Japan's Banking Crisis and Lost Decades

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December 19, 2010

in the 12th Macroeconomic Conference

Cause of Japan's Lost Decades

1. Financial side
   - Impaired functioning of financial intermediation
   - Peek and Rosengren (1997, 2000, 2005), Bayoumi (2001), Caballero, Hoshi, and Kashyap (2008)
2. Real side
   - Productivity slowdown or capital adjustment cost
   - Hayashi and Prescott (2002), Sugo and Ueda (2008), and Hirose and Kurozumi (2010)

- Independent framework

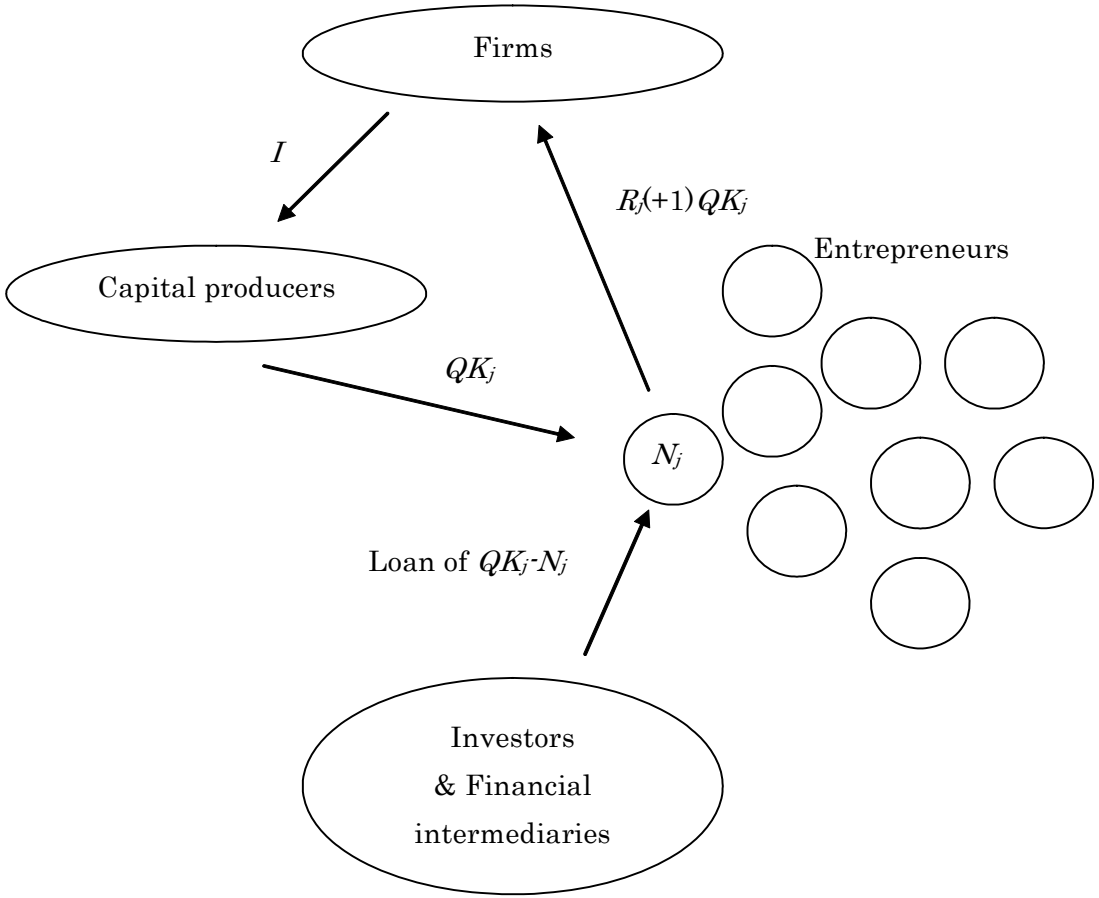
What We Do

- Unified framework
  - Based on Hirakata, Sudo, and Ueda (2010)
  - Explicitly incorporates banks
  - Bayesian estimation using Japanese data

- Identify shocks behind the lost decades
  - Shocks to the financial system
  - Technology and investment adjustment cost shocks

Model

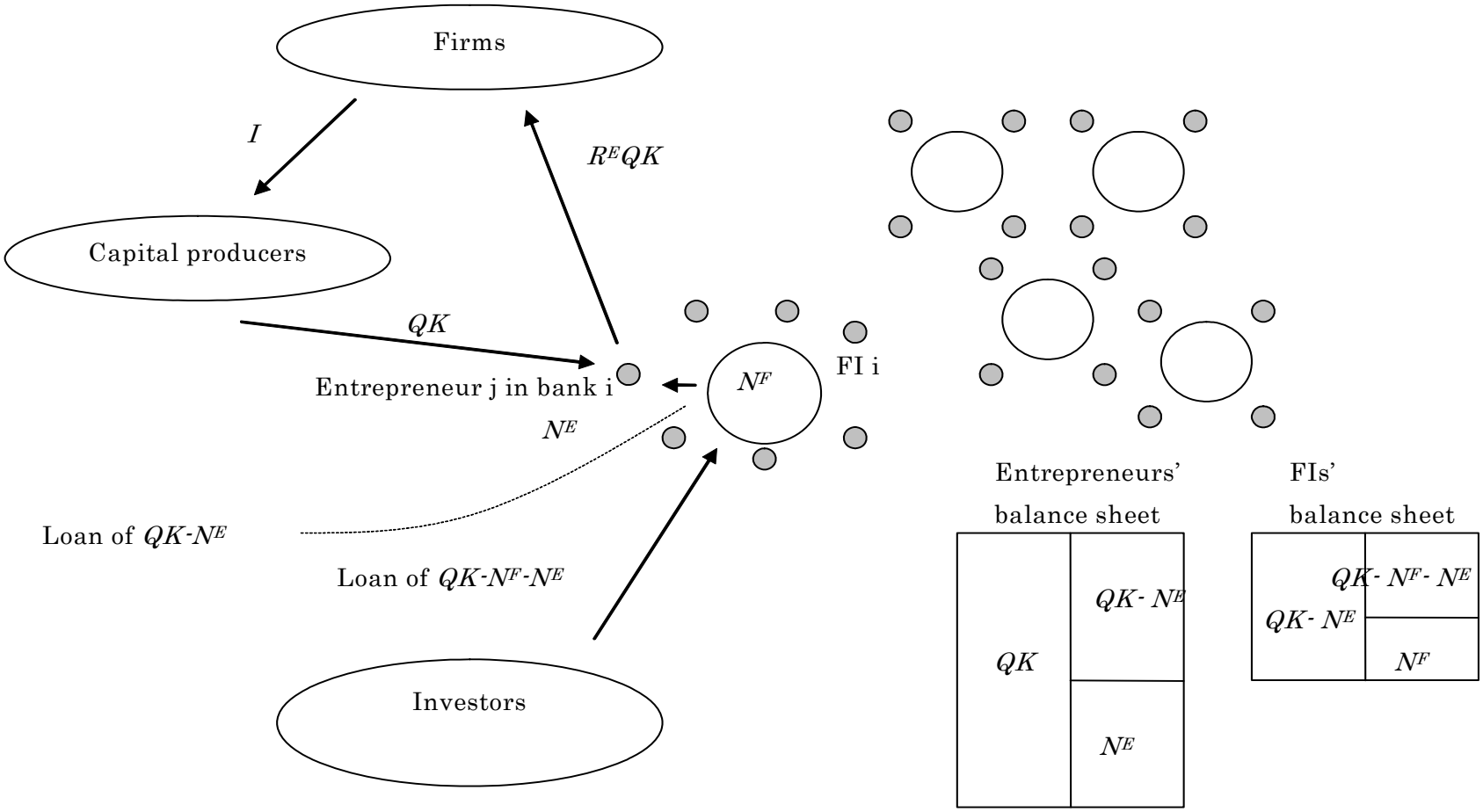
Credit Markets in BGG



Entrepreneurs' balance sheet

Asset	Debt
QK	QK-N
	Net worth
	N

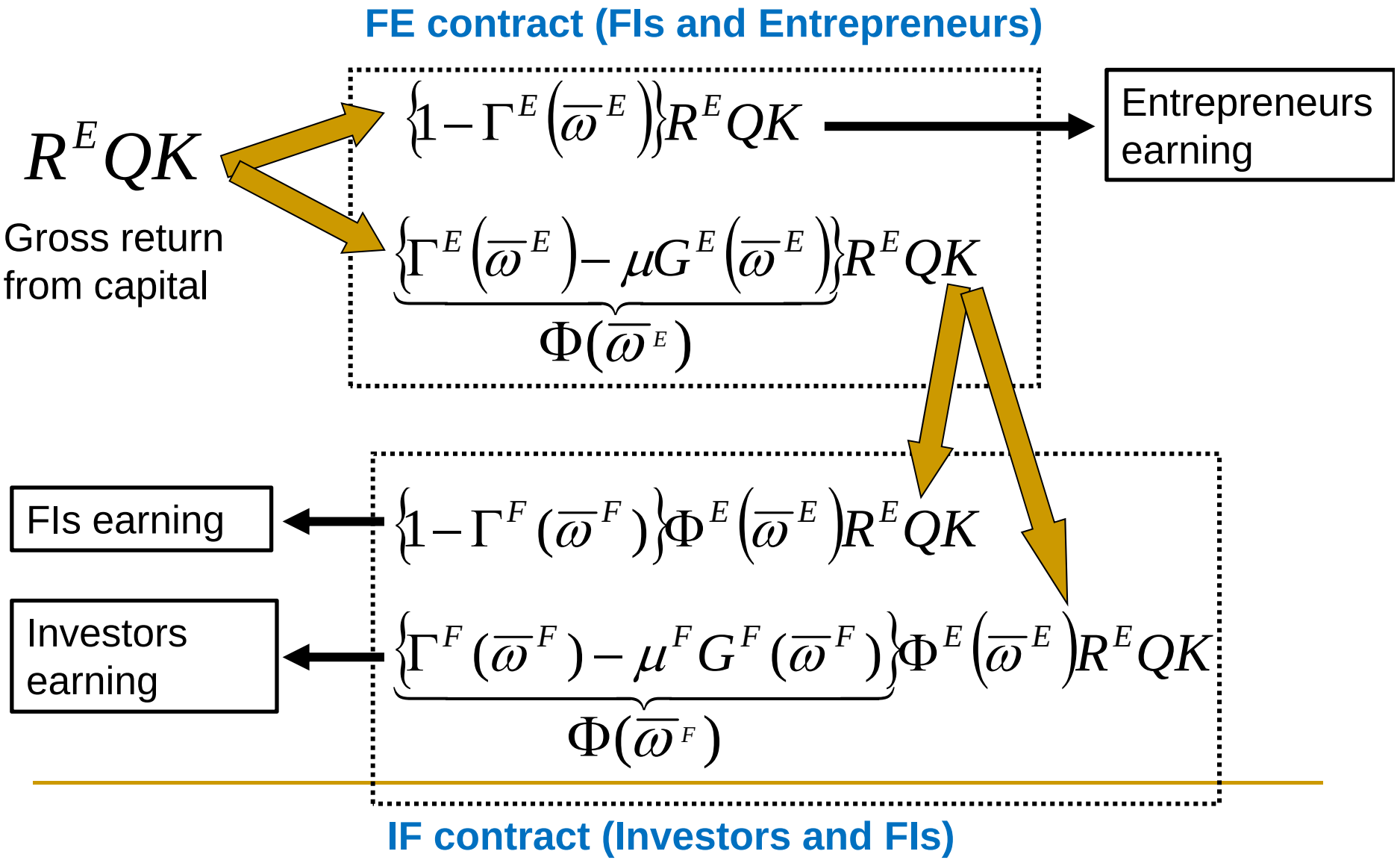
Credit Markets in HSU



Setup of Credit Markets

- Investors, banks (FIs), and entrepreneurs
  - IF contract : Contract b/w Investors and FIs
  - FE contract : Contract b/w FIs and Entrepreneurs
- Idiosyncratic technology shocks ω for banks and entrepreneurs
- Costly state verification (CSV)
  - Lenders monitor borrowers
- Debt contracts
  - $\omega^{E}_{j_i,t} > \overline{\omega}^{E}_{t}$: No defaults
  - $\omega^{E}_{j_i,t} < \overline{\omega}^{E}_{t}$: Defaults and monitor
- Monopolistic banks (FIs)

FE contract and IF contract



FIs optimal contract: Monopolistic FIs

FIs maximize profits subject to investors' and entrepreneurs' participation constraints.

$$\max_{\overline{\omega}^F, \overline{\omega}^E, K} \left\{1 - \Gamma^F(\overline{\omega}^F)\right\} \Phi^E\left(\overline{\omega}^E\right) R^E QK$$

FIs earning

Participation constraints

For Investors

$$\Phi^F\left(\overline{\omega}^F\right) \Phi^E\left(\overline{\omega}^E\right) R^E QK = R\left(QK - N^E - N^F\right)$$

For Entrepreneurs

$$\left\{1 - \Gamma^E\left(\overline{\omega}^E\right)\right\} R^E QK \geq R^E N^E$$

Def. R^F : Gross return of the FI-Entrepreneur (FE) contract

$$\Phi^E\left(\overline{\omega}^E\right) R^E QK = R^F\left(QK - N^E\right)$$

External Financial Premium

- External finance premium R^E is decreasing with N^F as well as N^E.
  - Similar to BGG

$$\begin{aligned}
\frac{E_t\left\{R_{t+1}^E\right\}}{R_t} &= \left[\Phi_t^F\left\{\overline{\omega}_i^F\left(\frac{N_{t+1}^F}{Q_tK_t},\frac{N_{t+1}^E}{Q_tK_t}\right),\overline{\omega}_{j_i}^E\left(\frac{N_{t+1}^F}{Q_tK_t},\frac{N_{t+1}^E}{Q_tK_t}\right)\right\}\right]^{-1} \\
&\quad \left[\Phi_t^E\left\{\overline{\omega}_{j_i}^E\left(\frac{N_t^E}{Q_tK_t}\right)\right\}\right]^{-1}\times\left(1-\frac{N_{t+1}^F}{Q_tK_t}-\frac{N_{t+1}^E}{Q_tK_t}\right) \\
&\equiv F\left(n_t^F,n_t^E\right).
\end{aligned}$$

Model: Evolution of Net Worth

- Shocks to the financial system: net worth

Entrepreneurial net worth

$$N_t^E = \gamma^E \underbrace{\left\{1 - \Gamma_{t-1}^E\left(\overline{\omega}^E\right)\right\}}_{\text{Share of borrowers in FE contract}} R_t^E Q_{t-1} K_{t-1} + \Delta_t^{N_E}$$

Net worth shock

FIs' net worth

$$N_t^F = \gamma^F \left[\underbrace{\Phi_{t-1}^E(\overline{\omega}^E)}_{\text{lenders' share in FE contract}} \times \underbrace{\left\{1 - \Gamma_{t-1}^F\left(\overline{\omega}^F\right)\right\}}_{\text{borrower's share in IF contract}} \right] R_t^E Q_{t-1} K_{t-1} + \Delta_t^{N_F}$$

Goods Markets

- Price setting:
  - Calvo-type sticky prices

- Capital Producer:
  - Capital accumulation with investment adjustment cost

$$F_I\left(I\left(s^{t+l}\right), I\left(s^{t+l-1}\right)\right) \equiv \frac{\kappa}{2}\left(\frac{\exp(e^I(s^t))I\left(s^{t+l}\right)}{I\left(s^{t+l-1}\right)} - 1\right)^2.$$

- Monetary policy
  - Taylor rule

$$R^n\left(s^t\right) = \theta R^n\left(s^{t-1}\right) + (1-\theta)\left(\phi_\pi \pi\left(s^t\right) + \phi_y \log\left(\frac{Y\left(s^t\right)}{Y}\right)\right) + e^R\left(s^t\right),$$

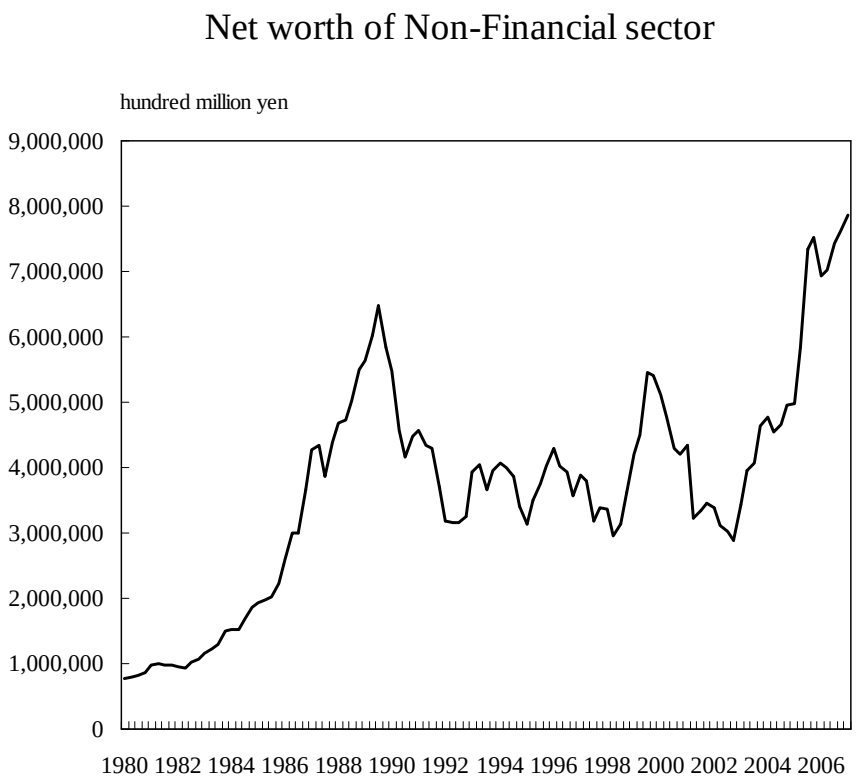
Estimation Strategies

Data

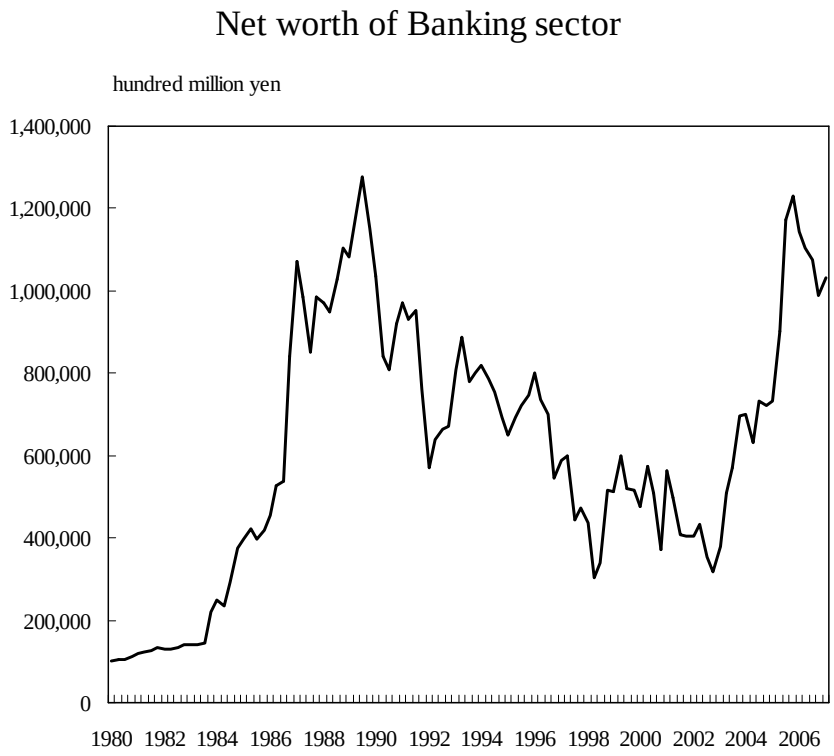
- Eight variables
  - Growth rates of real GDP, investment, consumption
    - Trend break in 1991Q2
  - Call rate and growth rate of GDP deflator
  - Growth rates of entrepreneurs' and FIs' net worth
    - Trend break in 1991Q2
    - Flow of Funds, and before 1997, TOPIX
  - Labor (Hayashi and Prescott [2002])
  - NOT make use of spreads
- 1981Q1 to 1998Q4

Data Series: Net Worth

Net worth of non-financial sector



Net worth of banking sector



Structural Shocks

- Eight shocks
  - FIs' net worth
  - Entrepreneurs net worth
  - Productivity
  - Investment adjustment cost
  - Preference
  - Government spending
  - Monetary policy
  - Price markup
    - The first two are i.i.d., and the other six are AR(1).

Method

- Calibration
  - Discount factor, depreciation ratio, capital share
  - Credit markets
- Bayesian MCMC
  - Dynare
- Extend sample to 2007Q2
  - Include the ZLB and QEP period
  - Fix estimated structural parameters
  - Re-identify shocks

Estimation

Parameter Estimates

Calvo
I adjust
Index

Policy

Persistence
of shocks

	Prior distribution			Posterior distribution		
	Distr.	Mean	St. Dev.	Mean	5%	95%
ξ_p	Beta	0.5	0.15	0.5269	0.4452	0.6033
κ	Normal	4	1.5	7.3146	5.3142	9.3830
γ_p	Beta	0.5	0.2	0.1448	0.0128	0.2683
θ	Beta	0.75	0.1	0.7710	0.7209	0.8173
ϕ_π	Gamma	1.5	0.125	1.4784	1.3240	1.6293
ϕ_y	Gamma	0.125	0.05	0.0223	0.0087	0.0351
ρ_B	Beta	0.5	0.2	0.8560	0.8037	0.9071
ρ_I	Beta	0.5	0.2	0.6001	0.4668	0.7314
ρ_A	Beta	0.5	0.2	0.8927	0.8276	0.9604
ρ_G	Beta	0.5	0.2	0.8131	0.7124	0.9138
ρ_R	Beta	0.5	0.2	0.1213	0.0310	0.2061
ρ_P	Beta	0.5	0.2	0.8790	0.8029	0.9556

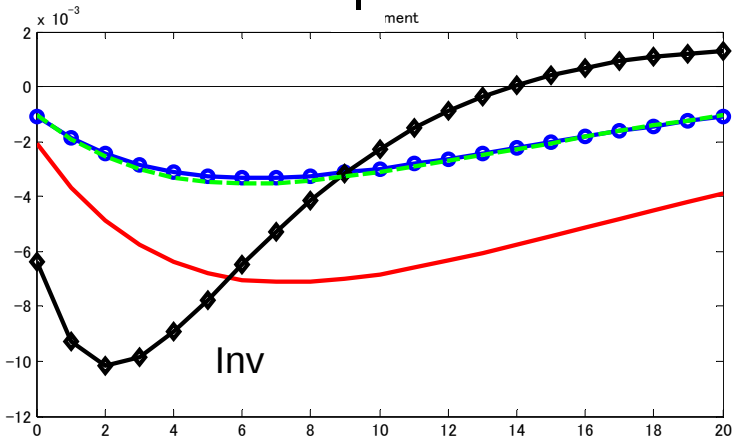
Parameter Estimates: Shocks

	Prior distribution			Posterior distribution		
	Distr.	Mean	St. Dev.	Mean	5%	95%
$\sigma(\epsilon_B)$	Inv. Gamma	0.01	2	0.0028	0.0019	0.0037
$\sigma(\epsilon_I)$	Inv. Gamma	0.01	2	0.0206	0.0157	0.0254
$\sigma(\epsilon_G)$	Inv. Gamma	0.01	2	0.0068	0.0059	0.0077
$\sigma(\epsilon_A)$	Inv. Gamma	0.01	2	0.0099	0.0086	0.0113
$\sigma(\epsilon_R)$	Inv. Gamma	0.01	2	0.0020	0.0016	0.0023
$\sigma(\epsilon_{N_F})$	Inv. Gamma	0.01	2	0.0522	0.0449	0.0588
$\sigma(\epsilon_{N_E})$	Inv. Gamma	0.01	2	0.2728	0.2361	0.3080
$\sigma(\epsilon_P)$	Inv. Gamma	0.01	2	0.0716	0.0581	0.0861

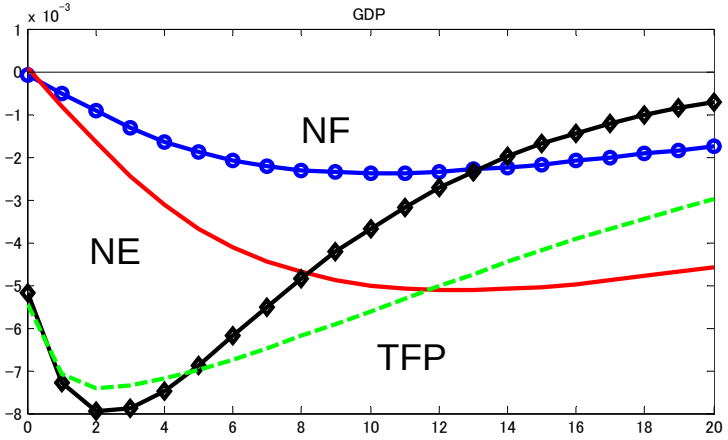
Impulse Responses to 1 S.E. Shocks

- Persistent effects of the net worth shocks
- Large effects of the inv adj cost shock

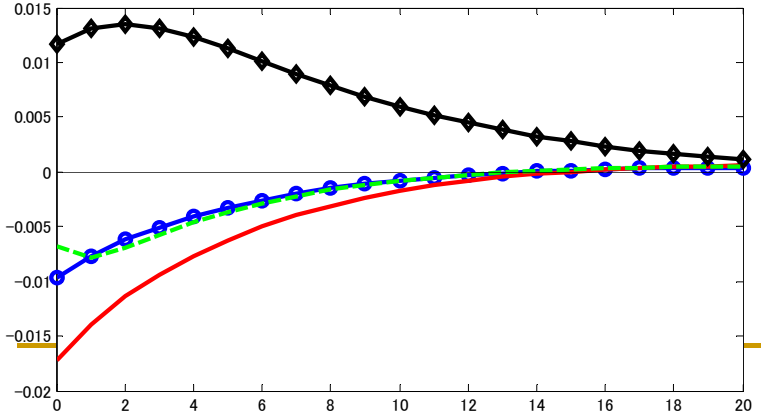
I



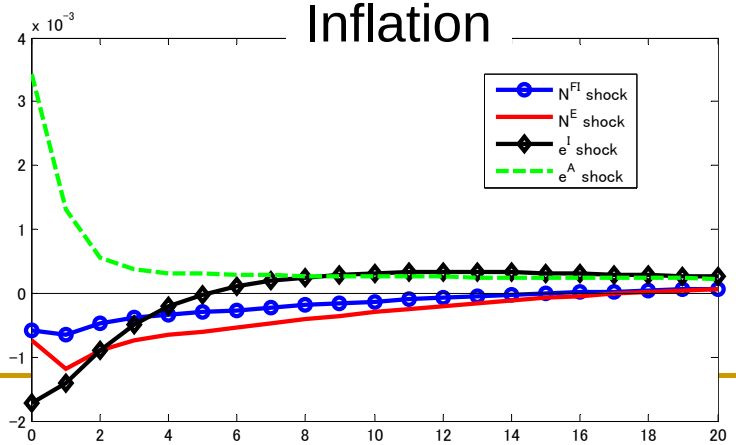
GDP



Q

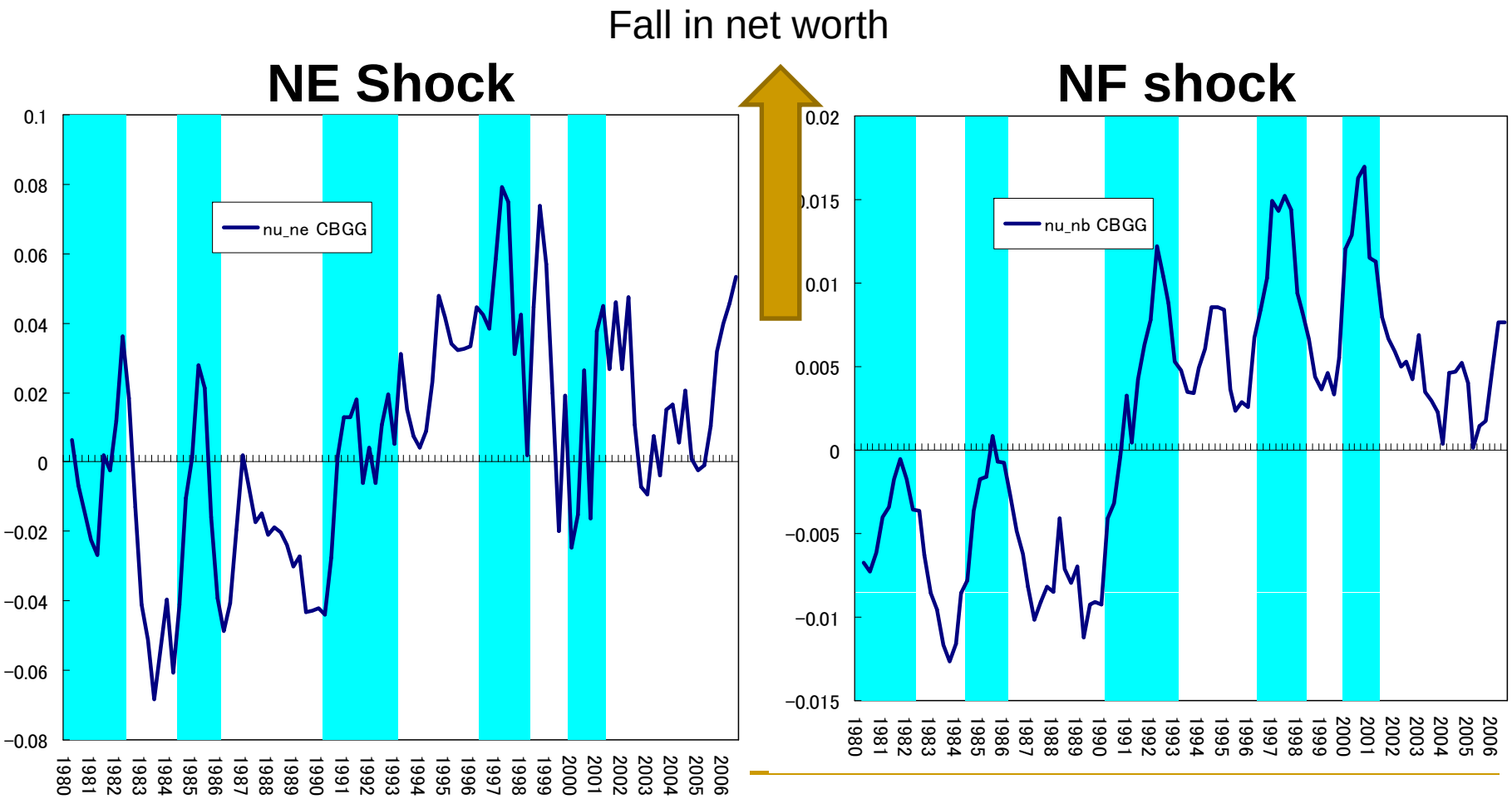


Inflation



Net Worth Shocks

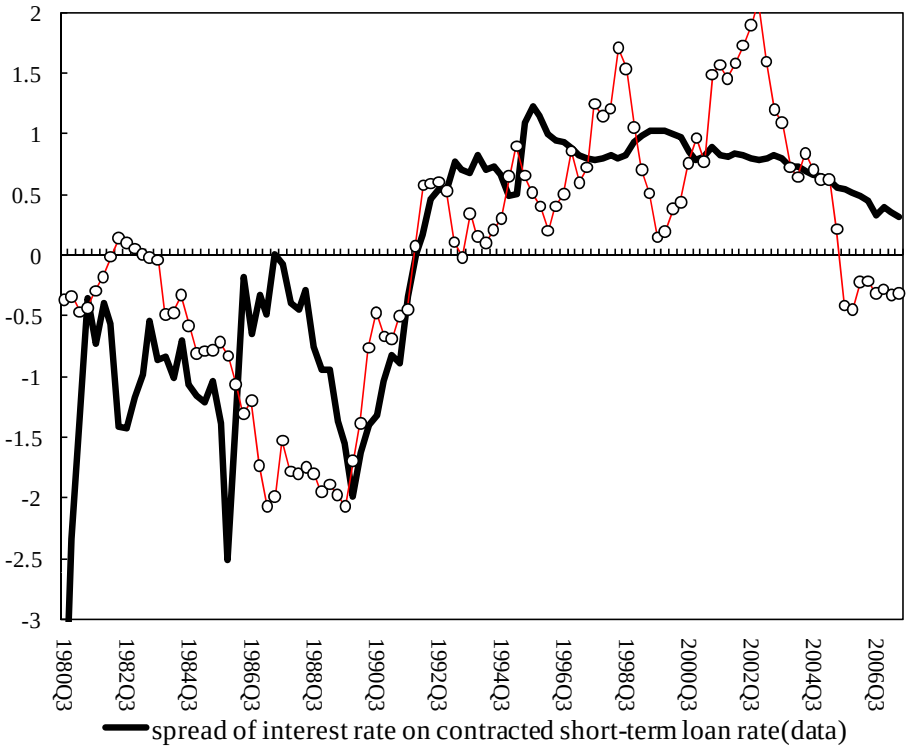
- The timing of recessions matches the timing of shock increases.

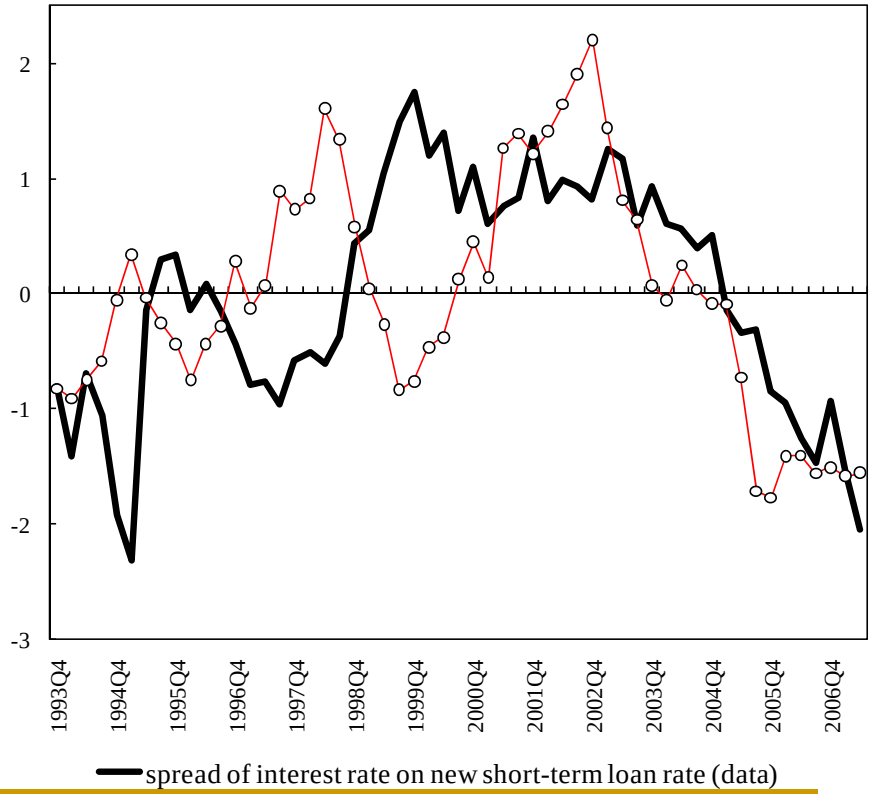


Model Evaluation in terms of Spreads

Model Generated Spreads (Z^E-R) and Actual Loan Spreads

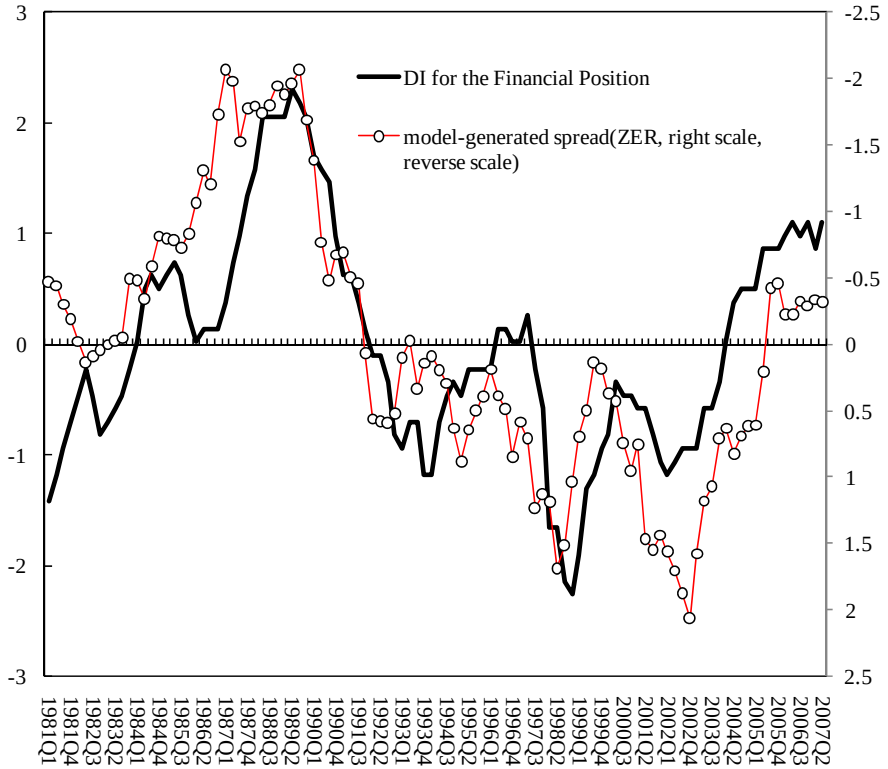
- Tracks a low frequency variation
- Correlations: 0.74 (3qtrs lead) and 0.72 (4qtrs lead)

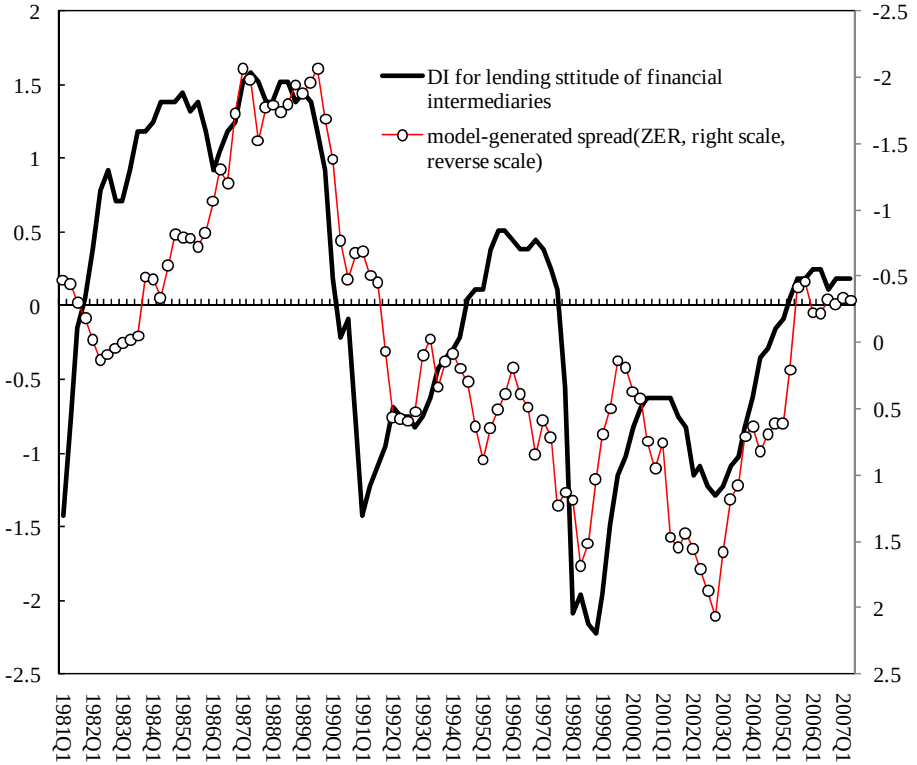




Z^E-R and Tankan DI

- High correlations
- Correlations: 0.77 (2qtrs lead) and 0.73 (1qtr lead)

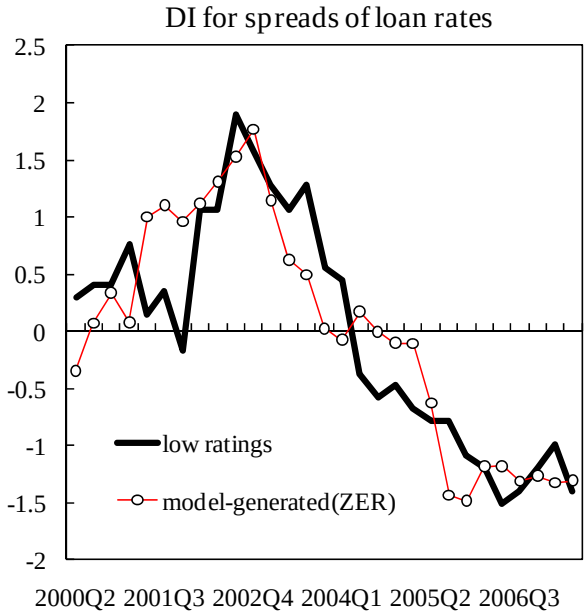




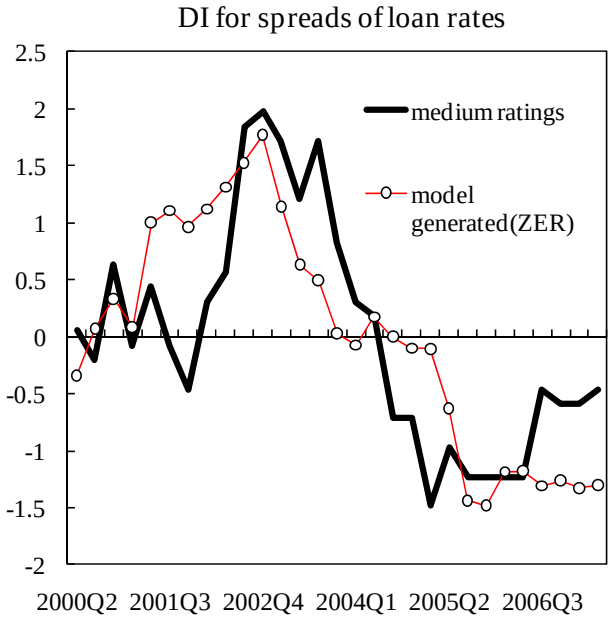
Z^E-R and : Bank Loan Survey

- High correlations with spreads for low rating firms
- Correlations: 0.90 (2qtrs lead), 0.75 (0qtr), and 0.47 (0qtr)

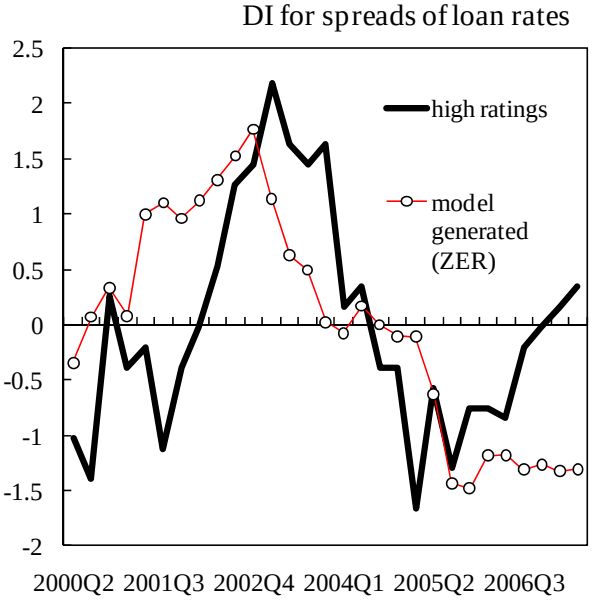
Low



Medium

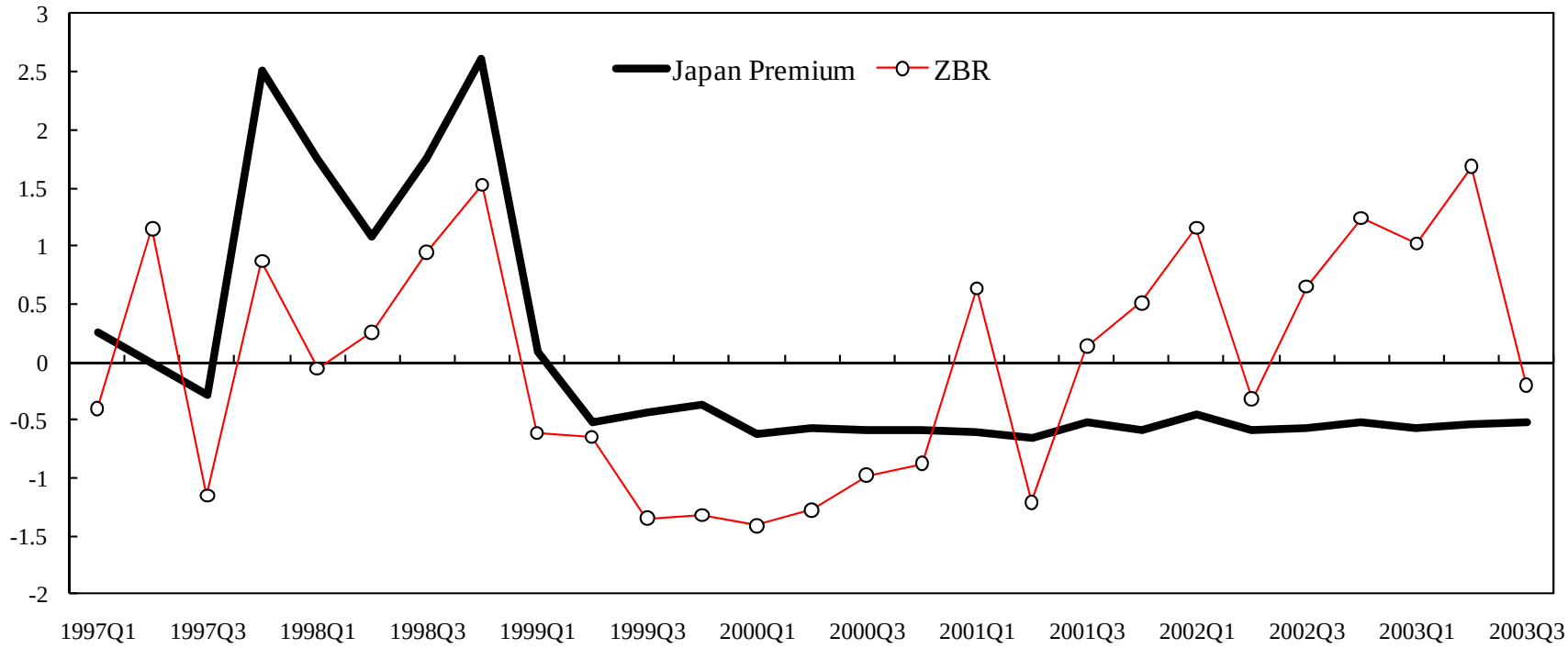


High



Z^F-R and the Japan Premium

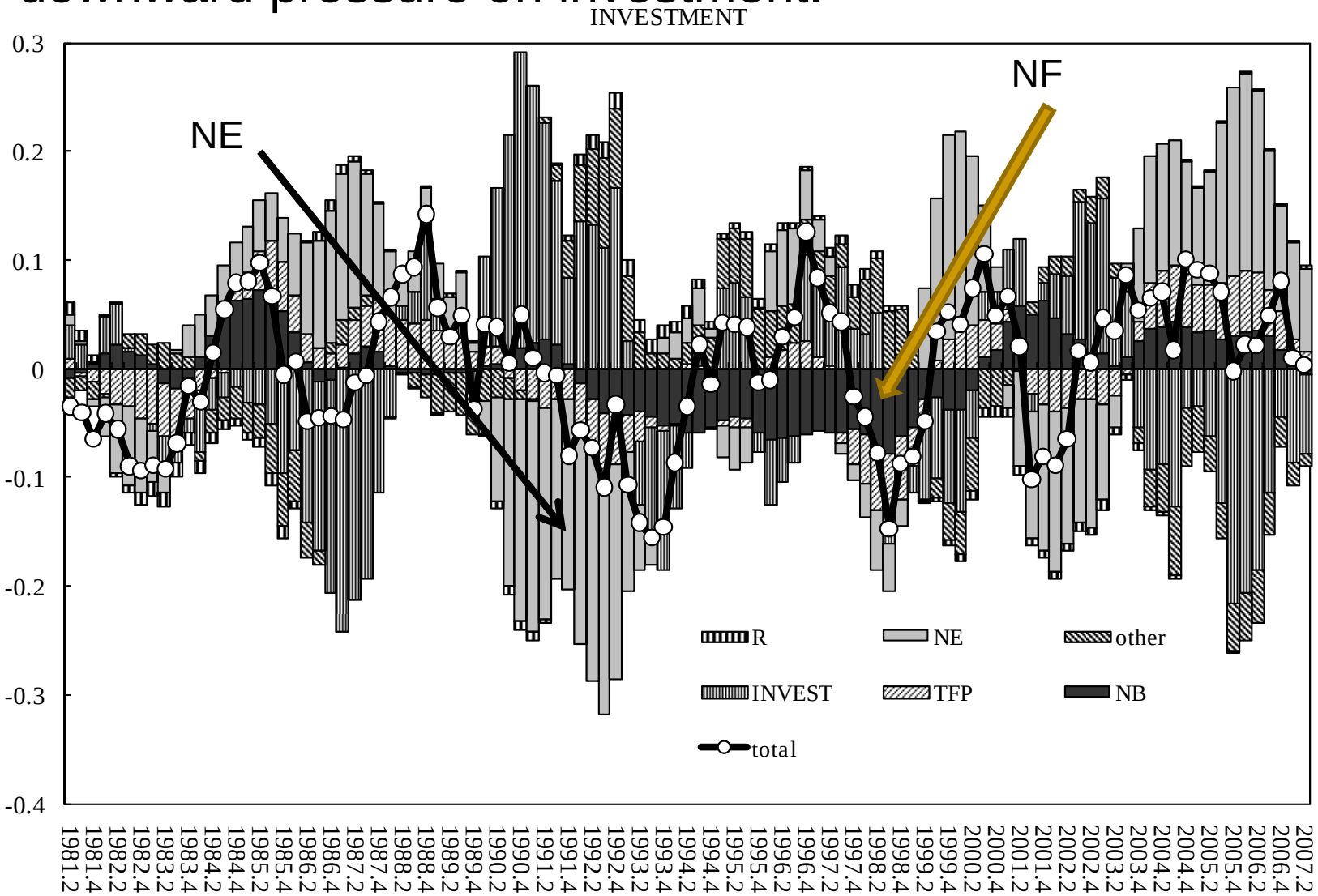
• Regarding banks' premium, the fit is good in 1997-98, but bad in 2001-02.



Causes of the Lost Decades

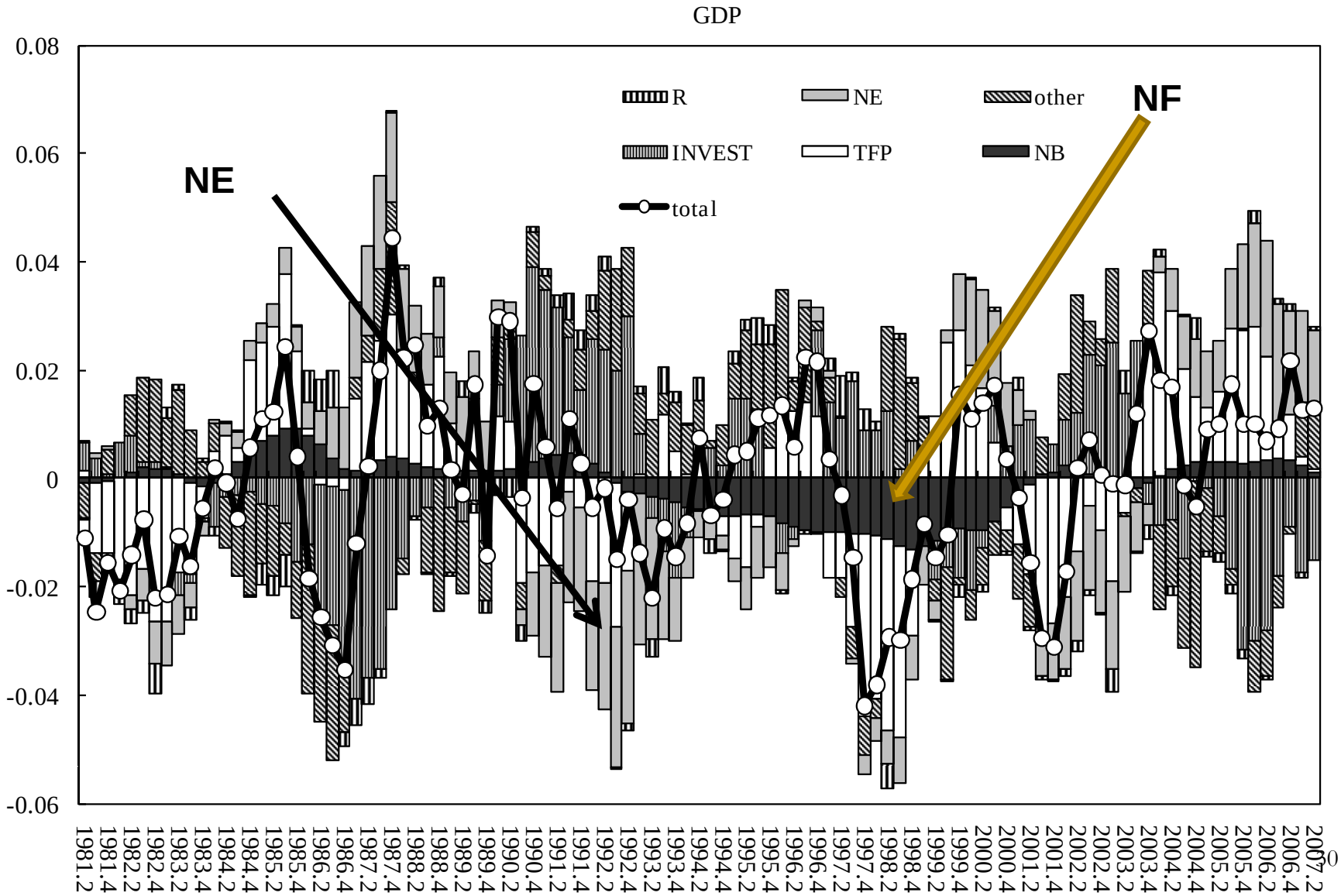
Historical Decomposition (Investment)

Throughout the 1990s, the shock to banks' net worth put downward pressure on investment.



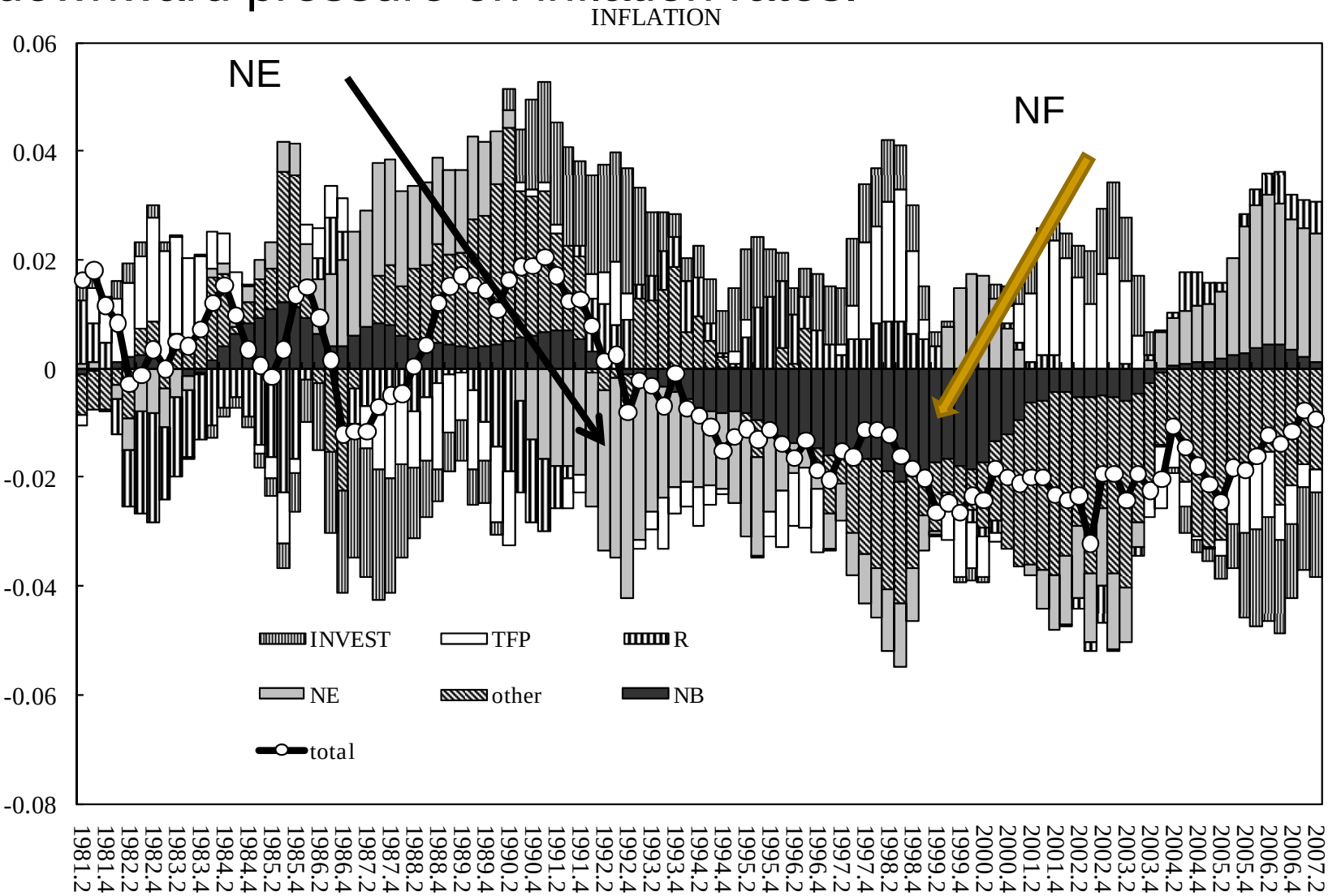
Historical Decomposition (GDP)

The TFP and inv adj cost shock also contribute to fluctuations



Historical Decomposition (Inflation)

Throughout the 1990s, the shock to banks' net worth put downward pressure on inflation rates.



Variance Decomposition

- The two net worth shocks explain 38%, 9%, and 3% variations of I, GDP, and inflation rates, respectively.
- Their contributions increase in the late 1990s.

	ε^A	ε^B	ε^G	ε^I	ε^{N^F}	ε^{N^E}	ε^P	ε^R
Investment	0.037	0.015	0.000	0.535	0.052	0.333	0.026	0.002
GDP	0.277	0.106	0.191	0.220	0.015	0.074	0.080	0.038
Inflation	0.172	0.269	0.015	0.116	0.065	0.188	0.044	0.132
During 1995-1999								
Investment	0.047	0.012	0.000	0.431	0.123	0.350	0.035	0.002
GDP	0.313	0.095	0.263	0.137	0.043	0.034	0.075	0.039
Inflation	0.192	0.187	0.014	0.078	0.215	0.117	0.033	0.164

Comparison among Models

- Contribution of the inv adj cost shock decreases.
  - Sugo and Ueda (2008) and Hirose and Kurozumi (2010)
  - CCC＜BGG＜Non-FA

	ε^A	ε^B	ε^G	ε^I
Chained BGG	0.037	0.015	0.000	0.535
BGG	0.054	0.018	0.001	0.706
Non-FA	0.060	0.021	0.000	0.892
	ε^{N^F}	ε^{N^E}	ε^P	ε^R
Chained BGG	0.052	0.333	0.026	0.002
BGG	0.000	0.171	0.049	0.000
Non-FA	0.000	0.000	0.026	0.001

Conclusion

- Cause of Japan's Lost Decades
  - Between two opposing views
    - Rather they are deeply connected.
    - Our DSGE model provides a unified framework.
  - Shocks to the financial system play an important but not dominant role for Japan's economic stagnation in the 1990s and 2000s.

- Future works
  - Co-movement of consumption and investment
  - Explain spreads
  - ZLB and unconventional policy