Financial Frictions and Macroeconomic Fluctuations

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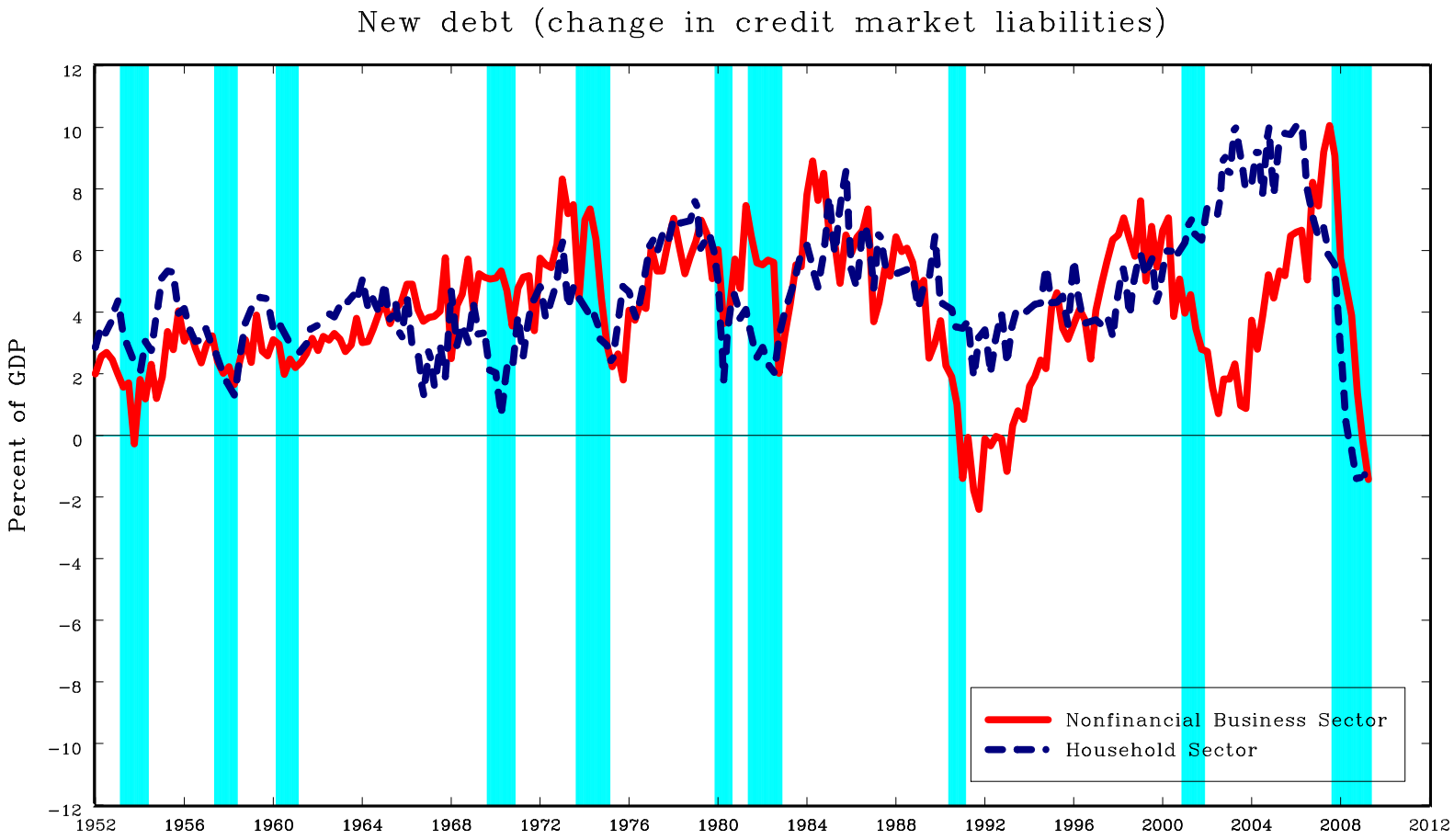
Cyclical pattern of credit



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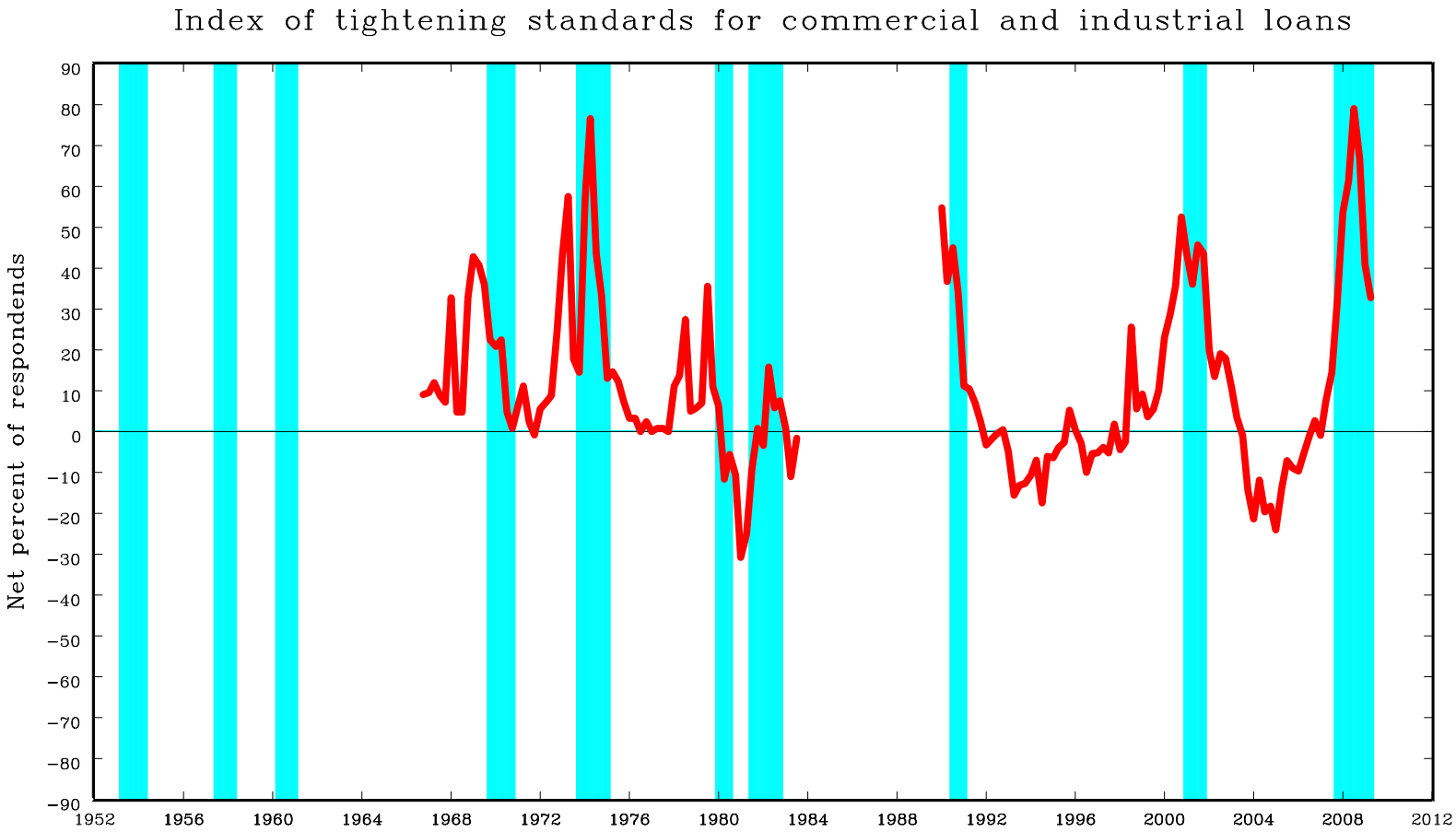
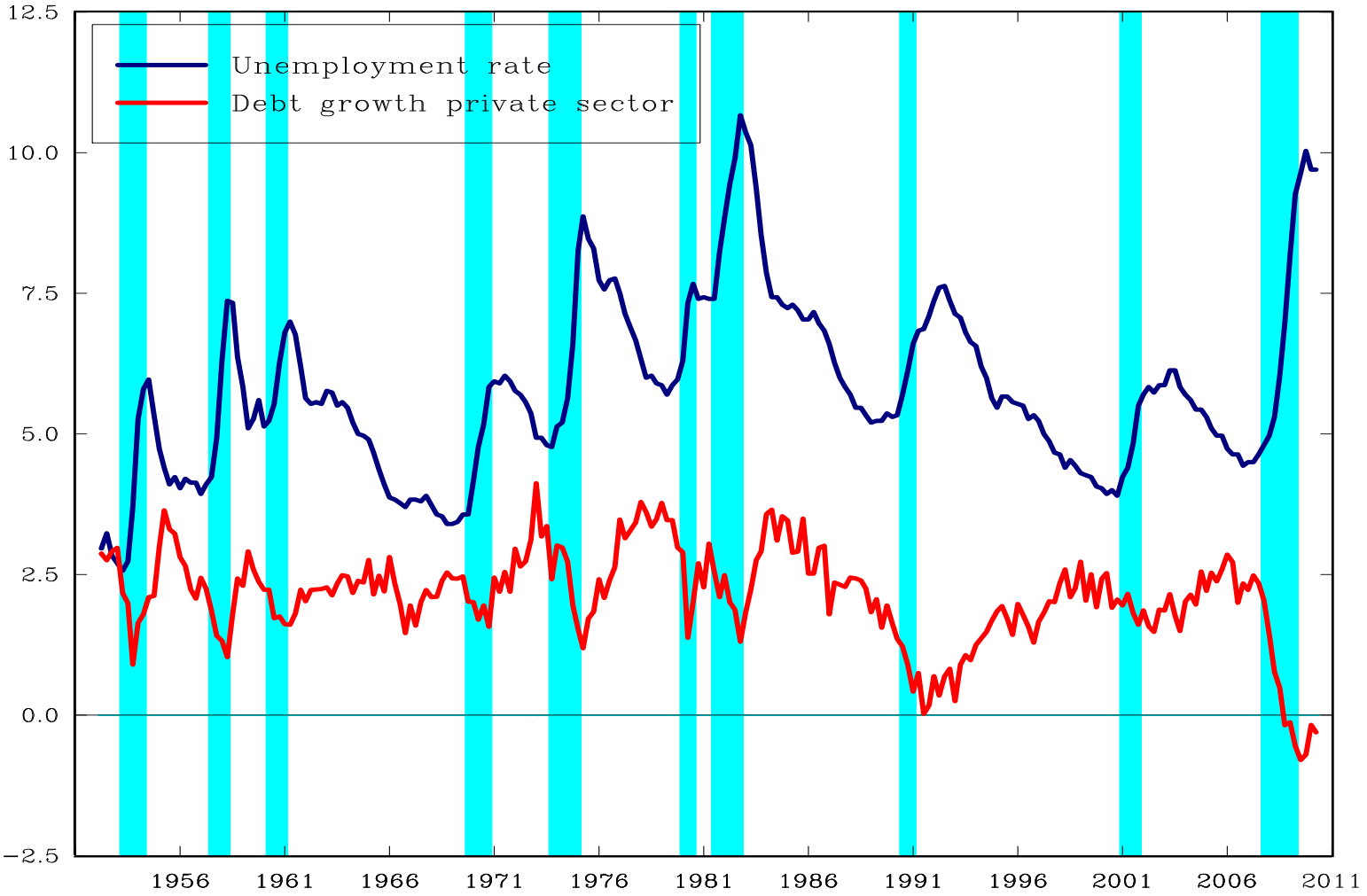
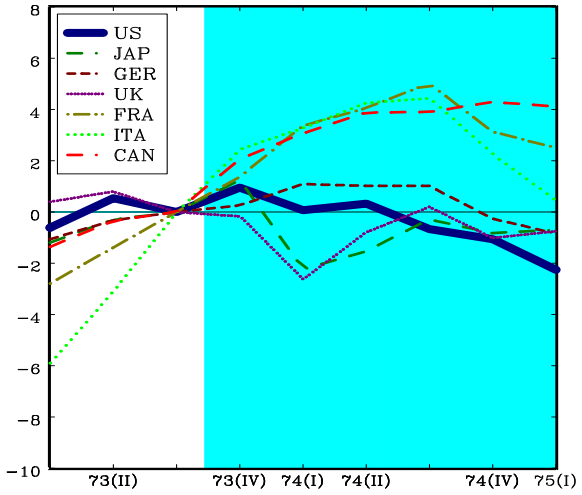


Strong comovement unemployment and debt flows

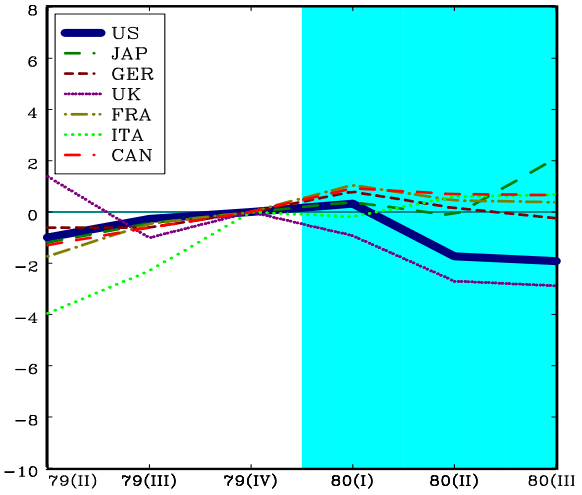


GDP DURING RECESSIONS

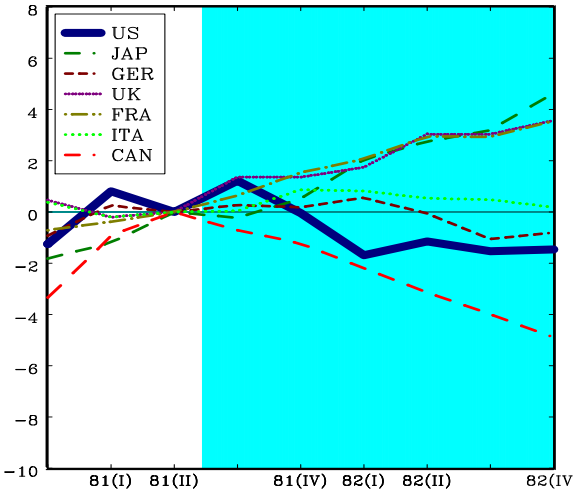
1973 Recession



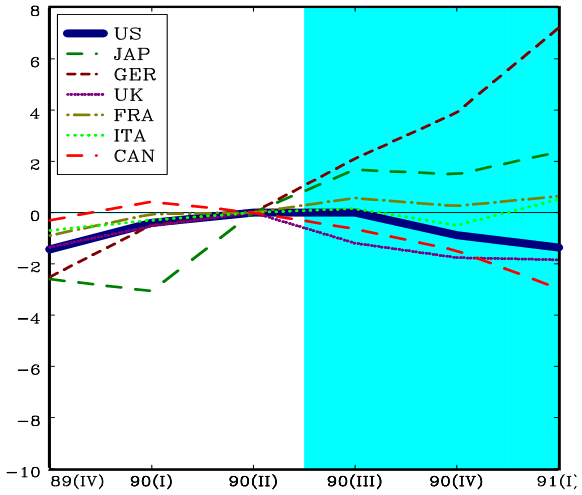
1980 Recession



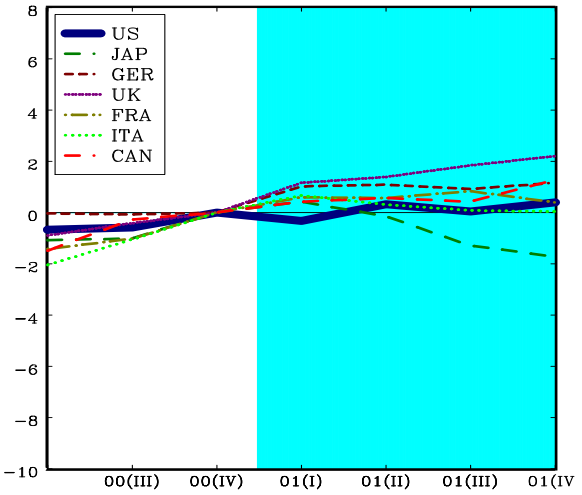
1981 Recession



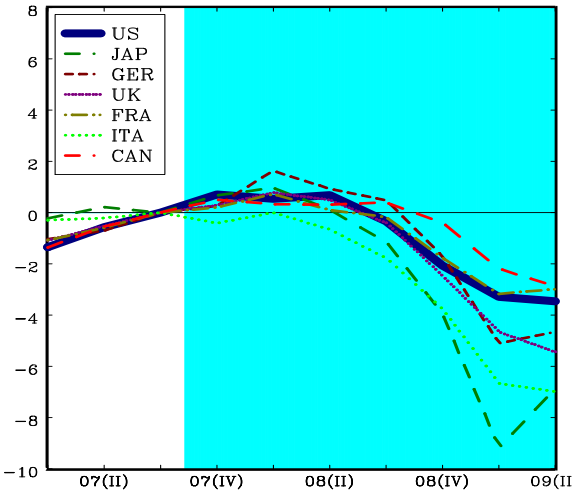
1990 Recession



2001 Recession

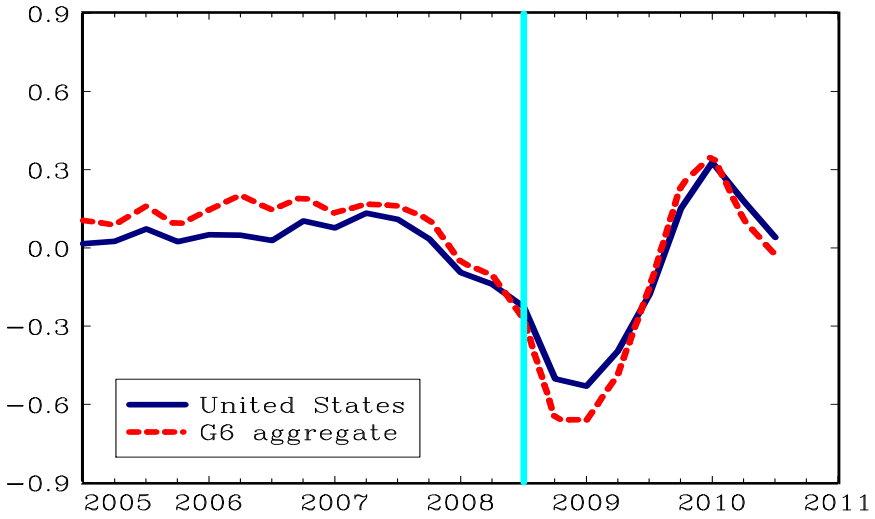


2007 Recession

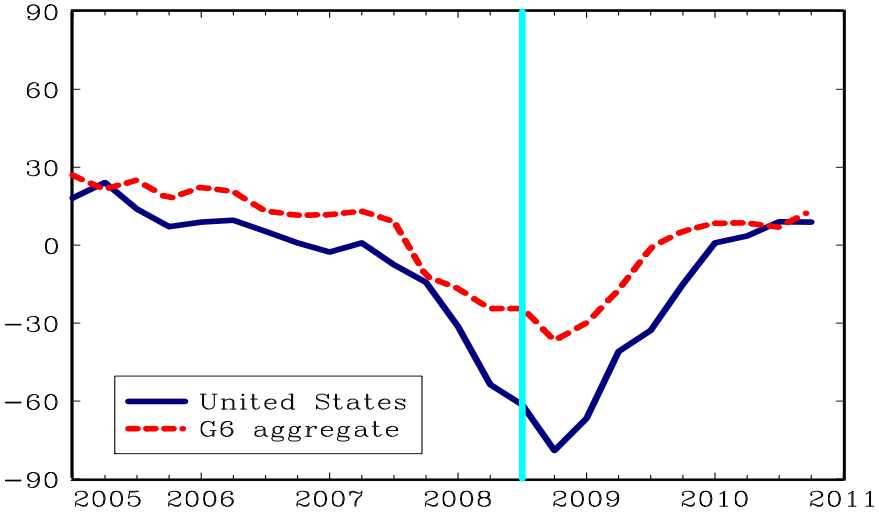


FINANCIAL CO-MOVEMENT

Growth in Net Business Debt



Percent Loan Officers Easing Credit



PLAN FOR THE PRESENTATION

1. Outline the necessary ingredients to model financial frictions.

2. Introduce a simple model to illustrate some of the most popular ideas proposed in the literature.

3. Discuss recent developments in the literature.

NECESSARY INGREDIENTS

1. **MISSING MARKETS**

   Some asset trades are not available or feasible.

2. **HETEROGENEITY**

   Agents must be heterogeneous in some important dimension.

1. MISSING MARKETS

- **Exogenous** market incompleteness.
  - It assumes that certain assets cannot be traded without providing a micro-foundation for why these assets cannot be traded.
    - Non-contingent debt.
    - Fixed borrowing limits.

- **Endogenous** market incompleteness.
  - It provides a micro-foundation for why certain assets or contingencies cannot be traded.
    - Limited enforcement.
    - Information asymmetry.

2. HETEROGENEITY

Different modeling approaches has been proposed in the literature:

- Finite lifespan
- Different discounting
- Tax benefits
- Bargaining gains from borrowing

COMMON PROPERTIES

Independently of the approach, exogenous or endogenous, all models with financial frictions share the following properties:

- There are at least two groups of agents: one group that in equilibrium raises external funds (borrowers) and one group that supplies the funds (lenders).

- Higher is the net worth of borrowers, and higher is the financing that can be raised externally, reducing financial distortions.

A SIMPLE THEORETICAL FRAMEWORK

- Two periods: 1, 2.
- Two types of agents:
  - Workers with utility $E\left\{c - \frac{h^2}{2} + \beta c'\right\}$
  - Entrepreneurs with utility $E\left\{c + \beta c'\right\}$
- Entrepreneurs enter period 1 with capital K and debt B.

Period 1 (Two stages)

Stage 1:

- Production of **intermediate** goods by entrepreneurs with technology

$$y = AK^{\theta}h^{1-\theta}$$

Stage 2:

- Production of **consumption** and **new capital** with intermediate goods
  - Consumption: one-to-one technology
  - New capital by entrepreneurs: $k^n = \omega i$

- Saving and investment decisions.

Period 2

- Only consumption goods are produced.

- Production takes place only with capital in two sectors:

  1. Entrepreneurial sector: $y' = A'k'$
  2. Other sector: $y' = A'G(k')$ $\qquad (G' > 0,\ G'' < 0,\ G'(0) = 1)$

- Assumption: $\beta A' > 1$.

ANALYSIS OF THE THEORETICAL FRAMEWORK

1. Equilibrium in the frictionless model.

2. Costly state verification model. (I will skip this)

3. Limited enforcement model.

4. Model with credit shocks.

5. Additional specifications.

MODEL (Workers)

$$\max_{h,c,k',b',c'} \quad \left\{ c - \frac{h^2}{2} + \beta c' \right\}$$

subject to:

$$c = B + wh - \frac{b'}{R} - qk'$$

$$c' = A'G(k') + b' \geq 0$$

$$c \geq 0, \quad c' \geq 0$$

First order conditions (λ = Lagrange multiplier for $c \geq 0$)

$$\begin{aligned} h &= w(1+\lambda) \\ (1+\lambda)q &= \beta A'G'(k') \\ 1+\lambda &= \beta R, \end{aligned}$$

MODEL (Entrepreneurs)

$$\max_{h,i,c,k',b',c'} \quad E\Big\{c + \beta c'\Big\}$$

subject to:

$$c = AK^{\theta}h^{1-\theta} - wh + qK + (q\omega - 1)i + \frac{b'}{R} - B - qk'$$

$$c' = A'k' - b'$$

$$c \geq 0, \quad i \geq 0, \quad c' \geq 0$$

First order conditions (γ = Lagrange multiplier for $c \geq 0$)

$$\begin{aligned} w &= (1-\theta)AK^{\theta}h^{-\theta} \\ qE\omega &\leq 1, \qquad (= \text{if } i > 0) \\ (1+\gamma)q &= \beta A' \\ 1+\gamma &= \beta R, \end{aligned}$$

SPECIALIZE TO THE CASE $E\omega = 0$

(No capital accumulation)

FRICTIONLESS MODEL

- Capital is fixed.
- The price of capital is $q = \beta A'$.
- All capital K is held by entrepreneurs.
- Borrowing is undetermined.
- Next period production is $Y' = A'K$.

COLLATERAL MODEL

- Entrepreneurs can default at the end of period 1.
- In case of default the lender can recover a fraction ξ of the capital.
- Borrowing limit

$$b' \leq \xi q' k'$$

- The liquidated capital can be sold to the non-entrepreneurial sector,

$$q' = A' G' (K - K^{e'})$$

COLLATERAL MODEL (Entrepreneurs)

$$\max_{h,c,k',b',c'} \quad \left\{ c + \beta c' \right\}$$

subject to:

$$c = qK + AK^{\theta}h^{1-\theta} - wh - B + \frac{b'}{R} - qk'$$

$$\xi q' k' \geq b'$$

$$c' = A'k' - b'$$

First order conditions

$$\begin{aligned} (1-\theta)AK^{\theta}h^{-\theta} &= w \\ (1+\gamma)q &= \beta A' + \mu \xi q' \\ 1+\gamma &= (\beta+\mu)R \end{aligned}$$

Multiplier decreasing in $K^{e'}$

$$\mu = \frac{\beta[1 - G'(K - K^{e'})]}{(1 - \xi)G'(K - K^{e'})},$$

Budget with $c = 0$ & binding borrowing constraint

$$\left(q - \frac{\xi q'}{R}\right) k' = qK + Y^e - B$$

EQUILIBRIUM (B large)

- Next period price of capital

$$q' = A'G'(K - K^{e'})$$

- Current price of capital

$$q = \beta q'$$

- Capital purchased by entrepreneurs (using $c = 0$, $R = 1/\beta$)

$$K^{e'} = \left(\frac{1}{1-\xi}\right)\left(K - \frac{B - Y^e}{q}\right).$$

Response to current productivity A

- Direct effect:
  - Entrepreneur's income Y^e increases and more capital is purchased by entrepreneurs
$$K^{e'} = \left(\frac{1}{1-\xi}\right)\left(K - \frac{B - Y^e}{q}\right)$$
  - Production increases also in period 2 because of higher $K^{e'}$.

- Amplification effect:
  - Higher $K^{e'}$ increases prices
$$q' = A'G'(K - K^{e'}), \qquad q = \beta q'$$
  - The increase in prices relaxes the borrowing constraint increasing $K^{e'}$

Response to future productivity A' ('news' shock)

- Direct effect:
  - The increase in A' increases production in period 2.
- Amplification effect:
  - The 'news' shock increases prices,

$$q' = A'G'(K - K^{e'}), \qquad q = \beta q',$$

    which relax the borrowing constraint and increases $K^{e'}$. Thus, production further increases in period 2.
  - As $K^{e'}$ increases, prices increase more with further relaxation of the borrowing constraint, increasing period 2 production.

QUANTITATIVE PERFORMANCE

- Most of the quantitative applications of the limited enforcement or collateral model do not generate large amplification effects.

- Why?

  – Typical macroeconomic models do not generate large asset price fluctuations (q and q').

  – The financial mechanism affects investment or the allocation of fixed factors. Empirically, however, a large share of output fluctuations is explained by labor movements.

ADDING WORKING CAPITAL

- In period one, wages need to be paid in advance.
- Entrepreneurs borrow intra-period to finance the wage bill.
- The enforcement constraint becomes

$$b' + wh \leq \xi q' k'$$

WORKING CAPITAL MODEL (Entrepreneurs)

$$\max_{h,k',b'} \quad \left\{ c + \beta c' \right\}$$

subject to:

$$c = qK + AK^{\theta}h^{1-\theta} - wh - B + \frac{b'}{R} - qk'$$

$$\xi q'k' \geq b' + wh$$

$$c' = A'k' - b'$$

First order conditions for labor

$$(1-\theta)AK^{\theta}h^{-\theta} = w(1+\mu)$$

Remark: Entrepreneurial income Y^e depends on μ.

Response to current productivity A

- Direct effect:
  - Entrepreneur's income Y^e increases and more capital is purchased by entrepreneurs
$$K^{e'} = \left(\frac{1}{1-\xi}\right)\left(K - \frac{B - Y^e}{q}\right)$$
  - Production increases also in period 2.

- Amplification effect:
  - Higher $K^{e'}$ increases prices
$$q' = A'G'(K - K^{e'}), \qquad q = \beta q'$$
  - The increase in prices relax the borrowing constraint increasing $K^{e'}$.
  - In addition, μ declines, further increasing the input of labor today.

Response to future productivity A' ('news' shock)

- Direct effect:
  - The increase in A' increases production in period 2.
- Amplification effect:
  - The 'news' shock increases prices,

$$q' = A'G'(K - K^{e'}), \qquad q = \beta q',$$

    which relax the borrowing constraint. This increases $K^{e'}$.
  - Higher $K^{e'}$ further increases prices which further relax the borrowing constraint and increases $K^{e'}$.
  - The increase in $K^{e'}$ reduces μ and increases the input of labor and output today.

LABOR WEDGE

- In the standard neoclassical model we have:

$$\begin{aligned} \text{Wedge} &\equiv \text{mrs - mpl} \\ &= \frac{\phi C}{1-H} - (1-\theta)\frac{Y}{H} \end{aligned}$$

- In the simple model used here we have

$$\begin{aligned} \text{Wedge} &\equiv \text{mrs - mpl} \\ &= H - (1-\theta)\frac{Y}{H} \\ &= -\mu w \end{aligned}$$

LABOR WEDGE DECOMPOSITION

$$\begin{aligned} \text{Wedge} &\equiv \text{mrs - mpl} \\ &\equiv \text{mrs - w} + \text{w - mpl} \end{aligned}$$

CREDIT SHOCKS
(Variable ξ)

Remember the enforcement or borrowing constraint

$$b' + wh \leq \xi q' k'$$

In equilibrium we have

$$K^{e'} = \left(\frac{1}{1-\xi}\right)\left(K - \frac{B - Y^e}{q}\right)$$

Response to change in ξ ('credit' shock)

- Direct effect:
  - The increase in ξ relaxes the borrowing constraint and more capital is allocated to entrepreneurs (higher $K^{e'}$). Thus, output increases in period 2.

- Amplification effect:
  - Higher $K^{e'}$ increases prices

$$q' = A'G'(K - K^{e'}), \qquad q = \beta q',$$

    which relax the borrowing constraint and increases $K^{e'}$ further.
  - The increase in $K^{e'}$ reduces μ and increases the input of labor and output today.

ASSET PRICE BUBBLES WITH FINANCIAL FRICTIONS

The fundamental price of capital in period 2 is

$$q' = A'G'(K - K^{e'})$$

Define $\mathcal{B}'$ the bubble. Then the actual price is

$$q' = A'G'(K - K^{e'}) + \mathcal{B}'$$

The consequences of a bubble is similar to a positive credit shock ξ.

$$b' + wh \leq \xi q'k' + \mathcal{B}'$$

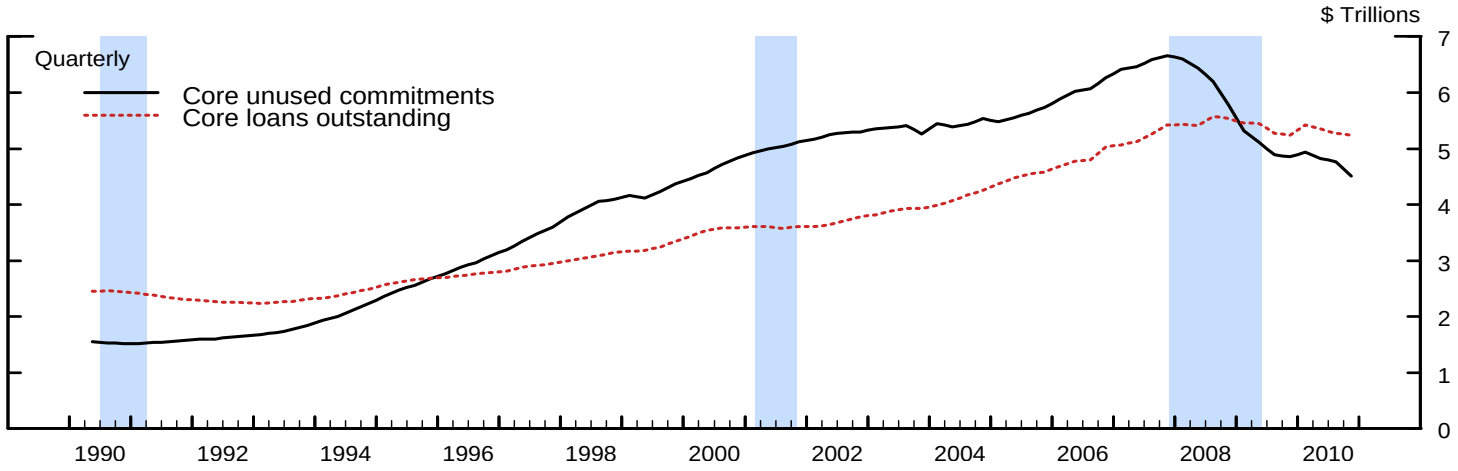
UNATTRACTIVE PROPERTY OF THE MODEL

- Financial frictions matter only if the collateral constraint is binding.

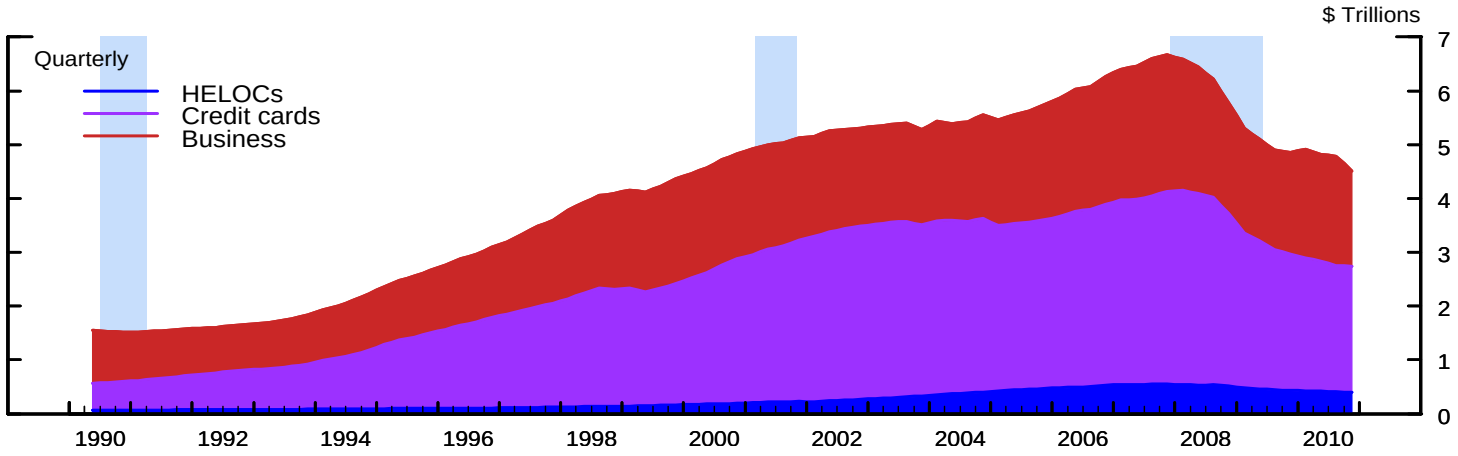
- In many models the collateral constraint is always binding.

- However, firms hold a lot of cash and unused lines of credit. So the borrowing constraint should be binding only occasionally.

Figure 6: Core Loans and Unused Commitments at Commercial Banks



(a) Core Loans Outstanding and Unused Commitments



(b) Composition of Unused Commitments

FIRM BALANCE SHEET

Capital, K	Debt, B
	Equity, E

FIRM BALANCE SHEET

Capital, K	Debt, B
	Equity, E

With off-balance sheet

Capital, K	Debt capacity, $B + U = \bar{B}$
Unused credit (cash), U	Equity, E

REDUCTION IN CREDIT CAPACITY (Financial shock)

- Suppose that equity E cannot be changed
- The firm cuts U first and then it cuts K.

Capital, K	Debt capacity, $B + U = \bar{B} \downarrow$
Unused credit (cash), $U \downarrow$	Equity, E

REDUCTION IN CREDIT CAPACITY (Financial shock)

- Suppose that equity E cannot be changed
- The firm cuts U first and then it cuts K.

Capital, $K \downarrow$	Debt capacity, $B + U = \bar{B} \downarrow$
Unused credit (cash), $U \downarrow$	Equity, E

REDUCTION IN CREDIT CAPACITY (Financial shock)

- Suppose that equity E cannot be changed
- The firm cuts U first and then it cuts K.

Capital, $K \downarrow$	Debt capacity, $B + U = \bar{B} \downarrow$
Unused credit (cash), $U \downarrow$	Equity, E

- However, in models, the substitution of B with E is quick and the impact on K is short lived.

FIRST VERSUS SECOND MOMENT SHOCKS

- A financial shock can take the form of a contraction in the credit capacity (first moment) or an increase in the volatility of the credit capacity (second moment).

Capital, K	Debt capacity, $B + U = \bar{B}$
Unused credit (cash), $U \uparrow$	Equity, $E \uparrow$

FIRST VERSUS SECOND MOMENT SHOCKS

- A financial shock can take the form of a contraction in the credit capacity (first moment) or an increase in the volatility of the credit capacity (second moment).

Capital, K	Debt capacity, $B + U = \bar{B}$
Unused credit (cash), $U \uparrow$	Equity, $E \uparrow$

- However, this will make borrowers even more unconstrained reducing the importance of the credit channel.

SUMMARY

- Borrowers hold buffers in the form of cash or unused credit
- The buffers reduce the relevance of the credit channel
- Even if the buffers are not sufficient to prevent the borrowing constraints to be binding in extreme cases (crises), the real impact is short lived.
- Second moment shocks are unlikely to have important real effects because borrowers build larger buffers.

QUESTIONS

- Why do borrowers keep buffers?
  - We need uncertainty generating **precautionary** behavior: Mendoza (2011), Perri and Quadrini (2011), Arellano, Bai and Kehoe (2012).

- Are there other channels, besides the **credit** channel, in which financial shocks have more persistent effects?
  - We will look at two additional channels: **asset** channel and **bargaining** channel.

- Are **second moment** shocks more important in these other channels?
  - We will see that second moment shocks can have real effects in the **asset** and **bargaining** channels.

ENDOGENOUS LIQUIDITY AND MULTIPLE EQUILIBRIA

- In case of default, the liquidated capital can be sold either to the non-entrepreneurial sector (as before) or to other entrepreneurs.
  - If sold to the non-entrepreneurial sector, only ξ units of capital are usable. The liquidation price is $q' = \xi A' G'(K - K^{e'})$.
  - If sold to other entrepreneurs, the whole capital is usable. The liquidation price is A'.

- Entrepreneurs can buy the liquidated capital only if they can raise additional debt. This is the case if the collateral constraint is not binding

$$b' + wh < \xi q' k'$$

MULTIPLE EQUILIBRIA

- *Bad equilibrium.* If entrepreneurs expect that the price of the liquidated capital is $q' = \xi A' G'(\overline{K} - K^{e'})$, they face a tight constraint and borrow up to the limit. But then, if an entrepreneur defaults, the lender is unable to sell the liquidated capital to other entrepreneurs and the recovery value is $\xi A' G'(\overline{K} - K^{e'})$ per each unit of capital. Therefore, the expectation of a low liquidation price is ex-post validated by the lack of 'liquidity' for entrepreneurs.

- *Good equilibrium.* If entrepreneurs expect that the price of the liquidated capital is $q' = A'$, they face a relaxed borrowing constraint. This may allow them to borrow more than required to purchase $k' = K$. Thus, the collateral constraint is not binding. But then, if an entrepreneur defaults, the lender is able to sell the liquidated capital to other entrepreneurs and the recovery value is A'. Therefore, the expectation of high liquidation prices is ex-post validated by the 'liquidity' of entrepreneurs.

TWO-COUNTRY MODEL

$$\max_{\{h_j, c_j, k'_j, b'_j, c'_j\}_{j=1}^{2}} \quad \sum_{j=1}^{2} \left\{ c_j + \beta c'_j \right\}$$

subject to:

$$c_j = q_j K + A_j K^{\theta} h_j^{1-\theta} - w_j h_j - B + \frac{b'_j}{R} - q_j k'_j$$

$$\xi_j q'_j k'_j \geq b'_j + w_j h_j, \qquad j = 1, 2$$

$$c'_j = A'_j k'_j - b'_j$$

$$c_j \geq 0, \quad c'_j \geq 0$$

TWO-COUNTRY MODEL
First order conditions

$$
\begin{aligned}
(1+\gamma)q_1 &= \beta A_1' + \mu_1 \xi_1 E q_1' \\
1+\gamma &= (\beta+\mu_1)R, \\
(1+\gamma)q_2 &= \beta A_2' + \mu_2 \xi_2 E q_2' \\
1+\gamma &= (\beta+\mu_2)R,
\end{aligned}
$$

$$
\begin{aligned}
(1-\theta)A_1 K^{\theta} h_1^{-\theta} &= w_2(1+\mu_1) \\
(1-\theta)A_2 K^{\theta} h_2^{-\theta} &= w_1(1+\mu_2),
\end{aligned}
$$