Lecture 1

Financial Market Frictions and Real Activity:

Basic Concepts

Mark Gertler NYU

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First Some Background Motivation.....

Old Macro

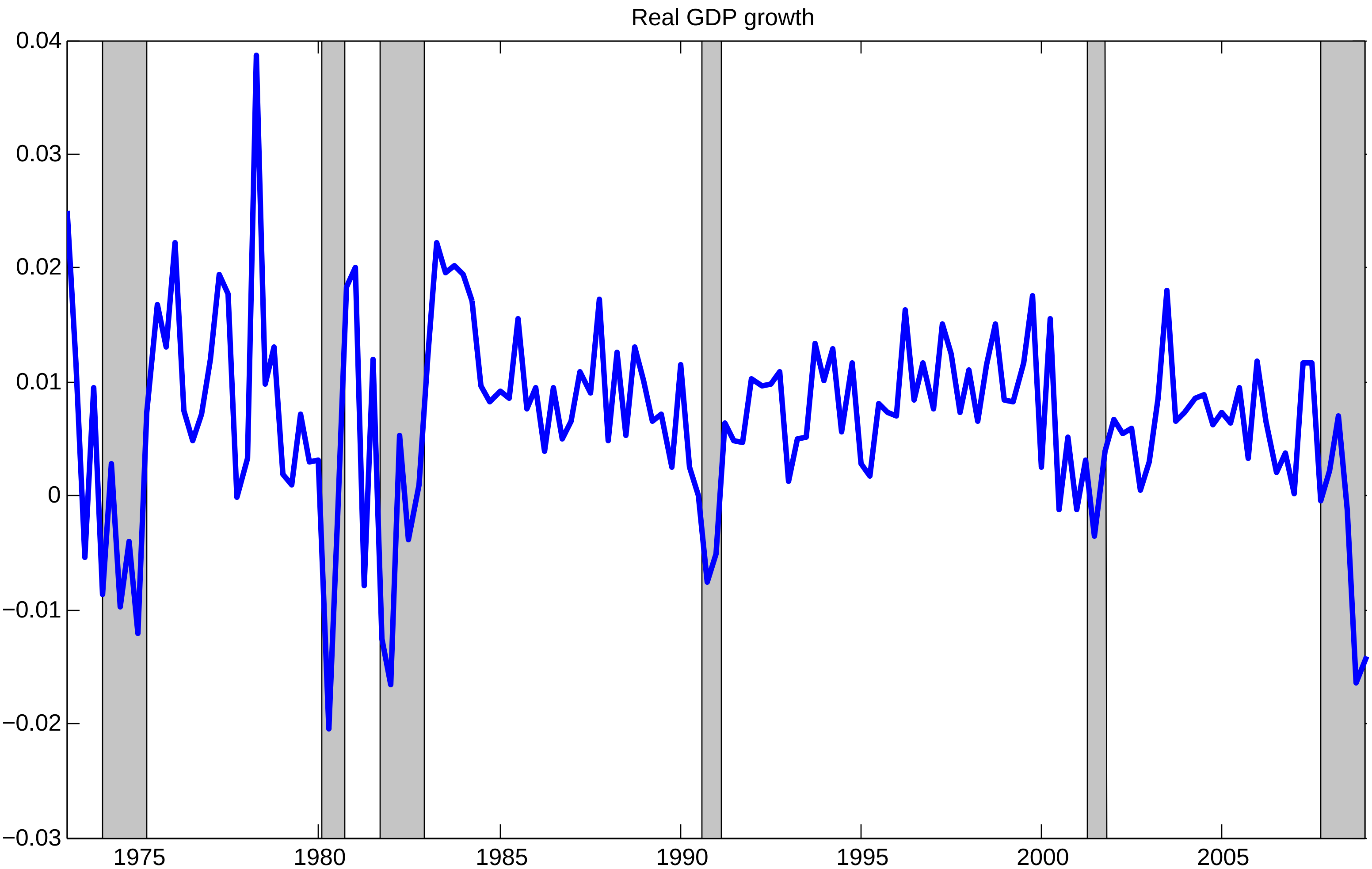
Analyzes pre versus post 1984:Q4.

New Macro

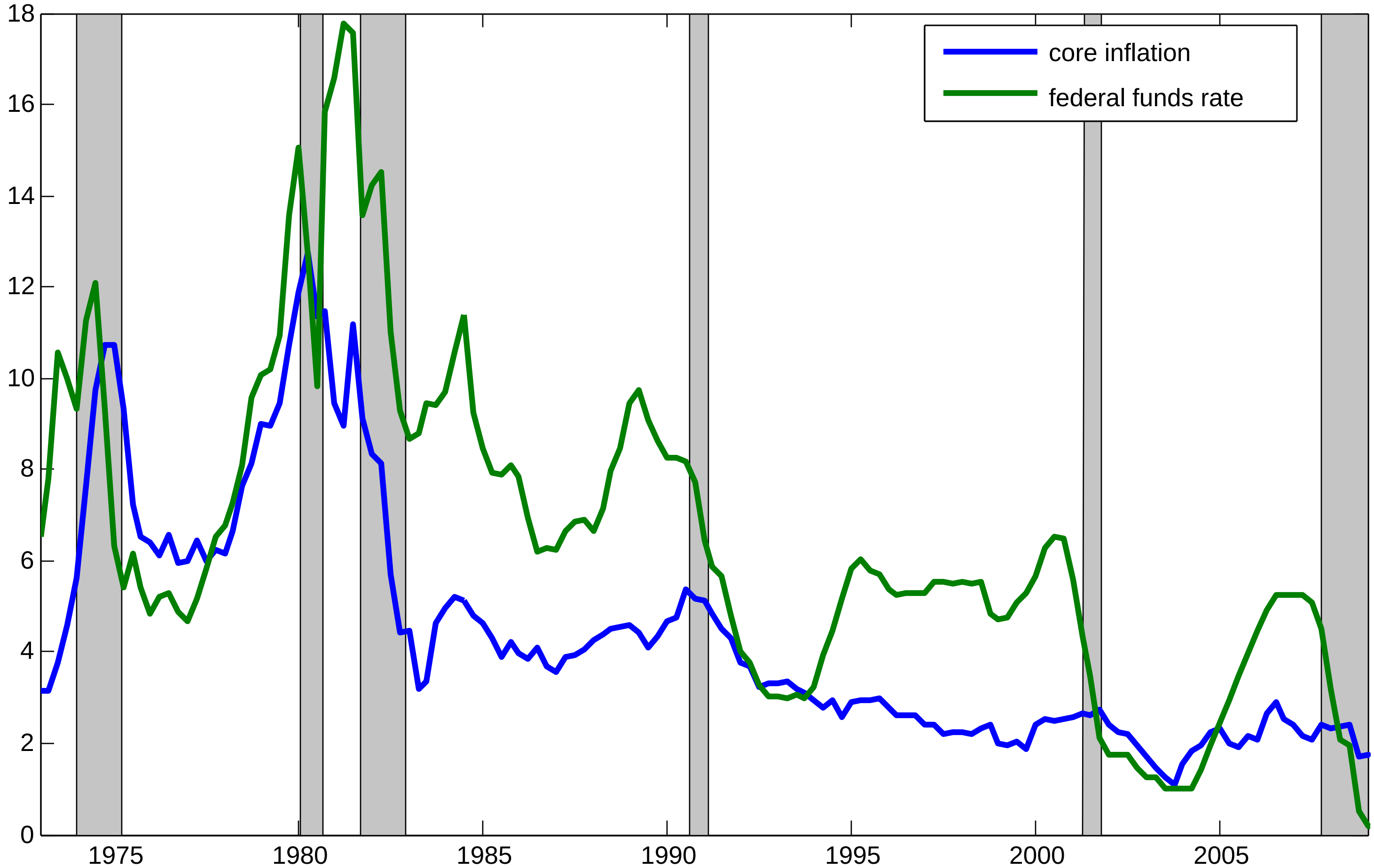
Analyzes pre versus post August 2007

Post August 2007:

- End of the Great Moderation
- Downturn Precipitated by Disruption of Financial Intermediation
- Unconventional Monetary Policy

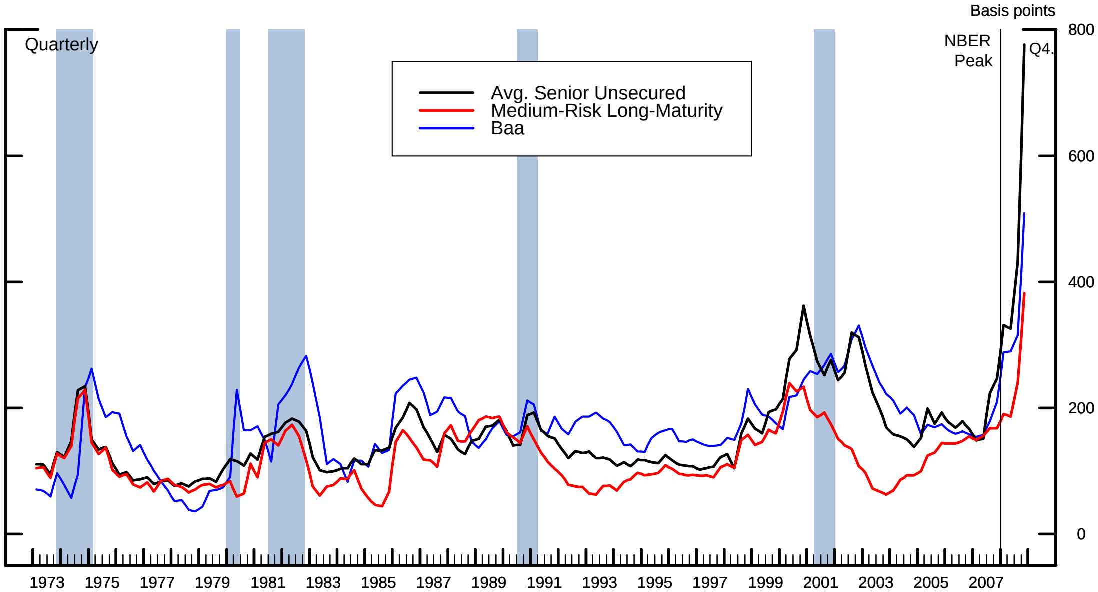


Real GDP growth
0.04
0.03
0.02
0.01
0
−0.01
−0.02
−0.03
1975
1980
1985
1990
1995
2000
2005

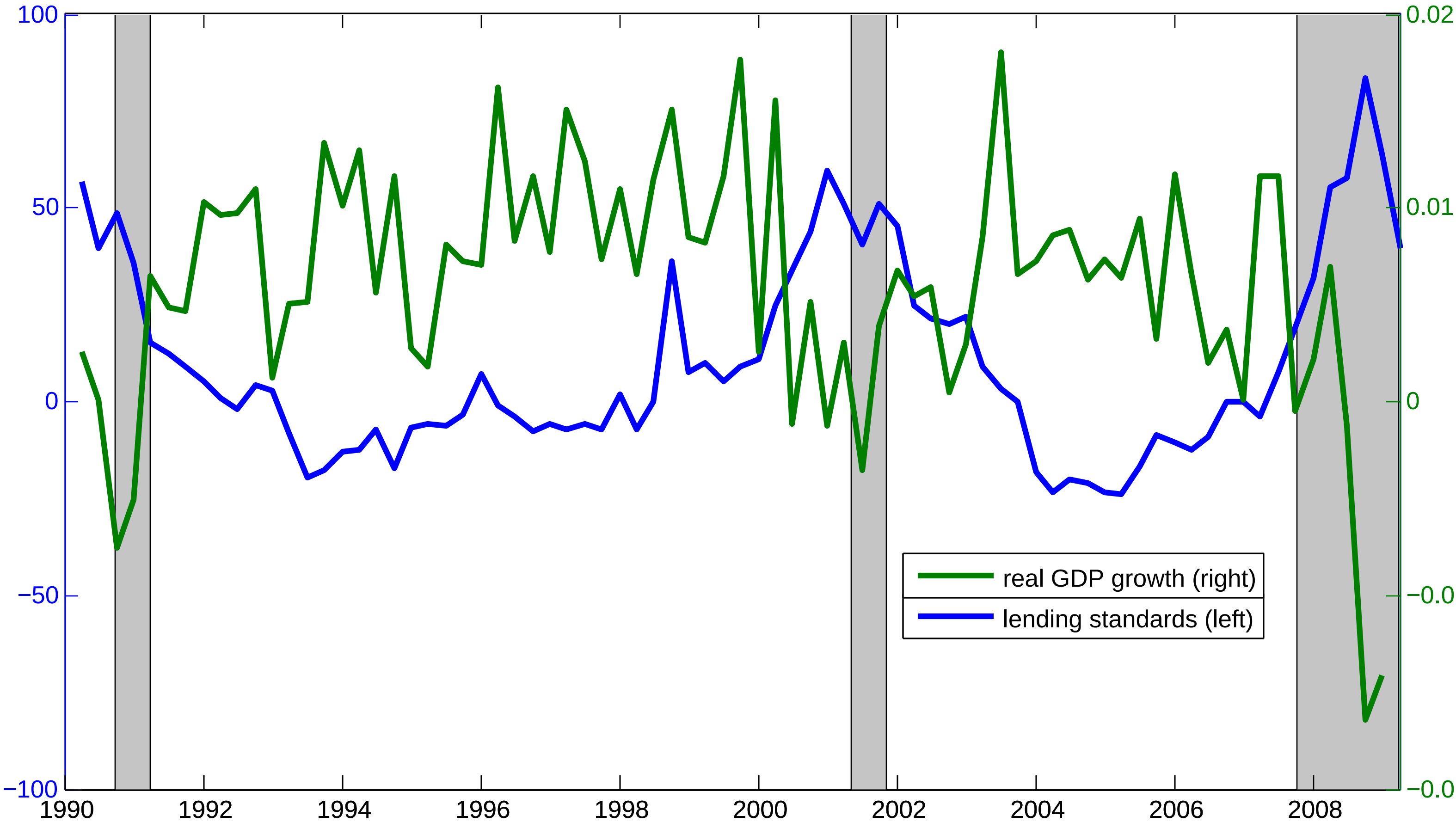


18
16
14
12
10
8
6
4
2
0
1975
1980
1985
1990
1995
2000
2005
core inflation
federal funds rate

Figure 1: Selected Corporate Bond Spreads



NOTE: The black line depicts the average credit spread for our sample of 5,269 senior unsecured corporate bonds; the red line depicts the average credit spread associated with very long maturity corporate bonds issued by firms with low to medium probability of default (see text for details); and the blue line depicts the standard Baa credit spread, measured relative to the 10-year Treasury yield. The shaded vertical bars denote NBER-dated recessions.



100
50
0
−50
−100
0.02
0.01
0
−0.0
−0.0
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
real GDP growth (right)
lending standards (left)

New Macro (con't)

However, existing quantitative models not adequate:

- Baseline models (Christiano/Eichenbaum/Evans, Smets/Wouters) have frictionless capital markets

- Models with financial frictions (Bernanke/Gertler/Gilchrist, Christiano/Motto/Rostagno need updating:

  Basic financial accelerator("adverse feedback loop") mechanism relevant, but

  - Frictions only on non-financial firms; intermediaries typically just a veil.
  - Only consider conventional monetary policy:

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. Idiosyncratic risk 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.

- Competive Risk Neutral Lender:

  Has opportunity cost of funds R.

Basic Environment (con't)

Project Finance:

$$QK = N + B$$

$K \equiv$ Capital Input

$N \equiv$ Entrepreneurs's Net Worth (Equity Finance)

$B \equiv$ Debt Finance

Basic Environment (con't)

Period 1 Payoff

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

$R_k \equiv$ Average Gross Return on Capital

$\widetilde{\omega} \equiv$ Idiosyncratic Shock

Entrepreneur takes $\widetilde{\omega} R_k$ as given, but K is a choice variable.

Basic Environment (con't)

Idiosyncratic Shock Distribution:

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

$$\widetilde{\omega} \; \epsilon \; [\underline{\omega}, \overline{\omega}]$$

$$H(\omega) = prob(\widetilde{\omega} \leq \omega)$$

$$h(\omega) = \frac{dH}{d\omega}$$

Perfect Information and Perfect Contract Enforcement

- Given $E\widetilde{\omega}R_k = R_k$, 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 μ 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: payment schedule baced on ω and decision to monitor

3. Constraint: Lender must receive opportunity cost in expectation.

Optimal Contract

1. Induce Truth-Telling (revelation principle)

2. Minimize Expected Monitoring Costs

$\Rightarrow$

- For any choice of Optimal Contract is Standard Debt: i.e, Debt with bankruptcy

Optimal Contract (con't)

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

$$D = \omega^* R_k QK$$

The contract then works as follows:

- If $\omega \geq \omega^*$:

  Lender's payoff is $D = \omega^* R_k QK$; Borrower's payoff is $(\omega - \omega^*) R_k QK$

- If $\omega < \omega^*$,

  The borrower announces default and then the lender monitors.

  Lender's payoff is $(1 - \phi)\omega R_k K$; Borrower's payoff is 0.

- – Observe that the deadweight bankruptcy cost is $\phi\omega R_k QK$.

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.

By giving the lender everything in the default state, the non-default payment D is minimized.

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

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

which is increasing in D.

Optimal Contract (con't)

Given the form of the optimal contract:

Lender's expected gross payment:

$$\int_{\omega *}^{\overline{\omega}} \omega^* R_k Q K dH + \int_{\underline{\omega}}^{\omega^*} \omega R_k Q K dH \equiv \Gamma(\omega^*) R_k Q K$$

with

$$\Gamma(\omega^*) = \int_{\omega *}^{\overline{\omega}} \omega^* dH + \int_{\underline{\omega}}^{\omega^*} \omega dH$$

Optimal Contract (con't)

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

$$\Gamma^{'}(\omega^*) = [1 - H(\omega^*)] > 0$$

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

Optimal Contract (con't)

Lender's expected net payment

$$\int_{\omega *}^{\overline{\omega}} \omega^* R_k Q K dH + \int_{\underline{\omega}}^{\omega^*} (1-\mu)\omega R_k Q K dH = [\Gamma(\omega^*) - \mu G(\omega^*)] R_k Q K$$

with

$$G(\omega^*) = \int_{\underline{\omega}}^{\omega^*} \omega dH$$

Optimal Contract (con't)

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

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

- $$G''(\omega^*) > 0$$

Entrepreneur's Decision Problem

- Objective:

$$\max_{\omega^*, K}, \max\{[1 - \Gamma(\omega^*)]R_k QK - RN, 0\}$$

- subject to

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

with

- $\lambda \equiv$ constraint multiplier $=$ shadow value of N

Entrepreneur's Decision Problem

Combining equations:

$$\max_{\omega^*, K}, \max\{[R_k - R - \mu G(\omega^*) R_k] QK, 0\}$$

- where $\mu G(\omega^*) R_k \equiv$ expected default costs $\equiv$ related to premium for external finance

Entrepreneur's Decision Problem (con't)

F.O.N.C:

- ω^*

$$\lambda = 1 + \frac{\mu G'(\omega^*)}{\Gamma'(\omega^*) - \mu G'(\omega^*)}$$

- K

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

- λ

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

Entrepreneur's Decision Problem (con't)

Three observations:

1. λ is increaing in ω^* (from top eq.)

2. ω^* increasing in R_k/R.(from middle equation)

3. $\frac{\lambda}{\{[1-\Gamma(\omega^*)]+\lambda[\Gamma(\omega^*)-\mu G(\omega^*)]\}} > 1$ is the premium for external finance.

(Note that the premium is increasing in ω^*).

Non-Rationing vs. Rationing Solution

- Lender's voluntary participation constraint:

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

- The expected return on debt per unit capital (the left side)depends on ω^*

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

which in genereal has an ambiguous sign.

Non-Rationing vs. Rationing Solution (con't)

- Non-Rationing Solution: Lender's expected return increasing in ω^*, i.e.,

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

- Rationing Solution: Just the opposite

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

Under reasonable parametrizations, the non-rationing solution holds.

Rationing Equilibrium

The following two equations determine ω^* and QK :

- Lender's voluntary participation constraint:

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

- Maximum feasible ω^*

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

- Observe that QK varies proportionately with N and with R_k/R.

Non-Rationing Equilibrium

The following two equations determine ω^* and QK :

- Lender's voluntary participation constraint:

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

- Optimal Choice of Captial

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

with

$$\chi(\omega^*) = \frac{\lambda(\omega^*)}{\{[1 - \Gamma(\omega^*)] + \lambda(\omega^*)[\Gamma(\omega^*) - \mu G(\omega^*)]\}} > 1; \qquad \chi'(\omega^*) > 0$$

Non-Rationing Equilibrium (con't)

Inverting the lender's voluntary participation constraint:

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

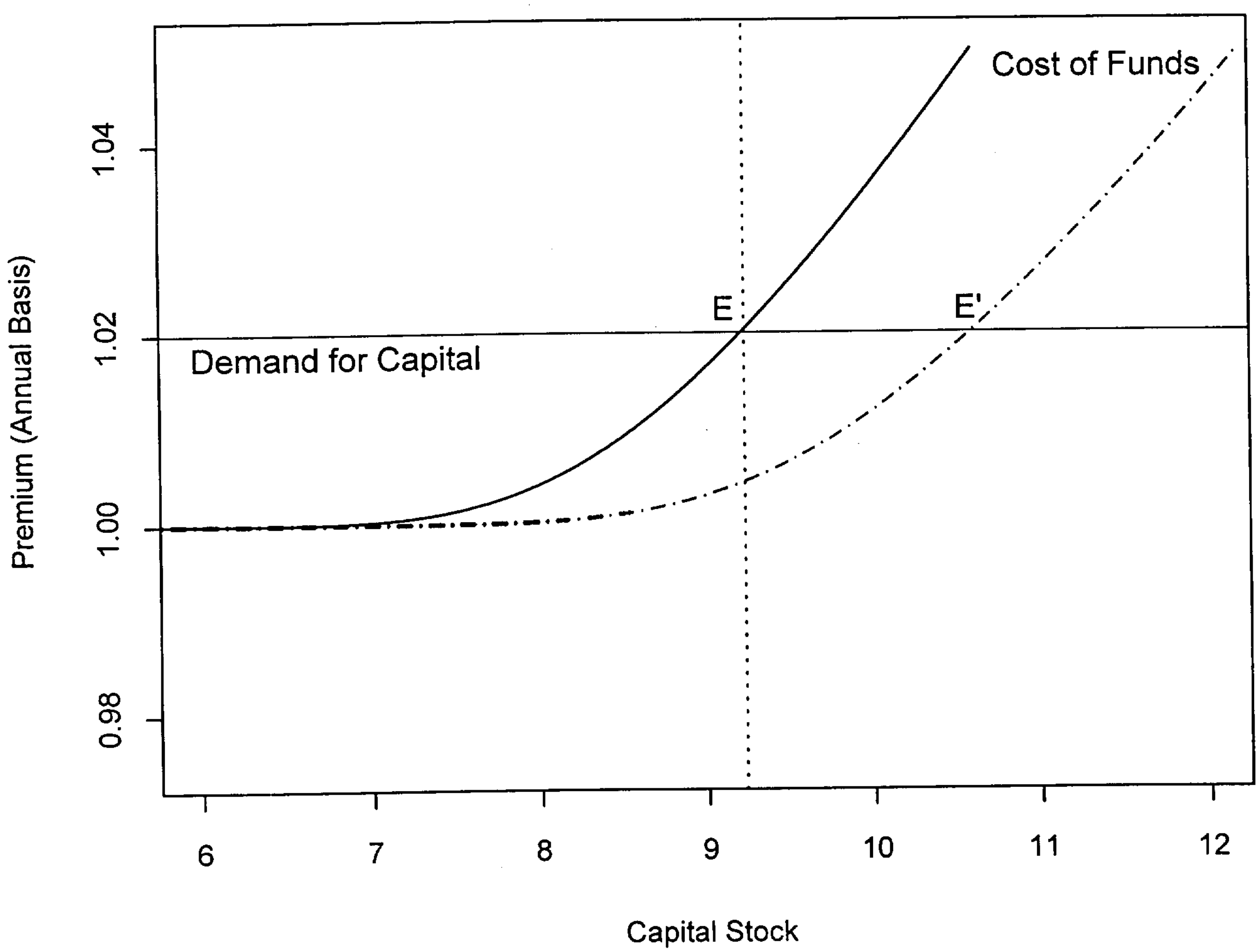
ω^* is increasing in R_k/R from FONCs for ω^* and K. $\Rightarrow$

$$\frac{QK}{N} = \phi(\frac{R_k}{R})$$

- with

$$\phi'(\frac{R_k}{R}) > 0$$

Figure 1: The Effect of an Increase in Net Worth



The Demand for Capital

- Capital demand

$$QK = \phi(\frac{R_k}{R})N$$

  where $\phi(\frac{R_k}{R})$ is the optimal leverage ratio.

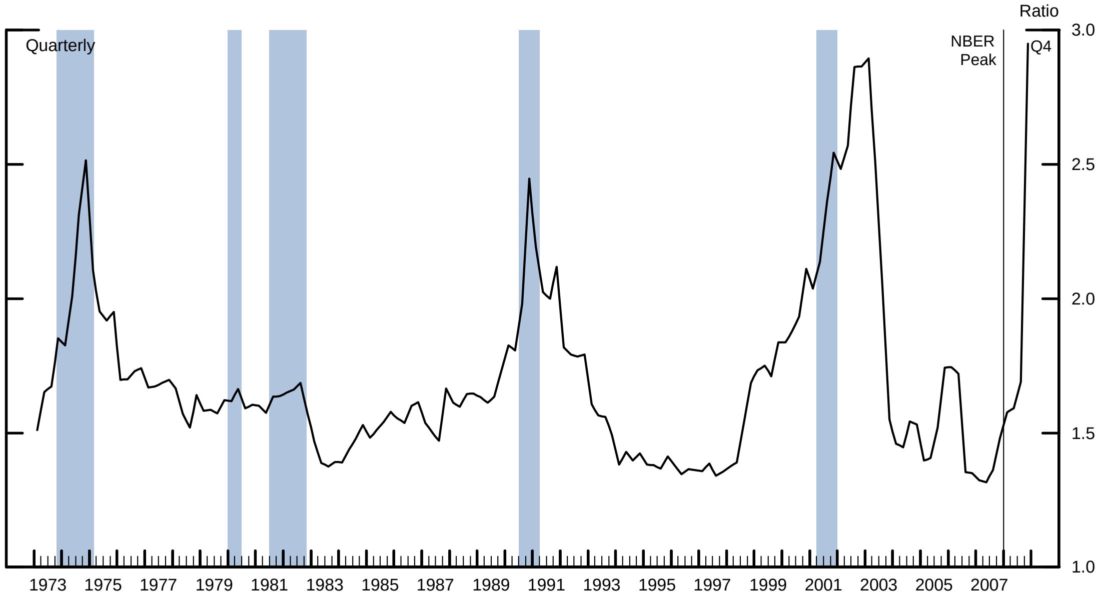
- $\phi(\frac{R_k}{R})$ does not depend on firm specific factors $\Rightarrow$

  Can aggregate capital demand across entrepreneurs:

$$Q\overline{K} = \phi(\frac{R_k}{R})\overline{N}$$

where $\overline{N}$ is aggregate net worth and $\overline{K}$ is aggregate capital demand.

Figure 2: Leverage Ratio



NOTE: The black line depicts the time-series of the cross-sectional averages of the leverage ratio for U.S. nonfinancial corporations. Leverage is defined as the ratio of the market-value of the firm's total assets (V) to the market-value of the firm's common equity (E), where the market-value of the firm's total assets is calculated using the Merton-DD model (see text for details). The shaded vertical bars denote NBER-dated recessions.

Balance Sheet Strength and the Spread

- Inverting yields

$$\frac{R_k}{R} = \chi(\frac{Q\overline{K}}{\overline{N}})$$

with

$$\chi'(\frac{Q\overline{K}}{\overline{N}}) > 0$$

where χ is the gross spread.

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

Increasing Idiosyncratic Risk

- Let ξ be an index of the spread of the distribution of ω.

  Then consider a mean-preserving increasing in the spread.

- Under reasonable parametrizations:

$$\frac{\partial H(\omega^*)}{\partial \xi} > 0$$

  i.e. everyting else equal, a mean-preserving spread increases the default probability $H(\omega^*)$

$$\frac{\partial h(\omega^*)}{\partial} > 0$$

  i.e., the density at the default cutoff also goes up.

Increasing Idiosyncratic Risk (con't)

- Lender's voluntary participation 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

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

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

Increasing Idiosyncratic Risk (con't)

$$\frac{QK}{N} = \phi(\frac{R_k}{R}, \xi)$$

with

$$\frac{\partial \phi(\frac{R_k}{R}, \xi)}{\partial \xi} < 0$$

- 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: $\Rightarrow$

- Borrower may decide to renege on debt.

- Lender can only recover the fraction $(1 - \lambda)$ of the gross return$R_k QK$, with $(1 - \lambda)R_k < R$

- Borrower is able to keep the rest,: $\lambda R_k QK$

Costly Enforcement Model (con't)

- Value of the project V

$$\begin{aligned} V &= R_k QK - R(QK - N) \\ &= (R_k - R)QK + RN \end{aligned}$$

- Incentive Constraint:

$$V \geq \lambda R_k QK$$

- Binding Incentive Constraint:

$$(R_k - R)QK + RN = \lambda R_k QK$$

Costly Enforcement Model (con't)

$$QK = [\frac{1}{1 - (1 - \lambda)R_k/R}]N$$

$\Rightarrow$

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

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

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.

Moving to General Equilbrium

Need to endogenize:

1. The external finance premium R_k/R
2. Net Worth N.
3. The price of capital Q

Moving to General Equilbrium (con't)

- Financial Accelerator $\Longrightarrow$
- – Procyclical Movements in N induce countercyclical movements in R_k/R
- – Unexpected movements in Q induce movements in N, leading to feedback between the real and financial sectors.
- FInancial Crisis
  - Sharp drop in N
  - Tightening net worth constraint (i.e., capital demand shrinks for a given N.)