Financial Intermediation

Macro II - Fluctuations - ENSAE, 2024-2025

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The Importance of Financial Intermediaries

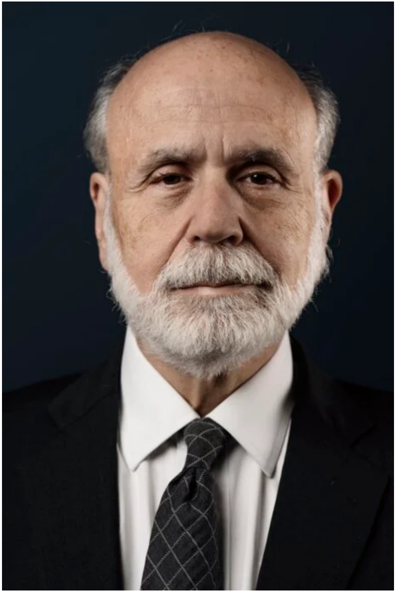

Figure 1: Ben Bernanke: Nobel Prize Winner in 2022

Ben Bernanke

- chairman of the Fed (2006-2014) succeeding Alan Greenspan
- aka Helicopter Ben
- was an expert of the Great Depression...
  - gvt/cb should have printed more money
- ...and had to face the Great Recession
  - gvt/cb should have been more careful about the state of financial intermediaries
- received the Nobel Prize in 2022 with Diamond and Dybvig
  - for their work on banks and their necessary bailouts during financial

Credit Markets

Credit markets are crucial to understand:

- financial crises
- the persistence of “garden-variety” recessions
- monetary policy
- financial regulation and prudential policies
  - now part of “macropru”, which takes a big mindshare in central banks

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A key insight from the literature on financial intermediation

- EFP is determined the net worth of *both* borrowers and lenders

Financial accelerator[2]:

- higher EFP: tighter credit standard, less lending, slows the economy
- weaker economy reduces financial health of lenders/borrowers, raises EFP

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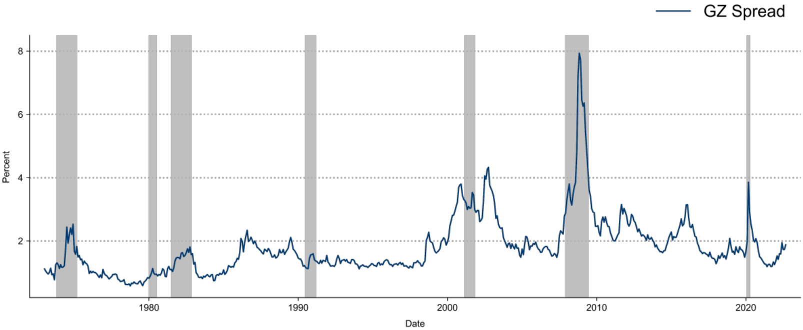

Figure 2: Measure of External Finance Premium[3]

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  - did not have access for federal reserve loans like banks
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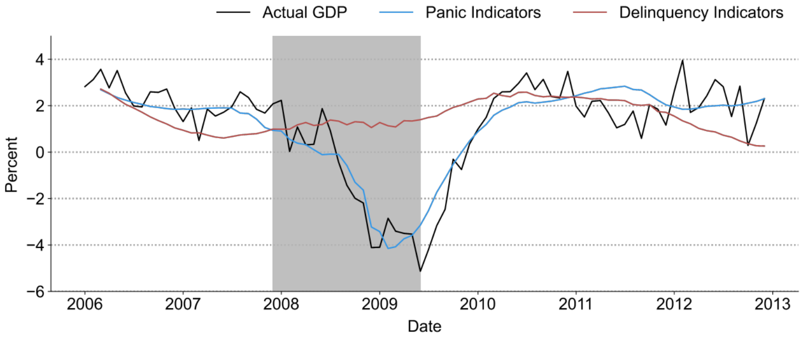
  - were *vulnerable* to bank runs
- Bernanke (2018) show that during the crisis, measures of financial panic (funding costs) predicted very well *real* quantities


Actual GDP
Panic Indicators
Delinquency Indicators
Percent
4
2
0
−2
−4
−6
2006
2007
2008
2009
2010
2011
2012
2013
Date

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- Model is rather simple in terms of microfoundations
  - … explains why it is underpublished

Summary

I consider a discrete-time economy.

The economy features three agents: households, bankers, and entrepreneurs. Each agent has a unit mass.

Households work, consume and buy real estate, and make one-period deposits into a bank. The household sector in the aggregate is net saver.

Entrepreneurs accumulate real estate, hire households, and borrow from banks.

In between the households and the entrepreneurs, bankers intermediate funds. The nature of the banking activity implies that bankers are borrowers when it comes to their relationship with households, and are lenders when it comes to their relationship with the credit-dependent sector – the entrepreneurs.

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Households

Representative agent chooses housing $H_{H,t}$, consumption $C_{T,t}$ and time spent working $N_{H,t}$ to solve

$$\max E_t \sum_{t=0}^{\infty} \beta_H^t \left(\log C_{H,t} + j \log H_{H,t} + \tau \log(1 - N_{H,t}) \right)$$

where $\beta_{H,t}$ is the discount factor and j, τ two preference parameters.

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subject to the **Budget constraint**:

$$C_{H,t} + D_t + q_t \left(H_{H,t} - H_{H,t-1}\right) = R_{H,t-1} D_{t-1} + W_{H,t} N_{H,t} + \epsilon_t$$

where:

- D_t: bank deposits earning gross return $R_{H,t}$
- q_t: price of housing
- W_t: wage rate

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where:

We can derive the following optimality conditions:

$$\frac{1}{C_{H,t}} = \beta_H E_t \left(\frac{1}{C_{H,t+1}} R_{H,t} \right)$$

$$\frac{q_t}{C_{H,t}} = \frac{j}{H_{H,t}} + \beta_H E_t \left(\frac{q_{t+1}}{C_{H,t+1}} \right)$$

$$\frac{W_{H,t}}{C_{H,t}} = \frac{\tau}{1 - N_{H,t}}$$

Entrepreneurs

The representative entrepreneur chooses consumption $C_{E,t}$, housing $H_{H,t}$, production Y_t, worker's time $N_{H,t}$

$$\max E_0 \sum_{t=0}^{\infty} \beta_E^t \log C_{E,t}$$

subject to:

$$C_{E,t}+q_t\left(H_{E,t}-H_{E,t-1}\right)+R_{E,t}L_{E,t-1}+W_{H,t}N_{H,t}+ac_{EE,t}=Y_t+L_{E,t}$$

$$Y_t = H_{E,t-1}^{\nu} N_{H,t}^{1-\nu}$$

$$L_{E,t} \leq m_H E_t\left(\frac{q_{t+1}}{R_{E,t+1}} H_{E,t}\right) - m_N W_{H,t} N_{H,t} \qquad (1)$$

- $L_{E,t}$ are loans to the entrepreneur with gross return $R_{E,t}$

Borrowing constraint:

$$L_{E,t} \leq m_H E_t \left(\frac{q_{t+1}}{R_{E,t+1}} H_{E,t} \right) - m_N W_{H,t} N_{H,t} \tag{2}$$

- entrepreneurs cannot borrow more than a fraction m_H of the expected value of their real estate stock
- a fraction m_N of the wage bill must be paid in advance
  - entrepreneurs can't borrow to cover it

Assumption: entrepreneurs discount future more than housholds and bankers

$$\beta_E < \frac{1}{\gamma_E \frac{1}{\beta_H} + (1 - \gamma_E) \frac{1}{\beta_B}}$$

with $\gamma_E \in [0, 1]$

Entrepreneurs: optimality conditions

We get the following optimality conditions

$$\left(1 - \lambda_{E,t} - \frac{\partial ac_{LE,t}}{\partial L_{E,t}}\right) \frac{1}{c_{E,t}} = \beta_E E_t \left(R_{E,t+1} \frac{1}{c_{E,t+11}} \right)$$

$$\left(q_t - \lambda_{E,t} m_H E_t \left(\frac{q_{t+1}}{R_{E,t+1}} \right)\right) \frac{1}{c_{E,t}} = \beta_E E_t \left(\left(q_{t+1} + \frac{\nu Y_{t+1}}{H_{E,t}} \right) \frac{1}{c_{E,t+1}} \right)$$

$$\frac{(1-\nu) Y_t}{1 + m_N \lambda_{E,t}} = W_{H,t} N_{H,t}$$

Comment: credit constraint introduces a wedge between the cost of factors and their marginal product.

- a distortion like a tax

Bankers

The representative banker maximizes private consumption $C_{B,t}$

$$\max E_0 \sum_{t=0}^{\infty} \beta_B^t \log C_{B,t}$$

$$C_{B,t} + R_{H,t-1}D_{t-1} + L_{E,t} + ac_{EB,t} = D_t + R_{E,t}L_{E,t-1} - \epsilon_t$$

where:

- D_t: households deposits
- $L_{E,t}$: loans to entrepreneurs
- $ac_{EB,t} = \frac{\phi_{EB}}{2}\frac{(L_{E,t-L_{E,t-1}})^2}{L_E}$ is quadratic adjustment cost[5]
- the ability to convert deposits into loans is limited by a borrowing constraint[6]

Bankers (optimality)

Denote:

- $m_{B,t} = \beta_B E_t \left(\frac{C_{B,t}}{C_{B,t+1}} \right)$: the stochastic discount factor of the banker
- $\lambda_{B,t}$: multiplier on the capital adequacy constraint *normalized by marginal utiliy of consumption*

Optimality conditions:

$$1 - \lambda_{B,t} = E_t \left(m_{B,t} R_{H,t} \right) \tag{3}$$

$$1 - \gamma_E \lambda_{B,t} + \frac{\partial ac_{EB,t}}{\partial L_{E,t}} = E_t \left(m_{B,t} R_{E,t+1} \right) \tag{4}$$

These two equations explain the spread between the deposit rate and the lending rate (aka the intermediation premium)

Bankers (optimality)

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Interpretation:

- the banker can consume more by borrowing from the household to fuel consumption
  - tightens its credit constraint
  - reduces the value of an extra deposit by $\lambda_{B,t}$
- the banker can consume more by reducing loans
  - it also tightens its credit constraint (reduces equity)
  - effect stronger if collateral requirement is higher

Market clearing

Total supply of housing $H_{E,t} + H_{H,t} = 1$

Market clearing conditions for goods and housing:

$$H_{E,t} + H_{H,t} = 1$$

Steady state properties

For the **household**:

$$R_H = \frac{1}{\beta_H}$$

For the **banker**:

Equation 3 and Equation 4 imply that as long as $\beta_B < \beta_H$, the bankers are credit constrained

With γ_E smaller than one, there is a spread between return on loans and return on deposits:

$$\lambda_B = 1 - \beta_B R_H = 1 - \frac{\beta_B}{\beta_H} > 0$$

$$R \; = \frac{1}{\;} \; \gamma \left(\frac{1}{\;} \quad \frac{1}{\;} \right) > R$$

For **entrepreneurs**

Entrepreneurs are constrained if $\beta_E R_E < 1$. that is equivalent to

$$\frac{1}{\beta_E} = \gamma_E \frac{1}{\beta_H} + (1 - \gamma_E) \frac{1}{\beta_B}$$

Effect:

- banker's credit constraint and entrepreneur credit constraint create a wedge and reduce steady-state output

Technical assumption: at the steady-state, constraints are binding. Iacoviello assume there remain binding in a neighborhood of the

Calibration

Time period: 1 quarter

Time discounts:

- households: $\beta_H = 0.9925$
- bankers: $\beta_B = 0.945$
- entrepreneurs: $\beta_E = 0.94$

Choice of leverage parameters such that $R_H = 3$ and $R_E = 5$.

Adjustment costs: $\phi_{EE} = \phi_{EB} = 0.25$

Weight of leisure in utility: $\tau = 2$ (active time spent=1/2 and Frisch elasticity[a] close to 1).

Share of housing in production: $\nu = 0.05$

Preference parameter for housing $j = 0.075$: ratio of real estate wealth to output 3.1 (0.8 commercial, 2.3 residential)

Leverage:

- $m_N = 1$: all labour paid in advance
- $m_H = 0.9$: entrepreneur loan-to-value (LTV)
- $\gamma_E = 0.9$: bank leverage (close to historical capital

Dynamics

Dynamics of intermediation spread

$$E_t\left(R_{E,t+1}\right) - R_H, t = \frac{\lambda_{B,t}}{m_{B,t}}(1-\gamma_E)$$

First simulation

Shock ϵ_t is calibrated on historical loan losses (amounts of debt writedowns)

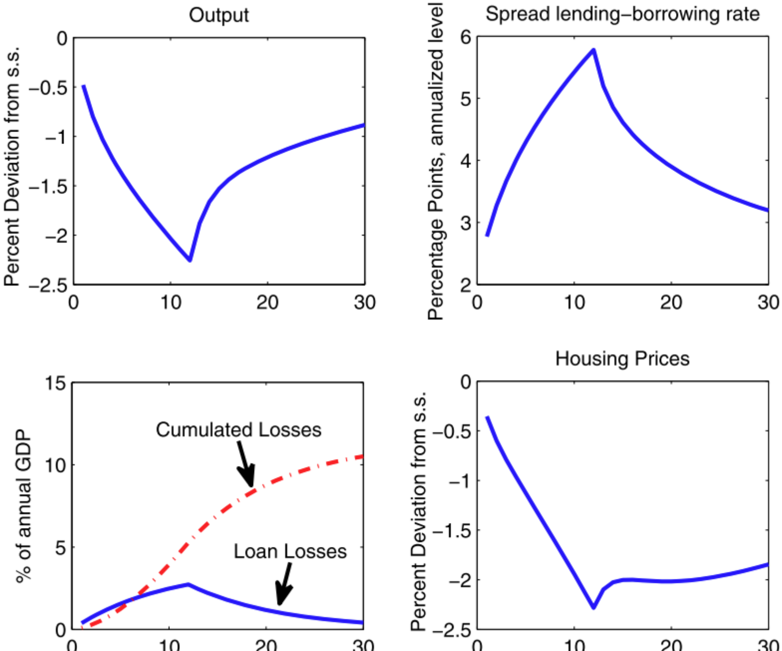
Follows

$$\epsilon_t = 0.9\epsilon_{t-1} + \iota_t$$

The exogenous deviation is the following

- increase by 0.38% of gdp each quarter during 12 quarters
- losses to financial system rise from zero to 2.8$ after 2 years
- gradual return to zero

First Simulation



Extended Model

The full model contains:

- two households:
  - patient: lend to banks
  - impatient:
    - credit constrained: borrow from the bank
    - redistributive shocks banks-impatient household
- habits in consumption + preference shocks

$$\max E_t \sum_t \beta_t \log(C_t - \eta C_{H,t-1}) + j A_{j,t} \log(H_{H,t}) + \tau \log(1 - N_{H,t})$$

- shocks to all borrowing capacities
- shocks to investment efficiency + tfp shocks

Model estimated with a bayesian approach from 1985 to 2010 - 8 shocks in total - 8 observable variables

Calibration

Table 1
Calibrated parameters for the extended model.

Parameter		Value
Household-saver (HS) discount factor	β_H	0.9925
Household-borrower (HB) discount factor	β_S	0.94
Banker discount factor	β_B	0.945
Entrepreneur (E) discount factor	β_E	0.94
Total capital share in production	α	0.35
Loan-to-value ratio on housing, HB	m_S	0.9
Loan-to-value ratio on housing, E	m_H	0.9
Loan-to-value ratio on capital, E	m_K	0.9
Wage bill paid in advance	m_N	1
Liabilities to assets ratio for Banker	γ_E, γ_S	0.9
Housing preference share	j	0.075
Capital depreciation rates	δ_{KE}, δ_{KH}	0.035
Labor Supply parameter	τ	2

Estimation Results

Table 2a
Estimation, structural parameters.

Parameter		Prior distribution			Posterior distribution		
		Density	Mean	St.dev.	5%	Mean	95%
Habit in consumption	η	beta	**0.5**	0.15	0.36	**0.46**	0.56
D adj. cost, Banks	ϕ_{DB}	gamm	**0.25**	0.125	0.05	**0.14**	0.26
D adj. cost, Household Saver (HS)	ϕ_{DH}	gamm	**0.25**	0.125	0.04	**0.10**	0.20
K adj. cost, Entrepreneurs (E)	ϕ_{KE}	gamm	**1**	0.5	0.23	**0.59**	1.41
K adj. cost, Household Saver (HS)	ϕ_{KH}	gamm	**1**	0.5	0.88	**1.73**	2.95
Loan to E adj. cost, Banks	ϕ_{EB}	gamm	**0.25**	0.125	0.03	**0.07**	0.13
Loan to E adj. cost, E	ϕ_{EE}	gamm	**0.25**	0.125	0.02	**0.06**	0.11
Loan to HB adj. cost, Banks	ϕ_{SB}	gamm	**0.25**	0.125	0.24	**0.47**	0.72
Loan to HB adj. cost, HH Borrower HB	ϕ_{SS}	gamm	**0.25**	0.125	0.14	**0.37**	0.66
Capital share of E	μ	beta	**0.5**	0.1	0.34	**0.46**	0.58
Housing share of E	ν	beta	**0.04**	0.01	0.03	**0.04**	0.05
Inertia in capital adequacy constraint	ρ_D	beta	**0.25**	0.1	0.10	**0.24**	0.41
Inertia in E borrowing constraint	ρ_E	beta	**0.25**	0.1	0.53	**0.65**	0.79
Inertia in HB borrowing constraint	ρ_S	beta	**0.25**	0.1	0.64	**0.70**	0.76
Wage share HB	σ	beta	**0.3**	0.1	0.22	**0.33**	0.45
Curvature for utilization function E	ζ_E	beta	**0.2**	0.1	0.20	**0.42**	0.63
Curvature for utilization function HS	ζ_H	beta	**0.2**	0.1	0.18	**0.38**	0.58

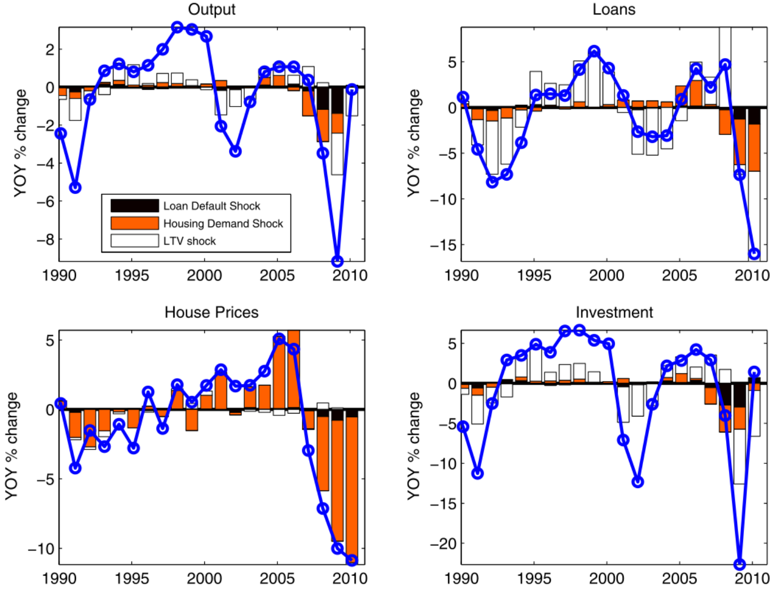
Estimation Results

Table 2b
Estimation, shock processes.

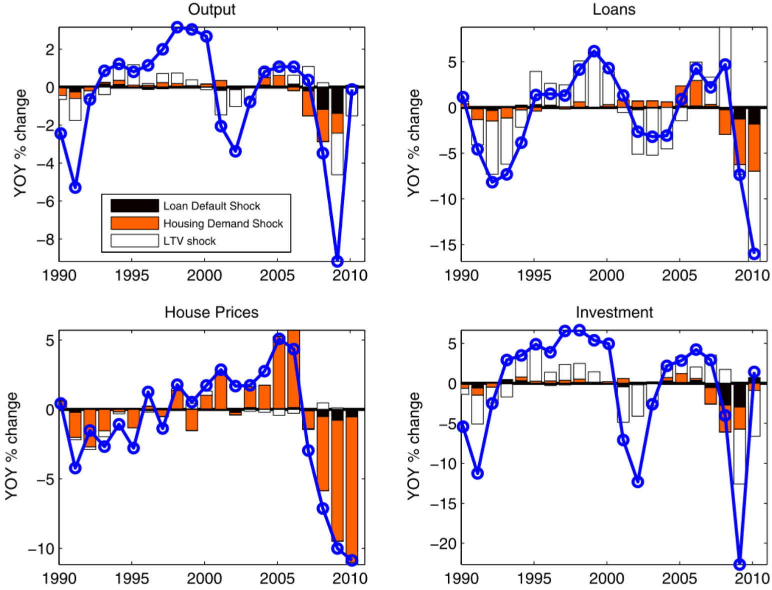
Parameter		Prior distribution			Posterior distribution		
		Density	Mean	St.dev.	5%	Mean	95%
Autocor. E default shock	ρ_{be}	beta	**0.8**	0.1	0.886	**0.932**	0.971
Autocor. HB default shock	ρ_{bh}	beta	**0.8**	0.1	0.944	**0.969**	0.988
Autocor. housing demand shock	ρ_j	beta	**0.8**	0.1	0.986	**0.992**	0.997
Autocor. investment shock	ρ_k	beta	**0.8**	0.1	0.840	**0.916**	0.973
Autocor. LTV shock, E	ρ_{me}	beta	**0.8**	0.1	0.750	**0.839**	0.917
Autocor. LTV shock, HB	ρ_{mh}	beta	**0.8**	0.1	0.781	**0.873**	0.948
Autocor. preference shock	ρ_p	beta	**0.8**	0.1	0.989	**0.994**	0.998
Autocor. technology shock	ρ_z	beta	**0.8**	0.1	0.973	**0.988**	0.997
St.dev., default shock, E	σ_{be}	invg	**0.0025**	0.025	0.0009	**0.0011**	0.0012
St.dev., default shock, HB	σ_{bh}	invg	**0.0025**	0.025	0.0012	**0.0013**	0.0015
St.dev., housing demand shock	σ_j	invg	**0.05**	0.05	0.0248	**0.0346**	0.0473
St.dev., investment shock	σ_k	invg	**0.005**	0.025	0.0049	**0.0081**	0.0161
St.dev., LTV shock, E	σ_{me}	invg	**0.0025**	0.025	0.0129	**0.0204**	0.0366
St.dev., LTV shock, HB	σ_{mh}	invg	**0.0025**	0.025	0.0090	**0.0115**	0.0150
St.dev., preference shock	σ_p	invg	**0.005**	0.025	0.0179	**0.0205**	0.0237
St.dev., technology shock	σ_z	invg	**0.005**	0.025	0.0062	**0.0070**	0.0080

Note: The posterior density is constructed by simulation using the Random-Walk Metropolis algorithm (with 250,000 draws) as described in An and Schorfheide (2007).

Identification

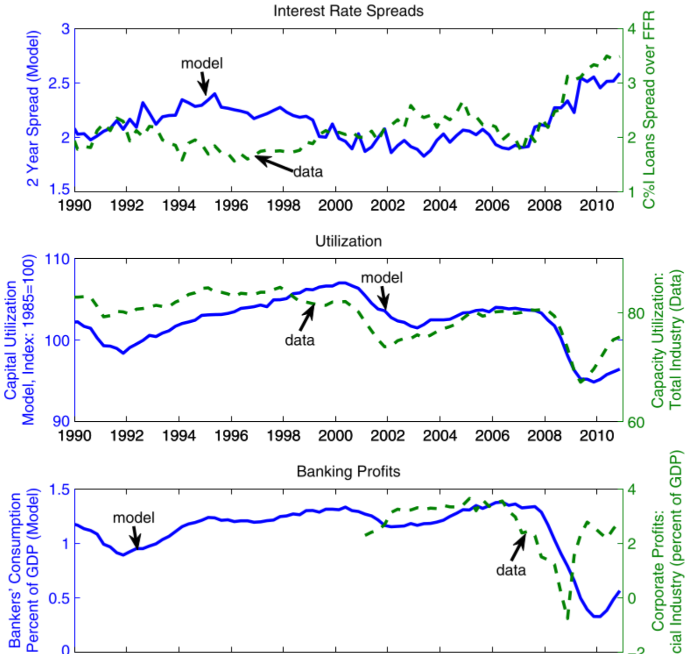


Identification

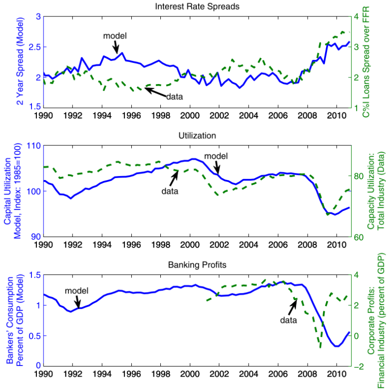


An estimated model can be used to *identify* shocks

Predictive Power of the Model



Predictive Power of the Model



The model predicts other moments that were not targeted:

- i.r. spreads
- capacity utilization
- corporate profits ≈ banker's consumption

Conclusion

The FBC model shows that financial shocks were likely a driver of the financial crisis ( )

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Conclusion

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But it is missing:

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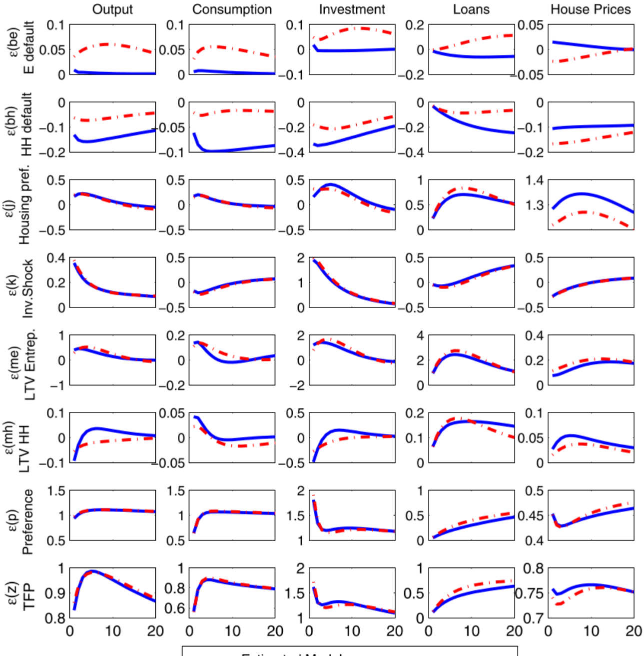
- a role for the central bank and money creation
  - especially money creation by banks...
- a more realistic macro environment
  - in particular, capital

Appendix

IRF of the full model (1)



IRF of the full model (2)