Labor Market Shocks and Monetary Policy

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The views expressed here are those of the authors and do not necessarily reflect the views of the Federal Reserve Bank of St. Louis or Bank of Canada.

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- U.S. employer-to-employer (EE) transition rate is procyclical and persistent.
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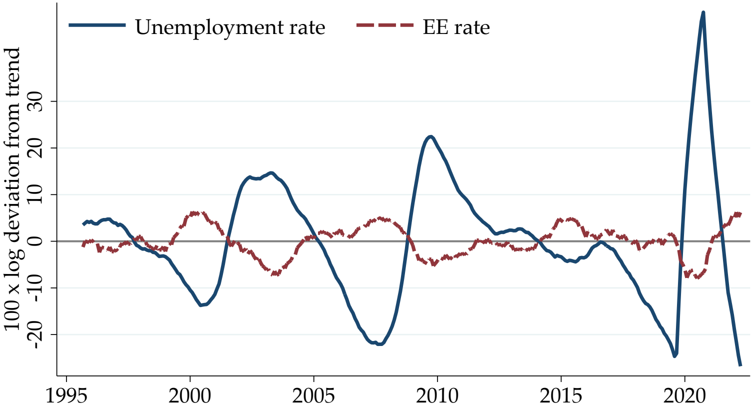
- Relative strength of wage vs productivity growth over the cycle can determine inflation.
  - Potential implications for monetary policy.

Comovement of Unemployment and EE Flows



Weakening correlation between unemployment and EE rates between 2016–2019.

Labor Costs

Questions

1. **Positive:** How do fluctuations in EE flows affect inflation dynamics?

2. **Normative:** What is the optimal monetary policy accounting for EE dynamics?

This Paper

- Develop HANK model with frictional labor market and on-the-job search (OJS).
  - income risk cyclicality and corr. with MPC. Acharya and Dogra (2020) and Patterson (2022)

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  - Document a significant weakening of $corr(u, EE)$ post Great-Recession (2016–19).
  - Quantify magnitude of “missing inflation” due to muted EE response as 0.23 pp.
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  - Decompose channels through which EE fluctuations affect marginal cost (inflation).
    - Labor market: direct (e.g. wage rebargaining), GE effect on tightness (e.g. labor demand).
- **Normative analysis:** Study optimal monetary policy within a class of Taylor rules.
  - Including the EE rate in the Taylor rule
    - reduces inflation and unemployment volatility.
    - provides non-monotonic welfare gains across worker productivity.

Literature

Roadmap

Motivation

Model

Solution

Results

Overview: HANK + Labor Search with OJS

- Households:
  - Experience labor market transitions over lifecycle with stochastic retirement and death.
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  - Intermediate goods: use labor services and produce differentiated goods.
  - Final good: assemble differentiated goods into final consumption good.

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- Monetary authority controls nominal interest rate through Taylor rule. Details

Timing

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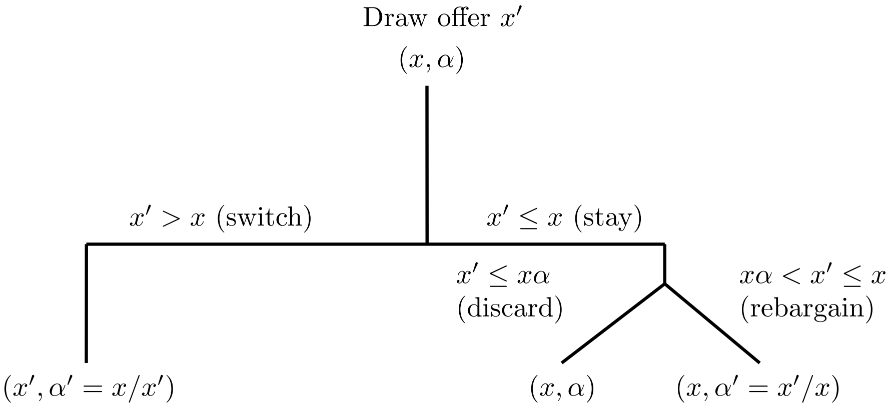
- Wages $w(h, x, \alpha)$: Depend on skill h, match productivity x, and bargained piece rate α.

Wage Determination

- Wage is an endogenous piece rate α of output $F(h,x) = hx$: $w(h,x,\alpha) = \alpha\phi^E F(h,x)$.
  - $\phi^E \in (0,1)$: maximum share of output a worker can receive with full piece rate $\alpha = 1$.
  - α determined by Bertrand competition over flows. Bagger et al. (2014), Graber and Lise (2015)



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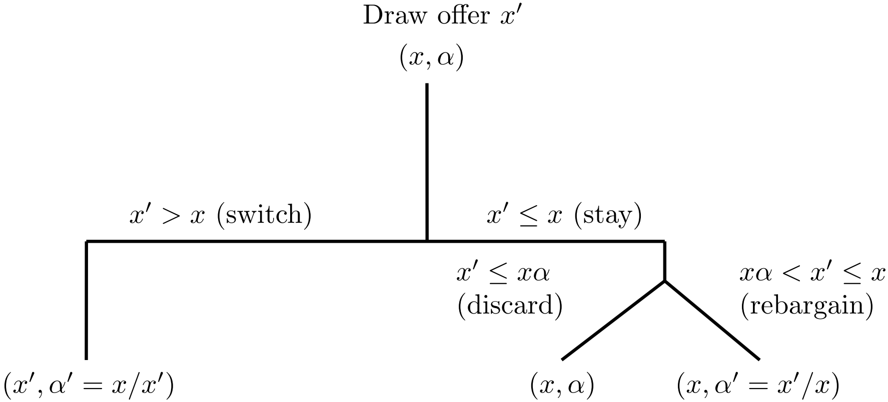

More offers ⇒ More frequent EE or rebargaining ⇒ Price of labor services ⇒ Inflation

Search and Matching

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- Vacancy creation: Service firm
  - Labor service firms take into account entire distribution of workers when posting vacancies
- Worker-firm match terminates due to:
  - (exogenous) job separation shock.
  - (exogenous) retirement.
  - (endogenous) worker quitting to take another job.

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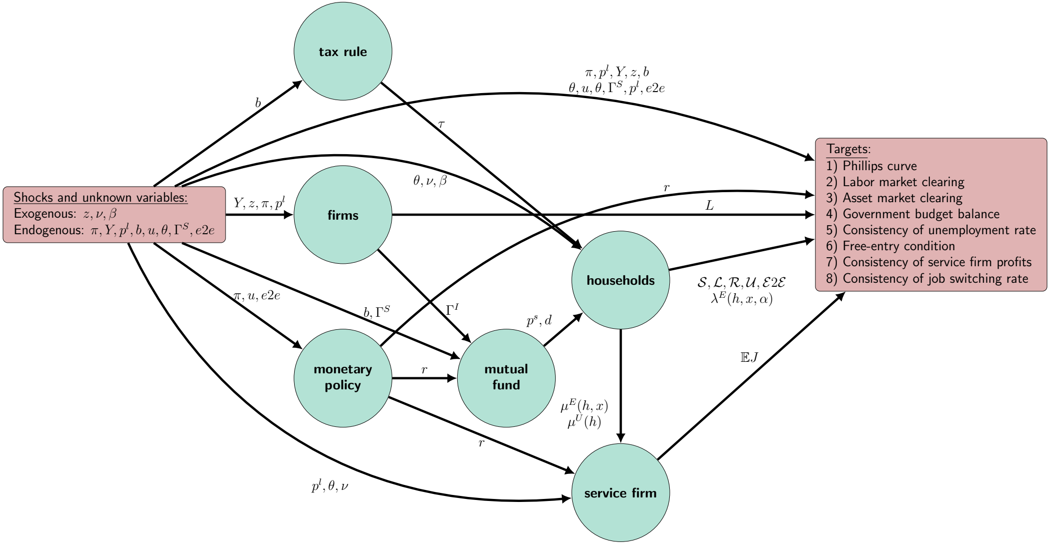
Directed Acyclic Graph (DAG) Model Representation



Solution: Sequence-space Jacobian method (Auclert et al., 2021) + worker distribution Details

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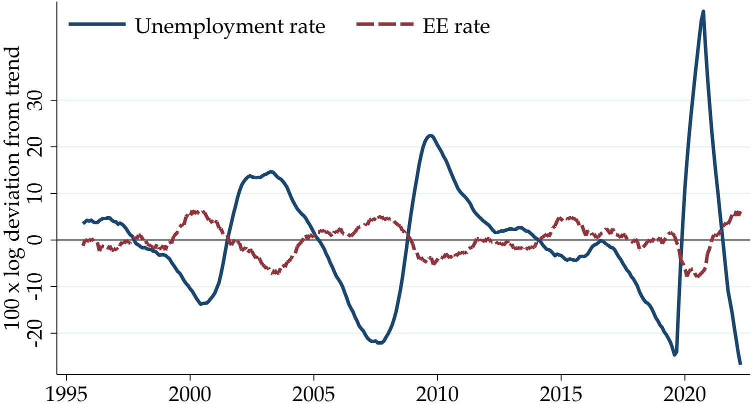
Positive Analysis

Post-Great Recession Case Study

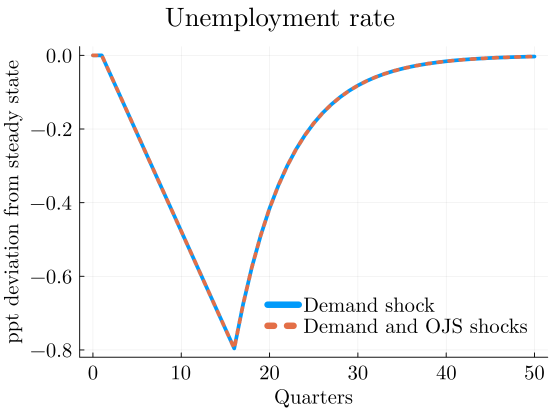
Missing $corr(u, EE)$ Post-Great Recession

- How do labor market dynamics affect the comovement of inflation and unemployment?
- **Case study**: Significant weakening of $corr(u, EE)$ post-Great Recession, 2016–19.



External Parameters Internal Parameters Shock Estimation Variance Decomposition Scatter

Labor Markets Under Demand and OJS Shocks



Common unemployment path,

Two Economies Details

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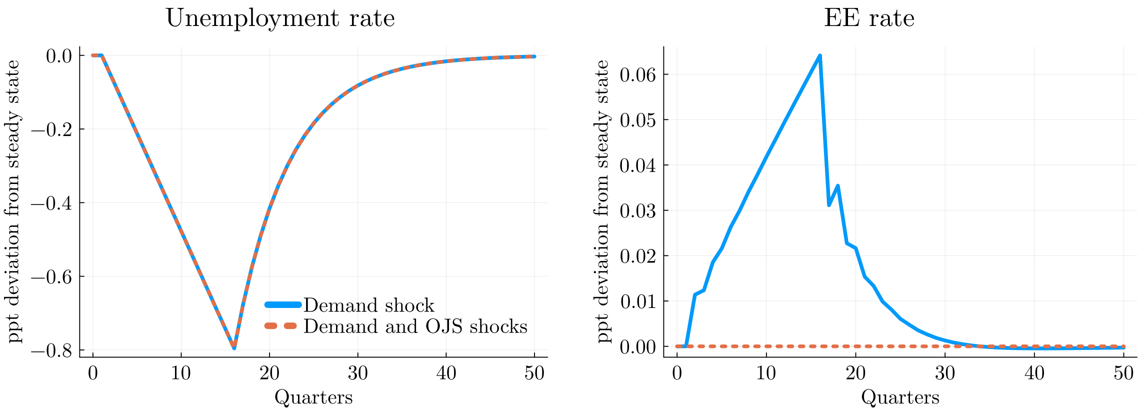
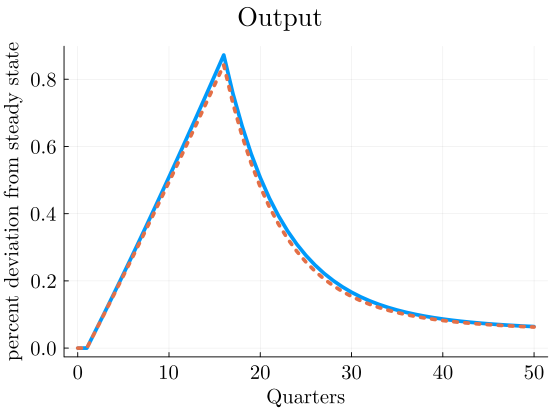


Common unemployment path, but different EE dynamics.

Two Economies | Details

Inflation Under Demand and OJS Shocks



Identical unemployment and similar output dynamics,

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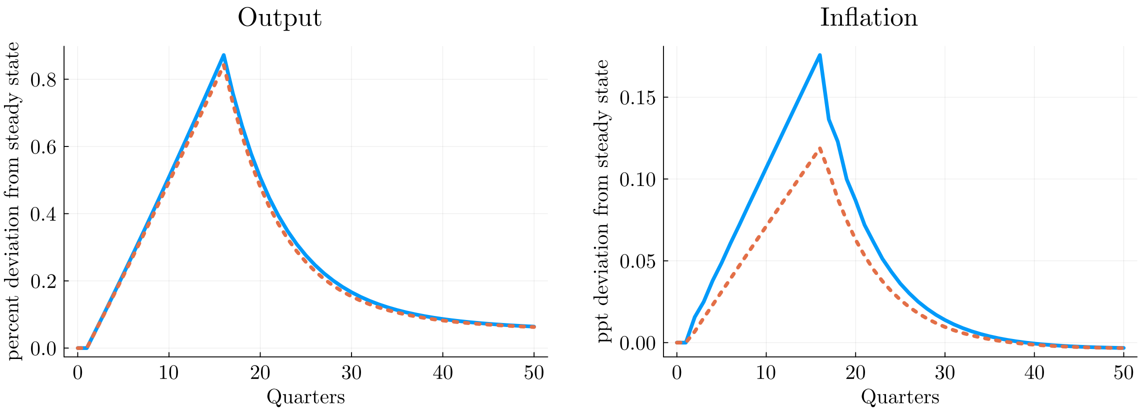

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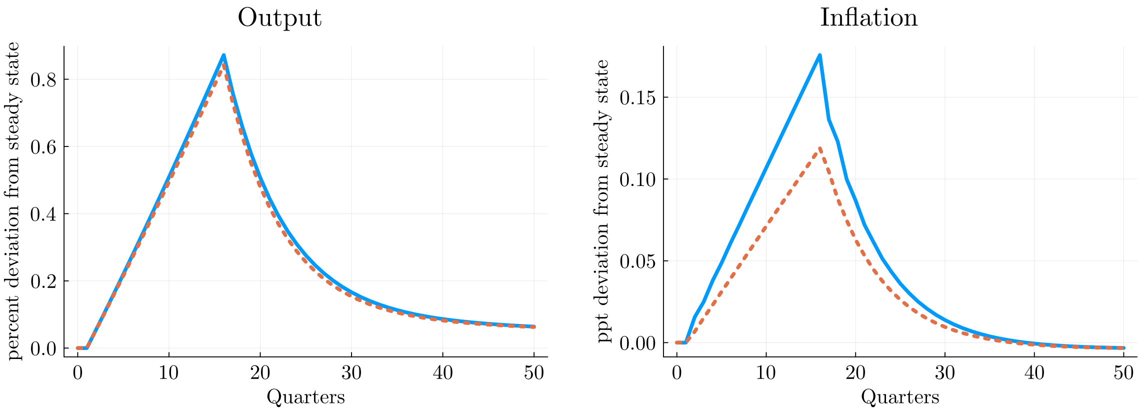


Identical unemployment and similar output dynamics, but muted inflation response.

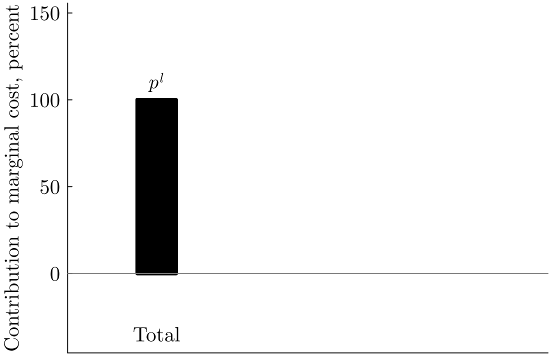
Annual inflation rate 0.23pp lower due to lower EE.

Ave x vs α | Dist x vs α | Covid-19 | PC

Positive Analysis

Decomposing Effects of OJS Shocks on Inflation

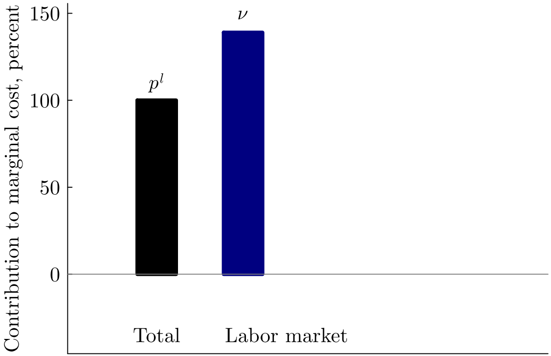
Decomposing effects of OJS shock on inflation



NKPC implies that inflation π is driven by marginal cost p^l to a first order approximation.
An increase in OJS efficiency ν leads to an increase in p^l.

DAG Details IRFs

Decomposing Effects of OJS: Labor Market



More frequent rebargaining and shorter matches lower expected match value.
For free-entry to hold, p^l increases.

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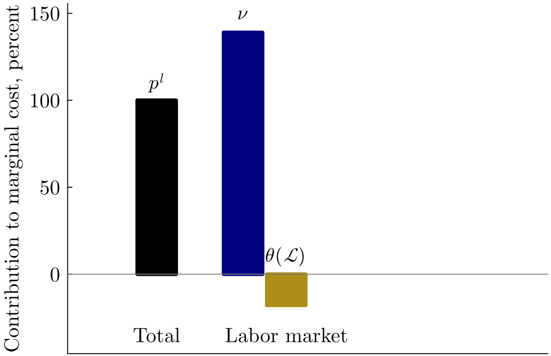

Improved productivity distribution raises supply of labor services.
For labor market to clear, θ decreases. For free-entry to hold, p^l decreases.

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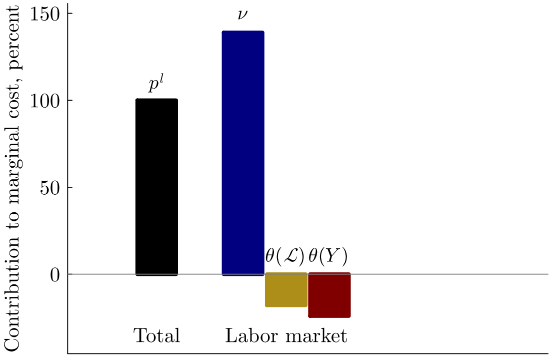
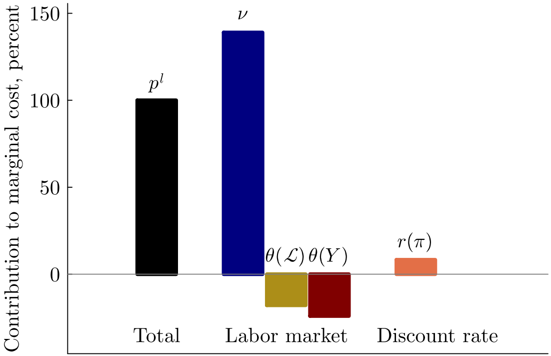


Crowd-out increases u—reducing C and Y—and hence reduces demand for labor services. For labor market to clear, θ decreases. For free-entry to hold, p^l decreases.

Decomposing Effects of OJS: Discount Rate



Inflation rises in equilibrium, which increases r through MP.
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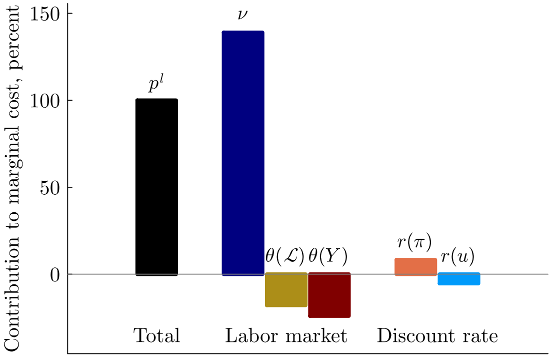

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Heterogeneous consumption responses to higher OJS

- PE: Results
  - positive consumption response stronger for wealth-poor among E but *wealth-rich* among U,
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- **Implications for our quantitative results**: In a complete-markets model,
  - Aggregate consumption response would follow response of wealth-rich.
  - Overstatement of decline in aggregate demand leads to larger GE effect on tightness.
  - This would lead to smaller increase in marginal cost p^l and inflation.
  - Thus, we would attribute smaller role to job ladder shocks in explaining missing inflation.

Normative Analysis

Optimal Monetary Policy

Optimal Monetary Policy

- Under a central bank loss function Yellen (2012), Debortoli et al. (2019)

$$\mathcal{W} = \text{var}(\pi_t - \pi^*) + \Psi\text{var}(Y_t - Y^*),$$

evaluate the performance of a generalized Taylor rule for Φ_u, Φ_{EE} combinations: Motivation

$$i_t = i^* + \Phi_\pi (\pi_t - \pi^*) + \Phi_u (u_t - u^*) + \Phi_{EE} (EE_t - EE^*).$$

- **Computational challenge:** Details
  - Each Φ_u, Φ_{EE} combination corresponds to a new set of Jacobians.
  - Costly in our model because Jacobians involve the worker distribution over many states.
  - **Key:** Use *policy* shocks to compute IRFs to *structural shock* under alternative Taylor rule.

McKay and Wolf 2022

Optimal Monetary Policy

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- Macroeconomic outcomes under baseline and optimal policies:
  - volatilities of output, tightness, consumption, and price of labor services reduce to one-third,
  - volatilities of real interest rate and price of shares double. Results
- Ignoring job mobility dynamics, i.e., $\Phi_{EE} = 0$, yields:
  - less aggressive response on unemployment gap $\Phi_u = -2.71$
  - 12 percent higher central bank loss relative to optimal MP.

Heterogeneous Welfare Gains

- Non-monotonic welfare gains across match productivity distribution: Results
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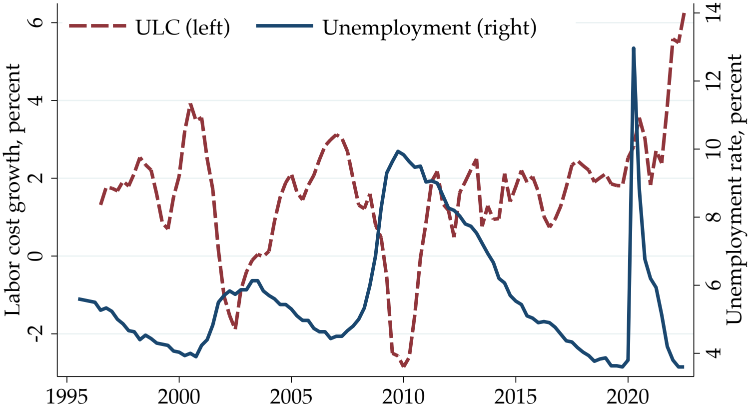
- Monotonically declining welfare gains across wealth distribution:
  - Wealth-poor benefit from less volatile unemployment risk.
  - Wealth-rich exposed to larger fluctuations in price of shares.
- Large welfare gains even among employed:
  - Employed workers benefit from improved job-ladder stability.
  - Unemployed workers, in addition, benefit from less severe downturns and faster recoveries.

Conclusion

- Develop a HANK model featuring a frictional labor market with on-the-job search.
- Analyze macro implications of an EE shock.
  - Quantify magnitude of missing inflation post-Great Recession to be 0.23pp.
  - Decompose channels through which an EE shock affects inflation.
- Evaluate monetary policy under a dual-mandate objective function.
  - Including EE rate in reaction function reduces overall inflation and unemployment volatility.
- **Future work**:
  - Heterogeneous labor market shocks.
  - Estimate model with and without labor market shocks and evaluate its performance.
  - Fiscal and monetary policy interactions accounting for rich labor market dynamics.

EXTRA SLIDES

Comovement of Unemployment and Labor Costs



Related Literature

1. **Missing disinflation/inflation around Great Recession**:
   Ball and Mazumder (2011), Coibon and Gorodnichenko (2015), Carvalho, Eusepi, Moench, and Preston (2017), Hazell, Herreno, Nakamura, and Steinsson (2020)
   This paper: Quantify role of job mobility on inflation

2. **Effects of job mobility on inflation**:
   RANK: Moscarini and Postel-Vinay (2019), Faccini and Melosi (2022); *HANK*: Alves (2019)
   This paper: Rich labor market heterogeneity, decomposition, and optimal MP

3. **HANK with labor search**:
   Ravn and Sterk (2016), Gornemann, Kuester, and Nakajima (2021)
   This paper: Incorporate job mobility dynamics

4. **Computational methods**: Auclert, Bardoczy, Rognlie, and Straub (2021)
   This paper: Incorporate discretized worker distribution into the SSJ method

Final and Intermediate Goods Firms

Final good firm:

- Combines differentiated intermediate goods using a CES technology and sells goods at P_t.

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  - Price of labor services p_t^l is determined in the labor market by worker flows.
- Pricing subject to quadratic costs ⇒ New Keynesian Phillips Curve: Rotemberg (1982)

$$\frac{\log\left(1+\pi_t-\pi^*\right)\left(1+\pi_t\right)}{1+\pi_t-\pi^*} = \vartheta\left(\frac{p_t^l}{z_t} - \frac{\eta-1}{\eta}\right) + \frac{1}{1+r_{t+1}} \frac{\log\left(1+\pi_{t+1}-\pi^*\right)\left(1+\pi_{t+1}\right)}{1+\pi_{t+1}-\pi^*} \frac{Y_{t+1}}{Y_t}.$$

Model

Monetary and Fiscal Authority

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- Consumption tax τ_c, income tax (τ_t, Υ), UI, pensions ϕ^R, and exogenous spending G_t.
- Finances deficits by issuing nominal debt B_t. Budget Constraint

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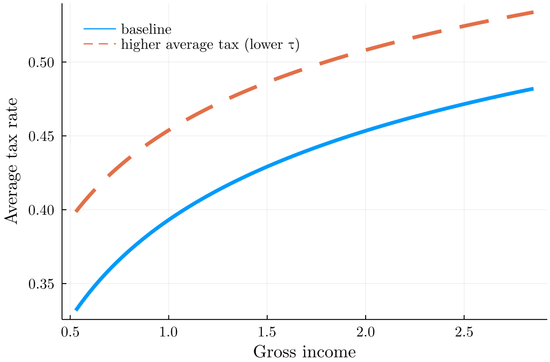
Mutual fund: Details

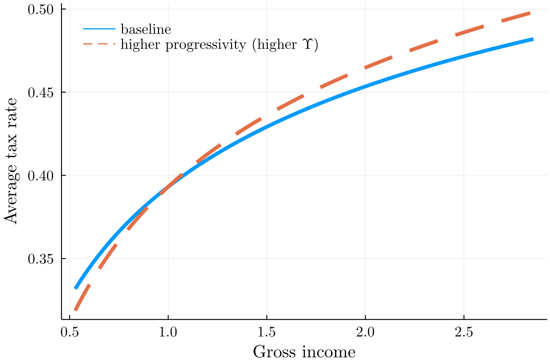
- Owns all firms and holds government debt.
- Issues shares and pays dividends.

Income Taxes

High average tax rate (low τ)



High progressivity (high Υ)



$$\text{Net income} = \tau\omega^{1-\Upsilon} \Rightarrow \text{average tax rate} = 1 - \tau\omega^{-\Upsilon}$$

Government Budget Constraint

$$
\begin{aligned}
B_{t-1} + G_t + P_t \int UI(h) d\lambda_t^U(s,h) + P_t \int \phi^R d\lambda_t^R(s) = & \frac{B_t}{1+i_t} \\
& + P_t \tau_c \int c(s,h,x,\alpha) d\lambda_t(s,h,x,\alpha) \\
& + P_t \int \left(UI(h) - \tau_t UI(h)^{1-\Upsilon} \right) d\lambda_t^U(s,h) \\
& + P_t \int \left(w(h,x,\alpha) - \tau_t w(h,x,\alpha)^{1-\Upsilon} \right) d\lambda_t^E(s,h,x,\alpha) \\
& + P_t \int \left(\phi^R - \tau_t (\phi^R)^{1-\Upsilon} \right) d\lambda_t^R(s)
\end{aligned}
$$

- Consumption tax τ_c and progressive income tax (τ_t, Υ).
- Unemployment benefit $UI(h)$, retirement pension ϕ^R, government expenditures G_t.
- Nominal debt B_t.
- $\lambda_t^X(.)$ worker distribution over relevant states.
- Nominal price level P_t.

Mutual Fund

- Owns intermediate and labor service firms, and all government bonds.
- Issues shares at price P^s and holds government bonds to earn a gross return of $1+i$.
- No-arbitrage implies returns on stock and bonds are equalized:

$$\frac{P^s_{t+1} + D_{t+1}}{P^s_t} = 1 + i_t.$$

- Cannot retain any funds. All balances are distributed to share owners as dividends:

$$D_t = B_{t-1} - \frac{B_t}{1+i_t} + P_t \Gamma^I_t + P_t \Gamma^S_t,$$

where Γ^I and Γ^S are per-period real profits of intermediate and service firms:

$$\Gamma^I_t = \left(1 - \frac{p^l_t}{z_t} - \frac{\eta}{2\vartheta} \log(1 + \pi_t - \pi^*)^2\right) Y_t$$

$$\Gamma^S_t = \int \left(p^l_t F(h,x) - w(h,x,\alpha)\right) d\lambda^E_t(s,h,x,\alpha).$$

Timing

1. **Aggregate shocks** are realized.
2. **Monetary authority** sets the nominal rate.
3. **Idiosyncratic shocks** are realized.
   - Life cycle and job destruction shocks.
   - Worker skills evolve.
4. **Labor search:** Service firms post vacancies, workers search, new matches are formed.
5. **Production:** Labor services, intermediate goods, and final goods are produced.
6. **Consumption:**
   - Profits are realized, wages, dividends and transfers are paid out.
   - Consumption-saving decisions are made.

Unemployed Worker

Value of unemployment:

$$V_t^U(s,h) = \max_{s' \geq 0,\ c} \ u(c) + \beta(1-\psi^R)\mathbb{E}_{h'|h}\left[\Omega_{t+1}^U(s',h')\right] + \beta\psi^R V_{t+1}^R(s')$$

$$\text{s.t.} \quad P_t c(1+\tau_c) + P_t^s s' = P_t \tau_t UI(h)^{1-\Upsilon} + (P_t^s + D_t)s$$

- ψ^R: Probability of retirement
- $V_t^R(s)$: Value of retirement
- $UI(h)$: Unemployment benefits
- P_t: Price of final good
- P_t^s: Price of mutual fund shares
- D_t: Dividends

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$$\text{s.t.}\quad P_t c(1+\tau_c) + P_t^s s' = P_t\tau_t UI(h)^{1-\Upsilon} + (P_t^s + D_t)s$$

Value of job search:

$$\Omega_t^U(s,h) = \zeta f(\theta_t)\,\mathbb{E}_x V_t^E(s,h,x,\underline{x}/x) + (1-\zeta f(\theta_t))\,V_t^U(s,h)$$

- ψ^R: Probability of retirement
- $V_t^R(s)$: Value of retirement
- $UI(h)$: Unemployment benefits
- P_t: Price of final good
- P_t^s: Price of mutual fund shares
- D_t: Dividends

Model

Employed Worker

Value of employment:

$$V_t^E(s,h,x,\alpha) = \max_{s'\geq 0,\ c} u(c) + \beta(1-\psi^R)\mathbb{E}_{h'|h}\left\{(1-\delta)\Omega_{t+1}^E(s',h',x,\alpha) + \delta\Omega_{t+1}^U(s',h')\right\}$$
$$+ \beta\psi^R V_{t+1}^R(s')$$
$$\text{s.t.} \quad P_t c(1+\tau_c) + P_t^s s' = P_t \tau_t w(h,x,\alpha)^{1-\Upsilon} + (P_t^s + D_t)s$$

- δ: Probability of match separation
- ν: On-the-job search efficiency

Employed Worker

Value of employment:

$$V_t^E(s,h,x,\alpha) = \max_{s'\geq 0,\ c} u(c) + \beta(1-\psi^R)\mathbb{E}_{h'|h}\left\{(1-\delta)\Omega_{t+1}^E(s',h',x,\alpha) + \delta\Omega_{t+1}^U(s',h')\right\}$$
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$$\text{s.t.} \quad P_t c(1+\tau_c) + P_t^s s' = P_t \tau_t w(h,x,\alpha)^{1-\Upsilon} + (P_t^s + D_t)s$$

Value of on-the-job search:

$$\Omega_t^E(s,h,x,\alpha) = \overbrace{\nu f(\theta_t)}^{\text{Offer}} \mathbb{E}_{\widetilde{x}}\left[\max\left\{\overbrace{V_t^E(s,h,\widetilde{x},x/\widetilde{x})}^{\text{Switch}}, \overbrace{V_t^E(s,h,x,\max\{\alpha,\widetilde{x}/x\})}^{\text{Stay–Discard offer or rebargain}}\right\}\right]$$
$$+ \underbrace{(1-\nu f(\theta_t))}_{\text{No offer}} V_t^E(s,h,x,\alpha)$$

- δ: Probability of match separation
- ν: On-the-job search efficiency

Model

Retired Worker

Value of retirement:

$$V_t^R(s) = \max_{s' \geq 0,\ c} u(c) + \beta(1-\psi^D)V_{t+1}^R(s')$$
$$\text{s.t.} \quad P_t c(1+\tau_c) + P_t^s s' = P_t \tau_t (\phi^R)^{1-\Upsilon} + (P_t^s + D_t)s$$

Retired only face mortality risk.

- ψ^D: Probability of death
- ϕ^R: Retirement pensions
- P_t^s: Price of mutual fund shares
- D_t: Dividends

Labor Service Firms

Value of matched firm: Details

$$J_t(h,x,\alpha) = p_t^l F(h,x) - w(h,x,\alpha) + \frac{1}{1+r_{t+1}}(1-\psi^R)(1-\delta)$$
$$\times\, \mathbb{E}_{h'|h}\left\{(1-\nu f(\theta_{t+1}))\, J_{t+1}(h',x,\alpha) + \nu f(\theta_{t+1}) \int_{\underline{x}}^{x} J\left(h',x,\max\{\alpha,\widetilde{x}/x\}\right) d\Gamma^x(\widetilde{x})\right\}$$

- p_t^l: Price of labor services
- r_t: Real interest rate
- κ: Cost of posting vacancy
- $F(h,x) = hx$: Match output
- S_t: Aggregate search effort
- Γ^x: Sampling distribution for match productivity

Model

Labor Service Firms

Value of matched firm: Details

$$J_t(h,x,\alpha) = p_t^l F(h,x) - w(h,x,\alpha) + \frac{1}{1+r_{t+1}}\left(1-\psi^R\right)(1-\delta)$$
$$\times \mathbb{E}_{h'|h}\left\{\left(1-\nu f(\theta_{t+1})\right) J_{t+1}(h',x,\alpha) + \nu f(\theta_{t+1}) \int_{\underline{x}}^{x} J\left(h',x,\max\{\alpha,\widetilde{x}/x\}\right) d\Gamma^x(\widetilde{x})\right\}$$

Value of posting vacancy:

$$V_t = -\kappa + q\left(\theta_t\right)\frac{1}{S_t}\left[\zeta \int_{s,h}\int_{\widetilde{x}} J_t\left(h,\widetilde{x},\underline{x}/\widetilde{x}\right) d\Gamma^x\left(\widetilde{x}\right) d\mu_t^U\left(s,h\right)\right.$$
$$\left. + \nu \int_{s,h,x,\alpha}\int_{x}^{\overline{x}} J_t\left(h,\widetilde{x},x/\widetilde{x}\right) d\Gamma^x\left(\widetilde{x}\right) d\mu_t^E\left(s,h,x,\alpha\right)\right]$$

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$$\times \mathbb{E}_{h'|h}\left\{(1-\nu f(\theta_{t+1}))\,J_{t+1}(h',x,\alpha) + \nu f(\theta_{t+1})\int_{\underline{x}}^{x} J\left(h',x,\max\{\alpha,\widetilde{x}/x\}\right) d\Gamma^x(\widetilde{x})\right\}$$

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$$\left. + \,\nu\int_{s,h,x,\alpha}\int_{x}^{\overline{x}} J_t\left(h,\widetilde{x},x/\widetilde{x}\right) d\Gamma^x\left(\widetilde{x}\right) d\mu_t^E\left(s,h,x,\alpha\right)\right]$$

Free-entry implies $V_t = 0$.

- p_t^l: Price of labor services
- r_t: Real interest rate
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- $F(h,x) = hx$: Match output
- S_t: Aggregate search effort
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Model

Labor Service Firms

- Post vacancies v at cost κ to hire workers in a frictional labor market.
  - Labor market tightness $\theta = v/S$, where $S = \int \zeta d\mu^U(s,h) + \int \nu d\mu^E(s,h,x,\alpha)$.
  - CRS matching function $M(v,S)$ determines number of new worker-firm contacts.
  - Worker and firm contact rates, $f(\theta) = \frac{M(v,S)}{S}$ and $q(\theta) = \frac{M(v,S)}{v}$, pinned down by θ.
- Produce $F(h,x) = hx$ labor services using one unit of labor.
- Sell labor services to intermediate firms in a competitive market at nominal price P^l.

Model

Solution of Model with Aggregate Shocks

Follow Auclert, Bardoczy, Rognlie, Straub (2021) to compute IRFs and model simulation.

1. Cast the model in sequence space for $t \in \{0, ..., T\}$ as a directed acylic graph (DAG).
   + simple blocks
   + heterogeneous-agent (HA) block
2. For each block, compute partial Jacobians of each output with respect to each input.
   - Automatic differentiation for simple blocks.
   - Numerical differentiation for HA block (fake-news algorithm).
3. Forward accumulate partials along topological sort of DAG to get total derivatives.
4. Use implicit function theorem to get the GE response of endogenous variables to shocks.
5. The GE Jacobian is sufficient to compute IRFs to aggregate shocks.
6. Simulate the model subject to aggregate shocks (IRF $\equiv$ MA).

DAG

Externally Calibrated Parameters

Parameter	Explanation	Value	Reason
σ	Curvature in utility function	2	Standard
ψ^R	Retirement probability	0.00625	40 years of work stage
ψ^D	Death probability	0.0125	20 years of retirement stage
Δh	Skill appreciation/depreciation amount	0.275	Set
π^E	Skill appreciation probability	0.018	Wage growth for job stayers
ξ	Matching function elasticity	1.6	Set
ζ	Search efficiency of the unemployed	1	Normalization
η	Elasticity of substitution	6	20 percent markup
ϑ	Price adjustment cost parameter	0.021	Slope of Phillips curve, Gali and Gertler (1999)
x_G	Government spending/GDP ratio	0.19	Total net federal outlay/ GDP
x_B	Debt/GDP ratio	2.43	Total public debt/GDP
τ_c	Consumption tax rate	0.0312	Sales tax receipt/consumption exp.
Υ	Progressivity of income tax	0.151	Heathcote et al. (2014)
ρ_τ	Responsiveness of income tax to debt level	0.10	Auclert et al. (2020)
π^*	Steady-state inflation rate	0.00496	2% annual inflation rate
Φ_π	Responsiveness of interest rate to inflation	1.5	Taylor (1993) and Gali (2015)
Φ_u	Responsiveness of interest rate to unemployment	-0.25	Taylor (1993) and Gali (2015)

Back

Internally Calibrated Parameters

Parameter	Explanation	Value	Target	Data	Model
β	Discount factor	0.981	Fraction with non-positive liquid wealth	0.16	0.11
κ	Vacancy creation cost	0.670	Unemployment rate	0.051	0.052
δ	Job separation probability	0.091	EU rate	0.038	0.033
ν	Search efficiency of employed	0.108	EE rate (w/o non-employment spell)	0.02	0.02
π^U	Skill depreciation probability	0.022	Earnings drop upon job loss	-0.35	-0.36
σ_x	Standard deviation of match productivity	0.063	Wage growth of job switchers	0.09	0.09
ϕ^E	Maximum share of output as wages	0.823	Labor share	0.67	0.74
ϕ^U	UI replacement rate	0.385	UI replacement rate	0.40	0.44
ϕ^R	Retirement benefit amount	0.473	Retirement income/labor income	0.34	0.41

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Back

Estimation of Shocks

- Estimate AR(1) processes for discount factor β, productivity z, OJS efficiency ν.
- Target autocorrelations and standard deviations of Y, u and EE.

	Data			Model		
	Std. Dev	Autocorr.	Corr. w/ Y	Std. Dev	Autocorr.	Corr. w/ Y
Y	0.024	0.963	1	0.005	0.924	1
u	0.148	0.953	-0.882	0.092	0.859	-0.882
EE	0.090	0.907	0.147	0.068	0.765	0.145
θ	0.275	0.930	0.809	0.062	0.105	0.626
π	0.245	0.388	0.538	0.270	0.825	0.543

Back

Variance Decomposition

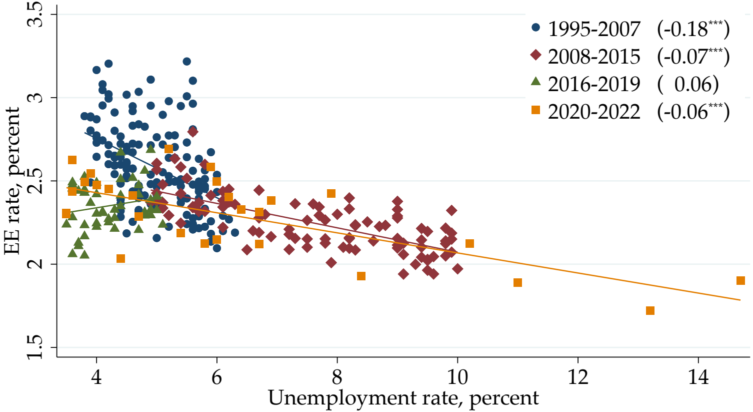
	Share of variance explained by		
	z	ν	β
Y	0.008	0.031	0.961
u	0.111	0.077	0.812
EE	0.070	0.787	0.143
θ	0.337	0.046	0.618
π	0.049	0.431	0.520

Shock	ρ	σ
z	0.332	0.002
ν	0.936	0.003
β	0.909	0.001

Back

Missing $corr(u, EE)$ Post-Great Recession

- How do labor market dynamics affect the comovement of inflation and unemployment?
- **Case study**: Significant weakening of $corr(u, EE)$ post-Great Recession, 2016–19.



Back

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Back

Model Simulation of Post-Great Recession

Goal: Quantify magnitude of "missing inflation" due to weakening $corr(u, EE)$ in 2016–2019.

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Consider two economies **starting from the same steady state**.

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Economy 1: *Counterfactual economy* — EE moves with unemployment

- Shocks to discount factor to match decline in unemployment post-Great Recession

$$\beta_t = (1 - \rho_\beta)\beta^* + \rho_\beta \beta_{t-1} + \varepsilon_{\beta,t}.$$

Model Simulation of Post-Great Recession

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Consider two economies **starting from the same steady state**.

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- Shocks to discount factor to match decline in unemployment post-Great Recession

$$\beta_t = (1 - \rho_\beta)\beta^* + \rho_\beta \beta_{t-1} + \varepsilon_{\beta,t}.$$

Economy 2: *Post-Great Recession* — flat EE rate

- Shocks to discount factor to match decline in unemployment post-Great Recession

$$\beta_t = (1 - \rho_\beta)\beta^* + \rho_\beta \beta_{t-1} + \varepsilon_{\beta,t}.$$

- Shocks to OJS efficiency to match path of EE rate

$$\nu_t = (1 - \rho_\nu)\nu^* + \rho_\nu \nu_{t-1} + \varepsilon_{\nu,t}.$$

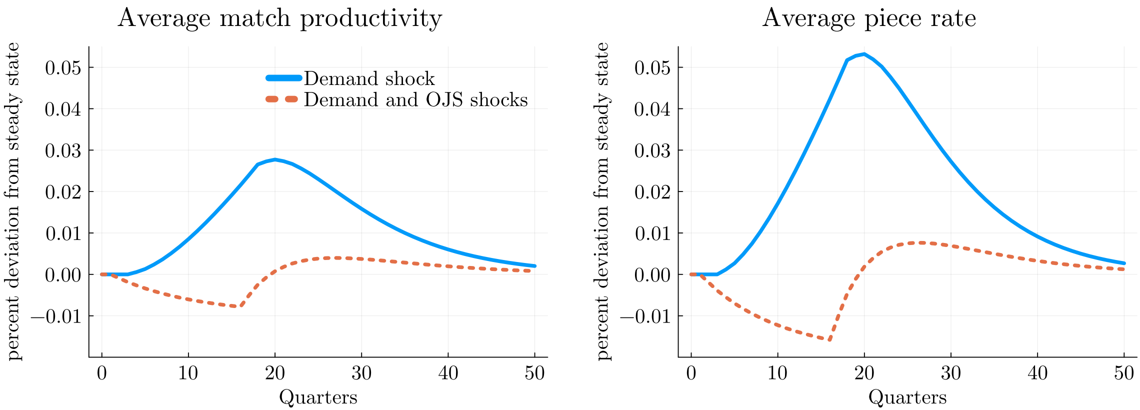
Results

Details on Model Simulation

- Targets over transition horizon $t \in \{0, \ldots, T\}$:
  1. Path of unemployment rate during post-Great Recession:
     - 15% decline by $\overline{T} = 16$ quarters and revert back to steady state with
       $$u_t = (1 - \rho_u)u^* + \rho_u u_{t-1}, \qquad \text{where } \rho_u = 0.85.$$
  2. Path of EE rate during post-Great Recession:
     - Remain at steady state level of EE rate despite declining unemployment rate.
- Two economies:
  1. Economy 1: positive demand shocks
     - Shocks modeled as innovations to discount factor β.
     - Assume at each $t = 0, \ldots, T$, shock $\varepsilon_\beta < 0$ hits economy.
  2. Economy 2: positive demand and negative OJS shocks
     - Shocks modeled as innovations to discount factor β and OJS efficiency ν.
     - Assume at each $t = 0, \ldots, T$, shocks $\varepsilon_\beta < 0$ and $\varepsilon_\nu < 0$ hit economy.

Results

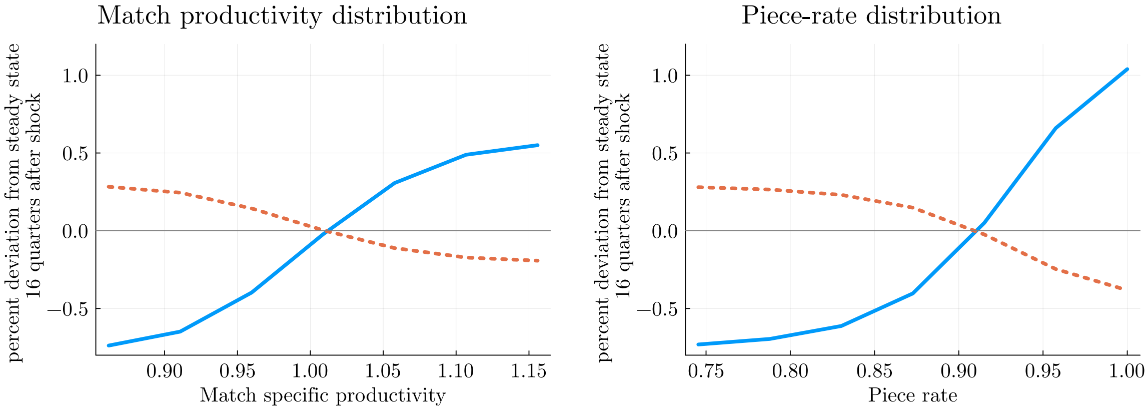
Average Match Productivity and Piece Rate



Negative OJS efficiency shocks limit the rise in average x and α.

Results

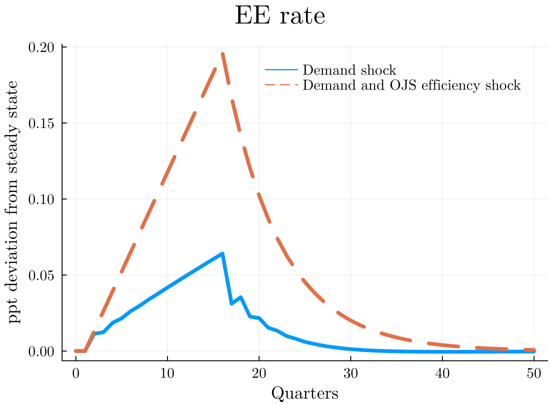
Distribution of Match Productivity and Piece Rate

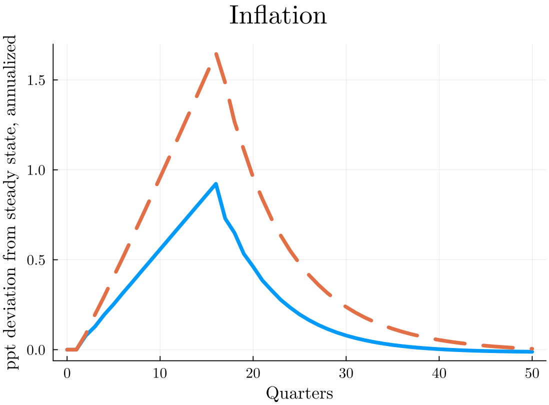


Negative OJS efficiency shocks leads to leftward shifts in distributions of x and α.

Results

COVID Recovery: "The Great Reallocation"

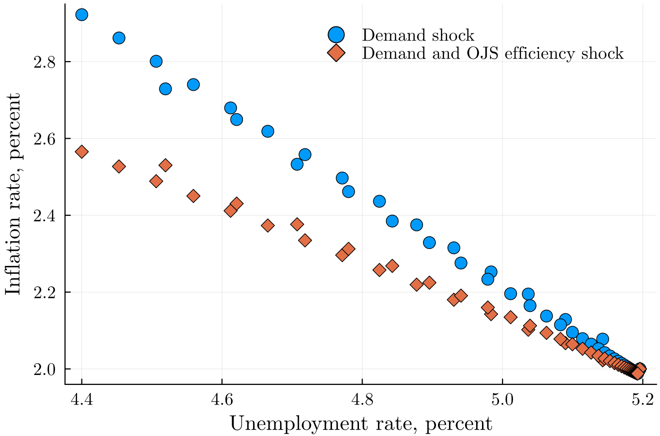




Higher EE and higher inflation.

Results

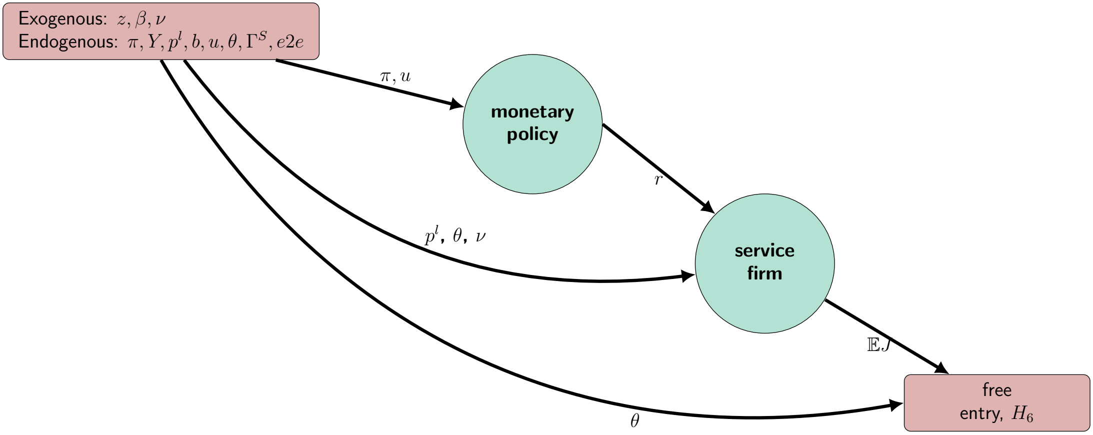
Phillips Curve Under Demand and OJS Shocks



Flatter Phillips curve under negative OJS efficiency shocks.

Results

Decomposing Effects of OJS Shock on Inflation



Results

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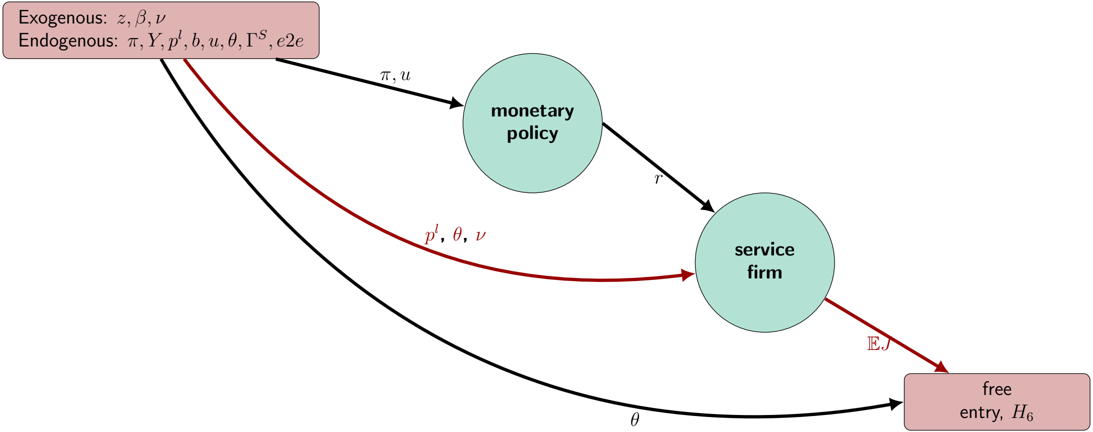

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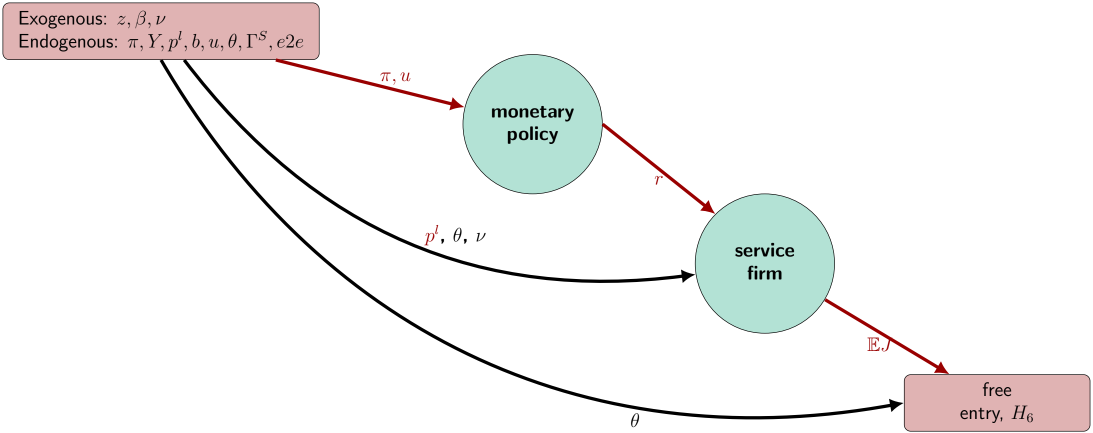


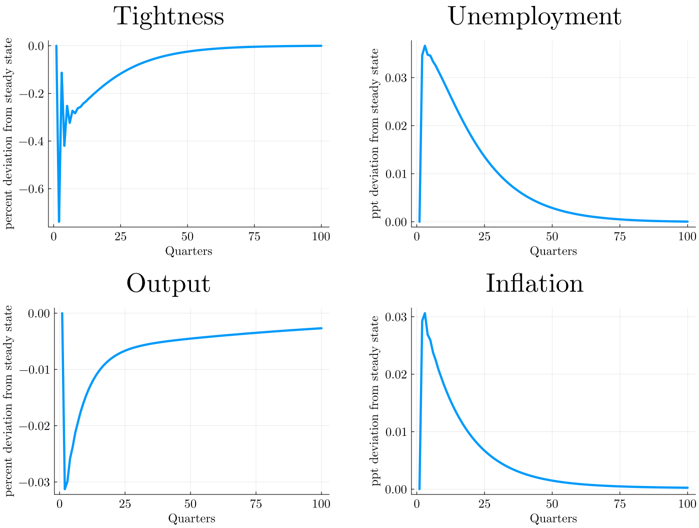
Results

Details for Inflation Decomposition

1. Start from total Jacobians of a block of interest, e.g., H6 (free-entry condition).
2. Apply IFT to H6 to get the derivative of p^l w.r.t. endogenous and exogenous variables.
3. Multiply the total derivative of p^l with GE IRFs of variables w.r.t ν.
4. This gives the response of p^l components ν, θ, π, u w.r.t ν (direct and indirect).
5. Can further decompose these components, e.g., θ using other related blocks, e.g., H2.

Results

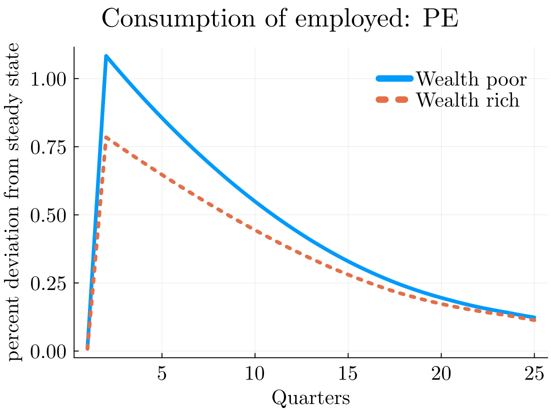
GE Effects of ν on Model Outcomes



Impulse responses to a unit increase in ν.

Results

Heterogeneous consumption responses



Higher future income raises consumption,

Results

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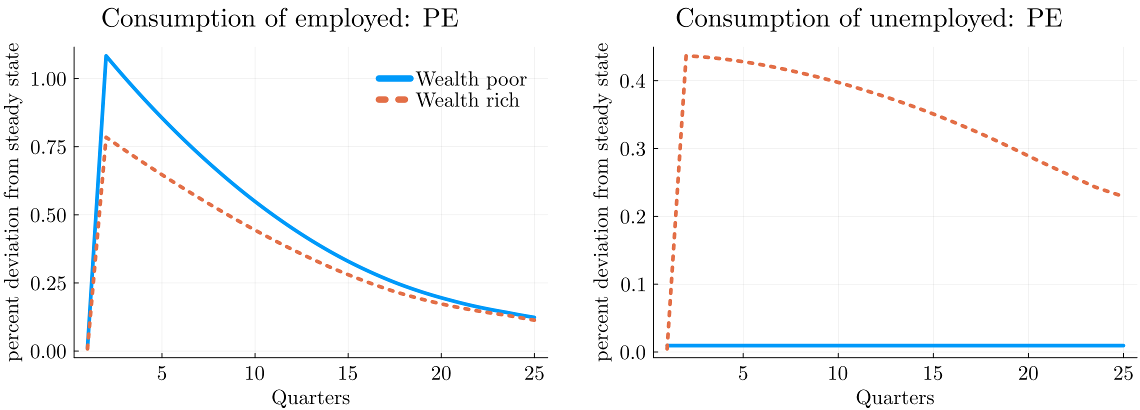
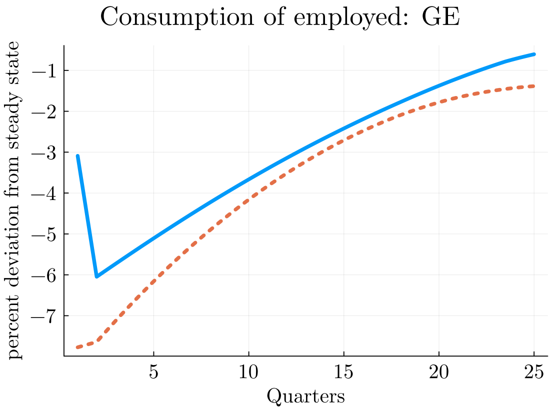
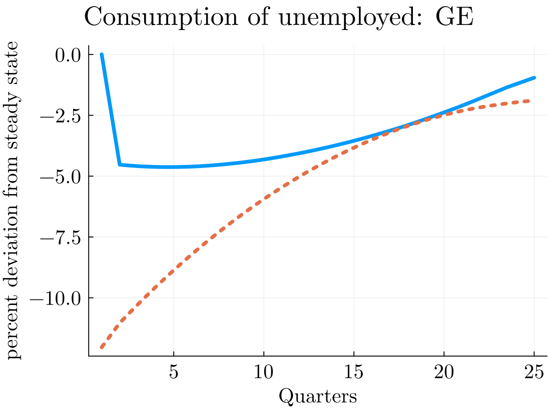


Higher future income raises consumption, except for wealth-poor unemployed

Results

Heterogeneous consumption responses



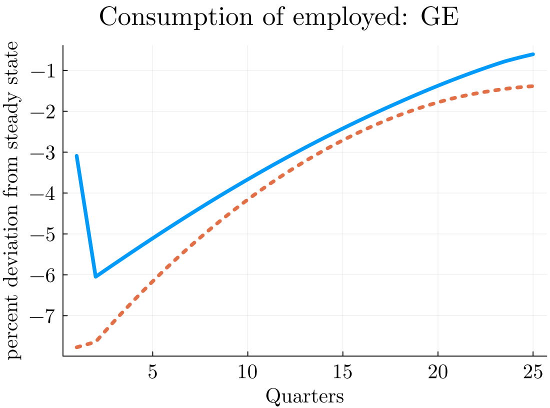


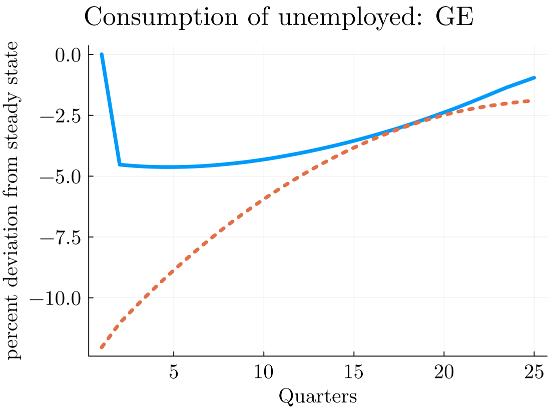
In GE, consumption declines due to real rates.

Decline more prominent for wealth-rich due to lower dividends and share prices.

Results

Heterogeneous consumption responses

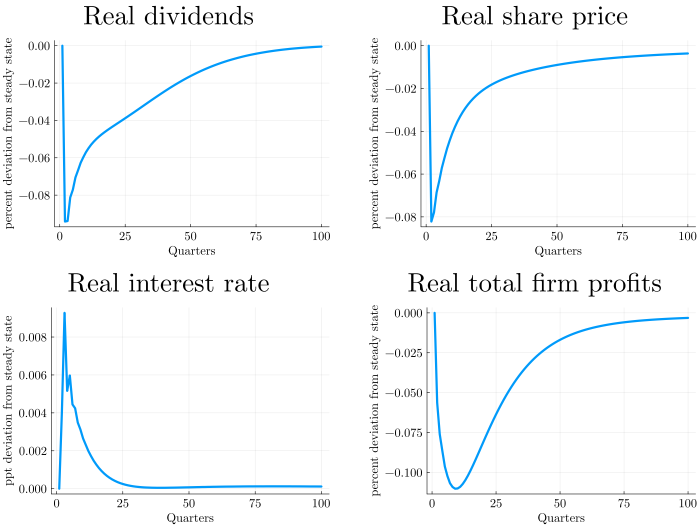




Complete markets would overstate aggregate demand decline.

Results

GE Effects of ν on Model Outcomes



Impulse responses to a unit increase in ν.

Results

Monetary Policy

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  - Unemployment rate is not a sufficient statistic to gauge the health of the labor market.
  - Including EE rate in the reaction function improves inflation and unemployment stability.
- **Agenda:** Study monetary policy under a dual-mandate central bank objective function.

Back

Evaluating Alternative Taylor Rules

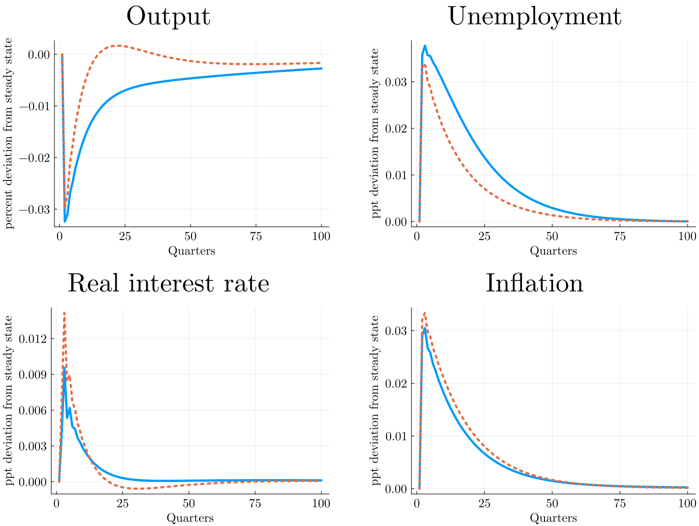
- Use *policy* shocks to compute IRFs to *non-policy shocks* under alternative Taylor rules.
  - **Key**: Firms and households do not care about the systematic component of monetary policy, but care about the current and future path of interest rates. McKay and Wolf (2022)
  - No need to recompute Jacobians. Derivatives under the baseline policy are enough.
- Solving the system for policy news shocks $\boldsymbol{\mu} = \{\mu_t\}_{t=1}^{T}$ given non-policy shock ε

$$\underbrace{\boldsymbol{i}_{\Phi_\pi,\Phi_u}(\varepsilon) + \boldsymbol{\Theta}^{i,\mu}_{\Phi_\pi,\Phi_u}\boldsymbol{\mu}}_{\text{IRF of } i \text{ under baseline}} = \widetilde{\Phi}_\pi \underbrace{\left(\boldsymbol{\pi}_{\Phi_\pi,\Phi_u}(\varepsilon) + \boldsymbol{\Theta}^{\pi,\mu}_{\Phi_\pi,\Phi_u}\boldsymbol{\mu}\right)}_{\text{IRF of } \pi \text{ under baseline}} + \widetilde{\Phi}_u \underbrace{\left(\boldsymbol{u}_{\Phi_\pi,\Phi_u}(\varepsilon) + \boldsymbol{\Theta}^{u,\mu}_{\Phi_\pi,\Phi_u}\boldsymbol{\mu}\right)}_{\text{IRF of } u \text{ under baseline}}$$
$$+ \widetilde{\Phi}_{EE} \underbrace{\left(\boldsymbol{EE}_{\Phi_\pi,\Phi_u}(\varepsilon) + \boldsymbol{\Theta}^{EE,\mu}_{\Phi_\pi,\Phi_u}\boldsymbol{\mu}\right)}_{\text{IRF of } EE \text{ under baseline}},$$

  allows for computing the IRF to ε under alternative Taylor rule $\widetilde{\Phi}_\pi, \widetilde{\Phi}_u, \widetilde{\Phi}_{EE}$.
- IRF to ε under alternative rule $\equiv$ IRF to ε and $\{\mu_t\}_{t=1}^{T}$ under baseline rule.

Back

GE Effects of ν under Baseline vs Optimal Policy



Impulse responses to a unit increase in ν under baseline (blue) and optimal (red) MP.

Results

Outcomes under Optimal Policy

- Volatilities of macroeconomic outcomes under baseline and optimal policies: Results

	π	Y	r	θ	u	C	p^l	p^s
Baseline Taylor rule	0.0013	0.0059	0.0019	0.0600	0.0047	0.0059	0.0203	0.1975
Optimal Taylor rule	0.0011	0.0020	0.0033	0.0175	0.0013	0.0020	0.0081	0.3051

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- Heterogeneous welfare gains under optimal policy: Results

Match quality x			Share s			Employment e	
Bottom	Middle	Top	Bottom	Middle	Top	E	U
0.24	0.13	0.16	0.13	0.18	0.10	0.15	0.20