Heterogeneous Effects of Monetary Policy across Income and Race: the Labour Mobility Channel

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Research Question

- Heterogeneous impact of monetary policy on wage inequality through heterogenous job flows responses

- Growing literature on monetary transmission to wealth inequality: focus on consumption-saving channel with exogenous income process

- Introduce meaningful wage inequality across occupational islands combined with participation and occupational decisions

Our Paper

- **Empirical Evidence:** Estimate job flows and wage growth elasticities to monetary shocks along income and demographic distribution

- **Theory** General equilibrium model with uninsurable risk, participation/occupational decisions to study monetary transmission and match evidence

  Uninsurable risk: conditionality of the flows on income

- **Occupational choice** is introduced through period-by-period dynamic discrete choice optimization: transition probabilities depend on occupational value functions

Empirical Evidence

- Construct a pseudo panel of wages (Mincer) and job flows (separations and findings)
- Estimate impact of high-frequency identified monetary policy shocks Gorodnichenko and Weber 2016 and Bauer and Swanson 2023
- Measure elasticities through *panel local projection estimations*
- Along the distribution of income and demographics (interacting variable

Key Mechanism: Model

The link between wealth and idiosyncratic risk, through value functions, and transition probabilities:

$$\theta_j(o|e_t, a_{t-1}, b_{t-1}) = \frac{\exp(\tilde{V}_j^o(e_t, a_{t-1}, b_{t-1}))}{\sum_o \exp(\tilde{V}_j^o(e_t, a_{t-1}, b_{t-1}))}. \tag{1}$$

On the reverse, transitions affect wage inequality and in turn precautionary saving decisions

Expanding the equilibrium concept: fixed point between consumption-saving and occupational decision (mean-field games)

Results

- **Evidence**: separations rise for bottom earners; findings for top earners: wages rise for bottom earners (selection channel)
- Separations rise for black, women and old only conditional on being low income (Chetty and Friedman on role of race)
- The selection channel in the Model: with monetary tightening labour demand declines more in low-wage occupations; in turn bottom earners exit the labour force and reduce transition
- Labour shortage increases wages of bottom earners or minorities
- Reallocation as cost push shock: use model to study monetary trade-offs

Related Literature

- **Empirical** role of MP for inequality: Coibion et al. 2017, Doepke and Schneider 2006, Amberg et al. 2021, Broer, Kramer, and Mitman 2021
- Merge **uninsurable risk with labour market flows**: Krusell, Mukoyama, and Şahin 2010
- **Occupational decisions** with discrete choice models: Rust 1987, Keane and Wolpin 1997
- Link to role of skill for inequality (Dolado, Motyovszki, and Pappa 2021), but we focus on occupational task (Autor, Levy, and Murnane 2003)
- **Methodologically**: extend sequence-space Jacobian method (see Auclert et al. 2019)

Empirical Analysis

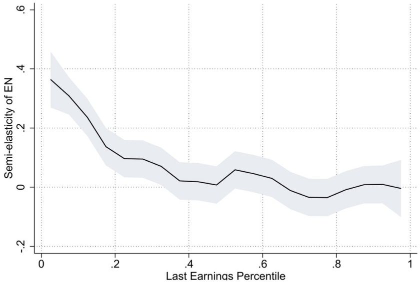
- **High-frequency identified monetary policy shocks and construction of pseudo panel**

- **Local projections** with quantile regression to estimate the impact of shocks on job flows and wage growth (monthly) across income percentiles using CPS data

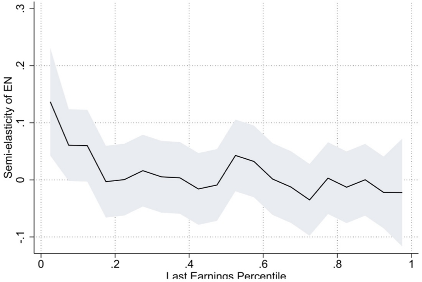
- **Econometric specification**:

$$y_{i,t+j} = \beta_i + \Gamma_{i,j} x'_{i,t} \Delta m_t I_t + \Theta Z_{i,t} + \epsilon_{i,t+j} \quad (2)$$

Estimated coefficient of separations across ventiles



Separations; Gorodnichenko and Weber 2016 shocks



Separations; Bauer and Swanson 2023 shocks

Figure: Semi-elasticity of separation rates (transitions from employment to non-employment) for each ventile of the earning distribution. The figure plots the coefficients for each income ventile and its 95% confidence intervals.

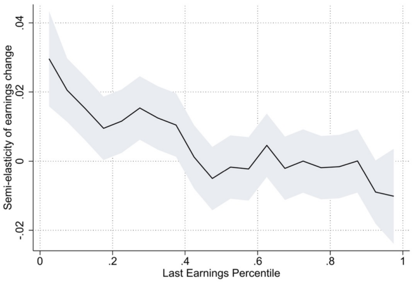
Estimated coefficient of findings across ventiles

Findings; Gorodnichenko and Weber 2016 shocks

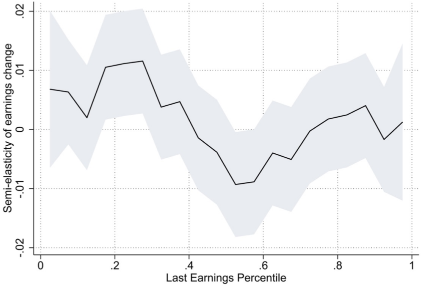
Findings; Bauer and Swanson 2023 shocks

Figure: Semi-elasticity of finding rates (transitions from non-employment to employment) for each ventile of the earning distribution. The figure plots the coefficients for each income ventile and its 95% confidence intervals.

Estimated coefficient of wages across ventiles



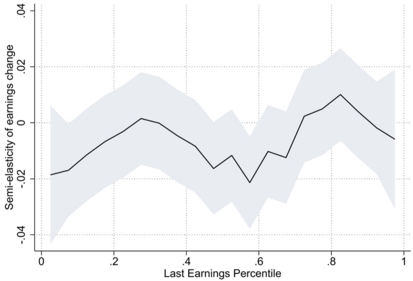
Wage Growth; Gorodnichenko and Weber 2016 shocks



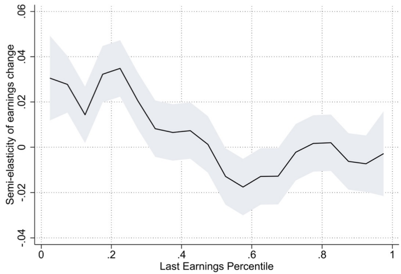
Wage Growth; Bauer and Swanson 2023 shocks

Figure: Semi-elasticity of earnings changes for each ventile of past earnings. Empirical estimates of the impact coefficient of the exogenous monetary policy shock interacted with income ventiles.

Estimated coefficient of wages across ventiles, contractionary shocks



Wage Growth; Gorodnichenko and Weber 2016 shocks



Wage Growth; Bauer and Swanson 2023 shocks

Figure: Semi-elasticity of earnings changes for each ventile of past earnings. Empirical estimates of the impact coefficient of the exogenous monetary policy shock interacted with income ventiles.

Job Flow Across Demographics

- Separations of *women, black and older* workers go up by more but only conditional on being below median

- Separations respond significantly more for bottom earners and *routinary* workers also in response to aggregate and sectoral technology shocks

Model Elements

- Households heterogeneous in income shocks, wealth, and skills
- Two-stage decision, fixed point equilibrium:
  1. First stage: occupational choice by comparing value functions: delivers endogenous transition probabilities
  2. Second stage: within occupation consumption-saving decision
- Production sector with nested production function employing shares of all occupation. Monopolistic firms with nominal rigidities
- Monetary policy: operational rules. Fiscal policy: balanced budget

Model: Households

Labor income

$$\xi^o_{j,t} = (1-\tau_t) e_t w^o_t \gamma^o_j n_t \tag{3}$$

Sequence of decisions

$$\begin{aligned} V_j(e_t, a_{t-1}, b_{t-1}, \phi_t) = \max_{o_t, c_t, a_t, b_t} & \; u(c_t, n^o_t) + \phi^o_t + \beta E_\phi E_e V_j(e_{t+1}, a_t, b_t, \phi_{t+1}) \\ \text{s.t.} \quad & c_t + a_t + b_t = \xi^o_{j,t} + (1 + r^a_t) a_{t-1} + (1 + r^b_t) b_{t-1} - \Phi(a_t, a_{t-1}) \\ & a_t \geq 0, \quad b_t \geq \underline{b} \end{aligned} \tag{4}$$

▸ Portfolio Adj

Model: Split of the Households' Problem

Occupation decision

$$o = \max_{[1,.....,O,O+1]} [\tilde{V}_j^o + \phi_t^o] \tag{5}$$

with optimal probabilities

$$\theta_j(o|e_t, a_{t-1}, b_{t-1}) = \frac{\exp(\tilde{V}_j^o(e_t, a_{t-1}, b_{t-1}))}{\sum_o \exp(\tilde{V}_j^o(e_t, a_{t-1}, b_{t-1}))}. \tag{6}$$

▸ Occupational V

Model: Firm's Problem

- Monopolistic competitive with quadratic adjustment cost on prices and capital ▸ Firm Max
- Output aggregation and production: $y_t = z_t k_{t-1}^{\nu} L_t^{1-\nu}$.

  Aggregation of labor across occupations: $L_t = \left(\sum_{o=1}^{O} \alpha_o l_{o,t}^{\sigma} \right)^{\frac{1}{\sigma}}$.

▸ Firm FOC prices, ▸ Firm FOC capital

Model: Asset Returns and Policies

Return on non-liquid assets

$$(1 + r_t^a) = \sum_{s=1}^{S} \left(\frac{v_t}{\mathcal{A}_t} \right) \frac{d_t + v_t}{v_{t-1}} + \frac{B^g - \mathcal{B}_t}{\mathcal{A}_t}(1 + r_t) \tag{7}$$

Fiscal policy

$$\tau_t \sum_{o=1}^{O} \sum_{s=1}^{S} w_t^o l_{o,t} = r_t B^g + G_t, \tag{8}$$

Monetary policy

$$i_t = r_t^* + \phi_\pi \pi_t + \phi_y (Y_t - Y_{ss}) \tag{9}$$

Aggregates

Skill-distribution Γ matrix

Occupation clustering with Bonhomme et al. 2020 k-means clustering:

$$\arg\min_{\mathbf{O}} \sum_{i=1}^{k} \sum_{\mathbf{h}\in O_i} \|\mathbf{h} - \mathbf{m}_i\|^2 \tag{10}$$

Skill assignment through classical Euclidean distance:

$$\gamma_j^o = \sum_{m}^{M} \text{abs}\left|h_m^j - h_m^o\right|, \tag{11}$$

Occupations:
(1) Manual trade occupations, (2) Management and supervisory occupations, (3) Machine operators, (4) Engineering occupations, (5) Healthcare and community occupations, (6) Personal services, (7) Technical-support occupations, and (8) Office and administrative support.

Analytical Results

Proposition 1. *The elasticity of labor income to monetary policy shocks reads as follows:*

$$
\begin{aligned}
\varepsilon_{\xi_t^o, r_t} = & \underbrace{-\frac{\tau_t}{1-\tau_t}\varepsilon_{\tau_t, r_t} + \sigma\varepsilon_{n_t, r_t} + (1-\sigma)\frac{r_t}{r_t+\delta}}_{\text{aggregate GE effects}} \\
& \underbrace{+\sigma\left(\sum_{o''=1}^{O}\alpha_{o''}^{\frac{1}{1-\sigma}} w_{o'',t}^{\frac{-\sigma}{1-\sigma}} \cdot \varepsilon_{w_{o'',t}, r_t}\right)\left(\sum_{o''=1}^{O}\alpha_{o''}^{\frac{1}{1-\sigma}} w_{o'',t}^{\frac{-\sigma}{1-\sigma}}\right)^{-1}}_{\text{aggregate GE effects}} - \\
& \underbrace{-(1-\sigma)\frac{n_t}{l_{o,t}}\sum_{j=1}^{J} m_j \gamma_j^o \int e_t \theta_j^o(e_t, a_{t-1}, b_{t-1}) \cdot \varepsilon_{\theta_{j,t}^o, r_t} \cdot dD_j}_{\text{occupation-specific effect}} \qquad (12)
\end{aligned}
$$

Analytical Results

Proposition 2. *The elasticity of the shift probability across occupations for each household j with respect to monetary policy shocks is as follows:*

$$\varepsilon_{\theta^o_{j,t},r_t} = \underbrace{r_t u_c \left(\frac{\partial r^a_t}{\partial r_t} a_{t-1} + \frac{\partial r^b_t}{\partial r_t} b_{t-1} - (\Phi'_1 + 1) \frac{\partial a^{o,*}_t}{\partial r_t} - \frac{\partial b^{o,*}_t}{\partial r_t} + \frac{\partial \xi^o_{j,t}}{\partial r_t} \right)}_{\text{income effect}} +$$

$$+ \underbrace{r_t u_n \frac{\partial n_t}{\partial r_t}}_{\text{labor hours effect}} + \underbrace{\beta r_t E_\phi E_e \frac{\partial V^o_j(e_{t+1}, a_t, b_t)}{\partial r_t}}_{\text{continuation value effect}} -$$

$$\underbrace{r_t \frac{\sum_{o''=1}^{O+1} exp(V^{o''}_j(e_t, a_{t-1}, b_{t-1})) \frac{\partial V^{o''}_j}{\partial r_t}}{\sum_{o''=1}^{O+1} exp(V^{o''}_j(e_t, a_{t-1}, b_{t-1}))}}_{\text{granularity effect}} \tag{13}$$

Monetary policy shock

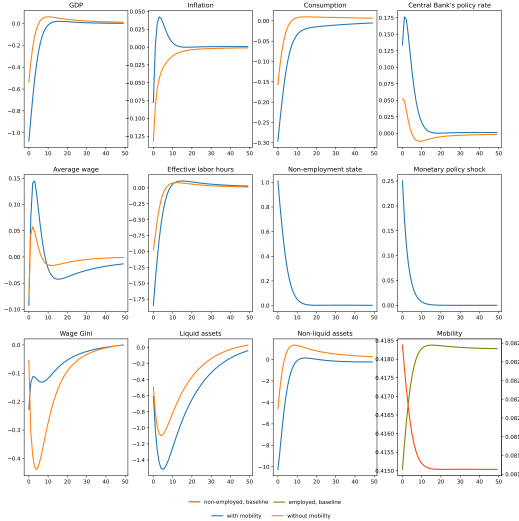


Figure: **Impulse Responses to a Monetary Policy Shock.**

Occupations

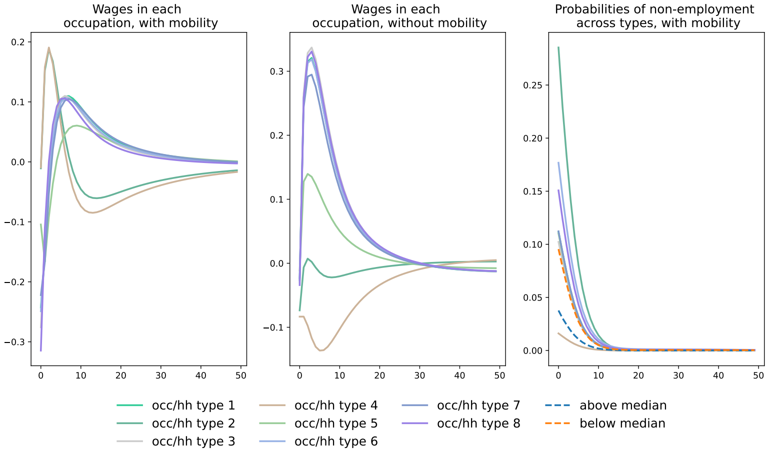


Figure: **Impulse Responses to the Monetary Policy Shock, Occupations**.

Model-based Regression: Wages

Regression without top/bottom dummies	Coefficient	T-stat
Intercept	-0.007***	-237.95
Monetary policy shock	-0.001***	-3.59
Regression with top/bottom dummies	Coefficient	T-stat
Dummy Bottom 50%	-0.010***	-10.54
Dummy Top 50%	-0.003***	6.23
Monetary policy shock * dummy Bottom 50%	0.012***	4.23
Monetary policy shock * dummy Top 50%	-0.014***	-8.10

Model-based Regression: Wage Gini and Separations

Regression Wage Gini	Coefficient	T-stat
Monetary policy shock	0.1861	1.42
Lag of monetary policy shock	-2.3596***	-19.73
Lag of dlog(Gini)	0.9871***	21.39
Second lag of dlog(Gini)	-0.1980***	-4.23
Regression Separation Rates	Coefficient	T-stat
Bottom decile	0.0199	1.56
Top decile	-0.00002	-1.17
Below the median	0.0592***	5.92
Above the median	-0.00002***	-4.59

The Role of Job Specialization

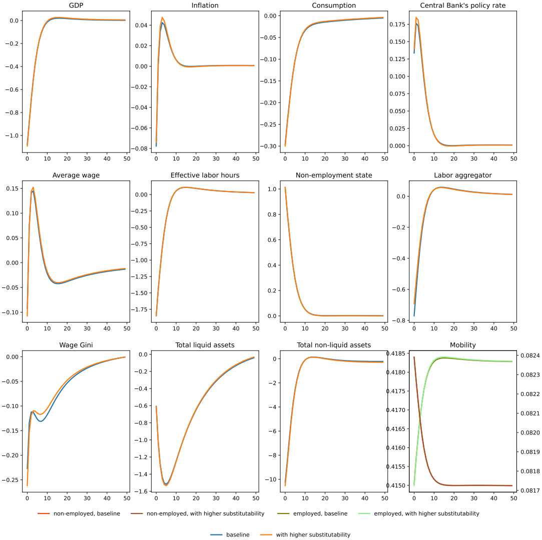


Figure: **Impulse Responses to the Monetary Policy Shock under Different**

Role of Job Specialization: Occupations

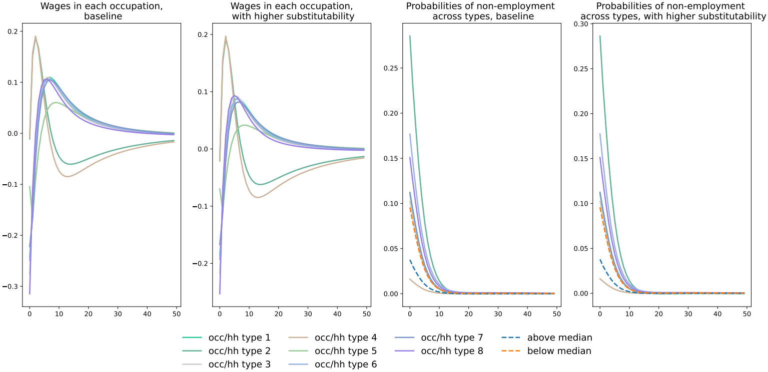


Figure: **Impulse Responses to the Monetary Policy Shock under Different Substitutability of Labor**.

The Role of Skill-Transferability

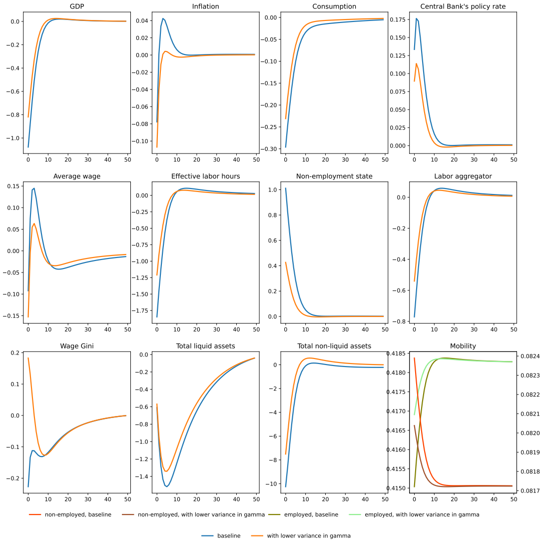


Figure: **Impulse Responses to the Monetary Policy Shock under the**

The Role of Skill-Transferability: Occupations

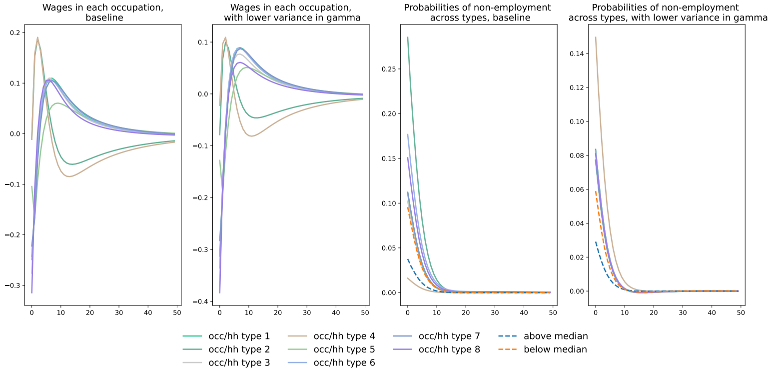


Figure: **Impulse Responses to the Monetary Policy Shock under the Baseline and a Lower Variance of the Skill Distribution.**

Monetary Policy Trade-offs

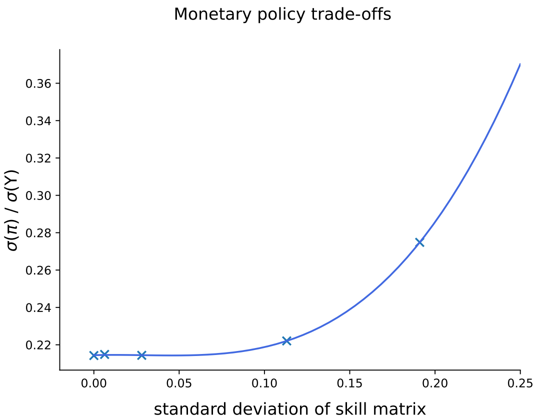


Figure: **Monetary Policy Frontier depending on Inequality**. The figure shows the inflation/output trade-offs for different distributions of skills. Y-axis shows the ratio of the standard deviation of inflation to the standard deviation of output. X-axis shows standard deviations of the Γ matrix. The baseline x-value is 0.11.

Conclusions

- Role of monetary policy for reallocation and wage inequality
- Monetary policy hits disproportionally more bottom earners
- Extend the Aiyagari 1994-Bewley 1980 to include dynamic participation and occupational choice (see Rust 1987)
- Model: monetary policy is channeled primarily through low-mobility of bottom earners
- Monetary policy is more effective in unequal societies.

Portfolio Adjustment Cost

$$\Phi(a_t, a_{t-1}) = \frac{\chi_1}{\chi_2} \left| \frac{a_t - (1 - r_t^a)a_{t-1}}{(1 + r_t^a)a_{t-1} + \chi_0} \right|^{\chi_2} [(1 + r_t^a)a_{t-1} + \chi_0] \tag{14}$$

back

Occupational Value Function

$$
\begin{aligned}
V_j^o(e_t, a_{t-1}, b_{t-1}) &= \max_{c_t, a_t, b_t} u(c_t, n_t) + \beta E_\phi E_e V_j(e_{t+1}, a_t, b_t, \phi_{t+1}) \\
\text{s.t.} \quad & c_t + a_t + b_t = \xi^o_{j,t} + (1 + r^a_t) a_{t-1} + (1 + r^b_t) b_{t-1} - \Phi(a_t, a_{t-1}) \\
& a_t \geq 0, \quad b_t \geq \underline{b}
\end{aligned}
\tag{15}
$$

back

Model: Firm's Problem

Output aggregation and production: $y_t = z_t k_{t-1}^{\nu} L_t^{1-\nu}$.

Aggregation of labor across occupations: $L_t = \left(\sum_{o=1}^{O} \alpha_o l_{o,t}^{\sigma}\right)^{\frac{1}{\sigma}}$.

$$J_t\left(k_{t-1}\right) = \max_{p_t, k_t, I_t, l_{o,t}} \left\{ \frac{p_t}{p_t} y_t - \sum_{o=1}^{O} w_t^o l_{o,t} - I_t - \frac{1}{2\varkappa\varepsilon_I}\left(\frac{k_t - k_{t-1}}{k_{t-1}}\right)^2 k_{t-1} \right.$$
$$\left. - \frac{\eta}{2\kappa} \ln(1+\pi_t)^2 Y_t + \frac{J_{t+1}(k_t)}{1+r_{t+1}} \right\} \tag{16}$$
$$\text{s.t.} \quad k_t = (1-\delta)k_{t-1} + I_t \tag{17}$$
$$p_t = \left(\frac{Y_t}{y_t}\right)^{\frac{1}{\eta}} p_t \tag{18}$$
$$y_t = z_t k_{t-1}^{\nu} L_t^{1-\nu} \tag{19}$$

back

Model: Firms' First order conditions

Labor demand

$$l_{o,t} = \left(\frac{p_t(1-\nu)\alpha_o}{\mu_p p_t w_t^o}\right)^{\frac{1}{1-\sigma}} \left(z_t k_{t-1}^{\nu}\right)^{\frac{\sigma}{(1-\nu)(1-\sigma)}} y_t^{\frac{\sigma-1+\nu}{(1-\nu)(\sigma-1)}}, \tag{20}$$

Phillips curve

$$\log(1+\pi_t) = \kappa \left(\frac{p_t}{p_t}\right)^{-\eta} (mc_t - \frac{1}{\mu_p}\frac{p_t}{p_t}) + \frac{Y_{t+1}}{Y_t}\log(1+\pi_{t+1})\frac{1}{1+r_{t+1}} \tag{21}$$

back

Model: Firms' First order conditions

Demand for capital

$$(1 + r_{t+1})q_t = \nu z_{t+1} \left(\frac{L_{t+1}}{k_t} \right)^{1-\nu} mc_{t+1} - \\ - \left[\frac{k_{t+1}}{k_t} - (1-\delta) + \frac{1}{2\varkappa \varepsilon_I} \left(\frac{k_{t+1} - k_t}{k_t} \right)^2 \right] + \frac{k_{t+1}}{k_t} q_{t+1} \tag{22}$$

The shadow price of capital

$$q_t = 1 + \frac{1}{\varkappa \varepsilon_I} \left(\frac{k_t - k_{t-1}}{k_{t-1}} \right) \tag{23}$$

back

Model: Households' aggregates

The choice of hours worked

$$\varphi n_t^{\rho} = \sum_{o=1}^{O} \sum_{j=1}^{J} m_j \int u_c(e_t, a_{t-1}, b_{t-1}, o_t) \theta_j(o|e_t, a_{t-1}, b_{t-1}) \frac{\partial \xi_{j,t}^o}{\partial n_t^o} dD_j \tag{24}$$

Effective hours supplied

$$L_t^{o,Supply} = n_t^o \zeta_t^o \sum_{j=1}^{J} m_j \gamma_j^o \int e_t \theta_j(o|e_t, a_{t-1}, b_{t-1}) dD_j(e_t, a_{t-1}, b_{t-1}) \tag{25}$$

Assets and Consumption

$$\mathcal{A}_t(r_i^a, r_i^b, \tau_i, N_i) = \sum_{j=1}^{J} m_j \sum_{o=1}^{O+1} \left(\int a_j^o(e_t, a_{t-1}, b_{t-1}) \theta_j(o|e_t, a_{t-1}, b_{t-1}) dD_j \right)$$

Distribution Graphs

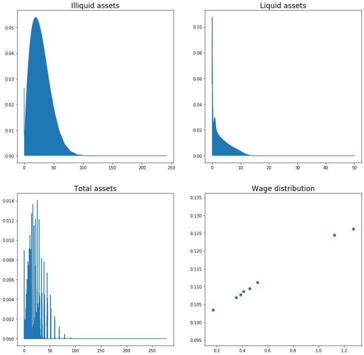


Figure: The figure shows the distribution of total wealth, liquid/non-liquid assets or wages. X-axis represents wealth/wage values and Y-axis represents probability densities.

Income and Asset Distributions, Model's steady state and Data.

Table: Data on income, liquid and non-liquid assets are from the Survey of Consumer Finance, averages over 1989-2019.

Statistics	**Data**	**Model**
Wealth distribution		
Mean Liquid Assets/GDP	0.26	0.26
Median Illiquid/GDP	2.92	3.80
Gini coefficients		
Income	0.52	0.39
Liquid assets	0.98	0.71
Illiquid assets	0.81	0.50
Income/Liquid Assets, by Occupation		
Managers and Professionals	1.80	1.48
Technical, Sales and Services	2.74	3.92

Income and Asset Distributions, Model's steady state and Data.

Table: Data on income, liquid and non-liquid assets are from the Survey of Consumer Finance, averages over 1989-2019.

Statistics	**Data**	**Model**
Shares of liquid assets per income percentile		
less than 20th percent.	0.05	0.04
20th-40th percent.	0.10	0.13
40th-60th percent.	0.08	0.12
60th-80th percent.	0.13	0.21
80th-100th percent.	0.63	0.39
Shares of illiquid assets per income percentile		
less than 20th percent.	0.07	0.06
20th-40th percent.	0.09	0.07
40th-60th percent.	0.11	0.15
60th-80th percent.	0.15	0.29
80th-100th percent.	0.57	0.28

Calibration: Other Parameters

Table: **Parameter Values, Description and Source**

Parameter	**Description**	**Value and source**
Skills and Occupations		
O	Number of occupations	8, clustered by k-means
J	Number of skill types	8, clustered from O*NET
m_j	Distribution of skill types	$1/J$ (uniform across J)
Γ	Skill transferability matrix	See Section **??**
Final Composite Good		
S	Number of sectors	1 (2 in **??**)
P_t	Aggregate Price	Normalized to 1 in the steady state.
Production Function		
σ_s	Elasticity of substitution between occupations	0.2 (baseline)
ν_s	Capital share	0.4, KLEMS, Section **??**
w^o	steady state wage per efficiency unit in occupation o	OES-BLS, see Section **??**
δ	Capital depreciation	0.02, Straub
ι	Capital adj. parameter	4, Straub

Calibration: Other Parameters

Table: **Parameter Values, Description and Source**

Parameter	Description	Value and source
Households		
β	Time discount factor	0.979, see Section **??**
χ_0	Portfolio adj. cost pivot	0.25, Straub
χ_1	Portfolio adj. cost scale	6.19 (target $\mathcal{B}_h = 1.04Y$, Straub)
χ_2	Portfolio adj. cost curvature	2, Straub
σ	EIS	0.5 Straub
ρ	Inverse Frisch elasticity	1 Straub
ρ_z	Autocorrelation of earnings	0.966, Straub
σ_z	Cross-sectional std of log earnings	0.92, Straub
h_t	Flow value of non-employment	47% of average income, see Section **??** Straub
φ	Dis-utility parameter	1.71 (target $n = 1$)

Calibration: Other Parameters

Table: **Parameter Values, Description and Source**

Parameter	**Description**	**Value and source**
Asset Markets		
r	Real interest rate	0.0125, Straub
ψ	Liquidity premium	0.005, Straub
μ_p	steady state markup	1.015, Straub
Monetary and Fiscal Policy		
ϕ	Coefficient on inflation in Taylor rule	1.5, Straub
ϕ_y	Coefficient on output gap in Taylor rule	0, Straub
τ	Tax rate	0.401, Straub
$\mathcal{B}_g$	Bond supply	2.8, Straub
κ	Slope of the Phillips curve	0.1, Straub