Doves for the Rich, Hawks for the Poor? Distributional Consequences of Monetary Policy

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Motivation

- Heterogeneity in wealth and income have received heightened interest in the macroeconomic policy and academic debate in the last years.
  - Yellen (2016).
  - Piketty (2014).
  - Rising inequality since 1970s.

- Interaction between inequality/redistribution and monetary policy has long been recognized but until recently only sparely incorporated into formal policy analysis of cyclical policy.
  - Workhorse model for central banks is representative-agent NK model.

- Our paper combines the workhorse model of monetary policy analysis with inequality, incomplete markets and labor market risk.

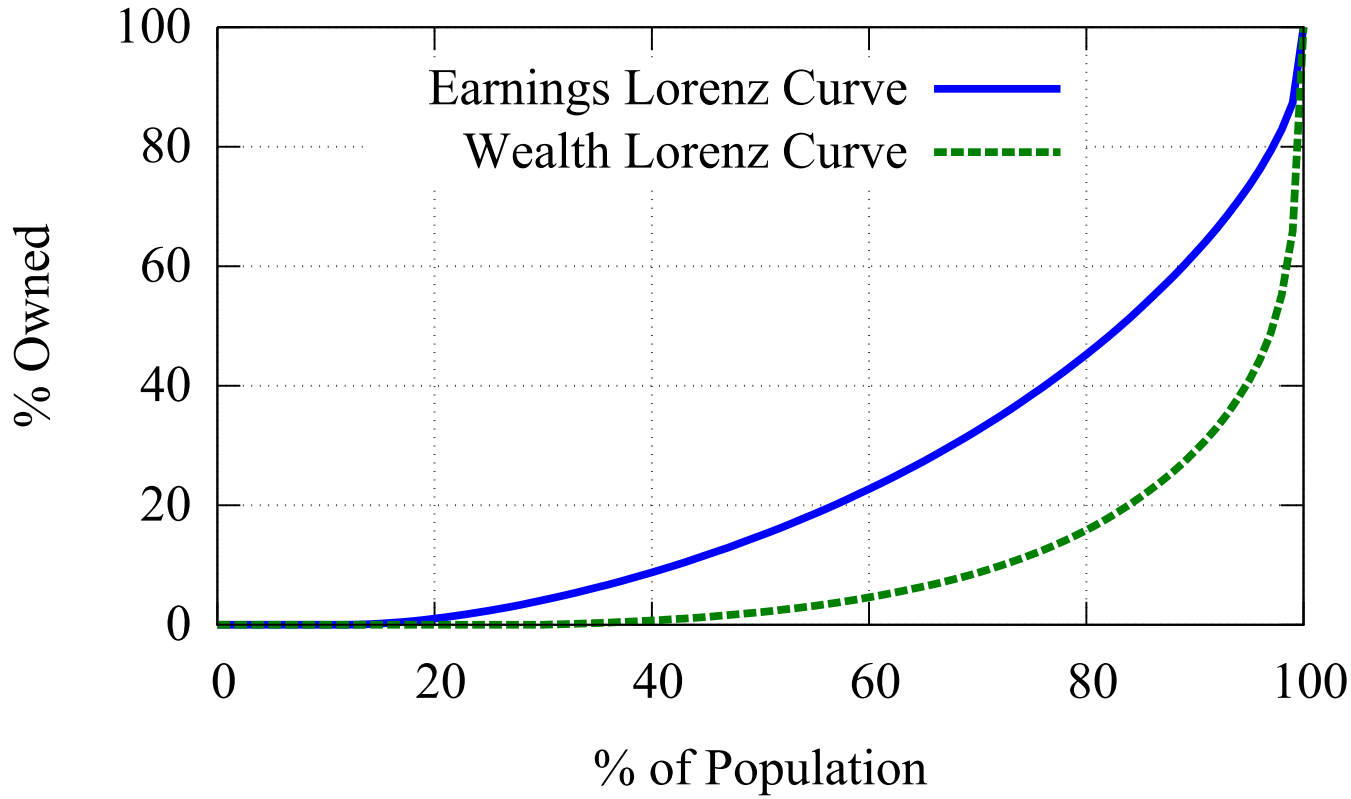
What We Do

- Develop a business cycle model combining three key frictions.
  - New Keynesian nominal frictions.
    $\rightarrow$ monetary policy.
  - Bewley-Aiyagari-Huggett/Krusell-Smith market incompleteness.
    $\rightarrow$ income and wealth inequality.
  - Diamond-Mortensen-Pissarides labor market frictions.
    $\rightarrow$ unemployment risk endogenous to policy.

- Calibrate the model to the U.S. economy.
  - Focus on normal times.
  - Replicate the observed inequality of income and wealth.

- Investigate interactions between MP and inequality.
  - Monetary transmission mechanism through heterogeneity.
  - Heterogeneous effects of MP shocks.
  - Aggregate and welfare implications of different MP rules.

Earnings and Wealth Inequality



- Survey of Consumer Finances (2004), households of age 21-65.
- High concentration of earnings (Gini=0.52) and wealth (Gini=0.82).
- Even more concentration of wealth, which leads to...

Heterogeneity in Income Composition

Wealth percentile	0-5	5-20	20-40	40-60	60-80	80-95	95-100
Labor income	91.9	83.4	91.4	89.5	89.3	80.6	54.8
Financial income	1.2	1.0	2.2	5.2	5.9	14.0	41.4
Transfers	7.3	16.2	7.6	6.0	5.0	6.1	3.3

- Income composition for households with different wealth.
  - Survey of Consumer Finances (2004), age 21-65.
  - Financial income includes financial income, business income, and capital gains/loss.
  - Transfers also include social security and pensions.

- The income composition channel.
  - Financial income ($\uparrow$ when R $\uparrow$) vs. labor income ($\downarrow$ when R $\uparrow$).
  - Top 5% vs. the rest.
  - Lower 95% care more for labor income than RA.

Comparison with Closely Related Literature

- NK model with cashless limit, Taylor rule, and endogenous inflation.
  - $\leftrightarrow$ Redistribution of wealth through exogenous surprise inflation. Doepke and Schneider (2006), Adam and Zhu (2016), Meh, Rios-Rull and Terajima (2010)
- Focus on income composition channel.
  - $\leftrightarrow$ Portfolio channel: Doepke and Schneider (2006), Erosa and Ventura (2002), Kaplan, Moll and Violante (2016), Auclert (2016), Garriga, Kydland and Sustek (2016)
- Interaction between market incompleteness and monetary policy.
  - $\leftrightarrow$ Fiscal policy: Heathcoate (2005), Costain and Reiter (2002), McKay and Reis (2015)
- Model-based analysis of both MP shock and systematic MP rule.
  - $\leftrightarrow$ VAR-based analysis of MP shock: Coibion et al (2012), Wong (2016)
- Solved using global approximation.

  Nonlinear effects of labor market frictions (Jung and Kuester (2011)).
  - $\leftrightarrow$ Local approximation.

Related Literature

- Heterogeneous-agent NK model: Kaplan, Moll and Violante (2016), Luetticke (2015), Bayer et al (2015), McKay and Reis (2015), Ravn and Sterk (2014, 2016)
- Empirical work on heterogeneity and monetary policy: Coibion et al (2012), Auclert (2015), Wong (2016)
- Redistribution effects from surprise inflation: Doepke and Schneider (2006), Adam and Zhu (2016), Meh, Rios-Rull and Terajima (2010)
- Heterogeneous-agent model with labor market frictions: Nakajima (2014), Krusell, Mukoyama and Sahin (2010), Costain and Reiter (2004)
- DSGE model with nominal and labor market frictions: Gali (2010), Trigari (2009), Walsh (2005), Kuester (2010)
- Heterogeneous effects of stead-state inflation: Erosa and Ventura (2002), Albanesi (2007)
- Redistribution through asset prices: Glover et al (2011)
- Heterogeneous earnings risk: Mukoyama and Sahin (2006), Guvenen, Ozkan and Song (2014)

Model

Model: Overview 1

- Households
  - Infinitely-lived.
  - Subject to idiosyncratic unemployment, preference, productivity shocks.
  - Self-insurance, using shares of the mutual funds.
  - Borrowing constrained ($\underline{a} = 0$).
  - Heterogeneous with respect to (e, s, β, a).
- Representative Mutual Funds
  - Hold equity of all firms, and nominal bonds.
  - Shares are held by households.
  - Profits from firms are distributed to households as dividends.
- Central Bank
  - Determine interest rate of nominal bonds.
  - Taylor rule with: ρ_{Π}, ρ_u, and monetary policy shocks.
- Government
  - Run unemployment insurance program.
  - Adjust τ to keep period-by-period budget balance.

Model: Overview 2

- Labor Firm (Mortensen-Pissarides)
  - Post a vacancy and hire a worker (search friction).
  - Rent out labor services in a competitive market.
  - Separate at probability λ.
- Capital Firm
  - Make investment and accumulate capital subject to adjustment costs.
  - Rent out capital services (utilization) in a competitive market.
- Intermediate Good Firm (NK-DSGE)
  - Use capital and labor to produce intermediate goods.
  - Subject to aggregate TFP shocks.
  - Sell intermediate goods to final good firms.
  - Monopolistically competitive.
  - Subject to quadratic nominal price adjustment cost.
- Final Good Firm (NK-DSGE)
  - Use differentiated intermediate goods to produce final goods (Dixit-Stiglitz).
  - Final goods are used for consumption and investment.

Model: Employed Household

$$
\begin{aligned}
& W(X, 1, s, \beta, a) \\
& = \max_{c, a' \geq 0} \left\{ u(c) + \beta \mathbb{E} \left[\left(1 - \lambda \left(1 - f(\widetilde{X}') \right) \right) W(X', 1, s', \beta', a') \right. \right. \\
& \qquad \left. \left. + \lambda \left(1 - f(\widetilde{X}') \right) W(X', 0, s', \beta', a') \right] \right\} \\
& \text{s.t.} \quad c + p_a(X) a' = \left(p_a(X) + d_a(X) \right) a + w(X) s \left(1 - \tau(X) \right)
\end{aligned}
$$

- $(p_a(X), d_a(X))$: (price, dividends) of a mutual-fund share.
- $w(X)$: real wage.
- λ: separation rate.
- $f(X)$: job-finding rate.
- $\tau(X)$: proportional UI tax rate.

Model: Unemployed Household

$$W(X,0,s,\beta,a) = \max_{c,a' \geq 0} \Big\{ u(c) + \beta \mathbb{E} \Big[f(\widetilde{X}') W(X',1,s',\beta',a') + \Big(1 - f(\widetilde{X}')\Big) W(X',0,s',\beta',a') \Big] \Big\}$$

$$\text{s.t.} \quad c + p_a(X) a' = (p_a(X) + d_a(X))\, a + b(s)$$

- b: UI benefit. Proportional to s with a cap.

Model: Aggregate Discount Factor

- Mutual fund aggregates households' preferences.
- Natural candidate: Wealth-weighted-average across all agents:

$$Q(X,X') = \int_{\mathcal{M}} \beta a \frac{u'(c')}{u'(c)} \, d\,\mu$$

- Bond-pricing Euler equation of mutual fund:

$$1 = \mathbb{E}\left[Q(X,X') \frac{R(X)}{\Pi(X')} \right].$$

Model: Labor Firm

$$J_L(X,s) = (h(X) - w(X))s + \mathbb{E}\zeta_F Q(X,X')(1-\lambda)J_L(X',s')$$

$$\kappa = \frac{M(U(X) + \lambda N(X), V(X))}{V(X)}\mathbb{E}J_L(X,s)$$

- $V(X)$ is determined by the zero profit condition.
- $h(X)$: rental cost of labor per efficiency unit.
- $Q(X,X')$: Aggregate discount factor.
- κ: vacancy posting cost.
- ζ_F: Financial shock.
- $M(U+\lambda N, V)$: matching function.

Model: Intermediate Good Firm

$$J_I(X, P_{j,-1}) = \max_{P_j, \ell_j, k_j} y_j(X, P_j) \left(\frac{P_j}{P(X)} \right) - \frac{\Psi}{2} \left(\frac{P_j}{P_{j,-1}} - \overline{\Pi} \right)^2 \bar{y}$$
$$- r(X) k_j - h(X) \ell_j - \Xi + \mathbb{E} \zeta_F Q(X, X') J_I(X', P_j)$$

subject to:

$$y_j = Z k_j^{\theta} \ell_j^{1-\theta}$$

$$\log(Z') = \rho_Z \log(Z) + \epsilon_Z, \text{ where } \epsilon_Z \sim \text{i.i.d. } N(0, \sigma_Z^2)$$

- Monopolistically competitive, facing quadratic price adjustment cost.
- P_j: price of a good j.
- $P(X)$: price of a final good (aggregate price level).
- (k_j, ℓ_j): capital and labor used for producing good j.
- Ξ: fixed cost of production.
- Ψ: parameter for price adjustment cost (controlling price rigidity).
- $\bar{y}$: steady state output.

Model: Central Bank

Central Bank sets the risk-free nominal rate R following a Taylor rule:

$$\log\left(\frac{R}{\overline{R}}\right) = \phi_{\Pi}\log\left(\frac{\Pi}{\overline{\Pi}}\right) - \phi_u\left(u-\overline{u}\right) + \zeta_R$$

$$\log(\zeta_R') = \rho_{\zeta_R}\log(\zeta_R) + \epsilon_{\zeta_R}\text{ , where } \epsilon_{\zeta_R} \sim \text{i.i.d. } N(0,\sigma^2_{\zeta_R})$$

- ζ_R: Monetary policy shock (tighter/looser policy than usual).
- ϕ_{Π}: *Systematic* response of policy rate for inflation stabilization.
- ϕ_u: *Systematic* response of policy rate for unemployment stabilization.
  - Stabilizing the unemployment rate means stabilizing the job-finding rate, which reduces idiosyncratic risk for hhs.

Model: Equilibrium and Computation

- Recursive equilibrium.
- Aggregate state variables: $X = (K, N, \zeta, \mu)$
  - K: capital stock
  - N: employment
  - $\zeta = (Z, \zeta_R, \zeta_F)$: aggregate shocks
  - μ: type distribution of households $\mu(e, s, \beta, a)$.
- Approximate equilibrium (Krusell and Smith (1998)).
- Augmented by recently developed methods:
  - Smolyak approximation (Krueger and Kuebler (2004)).
  - Reference type distribution (Reiter (2002,2010)).
  - Allows us to use 2 aggregate shocks and 2 aggregate states while capturing nonlinearities.
    (Financial and monetary policy shocks are consolidated)

Calibration

Calibration: Strategy

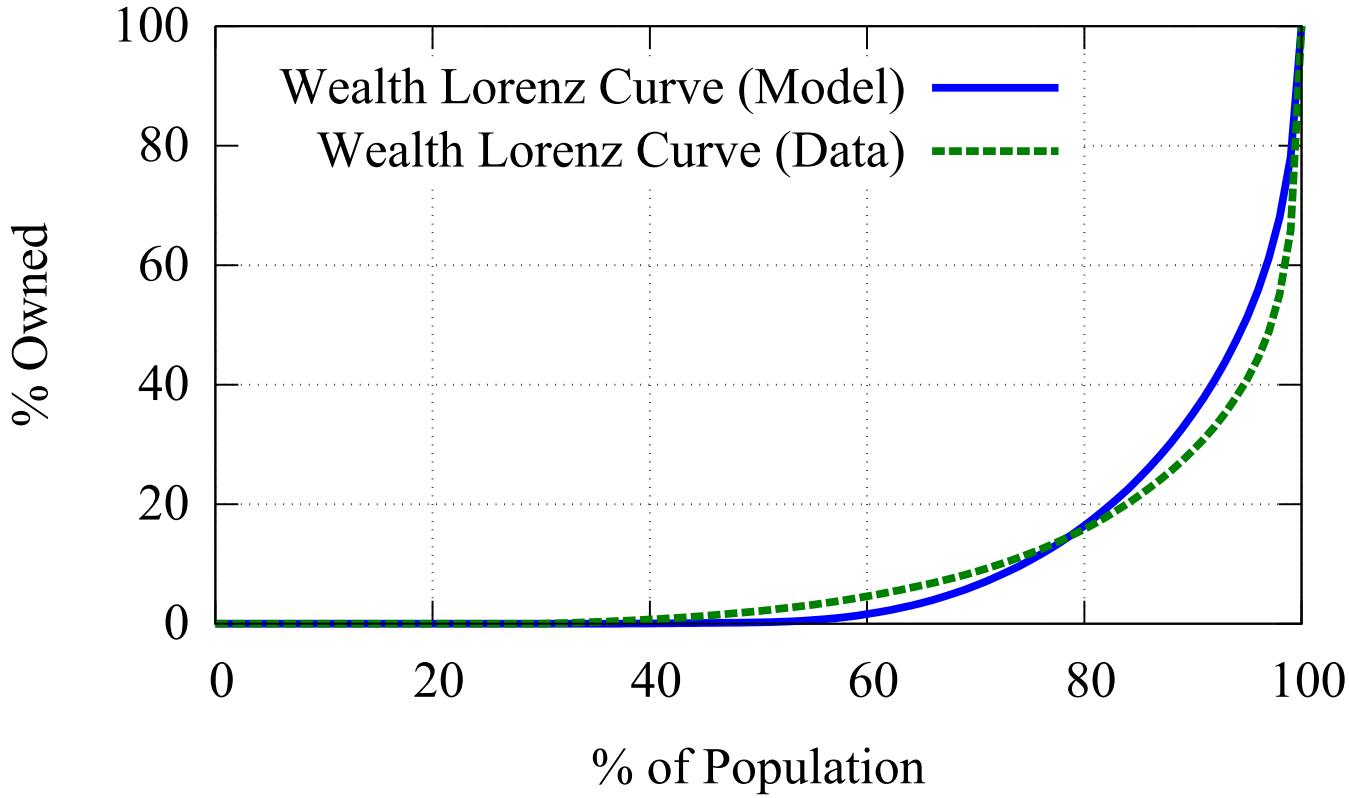
- Quarterly.
- Calibrate to U.S. 1984Q1 to 2007Q3.
- Fix most parameters through steady state considerations.
- MP response to unemployment, ϕ_u, capital adjustment cost ξ_1, and volatility of financial and TFP shocks, σ_{ζ_F} and σ_Z, are set to jointly match volatility of HP-filtered inflation, unemployment, output, and consumption (using RA model).

Calibration: Exogenous Individual Shocks

Parameter			Target
β_H	High discount factor	4%	Real interest rate
β_L	Low discount factor	≈ 0	Networth lower 30%
π_β	Pers of discount factor	40 years	Avg duration of β
ρ_s	Pers of AR(1) shock	0.95	Earnings autocorrelation
σ_s	S.D. of AR(1) shock	0.19	Earnings S.D.
π_{s_4}	Prob of becoming top 1%	0.01	Proportion of top 1%
π_{s_0}	Prob of leaving top 1%	0.97	Persistence of top 1%
s_4	Skill level of top 1%	0.81	Wealth Gini index

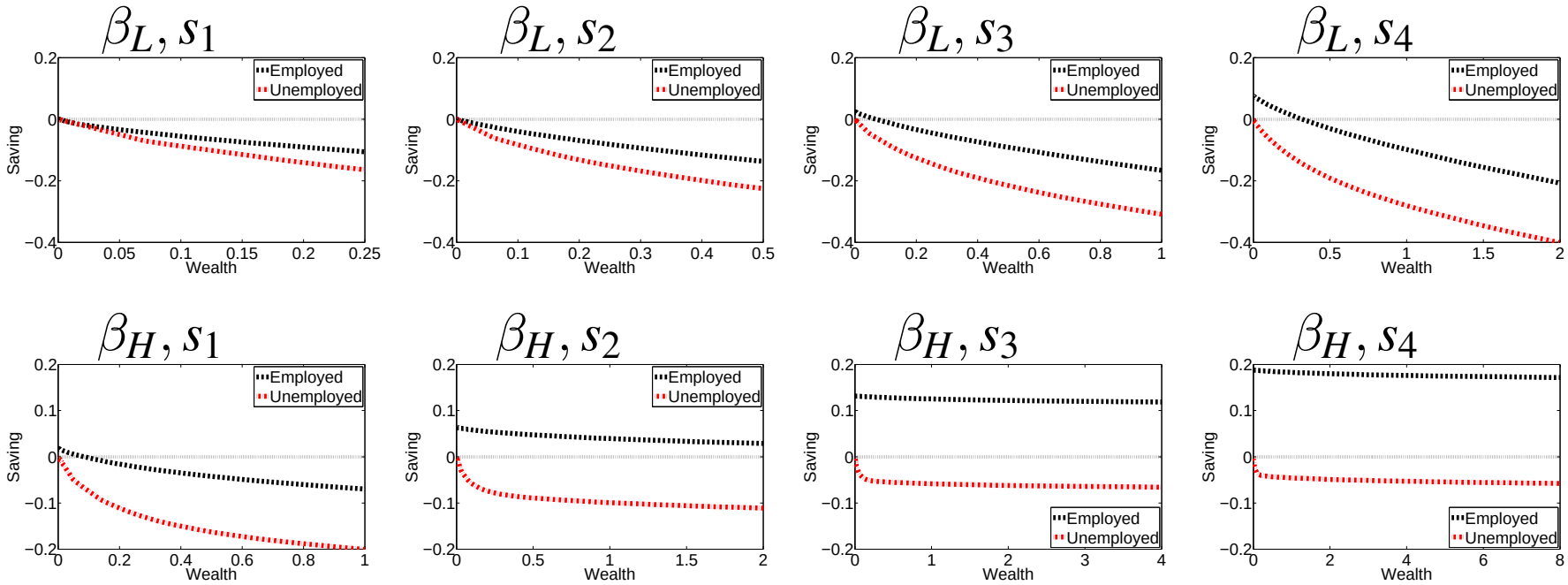
- 8 parameters that characterize exogenous individual shocks are calibrated to match 8 targets in the steady-state of the model.
- Discount factor shock: (Krusell and Smith (1998))
- Augmenting top 1% of earnings distribution: (Castaneda, Diaz-Gimenez and Rios-Rull (2003)), Nakajima (2012))

Calibration: Wealth Distribution



- Survey of Consumer Finances (2004) vs the model.
- Heavily skewed.
- 30 % of households hold very little wealth.

Calibration: Savings Policy Functions



- Most low-β HHs dissave.
- High-β HHs save when employed (except for lowest productivity s_1), and dissave when unemployed.

Calibration: Labor Market

- Wage function
  - wage in efficiency units, $w(X)$, is determined by wage function:
    $\log(w) = \log(\overline{w}) + \epsilon_w \left(\log\left(\frac{y}{N}\right) - \log\left(\frac{\bar{y}}{\bar{N}}\right) \right)$
  - $\epsilon_w = 0.45$ (Hagedorn and Manovskii (2008))
  - $\overline{w}$: labor share of 2/3.
    - Always stays in the bargaining set (checked numerically).
    - Nash bargaining is an alternative.
- Matching function
  - $M = \frac{VS}{(V^\alpha + S^\alpha)^{\frac{1}{\alpha}}}$
  - $\lambda = 0.10$.
  - α and κ are calibrated to match unemployment and job filling rate.
- Ψ: Parameter for the price adjustment cost is set such that, when converted to Calvo model, prices last 5 quarters on average.
- UI benefit
  - 40% replacement rate.
  - Cap at 40% of mean earnings.

Calibration: Central Bank

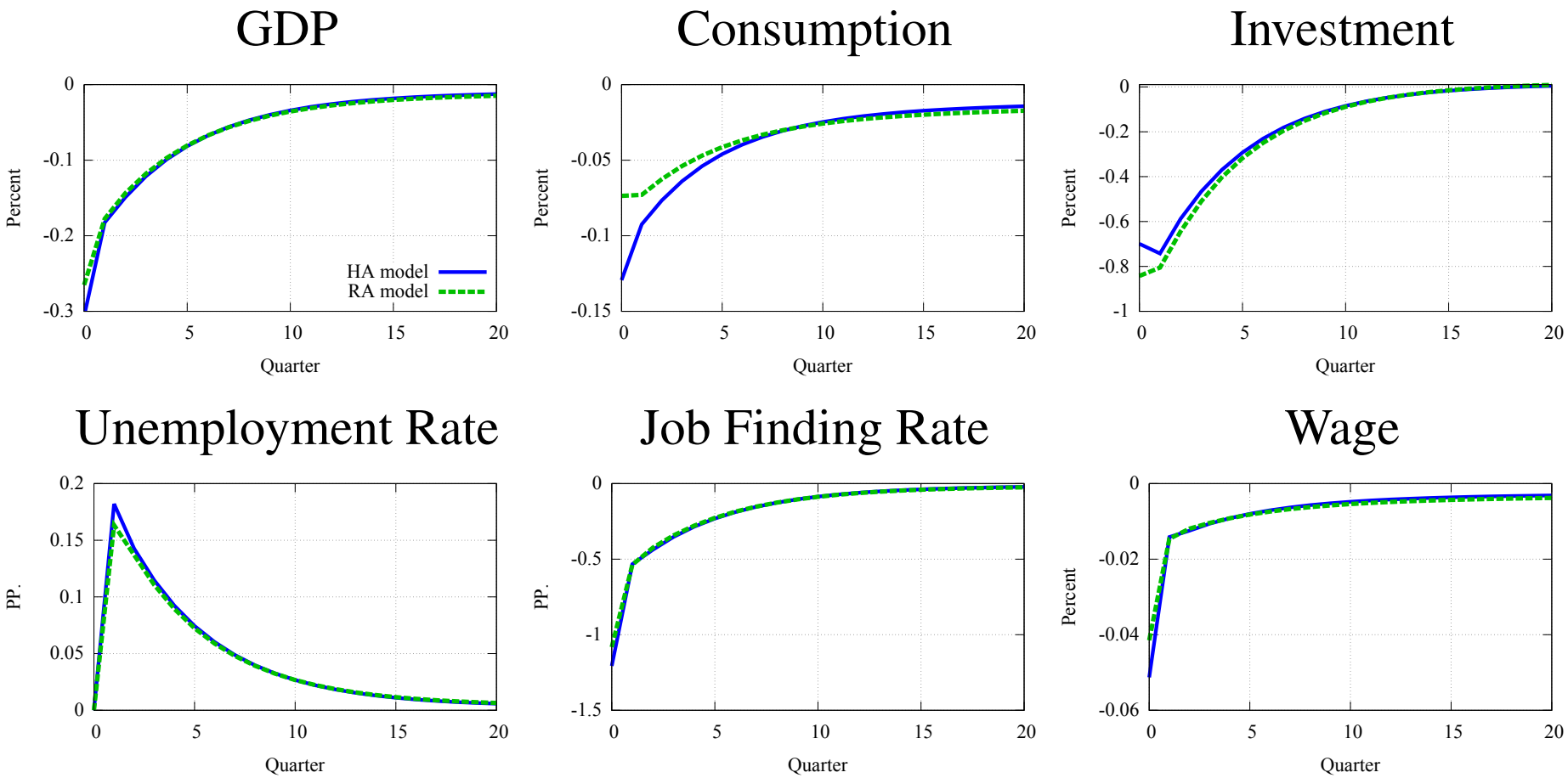
$$\log\left(\frac{R}{\overline{R}}\right) = \phi_{\Pi}\log\left(\frac{\Pi}{\overline{\Pi}}\right) - \phi_u\left(u-\overline{u}\right) + \zeta_R$$

$$\log(\zeta_R') = \rho_{\zeta_R}\log(\zeta_R) + \epsilon_{\zeta_R}\text{ , where } \epsilon_{\zeta_R} \sim \text{i.i.d. } N(0, {\sigma_{\zeta_R}}^2)$$

- Target (steady-state) inflation rate: $\overline{\Pi} = 2\%$ per year
- Target (steady-state) unemployment rate target: $\overline{u} = 5.7\%$
- Target (steady-state) nominal interest rate: $\overline{R} = 6\%$ per year
- Taylor response to inflation: $\phi_{\Pi} = 1.5$
- Taylor response to unemployment: $\phi_u = 0.107$
- Persistence of MP shock: $\rho_{\zeta_R} = 0.8$
- S.D. of MP shock: $\sigma_{\zeta_R} = 0.25\%$ per year

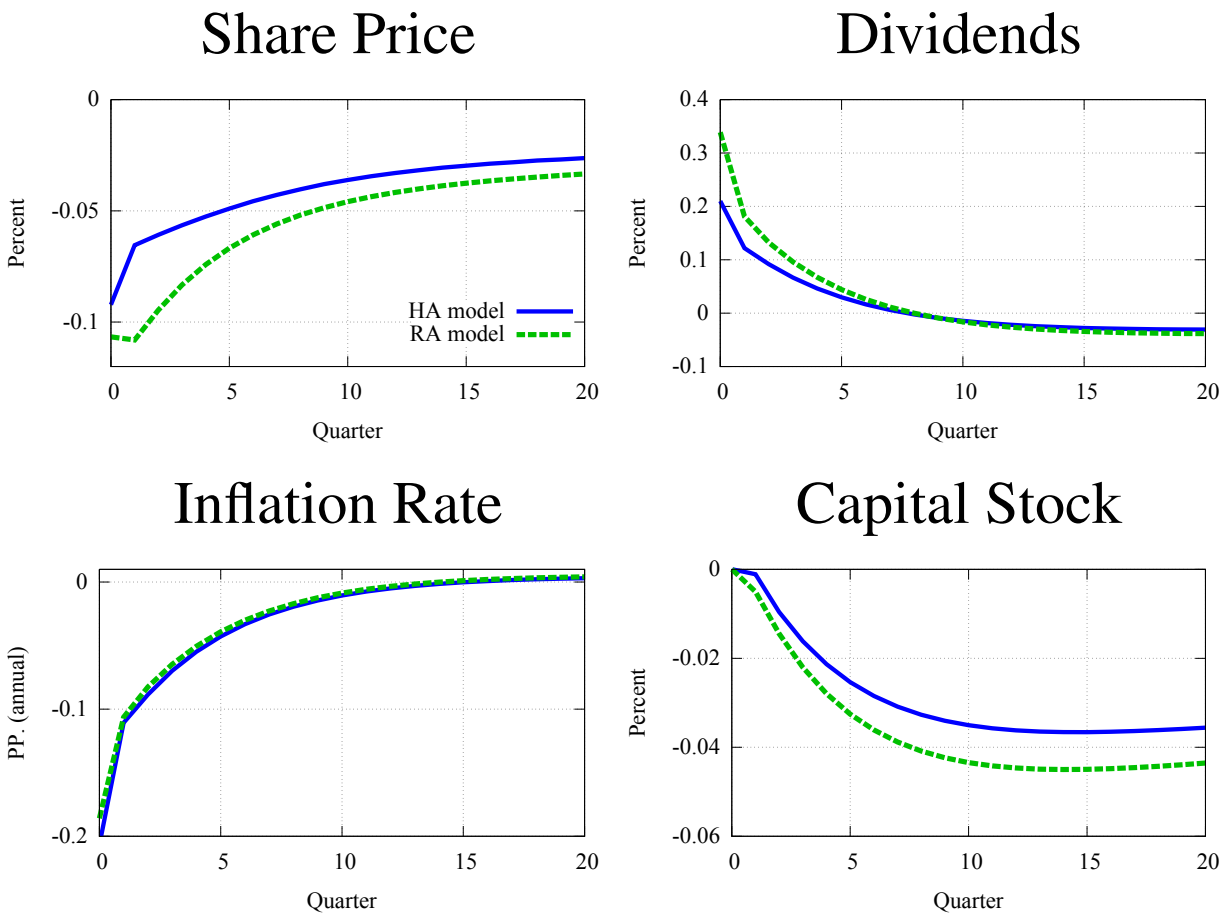
Impulse Response to MP Shock

IR to Contractionary MP Shock



- Impulse response to +1 S.D. (0.25% annually) contractionary MP shock.
- Amplification in the HA model, especially in C.

IR to Contractionary MP Shock

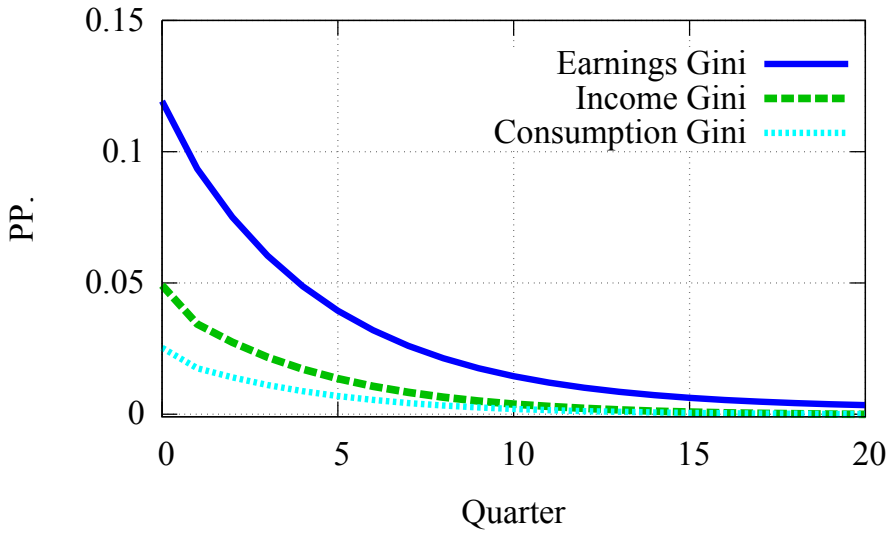


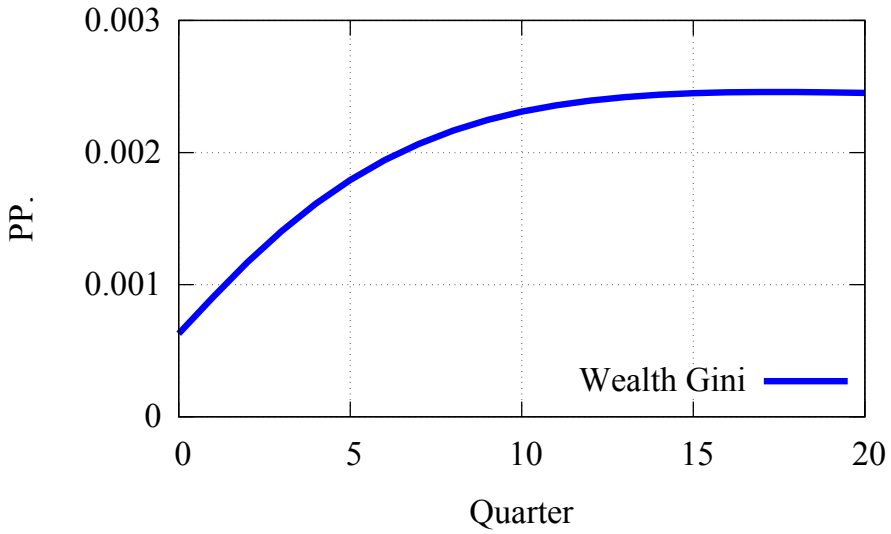
- Precautionary saving demand stabilizes asset prices.
- Mutual funds pay out less of their free cash flow.

Inequality and Monetary Transmission

- Inequality amplifies response of C, Y, and U.
- Stronger response of consumption in HA model to a MP shock (+100%).
  - Borrowing constrained HHs cut back C more than desired.
  - HHs close to borrowing constraint cut back C due to precautionary motive.
  - Neither channel exists in RA model.
- Investment counteracts and responds less strongly.
- Response of output (20%) is still stronger than RA model.
  - Aggregate demand channel.
  - In Ravn and Sterk (2012), since there is no investment, a higher consumption volatility directly leads to a higher output volatility.
- Negative response of the asset price is mitigated.
  - Precautionary saving demand.

Contractionary MP Shock and Inequality





- Contractionary MP shock widens inequality in income, cons, and wealth.
  - Earnings: Higher unemployment rate.
  - Income: UI, income inequality channel (spike in dividends).
  - Consumption: Borrowing constraint for lower-income households.
- Consistent with the empirical findings by Coibion et al (2012).

More Accommodative MP Rule

Shifting to More Accommodative MP Rule: Experiment

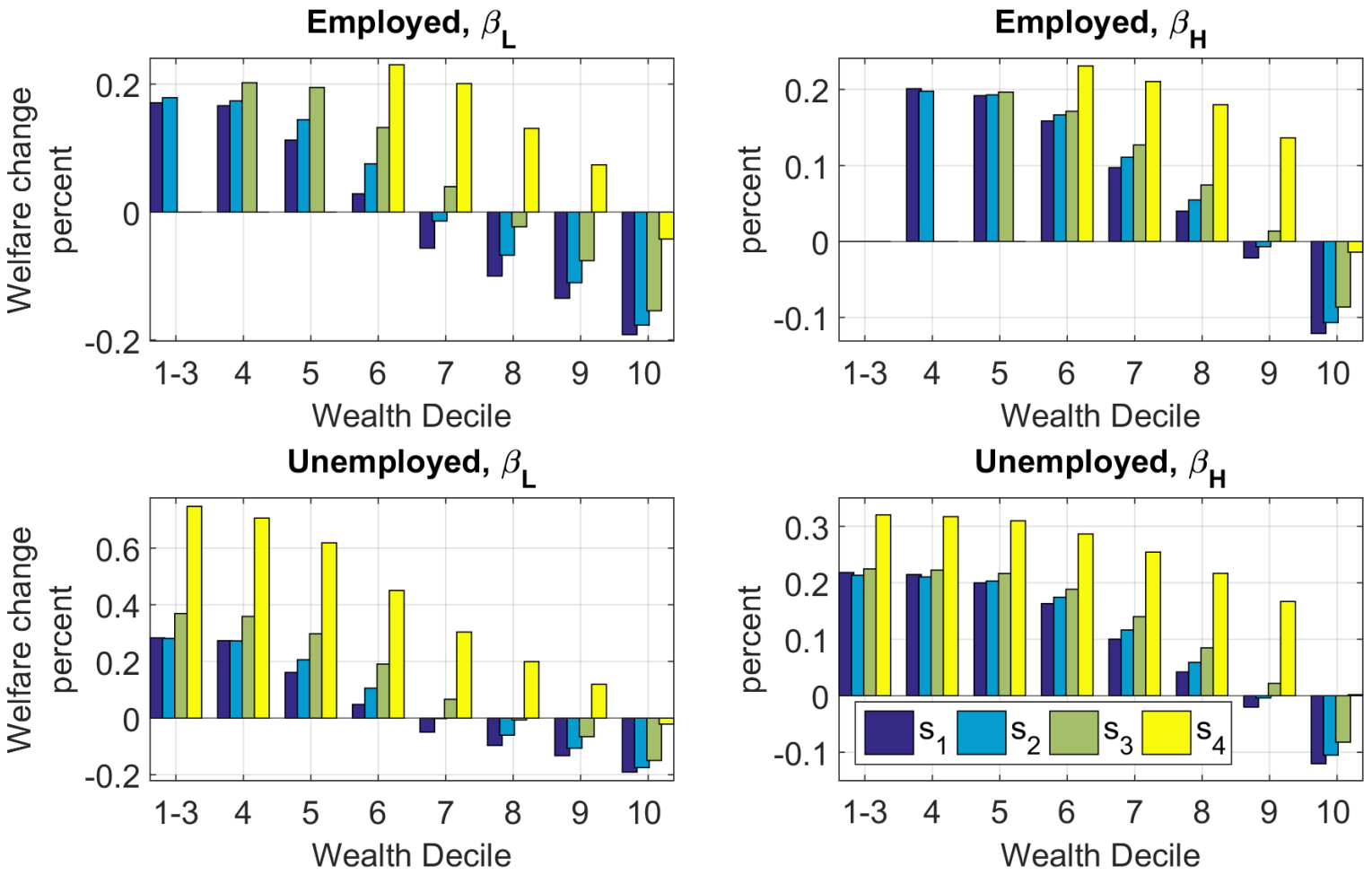
- Study implications of shifting to a more accommodative MP rule.
  - $\phi_u = 0.107 \rightarrow 0.25, 0.5, 0.63, 0.75, 0.87, 1$
- ϕ_Π is kept at 1.5.
- Compute changes in welfare (consumption equivalence)
  - Welfare on the transition path is taken into account.
  - Welfare of individual households and social welfare are analyzed.
- Such policy stabilizes unemployment (labor market risks) at the expense of higher inflation volatility.

Shifting to More Accommodative MP: Welfare Effects

	ϕ_u	0.05	0.107	0.25	0.5	0.63	0.75	1.00
	Representative agent	-0.09	—	0.09	0.12	0.11	0.09	0.05
	Heterogeneous agent, HH avg	-0.09	—	0.08	0.13	0.14	0.13	0.12
By Wealth	Top 0.1 percent	-0.14	—	0.07	0.02	-0.04	-0.10	-0.23
	Top 5 percent	-0.13	—	0.08	0.06	0.01	-0.03	-0.14
	80th–95th percentile	-0.12	—	0.08	0.09	0.07	0.01	-0.02
	60th–80th	-0.11	—	0.09	0.13	0.13	0.11	0.08
	40th–60th	-0.09	—	0.09	0.16	0.17	0.18	0.18
	30th–40th	-0.07	—	0.08	0.15	0.18	0.18	0.19
	Bottom 30 percent	-0.07	—	0.07	0.14	0.16	0.17	0.18
	Percent in favor ...							
	... relative to baseline	0.0	—	99.7	99.7	97.9	94.1	83.9
	... relative to next-lower	—	100	99.7	92.5	67.2	51.0	47.0

- Significant disagreement about the desirable balance between inflation and unemployment stabilization, between wealth rich and wealth poor.

Heterogeneous Welfare Effects of Switching to $\phi_u = 1$



- Low wealth HH gain more from more accommodative MP rule.
- Higher-skilled HH gain more from more accommodative MP rule.

Inequality and Optimal MP Rule

- In HA model, MP rule with more emphasis on employment stability over price stability compared with RA model is preferred.
  - Optimal $\phi_u = 0.46$ in RA model.
  - Utilitarian welfare in HA model is maximized at around $\phi_u = 0.63$.
  - The median voter in HA model prefers even higher ϕ_u.

- Majority of households care more about labor market risks than costs of inflation volatility and asset prices.

- Monetary policy provides insurance against unemployment risks.
  - Interaction with fiscal policy.

Concluding Remarks

- We investigate implications of inequality for monetary policy, using a DSGE model featuring nominal frictions, market incompleteness, and labor market frictions.

- Main Message: Inequality matters for monetary policy
  - In the HA model, social welfare is maximized with more emphasis on unemployment stabilization.
    - Trade-off between price adjustment costs and labor market risk.
    - MP mitigates market incompleteness against labor market risk.
  - Effects of MP shock on Y, C, U are amplified through heterogeneity.
  - Contractionary MP shock amplifies inequality in income and consumption.

- Extensions:
  - Heterogeneous labor market risk.
  - Portfolio choice: Real vs. Nominal.
  - Policy mix: fiscal and monetary policy.
  - Structural Reforms.

Heterogeneity in Wealth Composition

Wealth percentile	0-5	5-20	20-40	40-60	60-80	80-95	95-100
Wealth ($ 000)	-23	1	20	80	233	693	4,894
Equity	1	0	3	10	38	157	1,111
Bonds	3	1	6	17	51	148	820
Housing	15	8	41	115	221	389	1,344
Vehicle	9	4	11	17	23	30	55
Business	0	0	0	3	15	73	1,583
Mortgage	13	7	32	70	107	130	313
Car loan	6	3	4	6	8	6	8
Education loan	20	1	2	2	2	2	1
Credit card	5	1	2	3	4	2	2

- For now, abstract from...
  - heterogeneity of portfolio allocation between nominal and real assets.
  - Housing and mortgages (nominal debt).

Model: State Variables

- Individual state variables: $x = (e, s, \beta, a)$
  - e: employment status (0: unemployed, 1: employed)
  - s: skill level
  - β: $\in \{\beta_L, \beta_H\}$ time preference.
  - a: holdings of shares of the mutual fund (MF)

- Aggregate state variables: $X = (K, N, \zeta, \mu)$
  - K: capital stock
  - N: employment
  - $\zeta = (Z, \zeta_R, \zeta_F)$: aggregate shocks
    - Z: TFP shock
    - ζ_R: monetary policy (interest rate) shock
    - ζ_F: financial (risk premium) shock
  - μ: type distribution of households $\mu(e, s, \beta, a)$.

Model: Labor Firm: Wage Determination

- wage in efficiency units, $w(X)$, is determined by wage function.

$$\log(w) = \log(\overline{w}) + \epsilon_w \left(\log\left(\frac{GDP(X)}{N(X)}\right) - \log\left(\frac{\overline{GDP}}{\overline{N}}\right)\right)$$

- $\epsilon_w = 0.45$
- One possible equilibrium wage
  - Always stays in the bargaining set (checked numerically).
  - Nash bargaining is an alternative.
- Real (not nominal) wage rigidity.

Model: Capital Firm

$$J_K(X,k) = \max_{v,i,k'} \left\{ r(X)kv - i + \mathbb{E}\zeta_F Q(X,X')J_K(X',k') \right\}$$

subject to:

$$k' = (1-\delta(v))k + \xi\left(\frac{i}{k}\right)k$$

- k: capital stock.
- i: investment.
- v: capacity utilization (for smoother response of marginal costs).
- $r(X)$: rental rate of capital.
- $\delta(v)$: depreciation rate (increasing in v).
- $\xi(.)$: capital adjustment cost.
- ζ_F: financial shock.

Model: Final Good Firm

$$\max_{y, y_j \in [0,1]} P(X)y - \int_0^1 P_j y_j dj$$

subject to:

$$y = \left(\int_0^1 y_j^{\frac{\epsilon-1}{\epsilon}} dj \right)^{\frac{\epsilon}{\epsilon-1}}$$

- Dixit-Stiglitz production function with intermediate goods j.
- Chooses output of final goods, y, and inputs y_j.
- Yields the demand schedule for each intermediate good $y_j(X, P_j)$.

Model: Government

- The government runs the UI program.
- $\tau(X)$ is adjusted to satisfy the budget constraint:

$$\tau(X) \int_{\mathcal{M}} \mathbb{1}_{e=1} w(X) s \, d\mu = \int_{\mathcal{M}} \mathbb{1}_{e=0} b(s) \, d\mu \tag{1}$$

Type Distribution of Households

- Currently, most low-wealth HHs are low-β type. Implying weaker feedback from HHs' response to MP change, since β shocks are policy-invariant.
- Highest-wealth HHs are super-skill (s_4) type.

Income Composition

Wealth percentile	0-5	5-20	20-40	40-60	60-80	80-95	95-100
Data (SCF 2004)							
Labor income	92	83	91	89	89	81	55
Financial income	1	1	2	5	6	14	41
Transfers	7	16	8	6	5	6	3
Model (steady-state)							
Labor income	96	96	97	97	81	57	32
Financial income	0	0	0.1	2	18	42	68
Transfers	4	4	3	1	1	1	0.3

Financial income includes financial income, business income, and capital gains/loss.

- Wall-street: large fraction from financial income.
- Main-street: mostly labor income.

Business Cycle Properties: Output and Labor Market

	RA Model			HA Model			US Data 1984Q1-2008Q3		
	Std	Corr	Auto	Std	Corr	Auto	Std	Corr	Auto
Output and Components									
GDP	1.62	1.00	0.64	1.69	1.00	0.63	1.62	1.00	0.94
Cons	0.89	0.98	0.71	1.02	0.99	0.69	0.89	0.87	0.87
Inv	5.86	0.99	0.71	5.28	0.98	0.73	5.09	0.96	0.89
Cap util	0.83	0.75	0.27	0.96	0.78	0.24	2.21	0.84	0.94
Labor Market									
Emp	0.62	0.90	0.66	0.65	0.90	0.64	0.65	0.86	0.96
Unemp	10.2	-0.89	0.67	10.9	-0.90	0.65	10.2	-0.86	0.95
Vac	8.35	0.73	0.10	8.94	0.75	0.07	11.1	0.91	0.93
JF rate	5.08	0.87	0.40	5.37	0.88	0.38	5.13	0.80	0.83

- Red numbers are targeted, using RA model.
- Amplification through inequality.
  - Output is 4% more volatile in HA than RA model.
  - Consumption is 14% more volatile.
  - Unemployment is 7% more volatile.

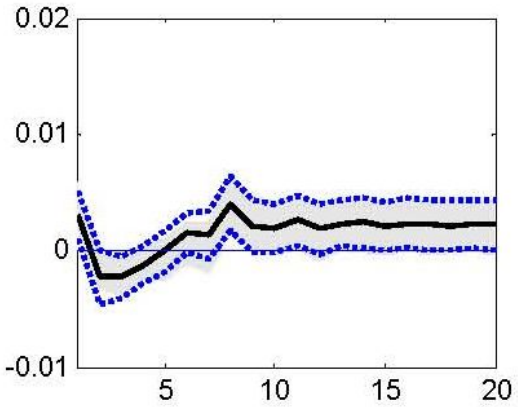
Business Cycle Properties: Productivity and Prices

	RA Model			HA Model			US Data 1984Q1-2008Q3		
	Std	Corr	Auto	Std	Corr	Auto	Std	Corr	Auto
Productivity and Prices									
GDP/N	1.10	0.97	0.63	1.14	0.97	0.62	1.07	0.87	0.88
Wage	0.50	0.97	0.63	0.51	0.97	0.62	0.95	0.41	0.84
Inflation	0.67	-0.40	0.63	0.67	-0.32	0.62	0.67	0.27	0.27
Nom rate	0.96	-0.25	0.60	0.97	-0.14	0.58	1.24	0.61	0.92

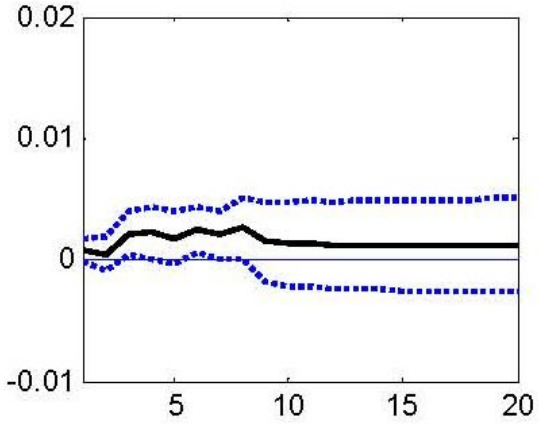
- Inflation volatility is targeted, using RA model.

Empirical Results of Coibion, Gorodnichenko, Kueng, Silvia (2012)

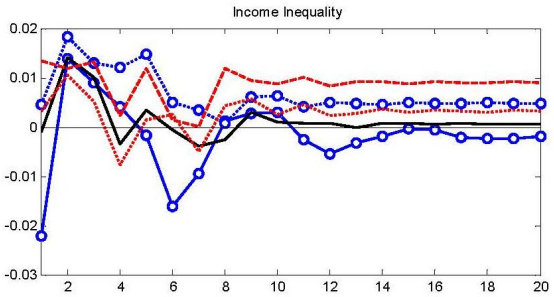
Income Gini



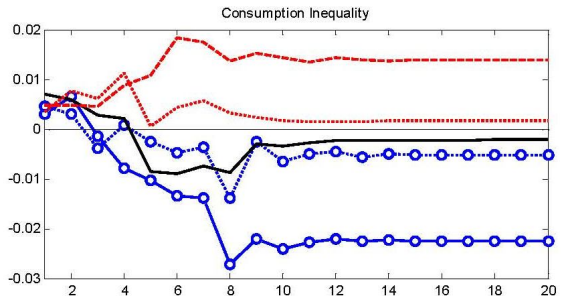
Consumption Gini



Income Cross-Section



Consumption Cross-Section



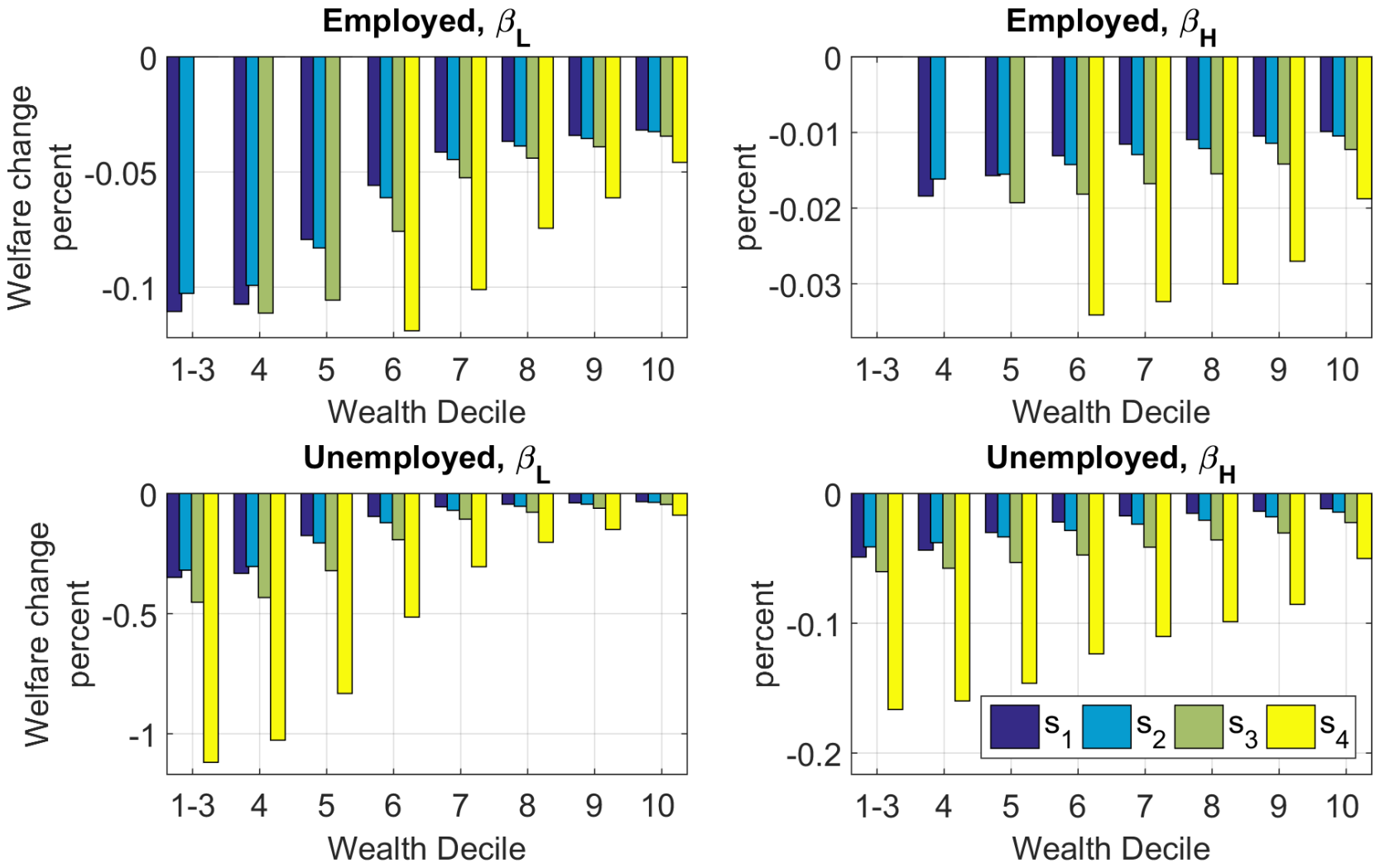
Welfare Effects of +1 S.D. Shock

		TFP	Monetary
	Representative agent	0.26	-0.01
	Heterogeneous agent, HH avg	0.44	-0.07
By Wealth	Top 5 percent	0.41	-0.01
	80th–95th percentile	0.34	-0.01
	60th–80th	0.29	-0.02
	40th–60th	0.41	-0.06
	30th–40th	0.54	-0.10
	Bottom 30 percent	0.60	-0.12

Note: Lifetime consumption-equivalent welfare gains.

- All HHs suffer from a contractionary MP shock, but Wall Street suffer less than Main Street, partly due to income composition channel.
  - Main Street: lose from lower employment and wage, and borrowing constraint.
  - Wall Street: loss is mitigated by higher financial income.

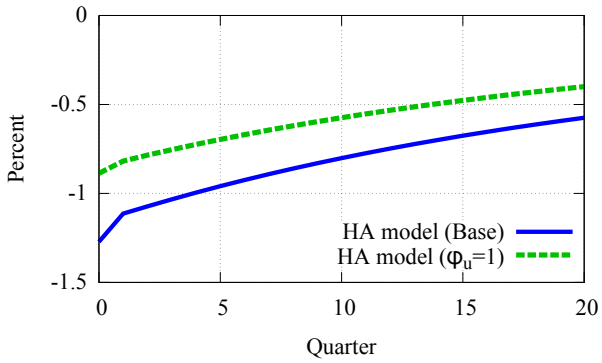
Heterogeneous Welfare Effects of Contractionary MP Shock



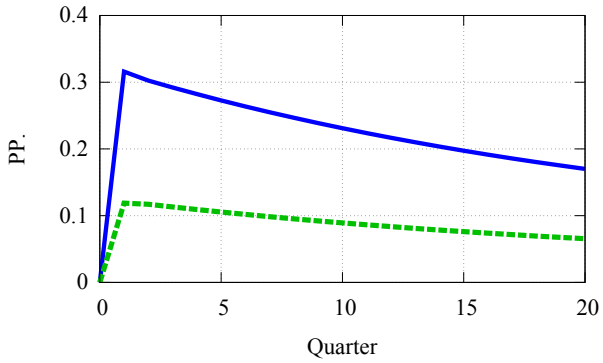
- Welfare loss declines in wealth.
- Super-skill HHs lose the most.

More Accommodative MP Rule: IR to Negative TFP Shock

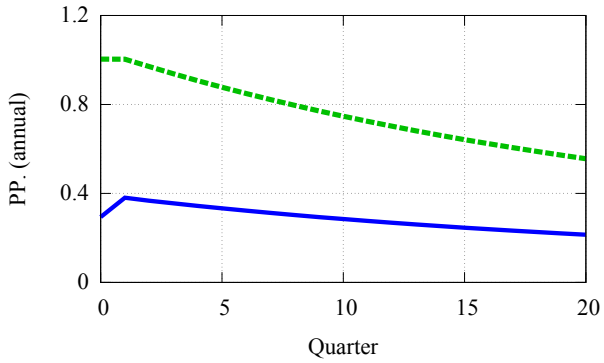
GDP



Unemployment Rate



Inflation



- Volatilities of GDP and unemployment rate are dampened by the dovish ($\phi_u = 1.0$) MP rule. $\rightarrow$ Wealth poor gain.
- Higher inflation volatility means higher nominal price adjustment costs on average. $\rightarrow$ Wealth rich lose.

$\rightarrow$ Trade-off between labor market risks and nominal price adjustment costs.

- Moreover...
  - Avg unemployment rate also declines (Jung and Kuester (2011)).
  - Asset prices decline ($\leftarrow$ lower precautionary saving).