Course in Heterogeneity and Fluctuations

III: Financial Frictions, Asset Prices, and the Great Recession

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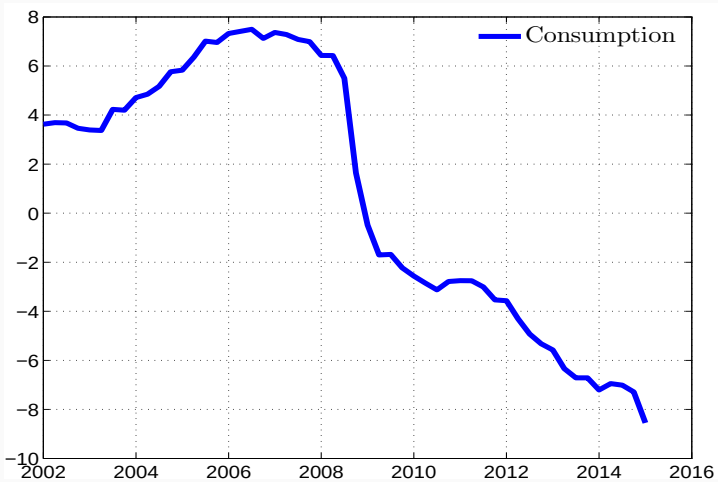
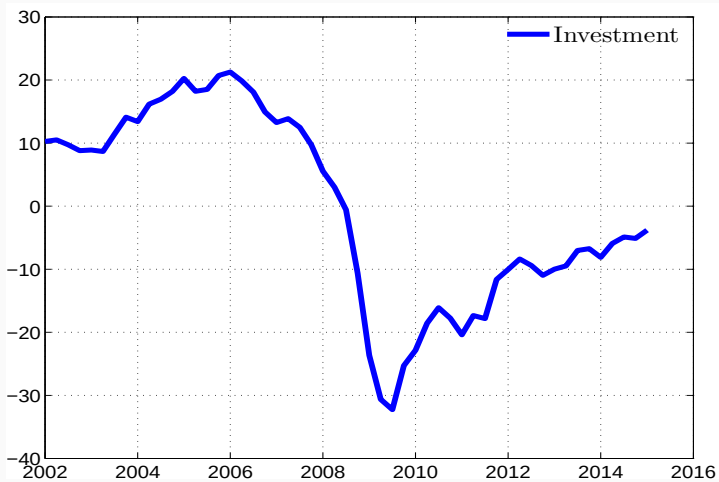
Nov/Dec 2019

Based on joint work with Zhen Huo

We have had a Great Recession

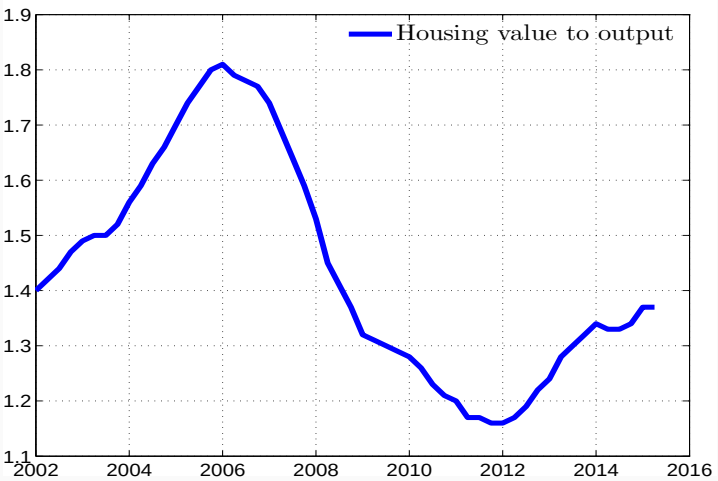
Facts on the last recession: output, unemp, cons, inv



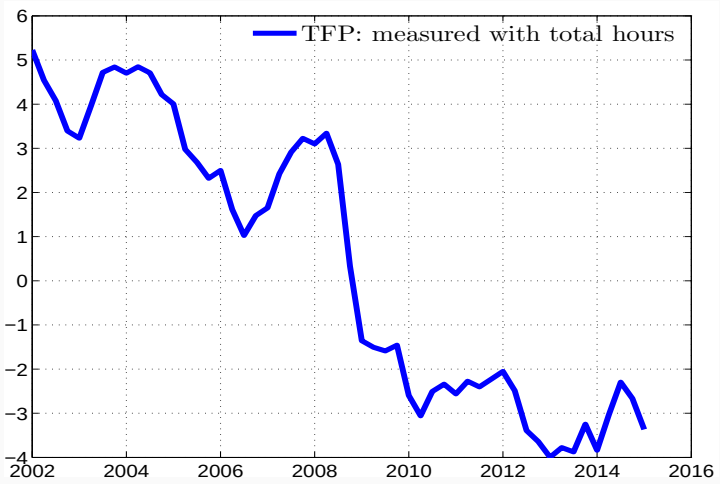


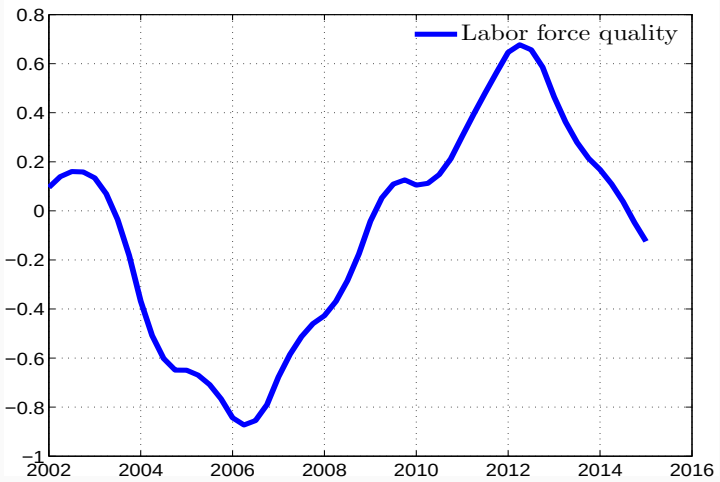
Note: Except for unemployment, figures show percentage deviation from a linear trend.

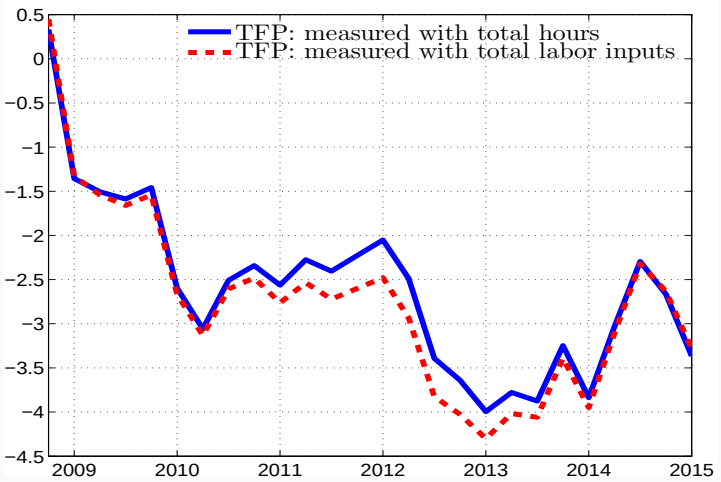
Facts on the last recession: wealth, mortg, houses, pr h



Facts on the last recession: productivity and labor quality







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- Financing difficulties contribute to cut spending both of firms and households.
- Most of the action occurs via a demand reduction.
- Yet models have a hard time to deliver this.

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  - A lot of wealth
  - Heterogeneity so that the financial frictions are not imposed

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5. Some labor market frictions that limit wage adjustments.

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2. Large reductions in assets (housing and stocks) prices.

1 Model

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The Model Characteristics: Steady State

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    2. Houses (land) that need to be purchased to be enjoyed.
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    4. Various job market frictions.

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- Households have assets a. These assets can be allocated to (frictionless) houses and/or to financial assets with a collateral constraint. The poor will have some housing wealth and a mortgage, the rich houses and shares of the economy's mutual fund.

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- Perfect competition and frictionless markets for tradables.

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  - Its return, r, is determined ex-post (it matters when we hit the economy with shocks). Possible capital gains and loses.

$$R(b) = \begin{cases} 1 + r, & \text{if } b \geq 0 \\ 1, & \text{if } b < 0. \end{cases}$$

Households' problem

$$V(\epsilon, e, a) = \max_{c_{N,i}, c_T, \mathrm{I}_N, h, d} u(c_A, h, d) +$$
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- The firm has to make sure that it can satisfy the demand at all locations.

Nontradable firms' problem

$$\Omega^N(k,n) = \max_{\substack{i,v,p_i \\ \ell_1,\ell_2}} \Psi^f[Q^g] p_i \int c(p_i,\epsilon,e,a)\,dx - w\ell - i - \kappa v + \sum_{\theta'} \Pi^{\theta}_{\theta,\theta'} \frac{\Omega^N(k',n')}{1+r^*} \qquad \text{s.t.}$$

$$\ell_2 \geq \Psi^f[Q^g] \int f^{\ell}[c(p_i,x),k,\ell_1] \frac{d(x,S)}{D} \qquad \text{DC}$$

$$\ell_1 + \ell_2 = n\bar{\epsilon} \qquad \text{SL}$$

$$k' = (1-\delta_k)k + i - \phi^N(k,i) \qquad \text{LMK}$$

$$n' = [1-\bar{\delta}_n]n + v \qquad \text{LML}$$

Tradable firms' are competitive and have adjustment costs

- Its output is used for exports, investment, and (part of) consumption.
- Decreasing returns.

$$\Omega^T(k,n) = \max_{i,v} F^T(k,\ell) - w\ell - i - \kappa v - \phi^{T,n}(n',n) + \sum_{\theta'} \Pi^{\theta}_{\theta,\theta'} \frac{\Omega^T(k',n')}{1+r^*} \qquad \text{s.t.}$$

$$k' = (1-\delta_k)k + i - \phi^{T,k}(k,i)$$

$$\ell = n\bar{\epsilon}$$

$$n' = [1-\bar{\delta}_n]n + v$$

Mutual fund

- Financial wealth in the economy is

$$L_+ = \int_{b>0} b(\epsilon, e, a)\, dx$$

- Mortgages in the economy are

$$L_- = \int_{b<0} -b(\epsilon, e, a)\, dx$$

- Net foreign asset position of the country (the mutual fund owns all firms)

$$B = L_+ - \left(\Omega^N - \pi^N + \Omega^T - \pi^T + \frac{1}{1+r^*} L_-\right)$$

- The realized rate of return is

$$1 + r = \frac{\Omega^N + \Omega^T + (1+r^*)B + L_-}{L_+}$$

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- We have to take care of wages dynamics. They are determined via the following formula Gornemann, Kuester, and Nakajima (2012).

$$\log w - \log \overline{w} = \varepsilon_w \left(\log Y - \log \overline{Y} \right)$$

- Solving the transition implies solving for sequences for home prices, wages, nontradable prices.

Equilibrium

An equilibrium is a set of decision rules and values for households, firms' values and decision rules, and a set aggregate variables of aggregate states, such that:

- Households' and firms' policy functions and value functions solve the corresponding program problems.
- Aggregate searching consistence

$$D = \int d(\epsilon, e, a)\, dx,$$

- Nontradable prices satisfies

$$p = p_i(K_N, N_N)\, dx,$$

- Housing market clears

$$\int h(\epsilon, e, a)\, dx = \mathrm{H}.$$

Equilibrium

- Average separation probability and labor force quality

$$\overline{\delta}_n = \frac{\sum_\epsilon \delta_n(\epsilon) n(\epsilon)}{N}, \qquad \overline{\epsilon} = \frac{\sum_\epsilon \epsilon\, n(\epsilon)}{N}$$

- Rate of return to the mutual fund satisfies

$$1 + r = \frac{\Omega^N + \Omega^T + (1 + r^*)B + \int_{b<0} b(x)}{\int_{b>0} b(x)}$$

2 Calibration

Mapping the Model to Data

Functional forms

- Preferences

$$u(c_A, h, d) = \frac{1}{1-\sigma_c}\left(c_A - \xi_d \frac{d^{1+\gamma}}{1+\gamma}\right)^{1-\sigma_c} + v(h)$$

- where there is an Armington aggregator for consumption

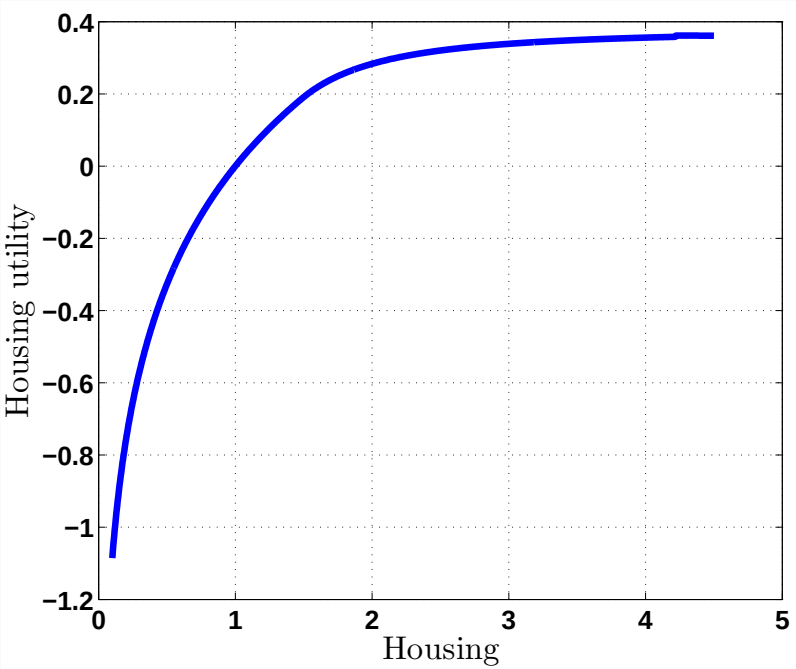
$$c_A = \left[\omega \left(c_N \mathrm{I}_N^{\rho}\right)^{\frac{\eta-1}{\eta}} + (1-\omega) c_T^{\frac{\eta-1}{\eta}}\right]^{\frac{\eta}{\eta-1}}$$

- and houses are inferior goods as a proxy for segmentation of housing markets

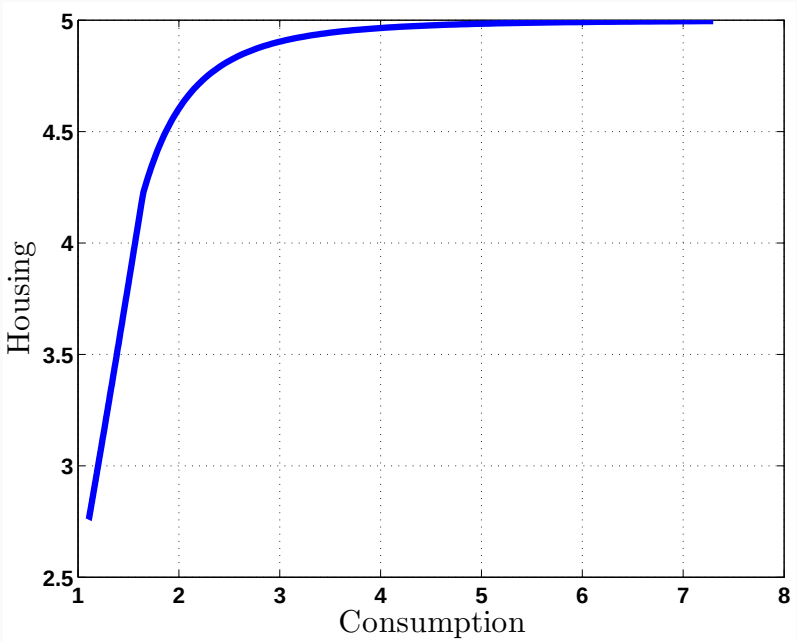
$$v(h) = \begin{cases} \xi_h \log(h), & \text{if } h < \widehat{h}_1 \\ \frac{\xi_h}{1-\sigma_h} h^{1-\sigma_h}, & \text{if } \widehat{h}_1 \leq h \leq \widehat{h}_2. \\ \xi_h \sqrt{\bar{h} - h}, & \text{if } h > \widehat{h}_2. \end{cases}$$

Housing Utility Function

Housing utility function



Engel Curve: consumption vs housing



Functional forms

- Production function

$$F^N(k, \ell_1, \ell_2) = z_N \; k^{\alpha_0} \; \ell_1^{\alpha_1} \; \ell_2^{\alpha_2}, \qquad F^T(k, \ell) = z_T k^{\theta_0} \ell^{\theta_1}$$

- Capital adjustment cost in the nontradable goods sector

$$\phi^N(i, k) = \frac{\psi}{2} \left(\frac{i}{k} - \delta_k \right)^2 k$$

- Capital and employment adjustment cost in the tradable goods sector

$$\phi^{T,k}(i, k) = \frac{\psi}{2} \left(\frac{i}{k} - \delta_k \right)^2 k, \qquad \phi^{T,n}(n', n) = \frac{\psi}{2} \left(\frac{n'}{n} - 1 \right)^2 n$$

- Matching technology

$$M(D, T) = \nu D^{\mu} T^{1-\mu}$$

Exogenously determined parameters

Parameter	Value
Risk aversion for consumption, σ_c	2.0
Satiation level for housing, $\overline{h}$	5.0
Curvature of shopping, γ	1.5
Elasticity of substitution bw tradables and nontradables, η	0.80
Price markup, ρ	1.1
Loan to value ratio, λ	0.80
Interest rate for international bonds, r^*	4%

Note: model period is half a quarter

Endogenously determined parameters: aggregate

Target	Value	Parameter	Value
Wealth to output ratio	4.00	β	0.97
Housing value to output ratio	1.70	ξ_h	0.54
Debt to output ratio	0.40	$\epsilon_{\mathbf{4}}$	37.41
Fraction of housing held by bottom 70%	0.25	$\widehat{h}_{\mathbf{1}}$	1.48
Fraction of housing held by bottom 80%	0.39	$\widehat{h}_{\mathbf{2}}$	4.22
Fraction of housing held by bottom 90%	0.58	σ_h	2.92
Share of tradables	0.30	ω	0.98
Occupancy Rate	0.81	ν	0.81
Capital to output ratio	2.00	δ_k	0.01
Labor Share in nontradables	0.64	$\alpha_{\mathbf{0}}$	0.27
$\alpha_{\mathbf{1}} = \alpha_{\mathbf{2}}$	——	$\alpha_{\mathbf{1}}$	0.36
Labor Share in tradables	0.66	$\theta_{\mathbf{1}}$	0.66
Vacancy cost to output ratio	0.02	κ	0.42
Home production to lowest earning ratio	0.50	$\overline{w}$	0.07
Units Parameters			
Output	1	z_N	0.93
Relative price of nontradables	1	z_T	0.48

Endogenously determined parameters: cross-section

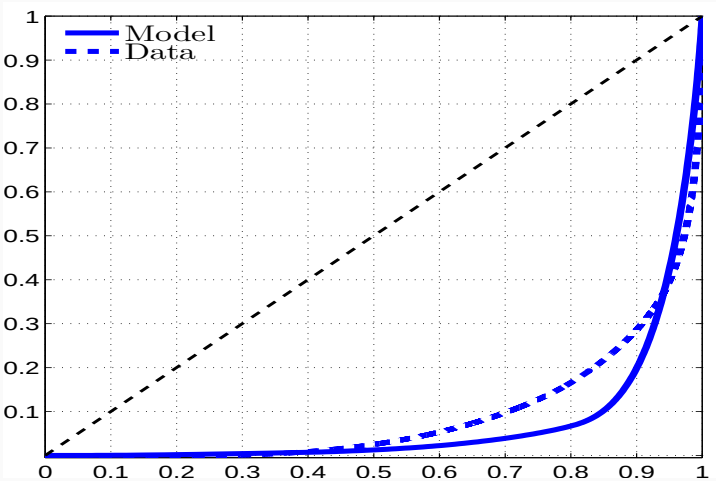
Lorenz

Target	Value	Parameter	Value
Job duration for type 1	1.5 year	$\delta_n^{\mathbf{1}}$	0.083
Job duration for type 3	5 year	$\delta_n^{\mathbf{3}}$	0.025
Job duration for type 4	5 year	$\delta_n^{\mathbf{4}}$	0.025
Unemployment rate	6%	$\delta_n^{\mathbf{2}}$	0.048
Wealth Gini index	0.82	$\Pi^{\epsilon}_{\mathbf{1},\mathbf{4}}$	0.0007
Earnings Gini index	0.64	$\Pi^{\epsilon}_{\mathbf{4},\mathbf{1}}$	0.0058
Earning autocorrelation	0.91	$\Pi^{\epsilon}_{\mathbf{1},\mathbf{1}}$	0.9656
Earning stdev	0.20	$\Pi^{\epsilon}_{\mathbf{2},\mathbf{2}}$	0.9770

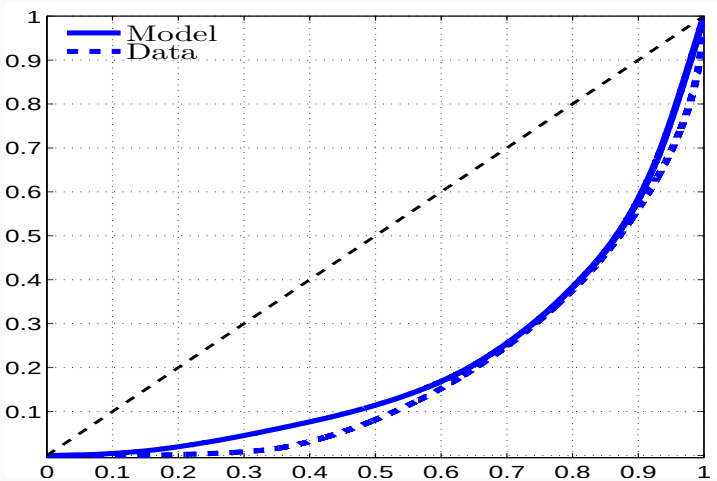
Lorenz Curve

Return

Networth

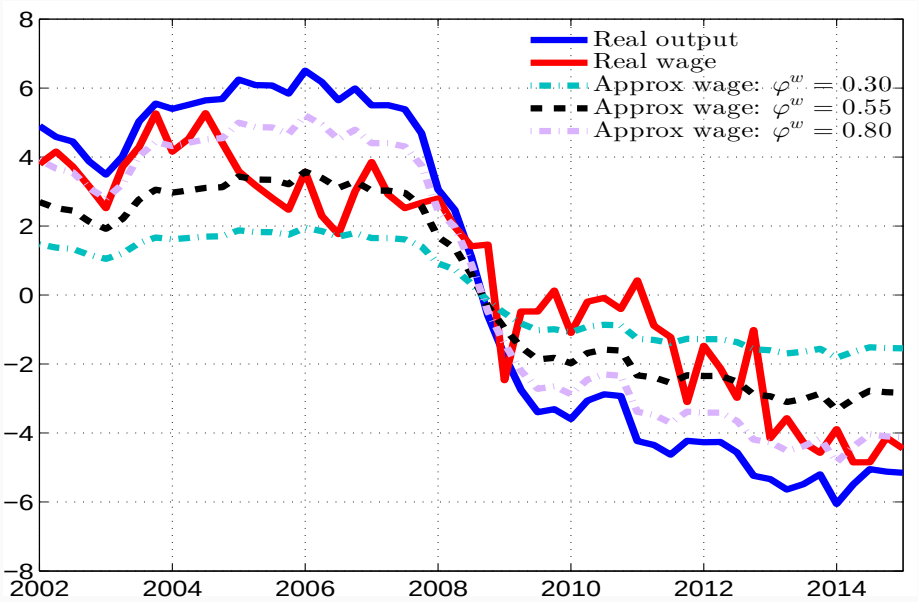


Housing



Dynamic Parameter I

- Real wage rule: $\log \frac{w_t}{P_t} - \log \frac{\overline{w}}{\overline{P}} = \varphi^w \left(\log Y_t^* - \log \overline{Y} \right)$
- Choose $\varphi^w = 0.55$: match correlation between real output and real wage
- Consistent with the movement during the Great Recession



Dynamic Parameter II

Summary of Dynamic Parameters

Parameter	Value	Target
Adjustment cost, ψ	1.60	Decrease in investment: 30%
DRS in tradables, $\theta_{\mathbf{0}}$	0.21	Increase in tradable sector: 4%
Goods market matching elasticity in, μ	0.80	Decrease in TFP: 1.5%
Wage elasticity, φ_w	0.55	Ratio of wage to output change: 0.55

Experiments: once and for all set of surprises

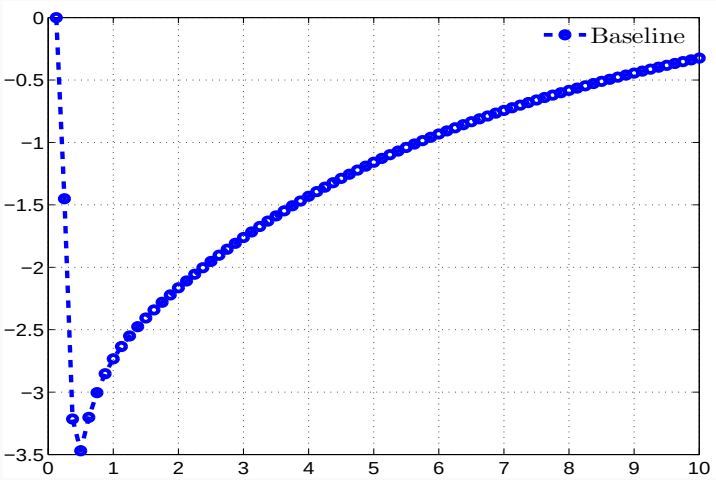
1. Baseline
    - Over three months the down payment changes from 20% to 40%
    - The borrowing interest rate's surcharge goes from zero to 0.5%
2. Decomposition: with only down payment or interest rate change
3. Role of asset price: constant housing price
4. Role of frictions: wage elasticity, matching frictions and adj costs
5. Allowing default: a larger drop of housing price
6. Credit cycle

Long Run Properties

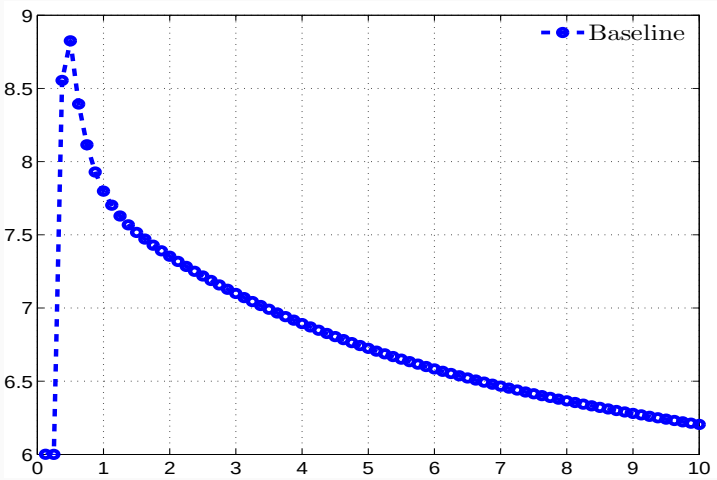
- Typically like in all Aiyagari (1994) - Bewley (1986) - Huggett (1993) - Imrohoroğlu (1989) type models, in the long run output and wealth end up being higher.

- But in our economies the transition is associated to a recession.

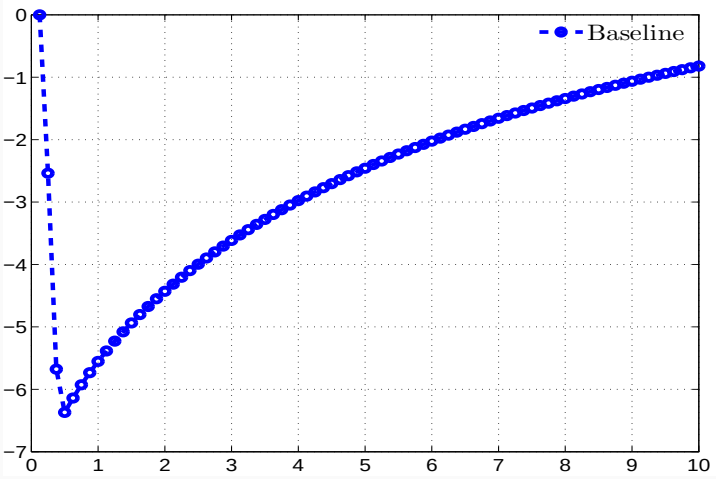
Experiment 1: Baseline



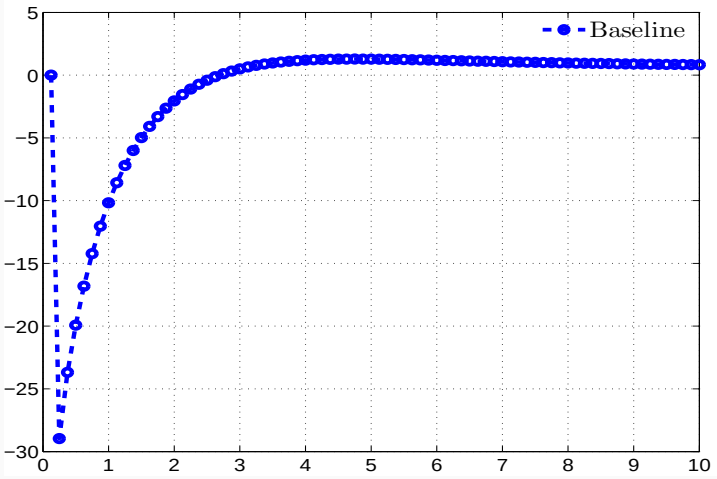
Real output



Unemployment

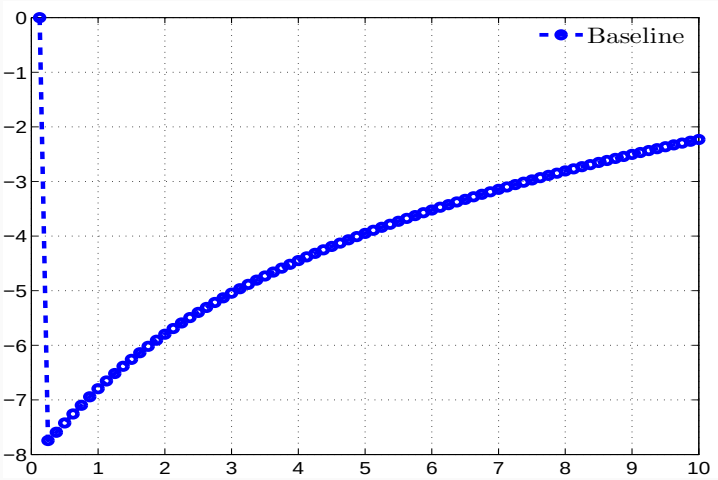


Consumption

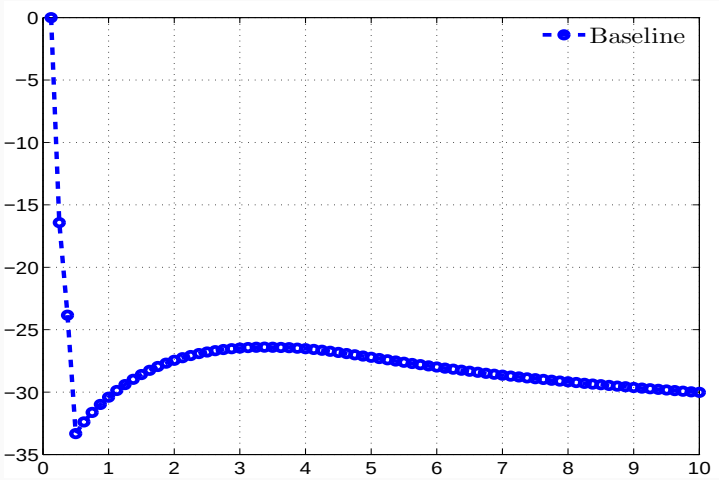


Investment

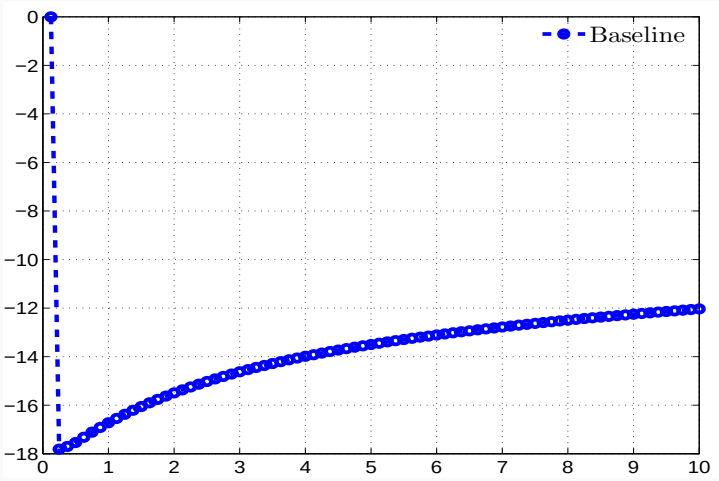
Experiment 1: Baseline



Wealth

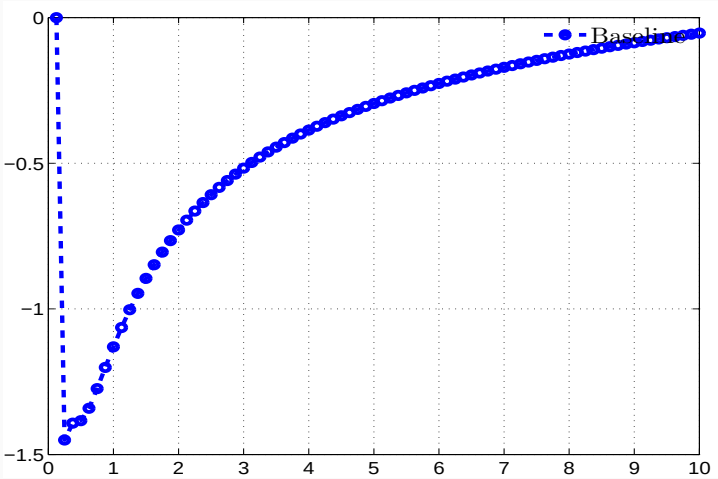


Debt

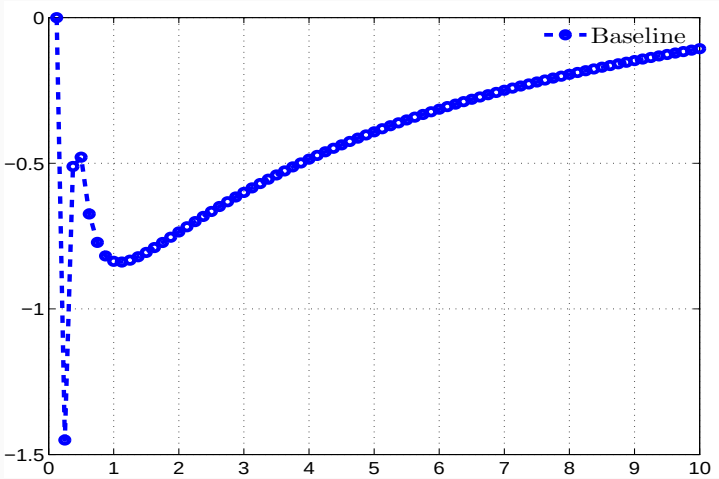


Housing price

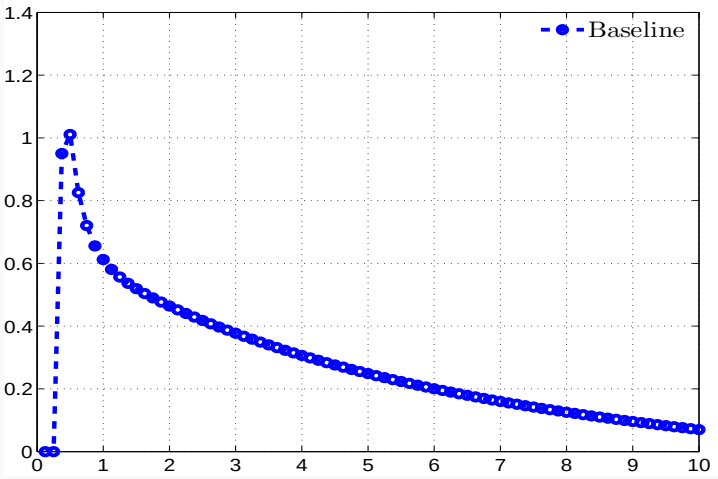
Experiment 1: Baseline



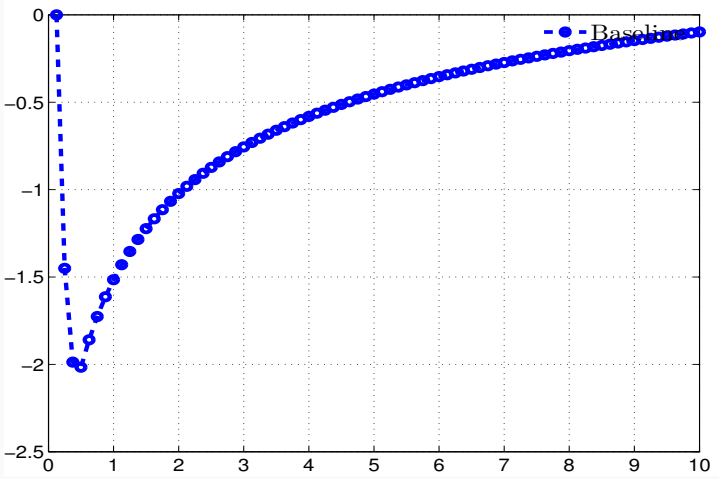
TFP with total hours



Labor Productivity

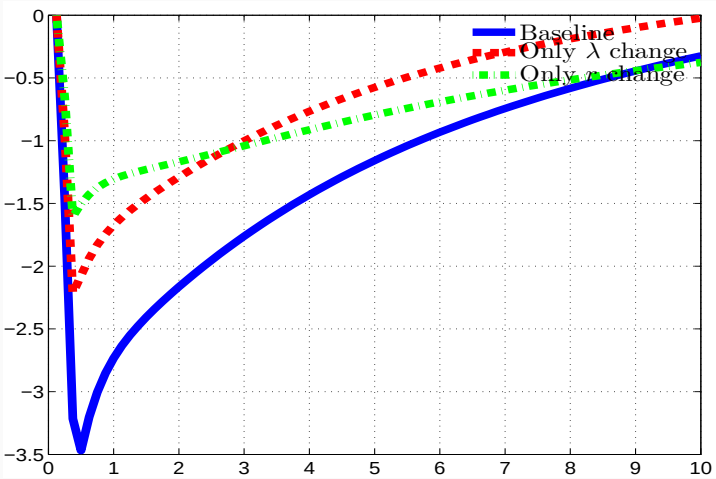


Labor quality

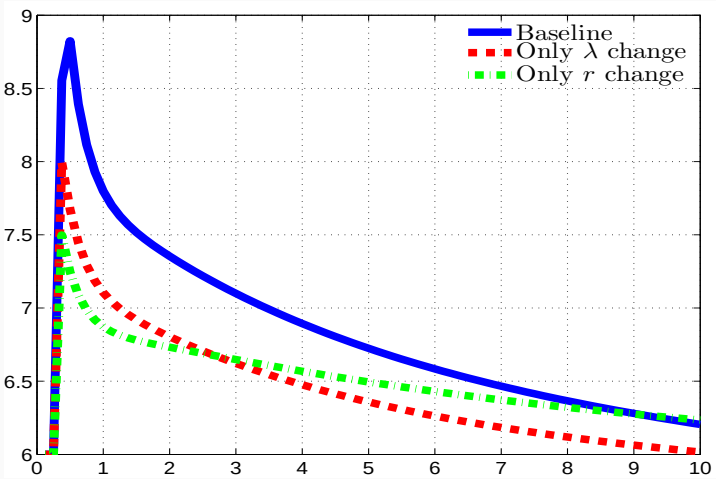


TFP with total labor inputs

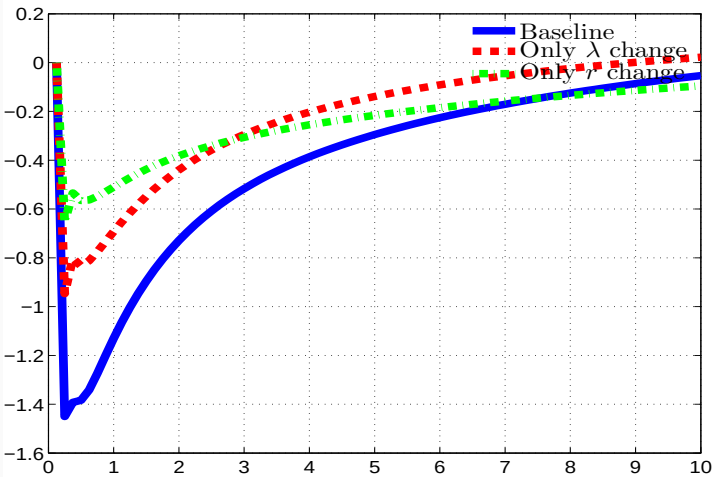
Experiment 2 : Only λ or r Change



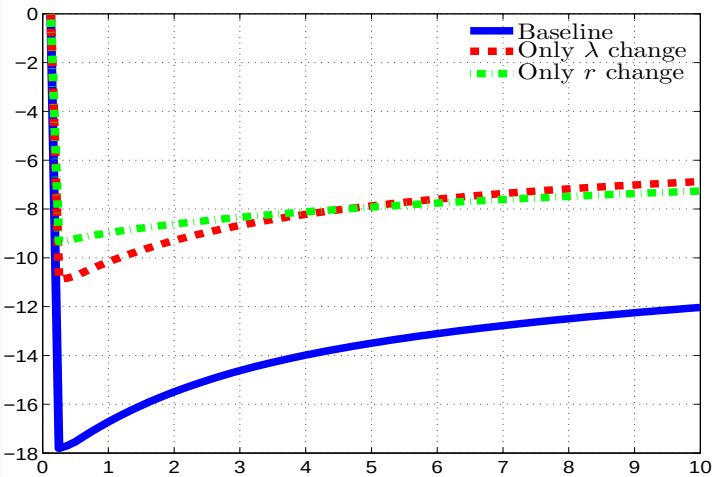
Real output



Unemployment rate

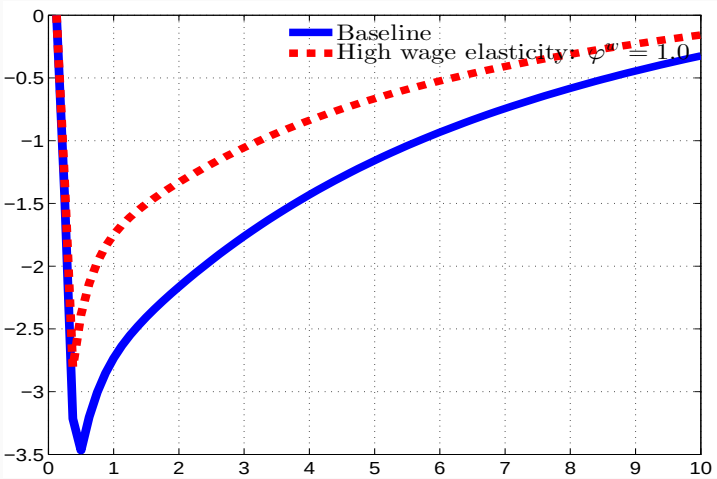


TFP

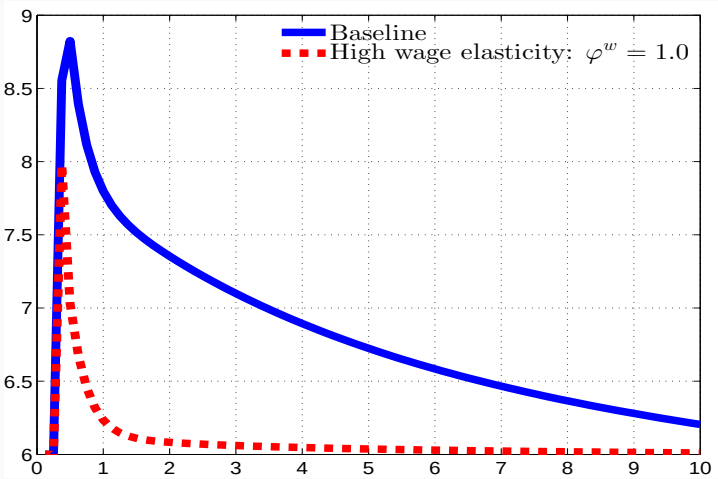


Housing price

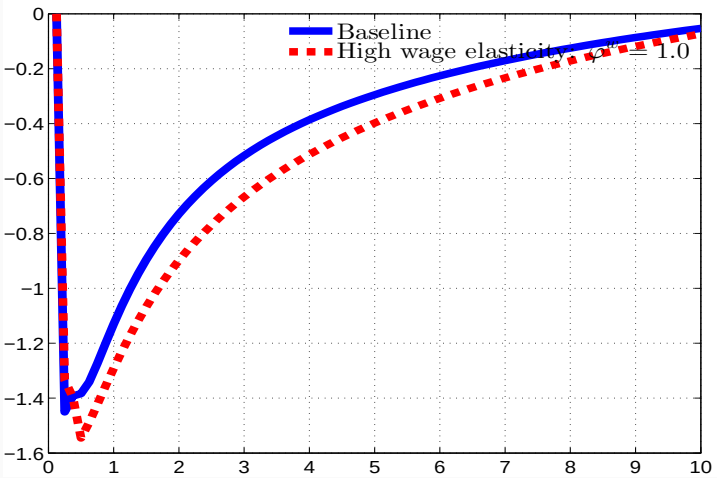
Experiment 4.1: Wage Elasticity



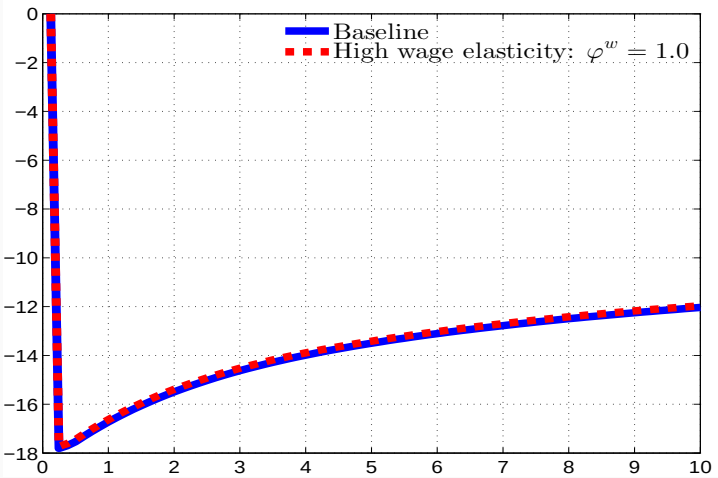
Real output



Unemployment rate

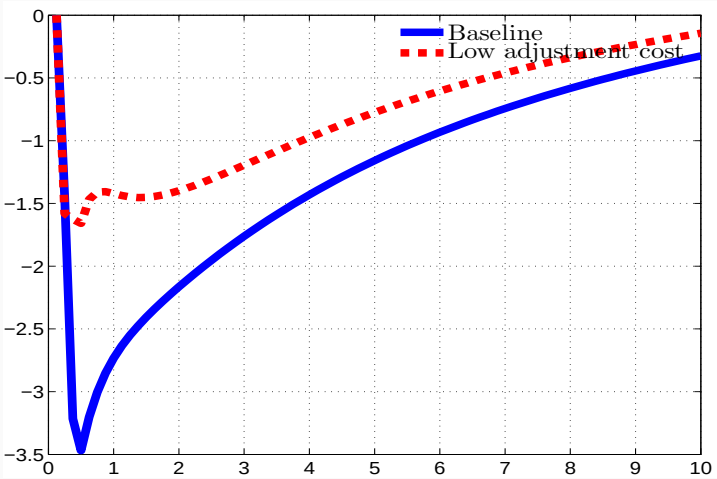


TFP

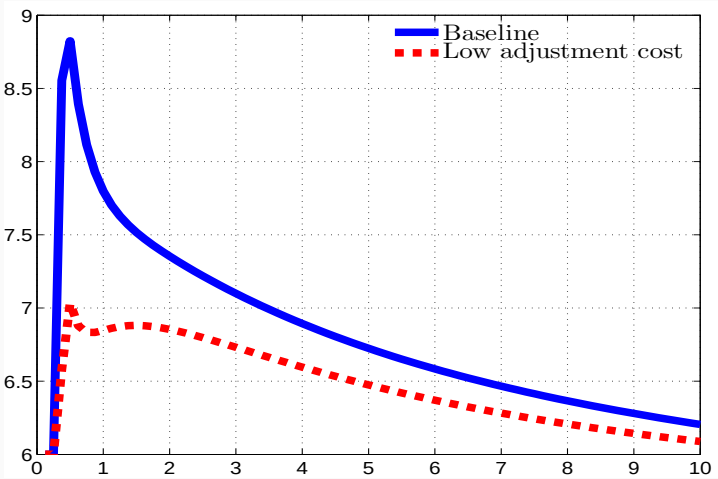


Housing price

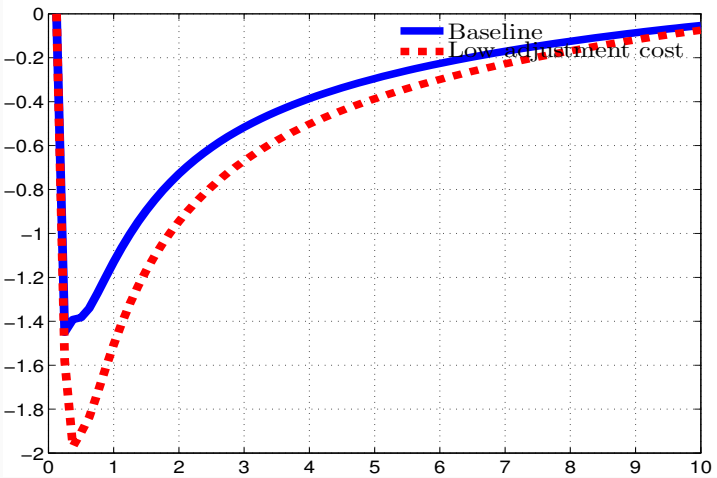
Experiment 4.2: Adjustment Cost



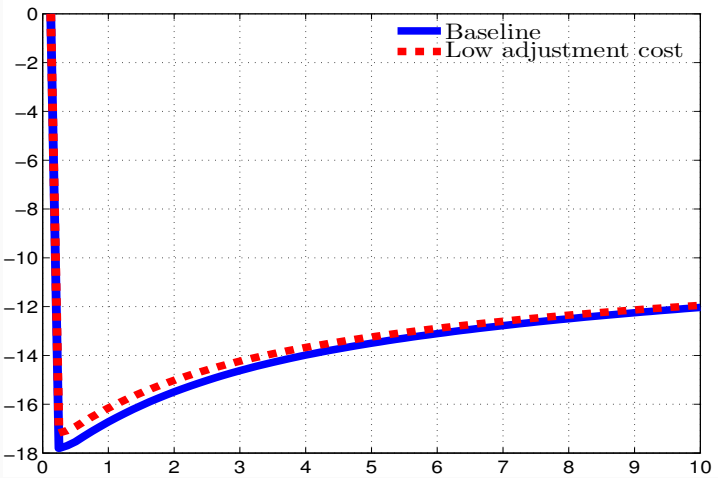
Real output



Unemployment rate

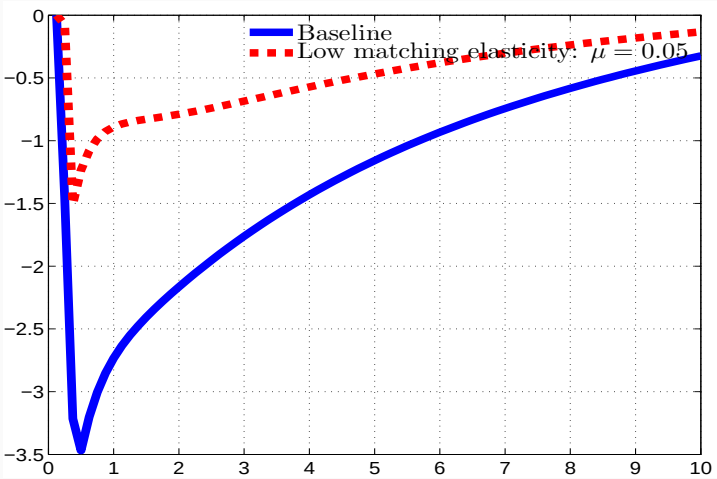


TFP

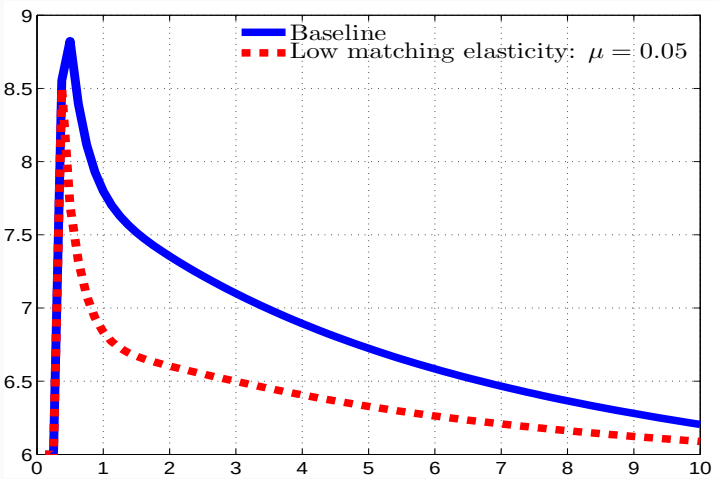


Housing price

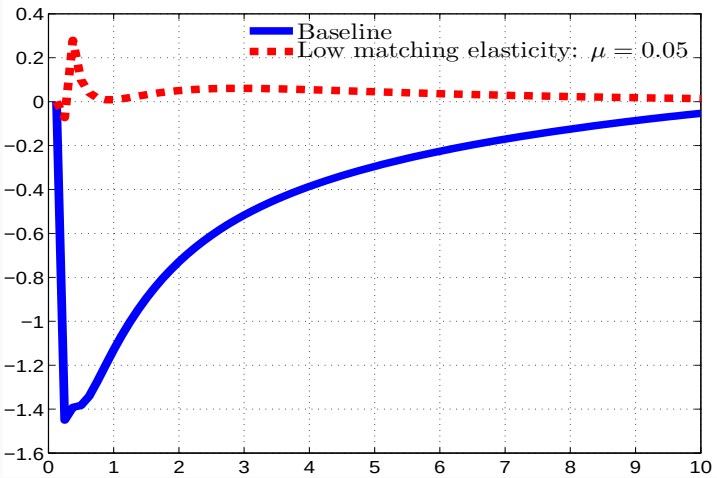
Experiment 4.3: Goods Market Frictions



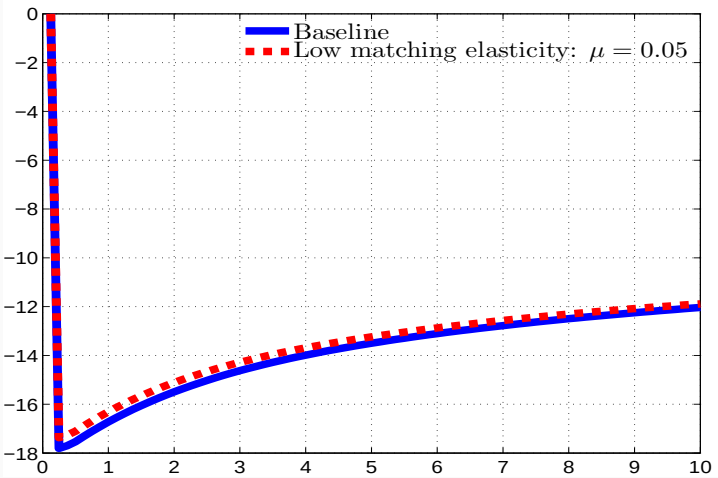
Real output



Unemployment rate

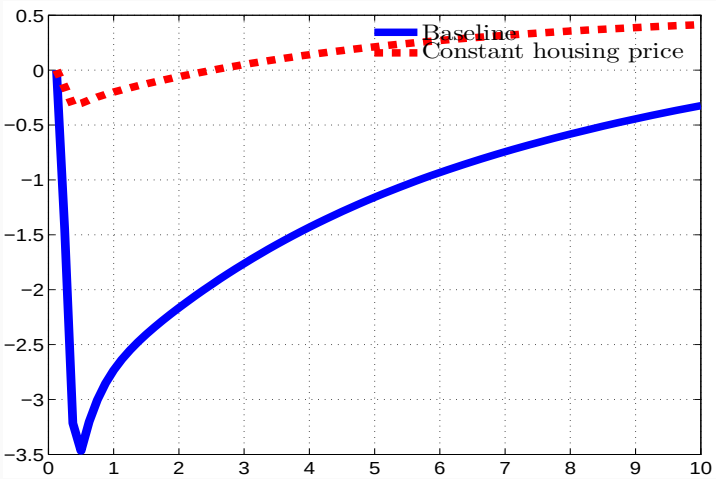


TFP

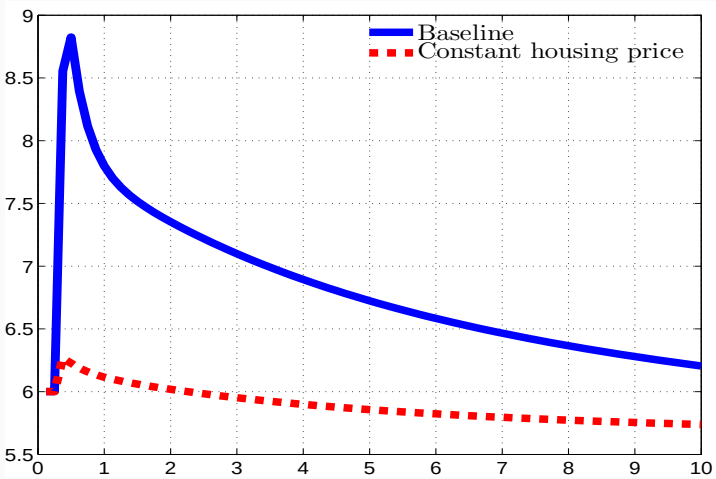


Housing price

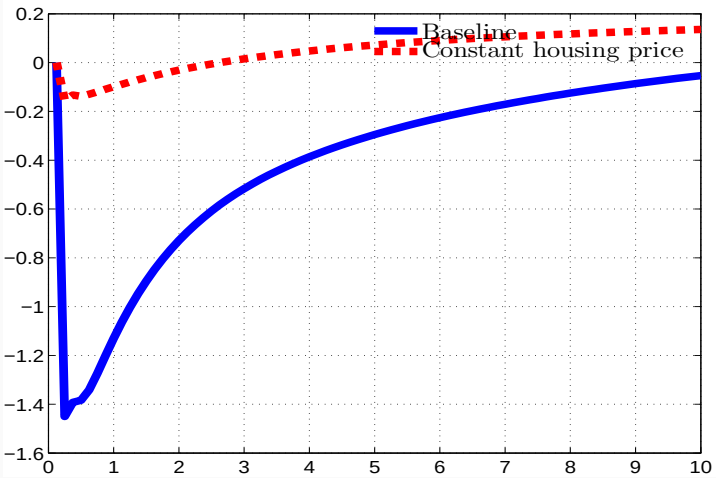
Another Experiment: Constant Housing Prices



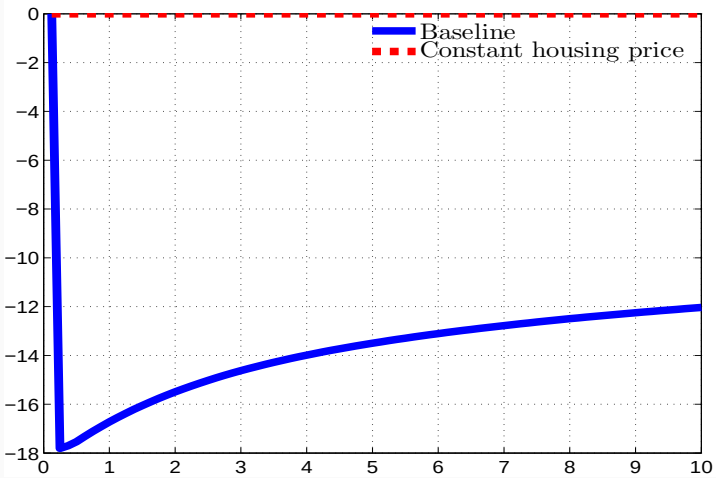
Real output



Unemployment rate



TFP



Housing price

Experiment 5: Allowing Households Holding no Housing

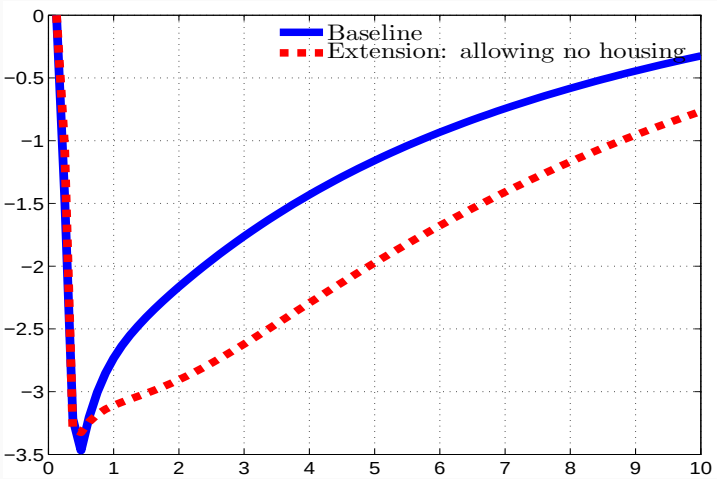
- 30% of households hold zero houses in the United States

- Change preference slightly to match this moment

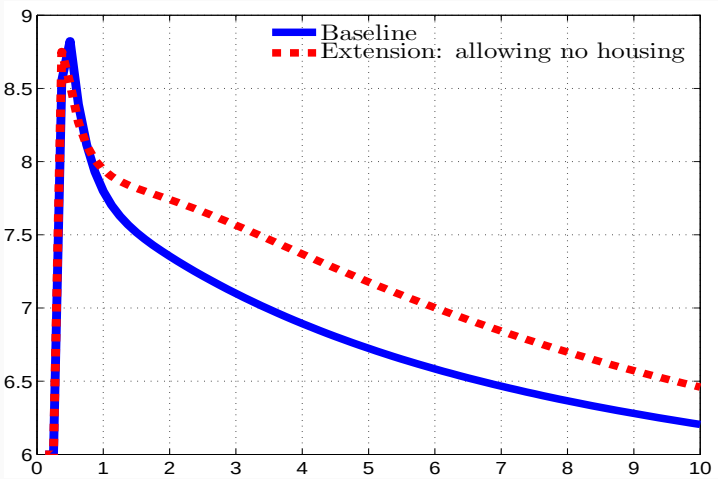
$$v(h) = \begin{cases} \xi_h \log(h + \underline{h}), & \text{if } h < \widehat{h}_1, \\ \frac{\xi_h}{1-\sigma_h}\left(h + \xi_h^1\right)^{1-\sigma_h} + \xi_h^2, & \text{if } \widehat{h}_1 \leq h \leq \widehat{h}_2, \\ \xi_h^3 \sqrt{\overline{h}^2 - (\overline{h} - h)^2} + \xi_h^4, & \text{if } h > \widehat{h}_2. \end{cases}$$

- Similar aggregate response, but richer cross-sectional implications

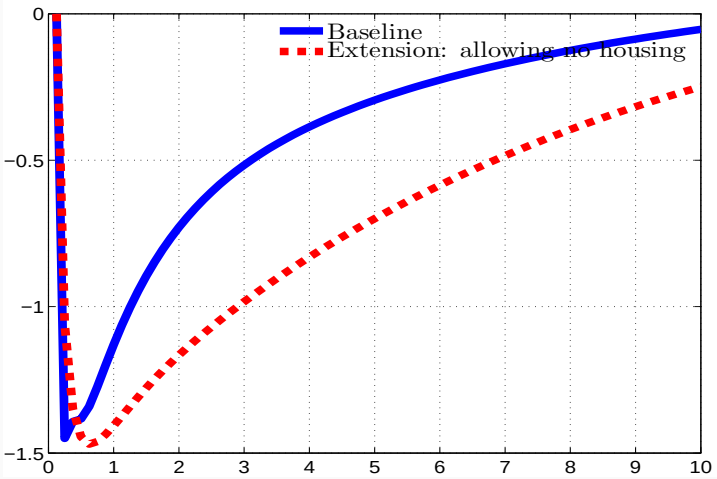
Experiment 5: Aggregate Response



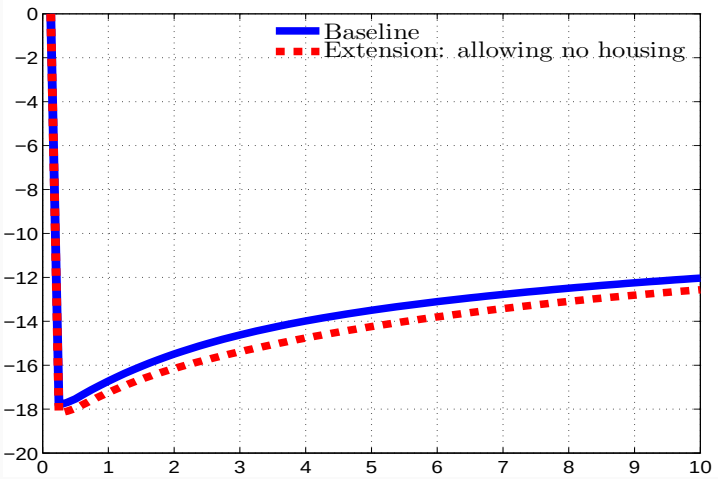
Real output



Unemployment rate

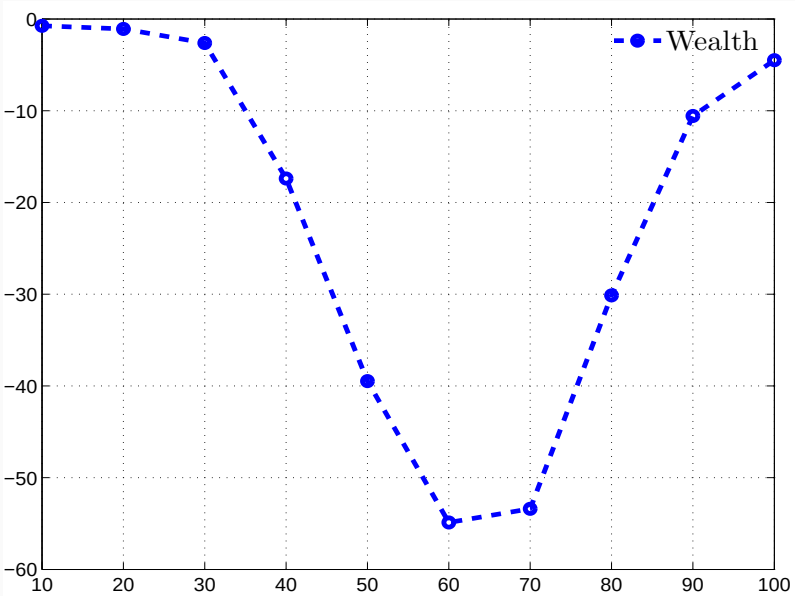


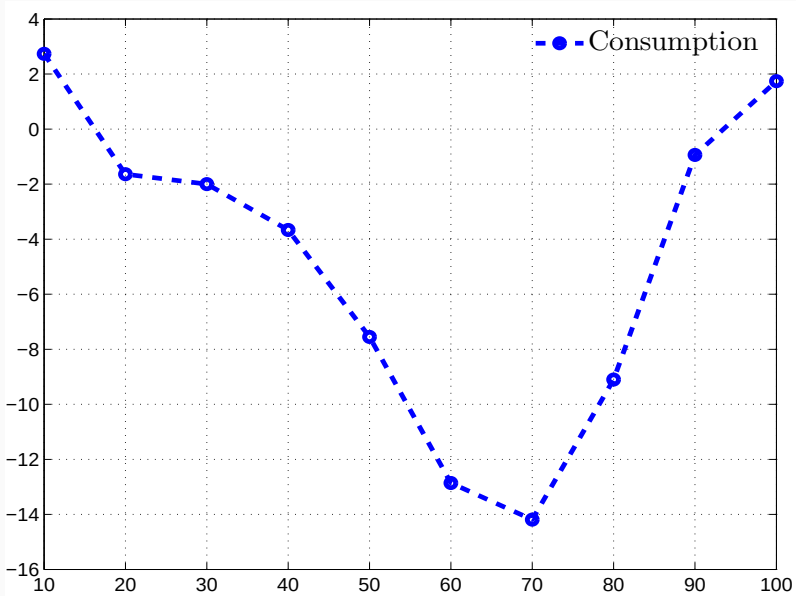
TFP



Housing price

Experiment 5: Cross-Sectional Effects





- This agrees with the evidence in Petev, Pistaferri, and Eksten (2012) and Parker and Vissing-Jorgensen (2009)

Experiment 6: Allowing Default

- Borrowing interest rate's surcharge goes from zero to 1%.
- Housing price drops more than 20%, and agents may be underwater.
- Allow borrowers to default, but savers suffer from the capital loss.

Experiment 6: Allowing Default

- Total saving in financial wealth in the economy is

$$L_{+,t} = \int_{b>0} b_t(\epsilon, e, a)\, dx$$

- Mortgages in the economy are

$$L_{-,t} = \int_{b<0} -b_t(\epsilon, e, a)\, dx$$

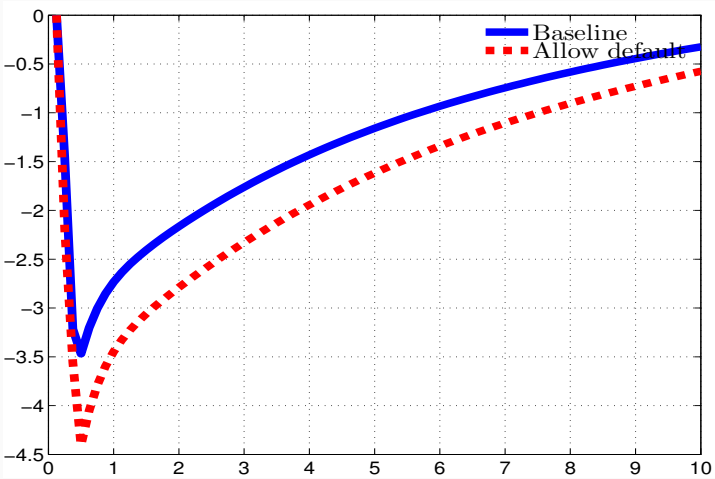
- Net foreign asset position of the country

$$B_t = L_{+,t} - \left(\Omega_t^N - \pi_t^N + \Omega_t^T - \pi_t^T + \frac{1}{1+r^*} L_{-,t}\right)$$

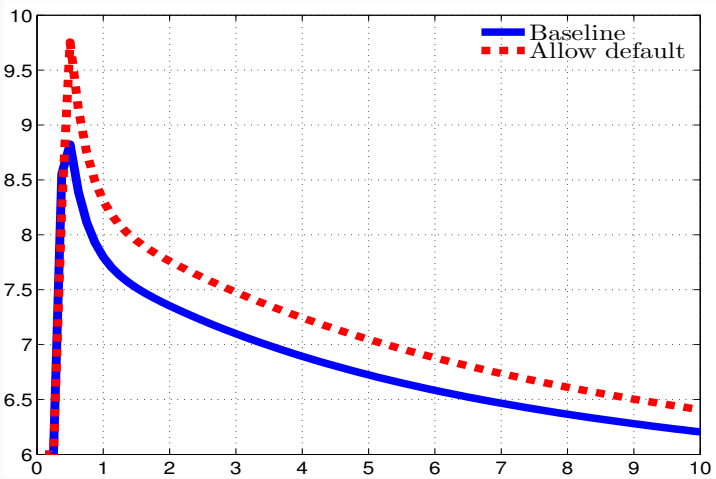
- The realized rate of return in next period is

$$1 + r_{t+1} = \frac{\Omega_{t+1}^N + \Omega_{t+1}^T + (1+r^*)B_t}{L_+} - \frac{\int_{b<0} \mathbb{I}_{p_{h,t+1} h_t(\epsilon,e,a)+b_t(\epsilon,e,a)>0}[p_{h,t+1} h_t(\epsilon, e, a) + b_t(\epsilon, e, a)]\, dx}{L_+}$$

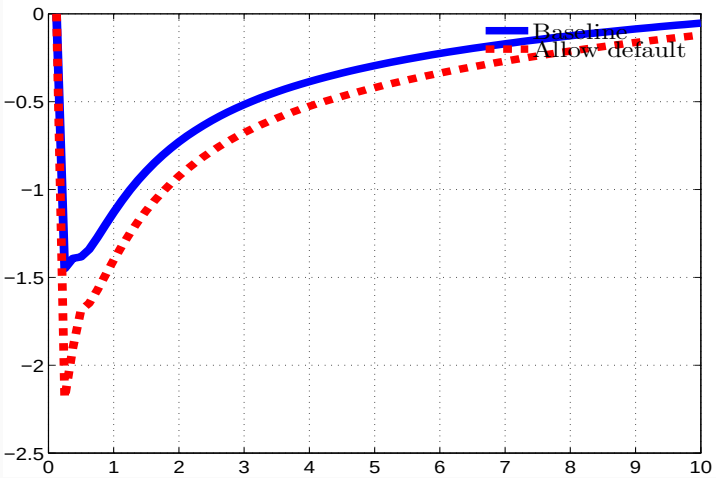
Experiment 6: Allowing Default



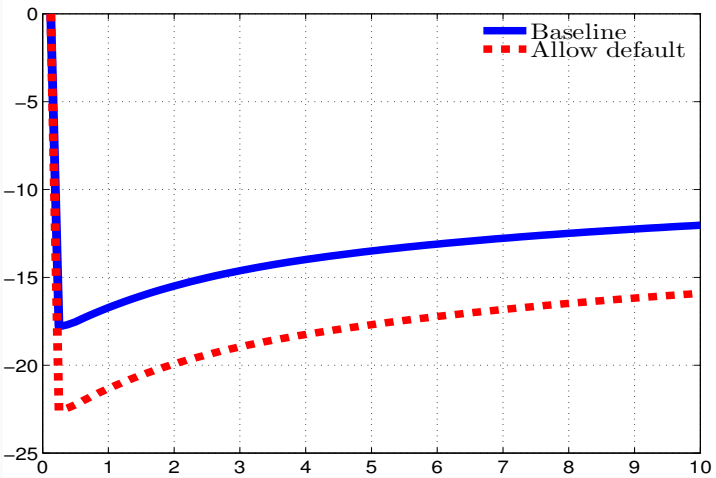
Real output



Unemployment rate

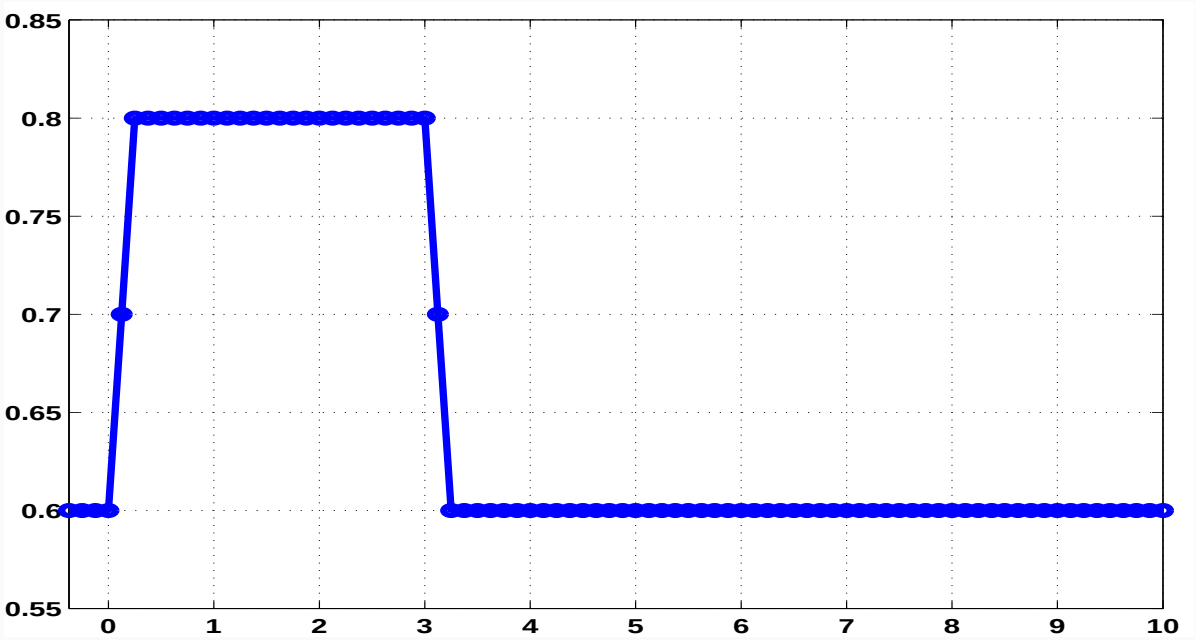


TFP



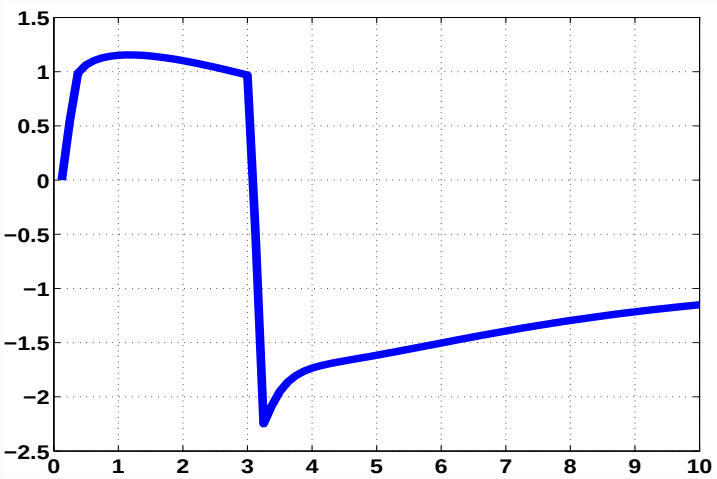
Housing price

Experiment 7: Credit Cycle

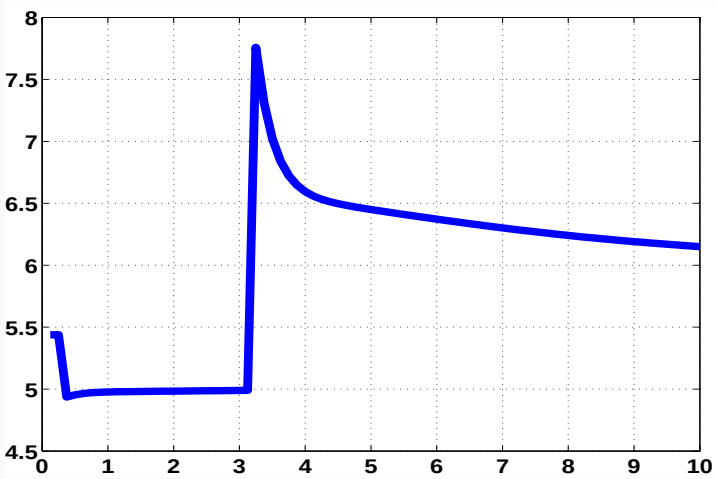


Loan to value ratio λ

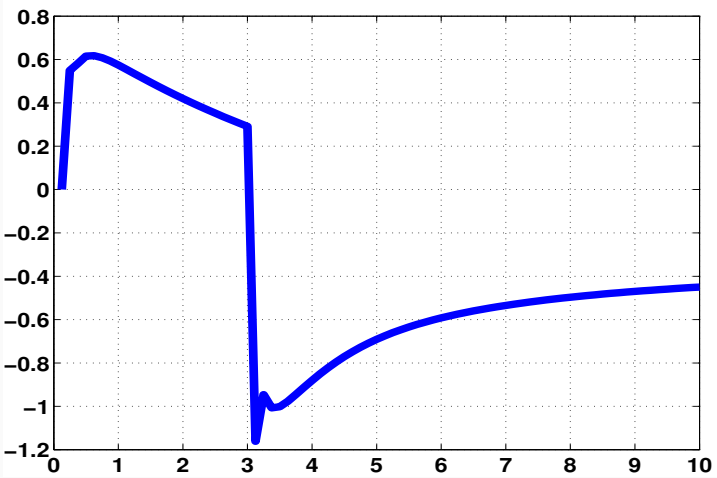
Experiment 7: Credit Cycle



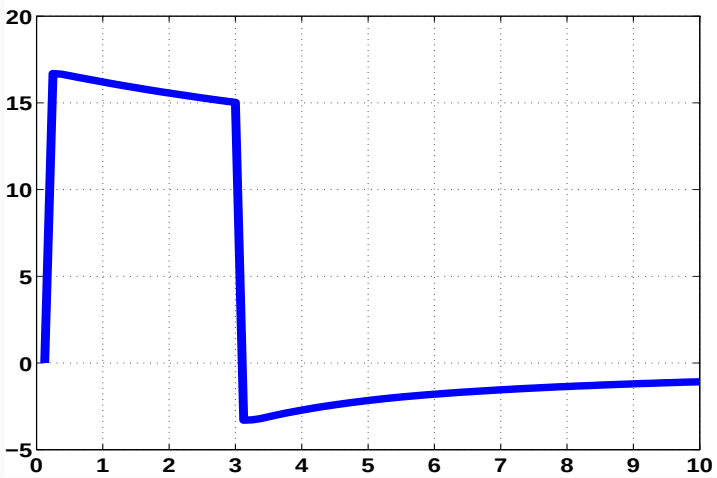
Real output



Unemployment rate



TFP



Housing price

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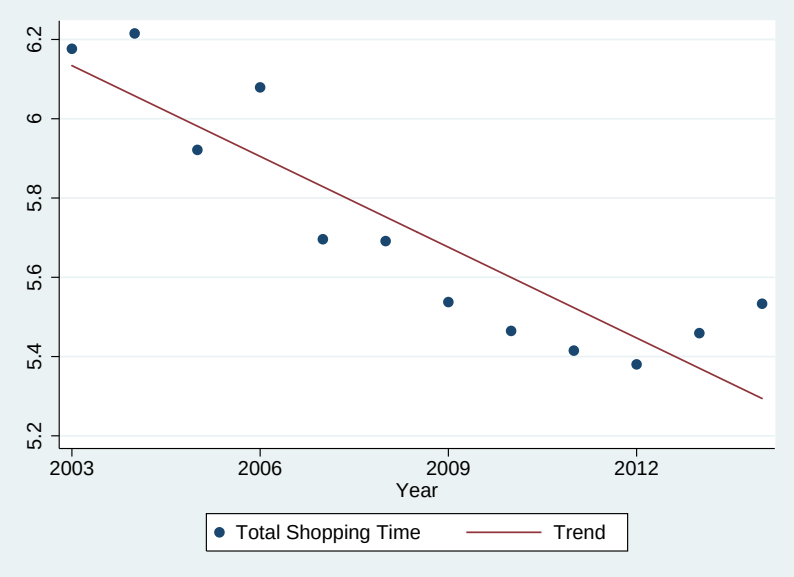
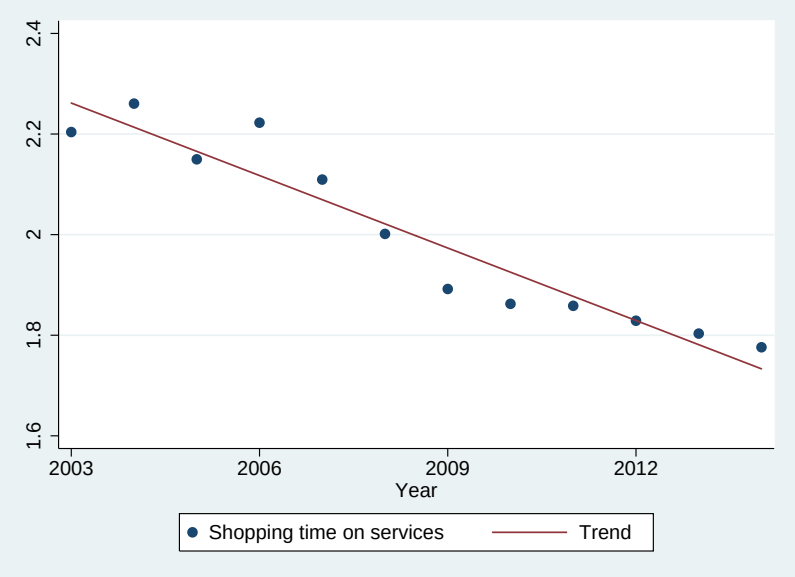
Thank you very much

American Time Use Survey Data on Shopping Time



Total shopping time



Shopping time on services

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- Firms make themselves vulnerable by being close to their credit limit to improve their bargaining position over wages Monacelli, Quadrini, and Trigari (2011)

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- Straight shocks to credit constraints Jermann and Quadrini (2012), Perri and Quadrini (2011), Macera (2015).

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- It may have played a larger role in the expansion of new firms (Dyrda (2015))

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