*) - \mu G(\omega^*)] R_k / R}
\]

where \( \frac{QK}{N} = 1 + \frac{B}{N} \equiv \text{leverage multiple} \)

- \( \omega^* \) is increasing in \( R_k / R \) from FONCs for \( \omega^* \) and \( K \). \( \Rightarrow \)

\[
\frac{QK}{N} = \phi\left(\frac{R_k}{R}\right)
\]

with \( \phi'\left(\frac{R_k}{R}\right) > 0 \)

- \( \Rightarrow \) Net worth constraint on capital and leverage

\[
QK = \phi\left(\frac{R_k}{R}\right) N
\]

\[
\Leftrightarrow
\]

\[
B = [\phi\left(\frac{R_k}{R}\right) - 1] N
\]
Aggregate Demand for Capital and Financial Crises

- Capital demand

\[ QK = \phi\left(\frac{R_k}{R}\right)N \]

where \( \phi\left(\frac{R_k}{R}\right) \) is the optimal leverage multiple

- \( \phi\left(\frac{R_k}{R}\right) \) does not depend on firm specific factors \( \Rightarrow \)

  Can aggregate capital demand across entrepreneurs:

\[ Q\bar{K} = \phi\left(\frac{R_k}{R}\right)\bar{N} \]

where \( \bar{N} \) is aggregate net worth and \( \bar{K} \) is aggregate capital demand.

- Financial Crisis: Sharp drop in \( N \) or in \( \phi\left(\frac{R_k}{R}\right) \) that reduces \( Q\bar{K} \).
Balance Sheet Strength and the Spread

- Inverting yields

\[ \frac{R_k}{R} = \chi \left( \frac{QK}{N} \right) \]

with

\[ \chi'(\frac{QK}{N}) > 0 \]

where \( \chi \) is the gross spread.

- Thus, in the market equilibrium, the spread is inversely related to aggregate balance sheet strength

  \( \Rightarrow \) during a crisis the balance sheet weakens and the spread increases.
Rationing vs. Non-Rationing (Baseline) Case

- Non-Rationing Case \( (\Gamma'(\omega^*) - \mu G'(\omega^*) \geq 0) \):
  - 1. Lender’s voluntary participation constraint:
    \[
    [\Gamma(\omega^*) - \mu G(\omega^*)]R_k = R(1 - \frac{N}{QK})
    \]
  - 2a. Optimal Choice of Capital
    \[
    R_k - \chi(\omega^*)R = 0
    \]

- If at the solution of 1 and 2a \( \Gamma'(\omega^*) - \mu G'(\omega^*) < 0 \), then the non-rationing case is not an optimum
  - Borrower can raise lender’s expected payment by reducing \( \omega^* \) (since expected default costs decline)
  - Intuitively, the loan supply curve is backward bending over the relevant region \( \Rightarrow \) rationing equilibrium.
Rationing Equilibrium

The following two equations determine $\omega^*$ and $QK$:

- Lender’s voluntary participation constraint:

  $$[\Gamma(\omega^*) - \mu G(\omega^*)]R_k = R(1 - \frac{N}{QK})$$

- Maximum feasible $\omega^*$

  $$\Gamma'(\omega^*) - \mu G'(\omega^*) = 0$$

- Observe that $QK$ varies proportionately with $N$ and with $R_k/R$. ⇒
  - Rationing case has qualitative predictions similar to Non-Rationing Case
Rationing Equilibrium

\[ R_k = \chi(\omega)R \]

\[ R \left(1 - \frac{N}{QK}\right) \]

\[ 0 \quad \omega^* \quad \overline{\omega} \]
Idiosyncratic Risk and the Leverage Ratio $\phi\left(\frac{R_k}{R}\right)$

- Increasing risk can tighten leverage constraints, reducing capital demand:

- Consider a mean preserving spread that:
  - Adds mass to the existing default region $[\omega, \bar{\omega}^*]$
  - Does not reduce the density $h(\bar{\omega}^*)$.

- Let $\xi$ be an index of the spread of the distribution of $\omega$. Then a mean-preserving spread (increase in $\xi$) $\Rightarrow$
  
  $\frac{\partial H(\bar{\omega}^*)}{\partial \xi} > 0$

  i.e. everything else equal, a mean-preserving spread increases the default probability $H(\bar{\omega}^*)$. 
Increasing Idiosyncratic Risk (con’t)

- **Lender’s Voluntary Participation (LVP) constraint:**
  
  \[ [\Gamma(\omega^*, \xi) - \mu G(\omega^*, \xi)] R_k = R(1 - \frac{N}{QK}) \]

  with \( \frac{\partial \Gamma(\omega^*, \xi)}{\partial \xi} < 0 \) and \( \frac{\partial G(\omega^*, \xi)}{\partial \xi} > 0 \).

- **Optimal Choice of Captial (OCC)**

  \[ R_k - \chi(\omega^*, \xi) R = 0 \]

  with \( \frac{\partial \chi(\omega^*, \xi)}{\partial \xi} > 0 \)

- From OCC: \( \frac{\partial \omega^*}{\partial \xi} < 0 \) and from LVP \( \frac{\partial K}{\partial \xi} < 0 \) (given \( \frac{\partial \omega^*}{\partial \xi} < 0 \))
Increasing Idiosyncratic Risk (con’t)

• Combining equations:

\[ \frac{Q K}{N} = \phi \left( \frac{R_k}{R}, \xi \right) \]

• with

\[ \frac{\partial \phi \left( \frac{R_k}{R}, \xi \right)}{\partial \xi} < 0 \]

• \( \Rightarrow \) Increasing idiosyncratic risks reduces capital demand by "tightening margins."
Costly Enforcement Model

• Same basic setup as in CSV model, except the financial market friction is motivated by costs of enforcing contracts as opposed to private information: ⇒

• Borrower may decide to renege on debt

• Lender can only recover the fraction \((1 - \theta)\) of the gross return \(R_kQK\), with \((1 - \theta)R_k < R\)

• Borrower is able to keep the rest: \(\theta R_kQK\)
Costly Enforcement Model (con’t)

- Value of the project $V$

\[
V = \frac{(R_k QK - RB)}{R} = \left[ R_k QK - R(QK - N) \right] R = \left( \frac{R_k}{R} - 1 \right) QK + N
\]

- Incentive Constraint:

\[
V \geq \theta \left( \frac{R_k QK}{R} \right)
\]
Entrepreneur’s Optimization Problem

- objective

$$\max_{K} \left( \frac{R_k}{R} - 1 \right) QK + N$$

- subject to incentive constraint:

$$\left( \frac{R_k}{R} - 1 \right) QK + N \geq \theta \frac{R_k}{R} QK$$

$$\lambda \equiv \text{Lagrange Multiplier}$$

$$\rightarrow 1 + \lambda = \text{shadow value of a unit of net worth}.$$
FONCs

- $K$:

$$
\lambda = \frac{\frac{R_k}{R} - 1}{1 - \frac{R_k}{R} (1 - \theta)} > 0
$$

- $\lambda$

$$
QK = \left[\frac{1}{1 - (1 - \theta)R_k/R}\right]^N
$$

$\Rightarrow$

$$
QK = \phi(R_k/R)N
$$

with $\frac{\partial \phi(R_k/R)}{\partial R_k/R} > 0$

$\rightarrow$ balance sheets constraint qualitatively similar to one arising from CSV model.
Costly Enforcement Model (con’t)

● Advantages

Less complicated but similar predictions to CSV model:

1. $QK$ depends positively on $N$

2. $\phi(R_k/R)$ is increasing in $R_k/R$. 
Costly Enforcement Model (con’t)

Disadvantages

• 1. No default

  2. No credit spreads (as debt is riskless)

  3. Can’t analyze shifts in idiosyncratic risk.

  4. Less obvious how to calibrate or estimate parameters.
the share of callable debt in the secondary market has varied substantially over the sample period, with almost all bonds being subject to a call provision until the late 1980s. Likely spurred by the decline in long-term nominal interest rates and the accompanied reduction in interest rate volatility, the share of callable debt fell to its historic low of about 25 percent by the mid-1990s. Over the past decade and a half, however, this trend has been almost completely reversed, as nonfinancial firms resumed issuing large amounts of callable senior unsecured debt.

In terms of default risk—at least as measured by the S&P credit ratings—our sample spans the entire spectrum of credit quality, from “single D” to “triple A.” At “BBB1,” however, the median observation is still solidly in the investment-grade category. An average bond has an expected return of 204 basis points above the comparable risk-free rate, while the sizable standard deviation of 281 basis points reflects the wide range of credit quality in our sample.

Using this micro-level dataset, we construct a simple credit-spread index that is representative of the entire maturity spectrum and the range of credit quality in the corporate cash market. Specifically, the GZ credit spread is calculated as

\[
S_t^{\text{GZ}} = \frac{1}{N_t} \sum_i \sum_k S_{it}[k],
\]

where \( N_t \) is the number of bond/firm observations in month \( t \)—that is, the GZ credit spread is simply an arithmetic average of the credit spreads on outstanding bonds in any given month. Figure 1 shows the GZ credit spread along with two widely used default-risk indicators that are also available over our sample period: the spread between yields on indexes of Baa- and Aaa-rated seasoned industrial corporate

**Figure 1. Selected Corporate Credit Spreads**

*Notes:* Sample period: 1973:1–2010:9. The figure depicts the following credit spreads: GZ spread = the average credit spread on senior unsecured bonds issued by nonfinancial firms in our sample (the solid line); Baa–Aaa = the spread between yields on Baa- and Aaa-rated long-term industrial corporate bonds (the dashed line); and CP–Bill = the spread between the yield on one-month A1/P1 nonfinancial commercial paper and the one-month Treasury yield (the dotted line). The shaded vertical bars represent the NBER-dated recessions.
IV. The Excess Bond Premium and Economic Activity

Our decomposition of the GZ credit spread implies that an important component of the variation in corporate credit spreads is due to fluctuations in the excess bond premium. We now examine whether movements in the excess bond premium provide independent information about future economic activity. First, we analyze the extent to which the forecasting power of the GZ credit spread documented in Section III is attributable to its predicted component or the excess bond premium. We then add the excess bond premium to an otherwise standard macroeconomic VAR and examine the implications of innovations to the excess bond premium for the real economy and asset prices.

A. Forecasting Results

Table 6 reports the results for the monthly indicators of economic activity, based on the specification in which the two components of the GZ credit spread—\( S_{GZ} \) and \( EBP \)—are allowed to enter the forecasting regression (2) separately. According to our estimates, both the excess bond premium and the predicted GZ credit spread contain significant independent explanatory power for all 3 economic indicators, at both the 3- and 12-month forecast horizons. The (absolute) magnitude of the estimated coefficients on the excess bond premium, however, tends to be significantly larger than that of the coefficients associated with the predicted GZ spread, a finding indicating that the information content of credit spreads for economic activity largely reflects fluctuations in the nondefault component of credit spreads as opposed to movements in expected defaults.

In Table 7, we repeat this forecasting exercise for the growth rate of real GDP and its main components. To conserve space, we report the results for the four-quarter
Figure 6 shows the amount of variation in the endogenous variables explained by the orthogonalized shocks to the excess bond premium. These innovations account for more than 10 percent of the variation in output and 25 percent of the variation in business fixed investment at business cycle frequencies, proportions that exceed the amount of variation typically explained by monetary policy shocks. In addition, shocks to the excess bond premium explain a significant portion of the variation in broad equity valuations.

Notes: The figure depicts the impulse responses to a one-standard-deviation orthogonalized shock to the excess bond premium (see text for details). The responses of consumption, investment, and output growth and that of the excess market return have been accumulated. Shaded bands denote 95-percent confidence intervals based on 2,000 bootstrap replications.
view that our proxy for the price of default risk responds to changes in the risk attitudes of financial intermediaries, at least as reflected in their willingness to make C&I loans and changes in the conditions of their balance sheets.

The 2007–2009 financial crisis offers a unique opportunity to explore this hypothesis further. Given that the origin of the crisis can undoubtedly be traced to the financial sector (e.g., Brunnermeier 2009 and Gorton 2009), we collected market-based data on the health of the financial sector, namely, the credit default swaps and equity valuations of primary dealers, major banks, and securities broker-dealers that trade in US Government securities with the Federal Reserve Bank of New York. By buying and selling an array of securities for a fee and holding an inventory of securities for resale, these highly leveraged financial intermediaries play a key role in most financial markets. As documented by Adrian and Shin (2010), broker-dealers differ from other...
types of institutional investors by their active procyclical management of leverage: expansions in broker-dealer assets are associated with increases in leverage as broker-dealers take advantage of greater balance sheet capacity; conversely, contractions in their asset holdings are associated with the deleveraging of their balance sheets.

The solid line in Figure 8 depicts the excess bond premium, while the overlayed dotted line represents the average one-year CDS spread for these institutions. The striking degree of comovement between the two series over the period shown again supports the interpretation that the excess bond premium fluctuates closely in response to movements in capital and balance sheet conditions of key financial intermediaries. Indeed, the collapse of Lehman Brothers on September 15, 2008—a watershed event in the recent crisis—provides a dramatic example of how disruptions in the effective risk-bearing capacity of the financial sector can influence the supply of credit.

To analyze more formally how shocks to the profitability of financial intermediaries affect our gauge of credit supply conditions, we consider a VAR, consisting of the option-implied volatility on the S&P 500 (VIX), the (value-weighted) excess market return, the (value-weighted) excess portfolio return of broker-dealers, the average one- and five-year broker-dealer CDS spreads, and the excess bond premium. By including both the one- and five-year CDS spreads, we allow such financial shocks to affect the market assessment of near- and longer-term default risk for these institutions. The VAR, using three lags of each endogenous variable, is estimated over the 2003:1–2010:9 period and also includes a dummy variable for September 2008.

Within this multivariate framework, we trace out the impact of an orthogonalized shock to the excess return of broker-dealers, an innovation that, according to


14 Prior to 2003, only a small subset of broker-dealers had CDS contracts traded in the market.
15 Standard regression diagnostics revealed that this observation exerted an unduly large influence on the estimated coefficients.