The Financial Accelerator in an Estimated New Keynesian Model (RED,2008)

Ian Christensen
Ali Dib

Reporter
高崧耀

中国经济与管理研究院

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contents

Abstract

- This paper estimates and simulates a sticky-price dynamic stochastic general-equilibrium model with a financial accelerator, to assess the importance of the financial accelerator mechanism in fitting the data and its role in the amplification and propagation of transitory shocks.
- Structural parameters of two models, one with and one without a financial accelerator, are estimated using a maximum-likelihood procedure and post-1979 US data.
- The estimation and simulation results provide quantitative evidence in favor of the financial-accelerator model. The model without a financial accelerator is statistically rejected in favor of a model with it.
- The presence of the financial accelerator amplifies and propagates the effects of demand shocks on investment, but it dampens those of supply shocks.
- However, we find that the importance of the financial accelerator for output fluctuations is relatively minor.

Indroduction I

Background

Financial friction orginated from the analysis of Townsend(1978)

- constly state verification (CSV).

The ability of firms to obtain financing plays an active role in investment behavior.

- Bernanke et al.(1999), Kiyotaki and Moore (1997)

Later, many scholar using these idea:

- Christiano(2005,2014)
- Iacoviello(2005,2015)
- Fernández-Villaverde(2010)
- ...

Indroduction II

Contribution

We estimate a sticky-price DSGE model + financial frictions as described in Bernanke. et al. (1999).

- We use our model to empirically evaluate the importance of **the financial accelerator in the amplification and propagation** of the effects of transitory shocks to the economy.
- Two versions of the model:
  a model that includes a financial accelerator and a model without it.
- Using a maximum-likelihood procedure with a Kalman filter and post-1979 US macro data.
  - Using data on investment because financial frictions exert an influence directly on investment behavior.
  - investment data are required to identify and precisely estimate the capital adjustment cost and capital share parameters.

Indroduction III

Main findings

- the financial accelerator improves the model's fit with the data.
- The elasticity of the external finance premium with respect to the firm leverage, is statistically significant and close to values used in typical calibrations.
- the model with a financial accelerator generates business cycles moments the closest to those observed in the data.

The nature of the role played by the financial accelerator in the estimated model, the impulse response

- amplifies and propagates the effects of the demand shocks on investment.
- while it dampens those of the supply shocks.

Indroduction IV

Frame

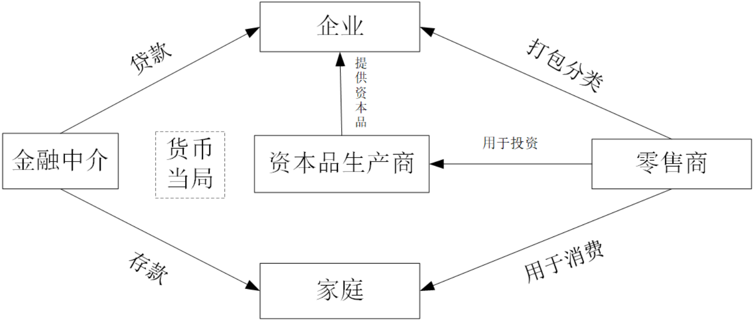

图: 经济主体流程图

Households I

The representative household's preferences:

$$U_0 = E_0 \sum_{t=0}^{\infty} \beta^t u\left(c_t, M_t/p_t, h_t\right) \tag{1}$$

$$u(\cdot) = \frac{\gamma e_t}{\gamma - 1} \log\left[c_t^{\frac{\gamma-1}{\gamma}} + b_t^{1/\gamma}\left(\frac{M_t}{p_t}\right)^{\frac{\gamma-1}{\gamma}}\right] + \eta \log\left(1 - h_t\right) \tag{2}$$

We interpret e_t as a taste (preference) shock for consumption, while b_t is interpreted as a money-demand shock.
These shocks follow first-order autoregressive processes:

$$\log\left(e_t\right) = \rho_e \log\left(e_{t-1}\right) + \varepsilon_{et} \tag{3}$$

$$\log\left(b_t\right) = \left(1 - \rho_b\right)\log(b) + \rho_b \log\left(b_{t-1}\right) + \varepsilon_{bt} \tag{4}$$

Households II

The household's budget constraint, in nominal terms, is

$$P_t c_t + M_t + D_t \leqslant W_t h_t + R_{t-1} D_{t-1} + M_{t-1} + T_t + \Omega_t \tag{5}$$

The first-order conditions for this optimization problem are:

$$\frac{e_t c_t^{-\frac{1}{\gamma}}}{c_t^{\frac{\gamma-1}{\gamma}} + b_t^{1/\gamma} m_t^{\frac{\gamma-1}{\gamma}}} = \lambda_t \tag{6}$$

$$\frac{e_t b_t^{1/\gamma} m_t^{-\frac{1}{\gamma}}}{c_t^{\frac{\gamma-1}{\gamma}} + b_t^{1/\gamma} m_t^{\frac{\gamma-1}{\gamma}}} = \lambda_t - \beta E_t \left(\frac{\lambda_{t+1}}{\pi_{t+1}} \right) \tag{7}$$

$$\frac{\eta}{1 - h_t} = \lambda_t w_t \tag{8}$$

$$\frac{\lambda_t}{R_t} = \beta E_t \left(\frac{\lambda_{t+1}}{\pi_{t+1}} \right) \tag{9}$$

Entrepreneurs I

At the end of each period

$$q_t k_{t+1} = n_{t+1} + d_t$$

Demand for capital:

$$E_t f_{t+1} = E_t \left[\frac{z_{t+1} + (1-\delta) q_{t+1}}{q_t} \right] \tag{10}$$

The demand for capital should satisfy the following optimality condition

$$E_t f_{t+1} = E_t \left[S(\cdot) R_t / \pi_{t+1} \right] \tag{11}$$

where $E_t \left(R_t / \pi_{t+1} \right)$ is an expected real interest rate, and the external finance premium is given by

$$S(\cdot) = S\left(\frac{n_{t+1}}{q_t k_{t+1}} \right) \tag{12}$$

with $S'(\cdot) < 0$ and $S(1) = 1$

Entrepreneurs II

- **Case:** $\frac{n_{t+1}}{q_t k_{t+1}} \downarrow \Rightarrow$ leverage ratio $\uparrow$.

From the Eqs. (11) and (12), we derive the log-linearized equation for the external funds rate as:

$$\hat{f}_{t+1} = \hat{R}_t - \hat{\pi}_{t+1} + \psi \left(\hat{q}_t + \hat{k}_{t+1} - \hat{n}_{t+1} \right) \tag{13}$$

where ψ represents the elasticity of the external finance premium with respect to a change in the leverage position of entrepreneurs.
Aggregate entrepreneurial net worth evolves according to

$$n_{t+1} = v v_t + (1 - v) g_t \tag{14}$$

v_t is given by

$$v_t = \left[f_t q_{t-1} k_t - E_{t-1} f_t \left(q_{t-1} k_t - n_t \right) \right] \tag{15}$$

Entrepreneurs III

where f_t is the ex post real return on capital held in t, and $E_{t-1}f_t = E_{t-1}\left[S(\cdot)R_{t-1}/\pi_t\right]$ is the cost of borrowing (the real interest rate implied by the loan contract signed in time $t-1$.

The first-order conditions for this optimization problem are:

$$z_t = \alpha\xi_t\frac{y_t}{k_t} \tag{16}$$

$$w_t = (1-\alpha)\xi_t\frac{y_t}{h_t} \tag{17}$$

$$y_t = k_t^{\alpha}\left(A_t h_t\right)^{1-\alpha} \tag{18}$$

where $\xi_t > 0$ is the Lagrangian multiplier associated with the production function and denotes the real marginal cost; w_t is the real wage; and z_t is the real marginal productivity of capital.

Capital producers I

Capital producers' optimization problem:

$$\max_{i_i} E_t \left[q_t x_t i_t - i_t - \frac{x}{2} \left(\frac{i_t}{k_t} - \delta \right)^2 k_t \right] \tag{19}$$

Thus, the optimal condition is

$$E_t \left[q_t x_t - 1 - \chi \left(\frac{i_t}{k_t} - \delta \right) \right] = 0 \tag{20}$$

which is the standard Tobin's Q equation.
The aggregate capital stock evolves according to

$$k_{t+1} = x_t i_t + (1 - \delta) k_t \tag{21}$$

$$\log (x_t) = \rho_x \log (x_{t-1}) + \varepsilon_{xt} \tag{22}$$

Retailers I

The retailer's optimization problem is

$$\max_{\{\tilde{p}_t(j)\}} E_0 \left[\sum_{l=0}^{\infty} (\beta\phi)^l \lambda_{t+l} \Omega_{t+l}(j)/p_{t+l} \right] \tag{23}$$

subject to the demand function

$$y_{t+l}(j) = \left(\frac{\tilde{p}_t(j)}{p_{t+l}} \right)^{-\theta} y_{t+l} \tag{24}$$

where the retailer's nominal profit function is

$$\Omega_{t+l}(j) = \left(\pi^l \tilde{p}_t(j) - p_{t+l} \xi_{t+l} \right) y_{t+l}(j) \tag{25}$$

The first-order condition for $\tilde{p}_t(j)$ is

$$\tilde{p}_t(j) = \frac{\theta}{\theta - 1} \frac{E_t \sum_{l=0}^{\infty} (\beta\phi)^l \lambda_{t+l} y_{t+l}(j) \xi_{t+l}}{E_t \sum_{l=0}^{\infty} (\beta\phi)^l \lambda_{t+l} y_{t+l}(j) \pi^l / p_{t+l}} \tag{26}$$

Retailers II

The aggregate price is

$$p_t^{1-\theta} = \phi \left(\pi p_{t-1}\right)^{1-\theta} + (1-\phi)\tilde{p}_t^{1-\theta} \tag{27}$$

These equations lead to the following New Keynesian Phillips curve:

$$\hat{\pi}_t = \beta E_t \hat{\pi}_{t+1} + \frac{(1-\beta\phi)(1-\phi)}{\phi}\hat{\xi}_t \tag{28}$$

where ξ_t is the real marginal cost, and variables with hats are log deviations from the steady-state values (such as $\hat{\pi}_t = \log\left(\pi_t/\pi\right)$).

Monetary authority

Following Ireland (2003), we assume that the central bank adjusts the nominal interest rate, R_t, in response to deviations of inflation, π_t, output y_t, and the money-growth rate, $\mu_t = M_t/M_{t-1}$, from their steady-state values. Thus, the monetary policy rule evolves according to:

$$\frac{R_t}{R} = \left(\frac{\pi_t}{\pi}\right)^{e_\pi} \left(\frac{y_t}{y}\right)^{e_y} \left(\frac{\mu_t}{\mu}\right)^{\varrho_\mu} \exp\left(\varepsilon_{Rt}\right) \tag{29}$$

where R, π, y, and μ are the steady-state values of R_t, π_t, y_t, and μ_t, respectively, and ε_{Rt} is a monetary policy shock normally distributed with zero mean and standard deviation σ_R. The newly created money is transferred to households, so $T_t = M_t - M_{t-1}$.

Symmetric equilibrium I

The non-linear equilibrium system

$$\frac{e_t c_t^{-\frac{1}{\gamma}}}{c_t^{\frac{-1}{\gamma}} + b_t^{1/\gamma} m_t^{\frac{\gamma-1}{\gamma}}} = \lambda_t \tag{30}$$

$$\left(\frac{b_t c_t}{m_t}\right)^{1/\gamma} = \frac{R_t - 1}{R_t} \tag{31}$$

$$\frac{\eta}{1 - h_t} = \lambda_t w_t \tag{32}$$

$$\frac{\lambda_t}{R_t} = \beta E_t \left(\frac{\lambda_{t+1}}{\pi_{t+1}}\right) \tag{33}$$

$$z_t = \alpha \xi_t \frac{y_t}{k_t} \tag{34}$$

$$w_t = (1 - \alpha) \xi_t \frac{y_t}{h_t} \tag{35}$$

Symmetric equilibrium II

$$y_t = k_t^{\alpha} \left(A_t h_t\right)^{1-\alpha} \tag{36}$$

$$y_t = c_t + i_t \tag{37}$$

$$\frac{\tilde{p}_t}{p_t} = \frac{\theta}{\theta - 1} \frac{E_t \sum_{l=0}^{\infty} (\beta\phi)^l \lambda_{t+l} y_{t+l} \xi_{t+l}}{E_t \sum_{l=0}^{\infty} (\beta\phi)^l \lambda_{t+l} y_{t+l} \pi^l \Pi_{i=1}^{l} \pi_{t+i}^{-1}} \tag{38}$$

$$1 = \phi \left(\frac{\pi}{\pi_t}\right)^{1-\theta} + (1-\phi) \left(\frac{\tilde{p}_t}{p_t}\right)^{1-\theta} \tag{39}$$

$$E_t f_{t+1} = E_t \left[S\left(\frac{n_{t+1}}{q_t k_{t+1}}\right) R_t / \pi_{t+1} \right] \tag{40}$$

$$E_t f_{t+1} = E_t \left[\frac{z_{t+1} + (1-\delta) q_{t+1}}{q_t} \right] \tag{41}$$

$$E_t n_{t+1} = v \left[f_t q_{t-1} k_t - E_{t-1} f_t \left(q_{t-1} k_t - n_t\right) \right] + (1-v) g_t \tag{42}$$

$$k_{t+1} = x_t i_t + (1-\delta) k_t \tag{43}$$

Symmetric equilibrium III

$$q_t x_t = 1 + \chi \left(\frac{i_t}{k_t} - \delta \right) \tag{44}$$

$$\frac{R_t}{R} = \left(\frac{\pi_t}{\pi} \right)^{\varrho_\pi} \left(\frac{y_t}{y} \right)^{\varrho_y} \left(\frac{\mu_t}{\mu} \right)^{\varrho_\mu} \exp\left(\varepsilon_{Rt}\right) \tag{45}$$

$$\mu_t = \frac{m_t \pi_t}{m_{t-1}} \tag{46}$$

Symmetric equilibrium IV

The steady-state equilibrium

$$q = 1 \tag{47}$$

$$\xi = \frac{\theta - 1}{\theta} \tag{48}$$

$$R = \pi/\beta \tag{49}$$

$$f = SR/\pi \tag{50}$$

$$f = z + 1 - \delta \tag{51}$$

$$\lambda c = \left[1 + b\left(\frac{\pi}{\pi - \beta}\right)^{\gamma-1}\right]^{-1} \tag{52}$$

$$\lambda m = \lambda cb\left(\frac{\pi}{\pi - \beta}\right)^{\gamma} \tag{53}$$

Symmetric equilibrium V

$$\frac{k}{y} = \alpha \frac{\xi}{z} \tag{54}$$

$$\frac{c}{y} = 1 - \delta \frac{k}{y} \tag{55}$$

$$wh\lambda = \frac{(1-\alpha)(\lambda c)\xi}{c/y} \tag{56}$$

$$h = \frac{wh\lambda}{\eta + wh\lambda} \tag{57}$$

$$y = Ah\left(\frac{k}{y}\right)^{\alpha/(1-\alpha)} \tag{58}$$

$$i = \delta k \tag{59}$$

Symmetric equilibrium VI

The log-linearized equilibrium system

$$((1-\gamma)\lambda c - 1)\hat{c}_t = \gamma\hat{\lambda}_t + \frac{\lambda m(R-1)}{R}\left(\hat{b}_t + (\gamma-1)\hat{m}_t\right) - \gamma\hat{e}_t \tag{60}$$

$$\frac{\gamma\hat{R}_t}{(R-1)} = \hat{b}_t + \hat{c}_t - \hat{m}_t \tag{61}$$

$$h\hat{h}_t = (1-h)\left(\hat{w}_t + \hat{\lambda}_t\right) \tag{62}$$

$$\hat{y}_t = \alpha\hat{k}_t + (1-\alpha)\hat{h}_t + (1-\alpha)\hat{A}_t \tag{63}$$

$$y\hat{y}_t = c\hat{c}_t + i\hat{i}_t \tag{64}$$

$$\hat{w}_t = \hat{y}_t + \hat{\xi}_t - \hat{h}_t \tag{65}$$

$$\hat{z}_t = \hat{y}_t + \hat{\xi}_t - \hat{k}_t \tag{66}$$

$$\hat{\mu}_t = \hat{m}_t - \hat{m}_{t-1} + \hat{\pi}_t \tag{67}$$

Symmetric equilibrium VII

$$\hat{R}_t = \varrho_\pi \hat{\pi}_t + \varrho_\mu \hat{\mu}_t + \varrho_y \hat{y}_t + \varepsilon_{Rt} \tag{68}$$

$$\hat{f}_t = \frac{z}{f} \hat{z}_t + \frac{1-\delta}{f} \hat{q}_t - \hat{q}_{t-1} \tag{69}$$

$$\hat{q}_t = \chi \left(\hat{i}_t - \hat{k}_t \right) - \hat{x}_t \tag{70}$$

$$\hat{\pi}_t = \beta \hat{\pi}_{t+1} + \frac{(1-\beta\phi)(1-\phi)}{\phi} \hat{\xi}_t \tag{71}$$

$$\hat{\lambda}_{t+1} = \hat{\lambda}_t - \hat{R}_t + \hat{\pi}_{t+1} \tag{72}$$

$$\hat{k}_{t+1} = \delta \hat{i}_t + \delta \hat{x}_t + (1-\delta) \hat{k}_t \tag{73}$$

$$\hat{f}_{t+1} = \hat{R}_t - \hat{\pi}_{t+1} + \psi \left(\hat{q}_t + \hat{k}_{t+1} - \hat{n}_{t+1} \right) \tag{74}$$

$$\frac{\hat{n}_{t+1}}{vf} = \frac{k}{n} \hat{f}_t - \left(\frac{k}{n} - 1 \right) \left(\hat{R}_{t-1} - \hat{\pi}_t \right) - \psi \left(\frac{k}{n} - 1 \right) \left(\hat{k}_t + \hat{q}_{t-1} \right) + \left(\psi \left(\frac{k}{n} - 1 \right) + 1 \right) \hat{n} \tag{75}$$

Parameter calibration

Table 1
Parameter calibration

Parameters	Definition	Values
β	discount factor	0.9928
η	weight on leisure in the utility function	1.315
θ	intermediate-goods elasticity of substitution	6
δ	capital depreciation rate	0.025
b	constant associated with money demand shock	0.062
π	gross steady-state inflation rate	1.0079
ν	survival rate of entrepreneurs	0.9728
S	gross steady-state risk premium	1.0075
k/n	steady-state ratio of capital to net worth	2

Parameter calibration

Table 2
Maximum-likelihood estimates: 1979Q3 to 2004Q3

Parameters	FA model		EstNoFA model	
	Estimates	Std. errors	Estimates	Std. errors
ψ	0.0420	0.0137	–	–
χ	0.5882	0.1742	0.4913	0.1293
α	0.3384	0.0259	0.3741	0.0363
γ	0.0598	0.0039	0.0857	0.0211
ϕ	0.7418	0.0118	0.7674	0.0408
ϱ_π	1.4059	0.0788	1.3557	0.2098
ϱ_y	0.2947	0.0690	0.1379	0.0647
ϱ_μ	0.6532	0.0783	0.7212	0.2135
σ_R	0.0058	0.0003	0.0061	0.0013
ρ_A	0.7625	0.0262	0.7745	0.0561
σ_A	0.0096	0.0015	0.0128	0.0067
ρ_b	0.7206	0.0242	0.5547	0.0164
σ_b	0.0103	0.0008	0.0135	0.0028
ρ_z	0.6156	0.0194	0.7549	0.0380
σ_z	0.0073	0.0007	0.0083	0.0012
ρ_x	0.6562	0.0161	0.7930	0.0476
σ_x	0.0331	0.0039	0.0240	0.0055
LL	1911.2		1904.3	

Impulse responses I

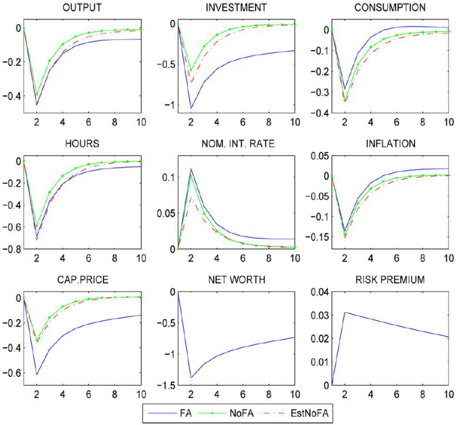

图: 1. The economy's responses to a tightening monetary policy shock.

1% positive shock to monetary policy(tightening):

- $y, i, c, h, \pi \downarrow$
- Financial accelerator mechanism $\Rightarrow$ net worth$\downarrow$, because return to capital$\downarrow$ and real interest costs$\uparrow$.
- The external finance premium$\uparrow$, reflecting leverage$\uparrow$.

Impulse responses II

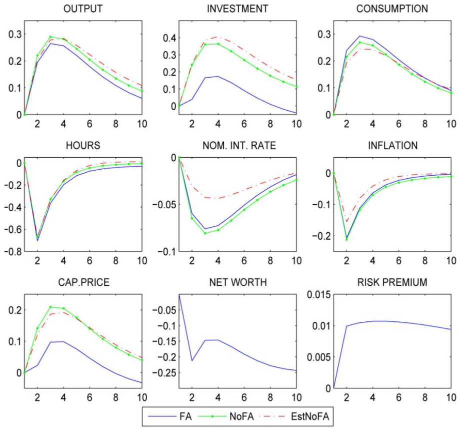

图: 2. The economy's responses to a positive technology shock.

1% positive technology shock:

- marginal consumption↑, investment↓.
- r, π ↓⇒ real cost of repaying existing debt↑, creating a **debt-deflation effect**⇒ net worth↓⇒ the external finance premium↑⇒ dampening the demand for capital↑⇒ **the response of investment and the price of capital to the technology shock are much smaller when the financial accelerator is present.**

Impulse responses III

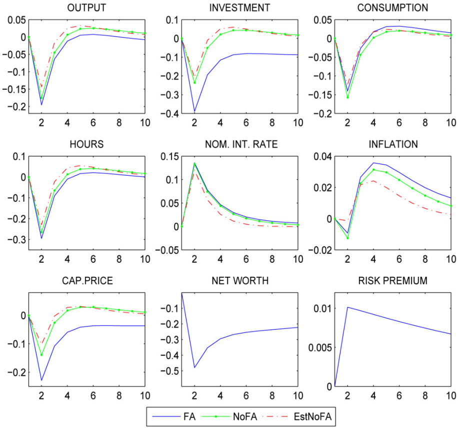

图: 3. The economy's responses to a positive money-demand shock.

1% positive money-demand shock:

- $C, S \downarrow \Rightarrow$ Y, I$\downarrow$.
- liquidity expected$\uparrow \Rightarrow \pi \uparrow \Rightarrow R, M\uparrow$, since the interest elasticity of money demand γ is small.
- In the FA model, there is much larger drop in investment and the price of capital owing to the accelerator effects.
- The lower returns to capital lead to net worth$\downarrow$ and external finance premium $\uparrow$.

Impulse responses IV

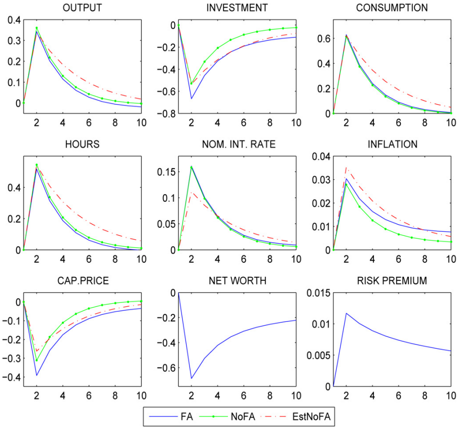

图: 4. The economy's responses to a positive preference shock.

1% positive preferencd shock:

- Marginal utility of consumption↑, therefore the opportunity cost of holding deposits (savings).
- As households divert deposits towards consumption, the return on deposits (risk-free real interest rate) ↑.
- Financial accelerator amplifies investment↓, but the responses of output and consumption are almost identical in the models with and without financial frictions.
- In the accelerator model, the real interest rate↑ has a larger effect on investment, due to net worth↓

Impulse responses V

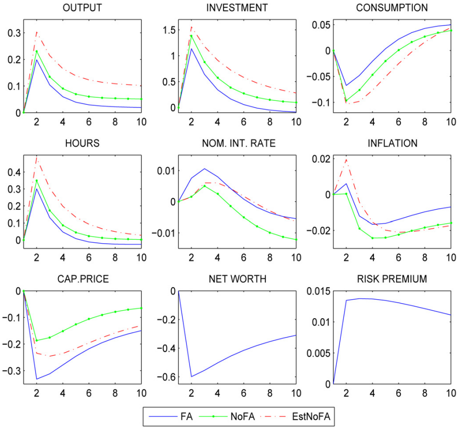

图: 5. The economy's responses to a positive investment-efficiency shock.

1%+ investment efficiency shock:

- The price of an efficiency unit of capital $q_t \downarrow$ and Y,I,H↑.
- In the FA model, the replacement cost of existing capital↓, the return on capital↓⇒net worth↓.
- The external finance premium↑⇒the cost of funding investment purchases↑, dampening investment↑.
- With less resources redeployed to purchase investment goods, the consumption↓ is less pronounced.

Impulse responses VI

- Overall, the presence of a financial accelerator mechanism, as proposed by Bernanke et al. (1999), significantly **amplifies and propagates** the impact of the **demand-side shocks—monetary policy, money demand, and preference shocks—on investment and the price of capital**.
- On the other hand, the financial accelerator mechanism **dampens (pushes down) the rise of output and investment following positive supply-side shocks—technology and investment-efficiency shocks.**

Volatility, autocorrelations, and cross-correlations I

Table 3
Standard deviations and relative volatilities: data and models

Var.	Data	All of the shocks			Demand shocks			Supply shocks			No investment shocks		
		FA	NoFA	EstNoFA	FA	NoFA	EstNoFA	FA	NoFA	EstNoFA	FA	NoFA	EstNoFA
						A. Standard deviations (in %)							
y_t	1.04	1.14	1.62	2.08	0.59	0.47	0.58	0.98	1.15	2.00	0.80	0.77	1.03
i_t	5.61	4.95	6.22	6.34	1.54	0.69	0.94	4.71	6.18	6.27	1.61	1.03	1.52
c_t	0.72	1.15	1.34	1.76	0.67	0.63	0.84	0.94	1.18	1.54	0.91	0.85	1.12
m_t	1.52	1.93	2.60	2.88	1.06	0.93	0.79	1.61	2.43	2.77	1.61	1.54	1.69
R_t	0.31	0.31	0.40	0.33	0.26	0.23	0.24	0.18	0.33	0.22	0.30	0.29	0.27
π_t	0.21	0.31	0.43	0.35	0.15	0.12	0.13	0.27	0.41	0.32	0.28	0.29	0.27
						B. Relative volatilities							
y_t	1	1	1	1	1	1	1	1	1	1	1	1	1
i_t	5.40	4.34	3.84	3.05	2.61	1.47	1.62	4.81	5.37	3.13	2.01	1.34	1.48
c_t	0.69	1.01	0.82	0.84	1.13	1.34	1.45	0.96	1.02	0.77	1.14	1.10	1.09
m_t	1.46	1.68	1.60	1.38	1.79	1.97	1.36	1.64	2.11	1.38	2.01	2.00	1.64
R_t	0.30	0.27	0.25	0.16	0.44	0.49	0.41	0.18	0.29	0.11	0.37	0.38	0.27
π_t	0.20	0.27	0.26	0.17	0.25	0.26	0.26	0.28	0.36	0.16	0.35	0.38	0.26

Volatility, autocorrelations, and cross-correlations II

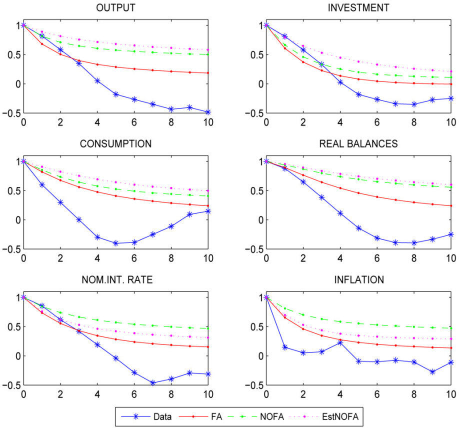

图: 6. Autocorrelations.

- The model with the active FA mechanism does a better job at matching the autocorrelations shown in the data within a four-quarter horizon.
- The FA model shows considerably lower autocorrelation in output, investment, consumption and real balances than the other models.
- while investment in the FA model is less autocorrelated than in the data, it is quite close at the 3- and 4-quarter horizon.

Volatility, autocorrelations, and cross-correlations III

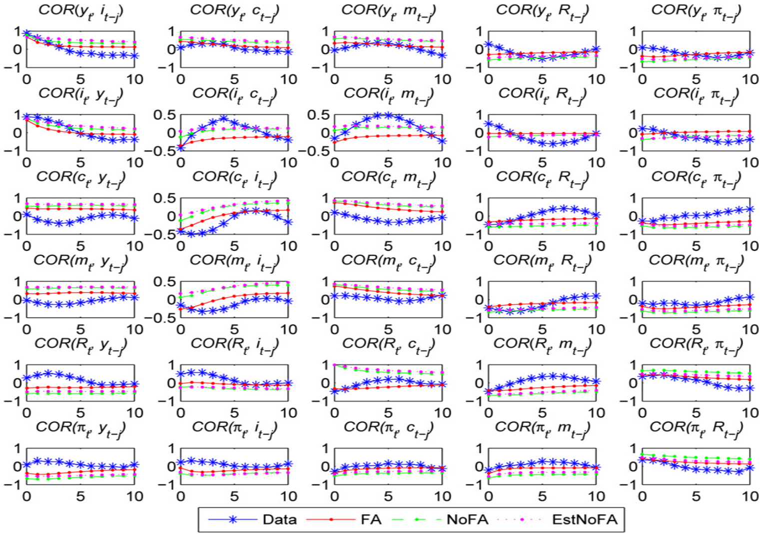

图: 7. Cross-correlations.

Variance decompositions I

Table 4
One-quarter-ahead forecast-error variance decompositions

Variable	Variance	Percentage owing to:				
		Technology	Mon. demand	Policy	Preference	Investment
			A. FA model			
y_t	0.0064	5.44	6.34	10.83	9.76	67.6
i_t	0.1490	0.01	1.08	2.47	1.59	94.8
c_t	0.0036	14.52	5.78	7.58	58.32	13.8
m_t	0.0060	34.93	18.71	29.53	0.00	17.25
R_t	0.0004	7.93	47.12	10.15	33.29	1.51
π_t	0.0005	84.60	0.19	13.29	1.05	0.86
			B. NoFA model ($\psi = 0$)			
y_t	0.0078	5.72	4.17	6.62	8.88	74.59
i_t	0.2131	0.25	0.28	0.53	0.70	98.24
c_t	0.0041	10.34	6.44	9.45	48.89	24.87
m_t	0.0061	33.22	17.85	30.0	0.01	18.92
R_t	0.0004	9.86	47.30	8.81	33.96	0.07
π_t	0.0005	84.29	0.33	14.53	0.84	0.00
			C. EstNoFA model			
y_t	0.0079	8.80	4.77	9.46	10.0	66.96
i_t	0.1457	0.69	0.551	1.38	1.35	96.03
c_t	0.0046	13.15	5.92	10.11	57.48	13.37
m_t	0.0058	37.66	12.43	37.35	0.01	12.54
R_t	0.0004	3.95	68.52	5.02	22.48	0.03
π_t	0.0005	77.03	0.01	16.98	1.67	4.31

Variance decompositions II

Table 5
Ten-quarter-ahead forecast-error variance decompositions

Variable	Variance	Percentage owing to:				
		Technology	Mon. demand	Policy	Preference	Investment
			A. FA model			
y_t	0.0117	23.48	3.88	9.60	8.05	54.96
i_t	0.2235	0.38	1.20	4.45	2.22	91.73
c_t	0.0096	37.80	2.75	3.39	35.44	20.60
m_t	0.0272	52.68	22.21	8.64	0.09	16.36
R_t	0.0009	26.39	34.81	7.41	26.87	4.50
π_t	0.0009	66.10	6.95	9.10	1.41	16.42
			B. NoFA model			
y_t	0.0168	21.01	2.22	4.07	6.42	66.26
i_t	0.3735	1.52	0.18	0.39	0.66	97.23
c_t	0.0096	31.67	3.15	5.41	33.21	26.55
m_t	0.0286	50.35	20.97	8.55	0.07	20.07
R_t	0.0009	30.65	31.25	5.18	24.78	8.14
π_t	0.0012	54.21	3.63	7.90	0.98	33.57
			C. EstNoFA model			
y_t	0.0247	27.35	1.79	4.44	6.86	59.55
i_t	0.3754	3.59	0.26	0.78	1.28	94.08
c_t	0.0141	36.17	2.23	4.95	42.04	14.61
m_t	0.0303	67.08	9.02	10.47	0.16	13.25
R_t	0.0007	21.41	45.20	3.78	27.83	1.77
π_t	0.0009	59.94	3.72	13.48	2.39	20.46

Variance decompositions III

Table 6
One-quarter-ahead forecast-error variance decompositions: excluding investment shocks

Variable	Variance	Percentage owing to:				
		Technology	Mon. demand	Policy	Preference	Investment
			A. FA model			
y_t	0.0021	16.82	19.57	33.47	30.14	0
i_t	0.0077	0.18	20.94	48.01	30.86	0
c_t	0.0031	16.84	6.71	8.80	67.65	0
m_t	0.0050	41.70	22.61	35.69	0.00	0
R_t	0.0004	8.06	47.84	10.30	33.80	0
π_t	0.0005	85.33	0.19	13.41	1.06	0
			B. NoFA model ($\psi = 0$)			
y_t	0.0020	22.54	16.44	26.06	34.96	0
i_t	0.0037	14.25	15.91	29.97	39.87	0
c_t	0.0031	13.79	8.58	12.57	65.08	0
m_t	0.0050	40.97	22.02	37.0	0.01	0
R_t	0.0004	9.86	47.33	8.82	33.99	0
π_t	0.0005	84.30	0.33	14.53	0.84	0
			C. EstNoFA model			
y_t	0.0026	26.63	14.43	28.64	30.29	0
i_t	0.0058	17.38	13.73	34.90	33.98	0
c_t	0.0040	15.12	6.84	11.67	66.36	0
m_t	0.0051	43.06	14.22	42.71	0.02	0
R_t	0.0004	3.95	68.54	5.02	22.49	0
π_t	0.0005	80.49	0.01	17.75	1.75	0

Conclusion

- The presence of a financial accelerator mechanism in our model significantly amplifies and propagates the impact of demand-side shocks —monetary policy, money demand, and preference shocks—on investment and the price of capital.
- However, the financial accelerator mechanism dampens (pushes down) the rise of investment following positive supply-side shocks—technology and investment-efficiency shocks. The role of the financial accelerator in investment fluctuations, therefore, depends on the nature of the shock.
- We also find that the initial impact of the accelerator on output and inflation is relatively minor in our model. This is partly due to the aggressive response of the monetary authority to output variations produced by our estimated policy rule.

感谢大家的聆听！