Heterogeneity, Transfer Progressivity and Business Cycles

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Introduction

- Progressive tax and transfers are prevalent in developed countries.
- Various work on macro implications of progressive nature of tax & transfers.
  - e.g., optimal progressivity, effects of progressivity on long-run labor supply, ...
- A natural, yet relatively unexplored question:

  $\Rightarrow$ How does progressivity of tax and transfers affect aggregate fluctuations?
- In particular, it would be timely and relevant to enhance the understanding the role of transfer progressivity
  - The size of various welfare programs steadily rising since 1970's (Ben-Shalom, Moffitt and Scholz, 2011)

What we do in this paper

- explore how the existence of progressive transfers alter the way aggregate shocks are transmitted to macroeconomy with heterogeneous agents.
    - not only volatility (McKay and Reis, 2016) but also comovement of aggregates
- present a simple static model of extensive margin labor supply
    - derives **analytically** how transfer progressivity affects the response of heterogeneous agents to aggregate conditions
- build quantitative dynamic general equilibrium models
    - **quantitatively** evaluate the role of transfer progressivity
    - **Counterfactuals**: tax progressivity vs. transfer progressivity
- explore the key model mechanism in micro-level panel data.

Preview of main findings

- A simple static model shows that greater transfer progressivity
  - makes low type's LS more elastic (and aggregate LS).
  - leads to less procyclical ALP through compositional effects (Bils, 1985)
- Our quantitative business cycle model addresses well-known weaknesses:
  - at odds with Dunlop-Tarshis observation: weak cyclicality of ALP
  - moderate volatility of hours in incomplete-markets model (Chang & Kim, 2014), even with indivisible labor (Hansen, 1985; Rogerson, 1988)

	U.S.	Model			
	Data	**Baseline**	No Tr.	No Prog.	No Het.
$Cor(Y/H, Y)$	0.30	0.69	0.95	0.85	0.84
$Cor(Y/H, H)$	-0.23	0.07	0.81	0.48	0.74
$\sigma(H)/\sigma(Y)$	0.98	0.73	0.51	0.57	0.80

Preview of main findings

- Business cycle implications of redistributive policies differ sharply, depending on whether tax or transfer progressivity is used.
  - Transfer progressivity $\uparrow$ leads to higher $\sigma(H)/\sigma(Y)$ and lower $Cor(Y/H, Y)$
  - Tax progressivity $\uparrow$
    - Direct effect: lower $\sigma(H)/\sigma(Y)$ and higher $Cor(Y/H, Y)$
    - Indirect effect: distributional effects (potentially sizeable)
- Finally, we document micro-evidence supporting our key mechanism:
  - Prob of adjusting extensive-margin is higher among low-wage workers.
  - Declines in full-time employment rate are steeper among low-wage workers during recent recessions.

Related literature

- Household heterogeneity matters for the dynamics of macro variables.
  - Krueger, Mitman & Perri (2016); Ahn, Kaplan, Moll, Winberry & Wolf (2017): focus on aggregate consumption
  - Our focus is on labor market fluctuations.
- Weakly procyclical average labor productivity in the US
  - Existing literature relies on additional shock: Benhabib, Rogerson & Wright (1991); Christiano & Eichenbaum (1992); Braun (1994); Takahashi (2019)
  - Our mechanism is based on heterogeneity of labor supply responsiveness.
- Transfers as social insurance affecting low-income households.
  - Hubbard, Skinner & Zeldes (1995): less precautionary savings
  - Yum (2018): less precautionary employment
- Trends in the cyclicality of average labor productivity (Gali & van Rens, 2017)
  - Our simple model connects welfare program expansions to this trend.
  - providing a potential explanation for this change.

A simple, static model

A simple static model

A model of LS at the extensive margin, building on Doepke & Tertilt (2016).

- Assume two types of wage offer (potential earnings): $x_i \in \{x_L, x_H\}$.
- Mass of each type: π_L and π_H s.t. $\pi_L + \pi_H = 1$.
- Agents differ in their asset holdings: a
- Decision problem of each type i:

$$\max_{c_i \geq 0, n_i \in \{0,1\}} \{\log c_i - bn_i\}$$

subject to

$$c_i \leq zx_i n_i + a + T_i, \quad i = L, H$$

  - z : aggregate shifter
  - T_i : transfers depending on potential earnings
- Progressive transfer : $T_L > T_H \geq 0$..

A static model of extensive margin labor supply

Aggregate employment is shaped by both decision rules and asset distribution.

- Optimal decisions: choose to work if

$$\log\left(zx_i + T_i + a\right) - b \geq \log\left(T_i + a\right)$$

assuming $b = \log(2) > 0$, we can rewrite

$$a \leq zx_i - T_i \equiv \tilde{a}_i$$

  - Threshold-based decision (type-specific).
  - Agents more likely to work if z,x higher or T lower.

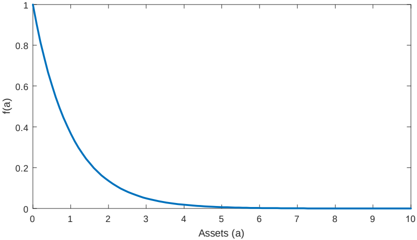
A static model of extensive margin labor supply

Aggregate employment is shaped by both decision rules and asset distribution.

- $F(a)$: conditional (diff'ble) dist fn of wealth. For $a \geq 0$,

$$
\begin{aligned}
F(a) &= 1 - \exp(-a) \\
f(a) &= F'(a) = \exp(-a)
\end{aligned}
$$

  - $f(a)$ has the mode at zero and is strictly decreasing.



A static model of extensive margin labor supply

Given the decision rules and the distribution,

- the fraction of agent working (i.e., **employment rate**) for each type is the integral of those whose asset level is lower than the threshold level $\underline{a}_i$.

$$N_i = F\left(\tilde{a}_i\right) = 1 - \exp(-\tilde{a}_i)$$

where

$$\underline{a}_i = zx_i - T_i.$$

Definition

The **labor supply elasticity** of each type is defined as

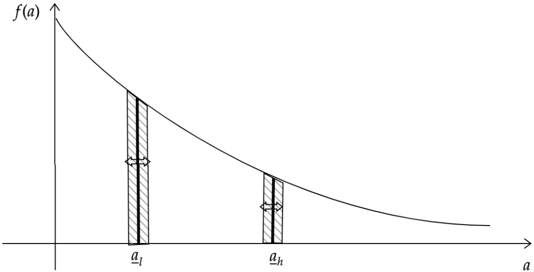
$$\varepsilon_i \equiv \frac{\partial N_i}{\partial z}\frac{z}{N_i}.$$

Heterogeneity of labor supply elasticity

Theorem

Assume $T_i = 0$. The labor supply elasticity of the low-potential-earnings is greater than that of the high-potential-earnings: $\varepsilon_L > \varepsilon_H$.

- Intuition:
  - $\underline{a}_L$ is lower than $\underline{a}_H$.
  - distribution of wealth is more concentrated around low a.
  - same threshold change $\tilde{a}_i$ affects more people among $x = L$.



Transfer progressivity and heterogeneity

- To simplify the algebra, we assume symmetry: $\pi_L = \pi_H = 0.5$,

$$x_H = 1 + \lambda \text{ and } x_L = 1 - \lambda, \quad \text{where } \lambda \in [0, 1]$$

$$T_L = T(1 + \omega\lambda) \text{ and } T_H = T(1 - \omega\lambda)$$

where $\omega \in [0, \frac{1}{\lambda}]$ captures progressivity of transfers.

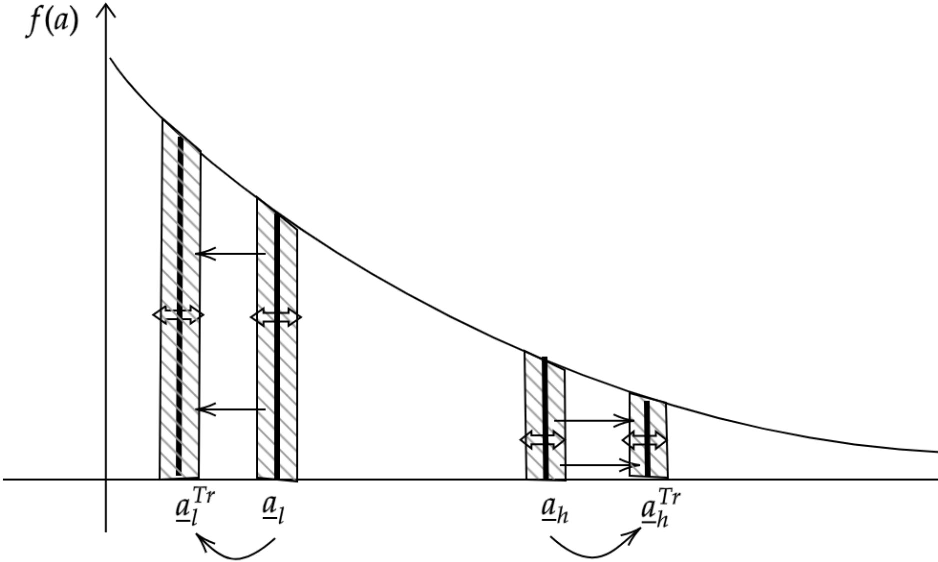
Theorem

Greater transfer progressivity increases the labor supply elasticity of the low-type agents, yet it decreases the labor supply elasticity of the high-type agents.

$$\frac{\partial \varepsilon_L}{\partial \omega} > 0 \ \& \ \frac{\partial \varepsilon_H}{\partial \omega} < 0$$

- Intuition: greater progressivity $T_L \uparrow$ ($\tilde{a}_L \downarrow$) and $T_H \downarrow$ ($\tilde{a}_H \uparrow$)

Transfer progressivity and heterogeneity



Transfer progressivity and volatility

Definition

Let N denote the aggregate employment rate: $N = \pi_L N_L + \pi_H N_H$. Let ε be the aggregate labor supply elasticity:

$$\varepsilon \equiv \frac{\partial N}{\partial z} \frac{z}{N}$$

Theorem

The aggregate labor supply elasticity is higher with greater progressivity.

$$\frac{\partial \varepsilon}{\partial \omega} > 0$$

- Recall: previous theorems and $f(a)$ being more concentrated as $a \downarrow$.

Transfer progressivity and comovement

Definition

Average labor productivity (ALP) is defined as

$$\chi \equiv \frac{\sum_{j\in\{L,H\}} \pi_i \left(z x_i N_i\right)}{\sum_{j\in\{L,H\}} \pi_i N_i} \equiv z\chi_0.$$

Theorem

A change in aggregate shifter z has a direct and an indirect effect on ALP. The indirect effect is negative: $\frac{\partial \chi_0}{\partial z} < 0$.

Theorem

ALP becomes less positively (or more negatively) correlated with z if transfer progressivity increases.

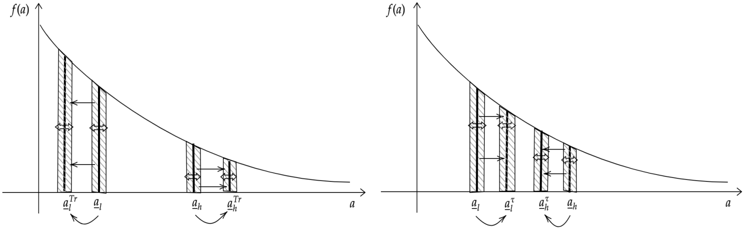
$$\frac{\partial}{\partial \omega}\left(\frac{\partial \chi_0}{\partial z}\right) < 0$$

Tax progressivity vs. transfer progressivity

- Consider progressive tax: $\tau_L < \tau_H$

$$\underline{a}_i = (1 - \tau_i) z x_i - T_i$$

Higher tax progressivity	Higher τ_H, lower τ_L	$\underline{a}_L \uparrow \quad \underline{a}_H \downarrow$
Higher transfer progressivity	Lower T_H, higher T_L	$\underline{a}_L \downarrow \quad \underline{a}_H \uparrow$



- Opposite business cycle implications (**direct** effect only)
- **Indirect** distributional effects could be substantial $\Rightarrow$ *quantitative* question!

Quantitative, dynamic models

Dynamic, incomplete-markets framework

- We derived the key insights in a highly styzlied environment missing
  - endogenous distribution of assets, risk in incomplete-markets, non-observable type to government...
- It is a quantitative question whether this mechanism would be relevant in a more realistic model environment.
- Hence, we now consider a standard quantitative dynamic model
  - Competitive markets; general equilibrium
  - Idiosyncratic productivity shocks + incomplete asset markets (Huggett 1993; Aiyagari 94)
  - Aggregate productivity shocks (Kydland & Prescott 1982)
  - Endogenous consumption-savings & extensive margin labor supply (Chang & Kim 2006; 2007)
  - Progressive taxation (Benabou 2002; HSV, 2014)
  - Progressive transfers (Yum, 2018)

Model specifications

1. **Model (HA-T)**: **H**eterogeneous-**A**gent,**T**argeted transfers
2. **Model (HA-N)**: **H**eterogeneous-**A**gent, **N**o transfers
   - similar to Chang and Kim (2007)
3. **Model (HA-F)**: **H**eterogeneous-**A**gent, **F**lat transfers
   - similar to Chang, Kim and Schorfheide (2013)
4. **Model (RA)**: **R**epresentative-**A**gent
   - similar to Hansen (1985)

Idiosyncratic and aggregate uncertainty

Households face both

- Aggregate productivity shocks

$$\log z' = \rho_z \log z + \varepsilon_z'$$

  where $\varepsilon_z \sim N(0, \sigma_z^2)$
- Idiosyncratic productivity shocks

$$\log x' = \rho_x \log x + \varepsilon_x'$$

  where $\varepsilon_x \sim N(0, \sigma_x^2)$

These are assumed to be captured by Markov chains

$$\{z_i\}_{i=1}^{N_z}, \{\pi_{kl}^z\}_{k,l=1}^{N_z}$$
$$\{x_i\}_{i=1}^{N_x}, \{\pi_{ij}^x\}_{i,j=1}^{N_x}$$

using Rouwenhorst (1995).

Household's decision problem

Consumption-savings & labor supply decisions

$$V(a, x_i, \mu, z_k) = \max \left\{ V^E(a, x_i, \mu, z_k), V^N(a, x_i, \mu, z_k) \right\}$$

$$V^E(a, x_i, \mu, z_k) = \max_{\substack{a' \geq \underline{a}, \\ c \geq 0}} \left\{ \log c - B\bar{n} + \beta \sum_{j=1}^{N_x} \pi^x_{ij} \sum_{l=1}^{N_z} \pi^z_{kl} V(a', x'_j, \mu', z'_l) \right\}$$

s.t.

$$\begin{aligned} c + a' &\leq \tau(e, \bar{e})e + (1 + r(\mu, z_k))a + T(m) \\ e &= w(\mu, z_k) x_i \bar{n} \\ m &= e + r(\mu, z_k) \max\{a, 0\} \\ \mu' &= \Gamma(\mu, z_k). \end{aligned}$$

Household's decision problem

$$V^N(a, x_i, \mu, z_k) = \max_{\substack{a' \geq \underline{a}, \\ c \geq 0}} \left\{ \log c + \beta \sum_{j=1}^{N_x} \pi_{ij}^x \sum_{l=1}^{N_z} \pi_{kl}^z V(a', x_j', \mu', z_l') \right\}$$

s.t.

$$\begin{aligned} c + a' &\leq (1 + r(\mu, z_k))a + T(m) \\ m &= r(\mu, z_k) \max\{a, 0\} \\ \mu' &= \Gamma(\mu, z_k). \end{aligned}$$

- Γ maps an infinite dimensional object to itself.

Tax and transfers

- In the literature, progressivity is based on both tax and transfers (HSV 2014)
  - We separate them out: $\tau \geq 0$ and $T \geq 0$.
- Progressive tax (Benabou 2002)

$$\tau(e, \bar{e}) = \max\left\{1 - \left(\lambda_s \left(e/\bar{e}\right)^{-\lambda_p}\right), 0\right\}$$

- Transfers have two components (Krusell & Rios-Rull, 1999):

$$T(\cdot) = T_1 + T_2(m)$$

  - T_1 : given to all households equally
  - T_2 : progressive capturing various means-tested programs.
- *Progressive* component of transfers (Yum, 2018):

$$T_2(m) = \omega_s(1+m)^{-\omega_p}$$

  - $\omega_s > 0$: captures scale (i.e., $T(0) = \omega_s$).
  - $\omega_p > 0$: captures degree of progressivity

Government and Firm

- Government budget: Total tax revenue is spent on transfers and G.
- Representative firm; competitive markets

$$\max_{K,L} \{z_k F(K,L) - (r(\mu, z_k) + \delta)K - w(\mu, z_k)L\}$$

which gives optimality conditions

$$r(\mu, z_k) = z_k F_1(K,L) - \delta,$$
$$w(\mu, z_k) = z_k F_2(K,L).$$

- Cobb-Douglas: $F(K,L) = K^{\alpha} L^{1-\alpha}$

Equilibrium

Recursive competitive equilibrium:
$r(\mu, z_k), w(\mu, z_k), \tau, G, T(\cdot), V(a, x_i, \mu, z_k), g_a(a, x_i, \mu, z_k),$
$g_n(a, x_i, \mu, z_k), \mu(a, x_i), K(\mu, z_k), L(\mu, z_k), \Gamma(\mu, z_k)$

- Households solves the problems described above taking prices and govt policies as given. Solutions include $V(a, x_i, \mu, z_k)$ and optimal decision rules $g_a(a, x_i, \mu, z_k)$, $g_n(a, x_i, \mu, z_k)$.
- Firm maximizes profit as defined above.
- Markets (capital, labor) clear.

$$\begin{aligned} K(\mu, z_k) &= \sum_{i=1}^{N_x} \int_a a d\mu \\ L(\mu, z_k) &= \sum_{i=1}^{N_x} \int_a x_i g_n(a, x_i, \mu, z_k) d\mu. \end{aligned}$$

- Govt budget balances.
- $\mu' = \Gamma(\mu, z_k)$ is consistent with decision rules given the stochastic processes.

Nested model specifications

1. **Model (HA-T)**: Baseline specification
2. **Model (HA-N)**: $T_1 = \omega_s = 0$
3. **Model (HA-F)**: $\omega_p = 0$
4. **Model (RA)**: No household heterogeneity

Solution method

Computing equilibrium

Heterogeneous-agent model with aggregate risk

Our numerical solution method is nontrivial for several reasons.

1. The key decision is a discrete employment decision. Therefore, our solution method relies on the nonlinear method (value function iteration), and the interpolation should be done carefully (Takahashi, 2014).
2. The aggregate law of motion and the state variable involve an infinite-dimensional object μ. Thus, we solve the model in the spirit of Krusell & Smith (1998): assume that μ can be approximated by its mean (approximate aggregation).
3. In addition, since market-clearing is nontrivial in our model with endogenous labor, our solution method incorporates a step to find market-clearing prices in simulation (Takahashi, 2014).

Computing equilibrium

Heterogeneous-agent model with aggregate risk

- **Inner loop**: we solve for the individual value functions and policy functions given the guess for the forecasting rules.

$$\hat{K}' = \exp\left(a_{0,i} + a_{1,i} \log K\right),$$
$$\hat{w} = \exp\left(b_{0,i} + b_{1,i} \log K\right),$$

  for each $i = 1, ..., N_z$.

- **Outer loop**: we simulate the model using the solutions at the individual level obtained in the inner loop. In each period, we make sure to find the market-clearing price using bisection. Then, update the forecasting rules based on the simulated macro variables.

- We stop if the estimated forecasting rules (i.e., $\{a_{0,i}, a_{1,i}, b_{0,i}, b_{1,i}\}_{i=0}^{N_z}$) converge.

Calibration

Calibration

Parameters calibrated externally

- Calibrated to U.S. data; quarterly

Parameters		Description
$\alpha =$	0.36	Capital share
$\delta =$	0.025	Capital depreciation rate
$\bar{n} =$	1/3	Hours of work
$\lambda_p =$	0.053	Tax progressivity (Guner et al., 2014)
$\lambda_s =$	0.911	Tax scale (Guner et al., 2014)
$\underline{a} =$	$-T_1/(1+r)$	Borrowing limit
$\rho_z =$	0.95	Persistence of log z (Cooley & Prescott, 1995)
$\sigma_z =$	0.007	S.D. of innovations (Cooley & Prescott, 1995)
$\rho_x =$	0.9847	Persistence of log x

Calibration

Parameters calibrated internally

Parameters			Target statistics		
Values		Description	Model	Data	Description
$\tilde{B} =$	.692	Disutility of work	.777	.782	Employment rate
$\beta =$	.985	Subject discount factor	.010	.010	Real interest rate
$\sigma_x =$	.126	sd of innovations to $\ln x$	.360	.359	Wage Gini index
$T_1 =$	.0337	Overall transfer size	.044	.044	Ratio of $E(T_1 + T_2)$ to output
$\omega_s =$	.117	Prog transfer scale	.0203	.0201	Ratio of Avg T_2 to output
$\omega_p =$	3.62	Transfer progressivity	3.07	3.06	$E(T_2 \| \text{1st inc quintile})/E(T_2)$

- For nested models, we minimize the number of re-calibrated parameters.
  - We keep parameters for idiosyncratic risk.
  - Recalibrate B and β.

Disaggregated moments in steady state

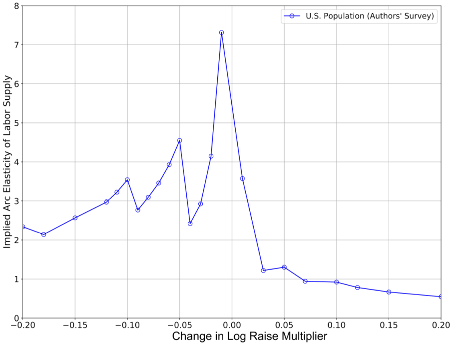
	Wealth quintile				
	1st	2nd	3rd	4th	5th
Share of wealth (%)					
U.S. Data (SIPP)	-2.2	1.2	6.8	18.4	76.3
U.S. Data (SCF)	-0.4	1.2	5.1	13.6	80.5
Model (HA-T)	-0.0	0.9	5.2	19.7	74.3
Model (HA-N)	-0.1	0.1	4.8	20.4	74.8
Model (HA-F)	-0.0	0.3	4.9	20.2	74.7
Employment rate (%)					
U.S. Data (SIPP)	70.0	77.9	80.9	82.5	79.7
Model (HA-T)	85.3	79.3	84.4	75.2	64.2
Model (HA-N)	100.0	99.2	74.0	66.0	51.9
Model (HA-F)	100.0	92.0	75.2	67.9	54.0

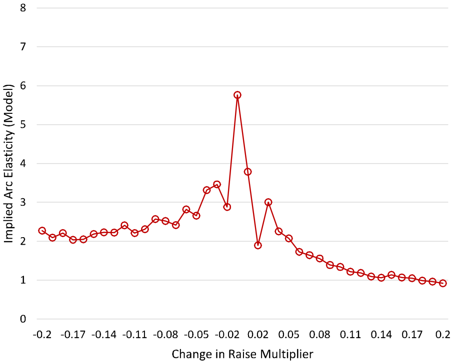
Disaggregated moments in steady state

	Income quintile				
	1st	2nd	3rd	4th	5th
Conditional mean/unconditional mean					
U.S. Data	3.06	0.99	0.52	0.26	0.17
Model (HA-T)	3.07	1.07	0.56	0.24	0.06
Model (HA-F)	1.00	1.00	1.00	1.00	1.00

Reservation raise and arc elasticities

Data source: Mui and Schoefer (2020)





Business cycle results

Business cycle analysis

We follow the standard business cycle analysis in the RBC literature.

- Model: we simulate the model and detrend the log aggregate variables using the HP filter (with a smoothing parameter of 1600).
- U.S. data: aggregate data from 1961Q1 to 2016Q4 is detrended after taking log using the HP filter (with a smoothing parameter of 1600).

We make sure that our solution method is accurate and robust.

- $R^2 > 0.9999$ for K'; $R^2 > 0.998$ for w.
- Den Hann error (2010) mean $< 0.1\%$; max $< 0.8\%$.

Cyclicality of aggregate variables

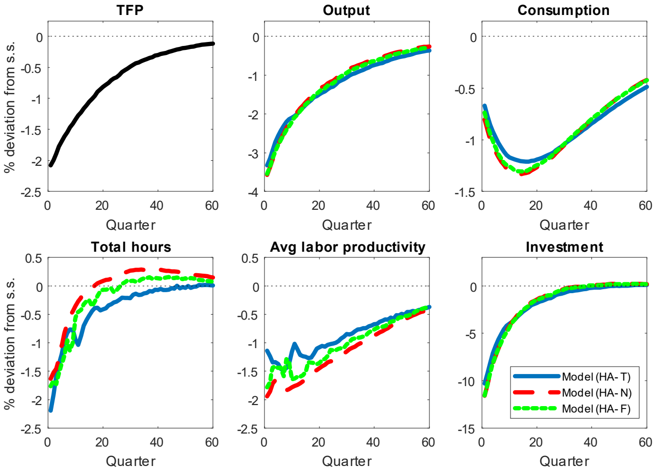
	U.S. data	Model (HA-T)	(HA-N)	(HA-F)	(RA)
$Cor(Y, C)$	0.81	0.85	0.85	0.84	0.84
$Cor(Y, I)$	0.90	0.99	0.99	0.99	0.99
$Cor(Y, L)$	-	0.92	0.96	0.96	-
$Cor(Y, H)$	0.86	0.77	0.95	0.87	0.99
$Cor(Y, Y/H)$	0.30	0.69	0.95	0.85	0.84
$Cor(H, Y/H)$	-0.23	0.07	0.81	0.48	0.74

Volatility of aggregate variables

		Model			
	U.S. data	(HA-T)	(HA-N)	(HA-F)	(RA)
σ_Y	1.50	1.27	1.48	1.46	1.83
σ_C/σ_Y	0.58	0.27	0.28	0.27	0.25
σ_I/σ_Y	2.96	2.87	2.99	2.99	3.08
σ_L/σ_Y	-	0.50	0.64	0.62	-
σ_H/σ_Y	0.98	0.73	0.51	0.60	0.80
$\sigma_{Y/H}/\sigma_Y$	0.52	0.64	0.54	0.57	0.25

Inspecting the mechanism

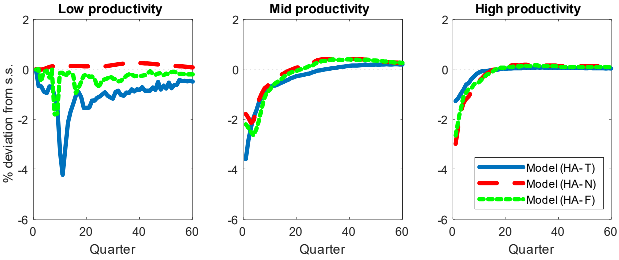
Impulse responses of aggregate variables



- IRFs computed following Koop et al. (1996) and Bloom et al. (2018)

Inspecting the mechanism

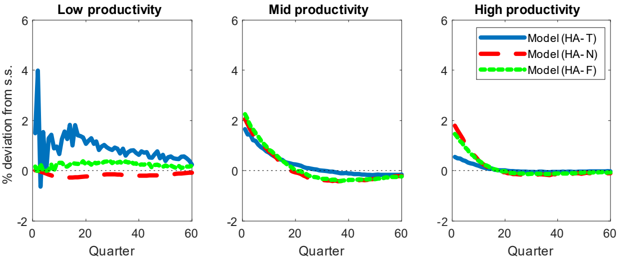
Impulse responses of labor supply across distribution



- The existence of transfers play a dual role in baseline model.
  1. Transfer progressivity: (HA-T) vs. (HA-F)
     - ★ In line with the static model mechanism
     - ★ Higher progressivity makes low productivity to be more elastic; high productivity to be less elastic.
  2. Insurance: (HA-F) vs. (HA-N)
     - ★ Risk, incomplete-markets
     - ★ In the absence of transfers, wealth-poor households very inelastic due to high precautionary motive

Inspecting the mechanism

Positive TFP shocks



Counterfactual exercise

Transfer progressivity vs. Tax progressivity

Counterfactual exercise

- Our baseline model features two separate nonlinear functions.
- We now investigate how redistributive policies (i.e., higher progressivity) affects both steady state and business cycles: either by
  - Higher transfer progressivity
  - Higher tax progressivity
- To control for the strength of redistributive policies, we adjust parameters such that the difference between Gini income before tax and transfers and after tax and transfers becomes 2 percentage point higher, compared to the baseline economy.

	Baseline Model (HA-T)	Counterfactuals *Higher progressivity* Transfers	Tax
Steady state			
Employment rate (%)			
Overall	77.7	71.2	78.4
By wealth quintile			
1st	85.3	50.0	92.7
2nd	79.3	83.8	75.3
3rd	84.4	80.6	85.1
4th	75.2	76.8	74.6
5th	64.2	64.6	64.2
Business cycles			
σ_Y	1.29	1.37	1.29
σ_H/σ_Y	0.73	1.09	0.75
$Cor(Y, Y/H)$	0.69	0.19	0.66
$Cor(H, Y/H)$	0.08	-0.44	0.05

Microeconomic evidence

Microeconomic evidence

- The key mechanism underlying our models:
  - Heterogeneity of extensive-margin responses
- There is limited recent empirical evidence on this heterogeneity.
  - Some earlier studies: Kydland (1984), Juhn, Murphy & Topel (1991).
- We empirically explore this heterogeneity in micro data.
- Specifically, we exploit the panel structure of PSID to see whether extensive margin LS responses differ by hourly wage.
  1. Probability of extensive-margin adjustment at the individual level
  2. Changes in employment rates during the last six recessions.

Microeconomic evidence

Probability of extensive-margin LS adjustment

First approach: based on labor market flow at the individual level

- i : individual index
- t : year when the individual is observed.
- An individual i in year t is full-time employed: $E_{i,t} = 1$ or $E_{i,t} = 0$ o.w.
- A binary variable of switching: $S_{i,t} = 1$ if $E_{i,t} \neq E_{i,t-1}$ or $S_{i,t} = 0$ o.w.
  - We exclude transitions from $E_{i,t-1} = 1$ to $E_{i,t} = 0$ if unemployment spell is positive in period t: to rule out lay-off driven transitions.

Microeconomic evidence

Probability of extensive-margin LS adjustment

- Choose a **base year** j and time length T. Compute

$$p_{i,j} \equiv \frac{1}{T-1} \sum_{t=j+1}^{j+T-1} S_{i,t}$$

i.e., individual-specific prob of extensive-margin adjustment.

- For each year j, obtain p_j^q: conditional mean of $p_{i,j}$ in wage quintile q.

$$p_j^q = E(p_{i,j} | i \text{ belongs to wage quintile } q)$$

- Long-run prob. of switching (extensive margin) by wage quintile :

$$p^q \equiv \frac{1}{J} \sum p_j^q$$

where J is the number of base years.

Microeconomic evidence

Probability of extensive-margin LS adjustment

	Length of tracking each individual T					
	5 years			10 years		
Wage quintile		Swiches			Swiches	
in base year	All	Pos only	Neg only	All	Pos only	Neg only
1st	.096	.059	.038	.075	.046	.029
2nd	.050	.029	.021	.042	.024	.018
3rd	.038	.019	.019	.032	.017	.015
4th	.034	.016	.019	.029	.013	.016
5th	.039	.018	.021	.034	.015	.019
Base years	1969-1993 ($J = 25$)			1969-1988 ($J = 20$)		
Avg. no. obs in base years	1,659			1,181		
Total no. obs.	41,483			23,623		
Avg. age	41.0			41.8		

Microeconomic evidence

Full-time employment rate changes during recessions

Second approach: based on short-run emp level changes during recessions

- Consider six recessions and choose a **peak** and a **trough** year:

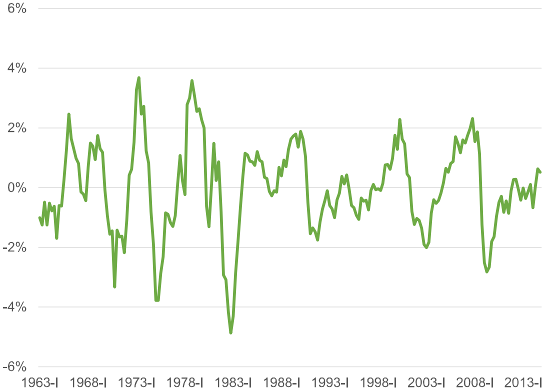
  69-71 73-76 80-83 90-92 00-02 06-10

  - Key forcing variable: aggregate-level variations (instead of idiosyncratic ones)
- N^q_{peak} : number of obs in wage quintile q in peak year of a recession
- For each recession, compute $\frac{1}{N^q_{peak}} \sum_i E^q_{i,peak}$

  i.e., conditional mean of E by wage quintile in the peak year
- $\frac{1}{N^q_{peak}} \sum_i \left(E^q_{i,trough} - E^q_{i,peak} \right)$: p.p. changes in emp rate by wage quintile
  - Note: we keep the set of households in each wage group fixed by assigning a wage quintile to each household in peak year.
  - measured changes in E not affected by compositional changes.

Microeconomic evidence

Full-time employment rate changes during recessions



A quarterly series of real GDP per capita is detrended using HP filter with a smoothing parameter of 1,600.

Microeconomic evidence

Full-time employment rate changes during recessions

	Recession					
	1969-71	1973-76	1980-83	1990-92	2000-02	2006-10
Wage quintile in peak year						
1st	-7.4	-9.9	-8.6	-8.4	-8.7	-15.3
2nd	-3.4	-8.5	-4.3	-5.8	-5.2	-12.9
3rd	-5.2	-6.1	-6.1	-4.9	-2.8	-10.8
4th	-5.2	-3.8	-5.8	-5.6	-4.9	-10.3
5th	-1.5	-6.1	-4.3	-4.2	-1.9	-5.4
No. obs.	1,621	1,838	1,984	2,145	2,880	2,779

Microeconomic evidence

Full-time employment rate changes during recessions

Excluding observations with positive unemployment spells

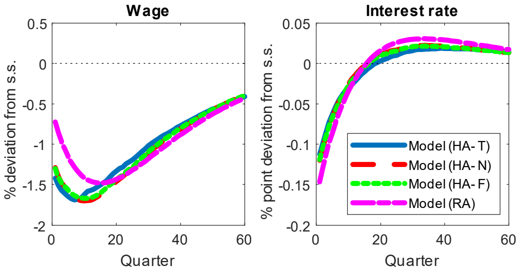
	Recession				
	1973-76	1980-83	1990-92	2000-02	2006-10
Wage quintile in peak year					
1st	-10.7	-5.1	-8.3	-4.8	-8.2
2nd	-7.2	-0.7	-4.5	-3.3	-8.7
3rd	-5.8	-4.6	-5.1	-1.4	-6.1
4th	-3.5	-6.1	-3.7	-4.2	-7.5
5th	-5.4	-4.7	-3.8	-1.6	-4.4
No. obs.	1,516	1,477	1,752	2,428	2,350

Conclusion

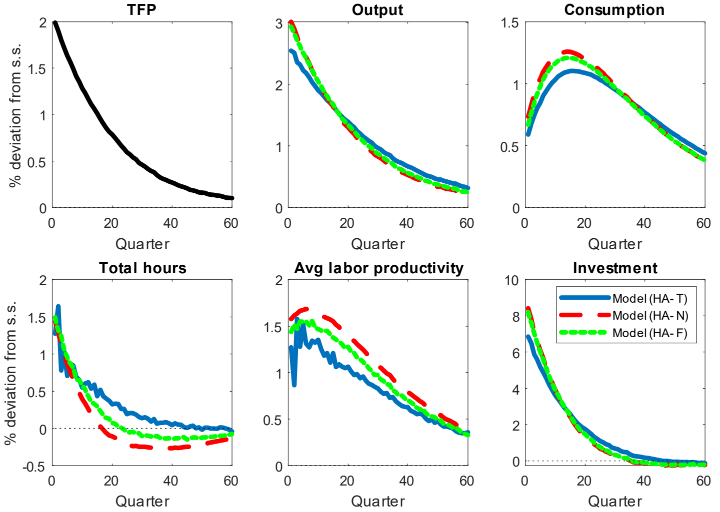
- We develop a simple static model to present analytical results on
  - heterogeneity of LS elasticity and the interaction of progressivity and heterogeneity in shaping aggregate fluctuations.
- We present a quantitative, dynamic incomplete-markets model.
  - average labor productivity is moderately procyclical
  - while retaining the success of the canonical RA model of Hansen-Rogerson in terms of a large relative volatility of aggregate hours.
- Counterfactual exercises show that two redistributive policies adjusting **transfer progressivity** and **tax progressivity** have very different implications for aggregate fluctuations.
- We document microeconomic evidence supporting our mechanism.

Inspecting the mechanism

Equilibrium prices



Impulse responses following positive TFP shocks



Calibration

Transfers

We use the SIPP to measure the progressivity of transfers (broadly).

- Supplemental Security Income (SSI)
- Temporary Assistant for Needy Family (TANF): Formerly, Aid to Families with Dependent Children (AFDC)
- Supplemental Nutrition Assistance Program (SNAP): Formerly, food stamp
- Supplemental Nutrition Program for Women, Infants, and Children (WIC)
- Child care subsidy
- Medicaid

We do not include programs explicitly targeted towards old population such as

- Social Security
- Medicare