



FEDERAL
RESERVE
BANK *of*
ST. LOUIS

OPTIMAL MONETARY POLICY FOR THE MASSES

James Bullard (FRB of St. Louis)

Riccardo DiCecio (FRB of St. Louis)

Swiss National Bank Research Conference 2018
Current Monetary Policy Challenges
Zurich, Switzerland
Sept. 21, 2018

Any opinions expressed here are our own and do not necessarily reflect those of the FOMC.

Introduction

INEQUALITY AND MONETARY POLICY

- Can monetary policy be conducted in a way that benefits all households even in a world of substantial heterogeneity?
- The answer in this paper is “yes.”

SOME RECENT LITERATURE

- Kaplan, Moll, and Violante (*AER*, 2018):
 - NK macro with heterogeneous households ("HANK"); reasonable Gini coefficients.
 - The monetary policy transmission mechanism is substantially altered relative to standard model.
- Bhandari, Evans, Golosov, and Sargent (Working paper, NYU, 2018):
 - Incomplete markets, nominal friction, heterogeneous households ("HAIM"); reasonable Gini coefficients.
 - Optimal monetary-fiscal policy (Ramsey) substantially altered relative to standard model.
 - See A. Bhandari, D. Evans, M. Golosov, and T. Sargent, "Inequality, Business Cycles, and Monetary-Fiscal Policy," Working Paper, New York University, June 6, 2018, available at <http://www.tomsargent.com/research/begs2.pdf>.

SOME RECENT LITERATURE

- Bullard and DiCecio (Working paper, St. Louis Fed, 2018):
 - Incomplete markets, nominal friction, heterogeneous households (“HAIM”); reasonable Gini coefficients.
 - Optimal monetary policy repairs the distortion caused by the friction for all households.
- See also the conference on “Monetary Policy and the Distribution of Income and Wealth,” held at the St. Louis Fed on Sept. 11–12, 2015. Program available at https://research.stlouisfed.org/conferences/monetary_policy_conf/program.

WEALTH, INCOME AND CONSUMPTION INEQUALITY

- There is a lot of wealth, income and consumption inequality in this stylized model.
- The role of credit markets, if they work correctly, is to reallocate uneven income profiles across the life cycle into equal consumption shares by cohort, appropriately scaled by life-cycle productivity.
- The model equilibrium features reasonable Gini coefficients.

THE MONETARY POLICY IMPLICATIONS

- The role of monetary policy in this model is to make sure private credit markets are working correctly (i.e., complete).
- Optimal monetary policy in this model looks like “nominal GDP targeting”—countercyclical price level movements.
- This result continues to hold even when there is “massive” heterogeneity—enough heterogeneity to approximate income, financial wealth, and consumption inequality in the U.S.
- Hence, *the main result is that NGDP targeting constitutes “optimal monetary policy for the masses” in this environment.*

Environment

LIFE-CYCLE MODELS

- General-equilibrium life-cycle economy = many-period overlapping generations.
- Key variables are *privately issued* debt, real interest rates and inflation.
- Think of privately issued debt = “mortgage-backed securities.”
- There is no government spending nor are there taxes of any kind.

SYMMETRY ASSUMPTIONS

- We make a set of important “symmetry assumptions.”
- These assumptions involve the symmetry of the life-cycle productivity endowment pattern of the households (detailed below), along with log preferences, no discounting, and no population growth.
- These assumptions help deliver the result that in the equilibria we study:
 - *The real interest rate is exactly equal to the output growth rate at every date, even in the stochastic economy.*
- We can think of this as the Wicksellian natural real rate of interest.
- This in turn creates a set of easy to understand baseline results for this economy.

ENVIRONMENT DETAILS

- Standard $(T + 1)$ -periods (quarterly) DSGE life-cycle endowment economy.
- Each period, a new cohort of households enters the economy, makes economic decisions over the next 241 periods, then exits the economy.
- There is one asset in the model, *privately issued* debt (consumption loans).
- The monetary authority controls the nominal price level $P(t)$ directly.
 - For a money demand version, see Azariadis et al. (2015).
- All households have log preferences with no discounting.
 - Other assumptions: No population growth, no capital, no default, flexible prices, no borrowing constraints.

KEY FRICTION: NSCNC

- *Loans are dispersed and repaid in the unit of account—that is, in nominal terms—and are not contingent on income realizations.*
- There are two aspects to this assumption.
 - The non-state contingent aspect means that real resources are misallocated via this friction.
 - The nominal aspect means that the monetary authority may be able to fix the distortion.

LINEAR PRODUCTION TECHNOLOGY

- We model a growing economy in which a linear technology is improving over time.
- Aggregate real output $Y(t)$ is given by

$$Y(t) = Q(t)L(t), \quad (1)$$

where $L(t)$ is the aggregate labor input and $Q(t)$ is the level of technology (also TFP and labor productivity).

- The level of technology grows at a stochastic rate $\lambda(t, t+1)$ between dates t and $t+1$,

$$Q(t+1) = \lambda(t, t+1)Q(t), \quad (2)$$

where the stochastic process for λ is defined on the next slide.

STOCHASTIC STRUCTURE

- The real wage $w(t)$ is then exogenously given by

$$w(t+1) = \lambda(t, t+1) w(t), \quad (3)$$

where $w(0) > 0$, and $\lambda(t, t+1)$ is the gross rate of aggregate productivity growth between date t and date $t+1$, and where

$$\lambda(t, t+1) = (1 - \rho) \bar{\lambda} + \rho \lambda(t-1, t) + \sigma \epsilon(t+1), \quad (4)$$

where $\bar{\lambda} > 1$ represents the average gross growth rate, $\rho \in (0, 1)$, $\sigma > 0$, and $\epsilon(t+1)$ is a truncated normal with bounds $\pm b$, $b > 0$, such that the ZLB avoided.

TIMING PROTOCOL

- At the beginning of date t , nature moves first and chooses $\lambda(t-1, t)$, which implies a value for $w(t)$.
- The policymaker moves next and chooses a value for $P(t)$.
- Households then decide how much to work, consume and save.

NOMINAL INTEREST RATE CONTRACTS

- Households meet in a large competitive credit market.
- Households contract by fixing the nominal interest rate one period in advance.
- The non-state contingent nominal interest rate, “the contract rate,” is given by

$$R^n(t, t+1)^{-1} = E_t \left[\frac{c_t(t)}{c_t(t+1)} \frac{P(t)}{P(t+1)} \right]. \quad (5)$$

- This rate can be understood as expected nominal GDP growth.
- In the equilibria we study, this expectation is the same for all households, even those born at different dates or with different levels of productivity.

WHAT MONETARY POLICY DOES

- The countercyclical price level rule delivers complete markets allocations:

$$P(t) = \frac{R^n(t-1, t)}{\lambda^r(t-1, t)} P(t-1), \quad (6)$$

where λ^r indicates a realization of the shock and R^n is the expectation given in the previous slide—similar to Sheedy (BPEA, 2014) and Koenig (IJCB, 2013).

- Given this policy rule, households consume equal amounts of available production, given their productivity, “*equity share contracting*,” which is optimal under homothetic preferences.
- This price level rule renders the households’ date- t decision problem deterministic because it perfectly insures the household against future shocks to income.
- Consumption and asset holdings fluctuate from period to period, but in proportion to the value of $w(t)$.

Life-Cycle Productivity

LIFE-CYCLE PRODUCTIVITY PROFILES

- Households entering the economy draw a scaling factor $x \sim \mathcal{U} \left[\zeta^{-1}, \zeta \right]$ and receive a life-cycle productivity profile which is a scaled version of the baseline profile, e_s :

$$e_{s,i} = x \cdot e_s,$$

where $\zeta \geq 1$ determines the within-cohort dispersion.

- This process means all idiosyncratic risk is borne by agents at the beginning of the life cycle.
- Huggett, Ventura and Yaron (*AER*, 2011) argue that differences in initial conditions are more important than differences in shocks.

AVERAGE LIFE-CYCLE PRODUCTIVITY

- The baseline profile, e_s , is given by:

$$e_s = f(s) = 2 + \exp \left[- \left(\frac{s - 120}{60} \right)^4 \right].$$

- Profiles begin at a low value, rise to a peak in the middle period of life, and then decline to the low value.
- Once assigned, profiles do not change.
- Life cycle productivity profiles are symmetric.
- Agents can sell productivity units available in a particular period in the labor market at the competitive wage per effective efficiency unit.

BASELINE LIFE-CYCLE PRODUCTIVITY

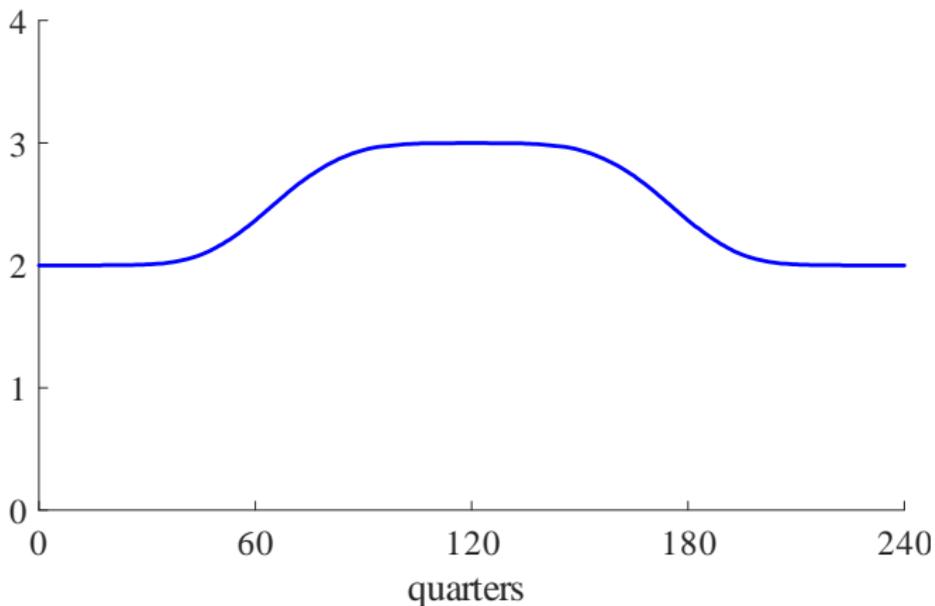


FIGURE: Baseline endowment profile. The profile is symmetric and peaks in the middle period of the life cycle.

THE MASS OF LIFE-CYCLE PRODUCTIVITY

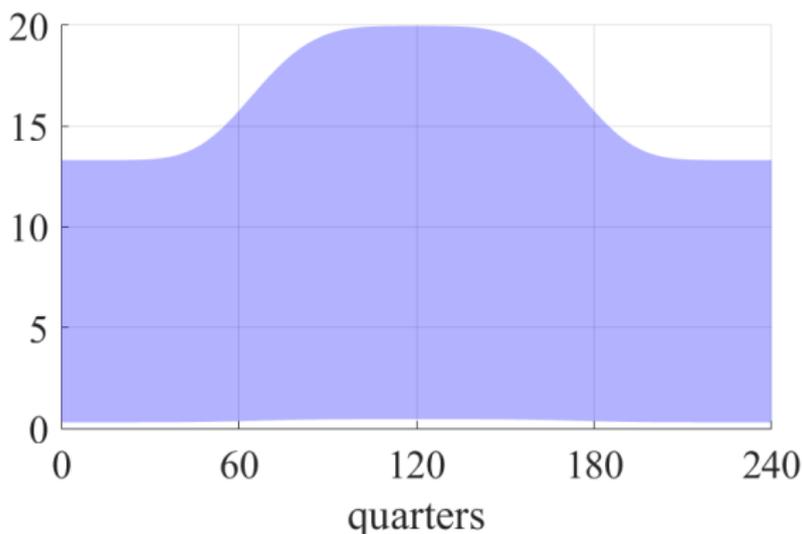


FIGURE: The mass of endowment profiles: $e_{s,i} \sim e_s \cdot \mathcal{U}(\bar{\zeta}^{-1}, \bar{\zeta})$,

$$e_s = 2 + \exp \left[\left(-\frac{s-120}{60} \right)^4 \right], \bar{\zeta} = 6.5.$$

STATIONARY EQUILIBRIA

- We let $t \in (-\infty, +\infty)$.
- We only consider stationary equilibria under perfectly credible policy rules governing $P(t)$.
- We let $R(t)$ be the gross real rate of return in the credit market.
- Stationary equilibrium is a sequence $\{R(t), P(t)\}_{t=-\infty}^{+\infty}$ such that markets clear, households solve their optimization problems, and the policymaker credibly adheres to the stated policy rule.
- Key condition is that aggregate asset holding $A(t) = 0 \forall t$.

STATIONARY EQUILIBRIA

THEOREM

Assume symmetry as defined above. Assume the monetary authority credibly uses the price level rule $\forall t$. Then the general equilibrium gross real interest rate, $R(t-1, t)$, is equal to the gross rate of aggregate productivity growth, and hence the real growth rate of the economy, $\lambda(t-1, t)$, $\forall t$.

COROLLARY

For any two households that share the same productivity profile, consumption is equalized at each date t .

Characterizing the Equilibrium

LABOR/LEISURE

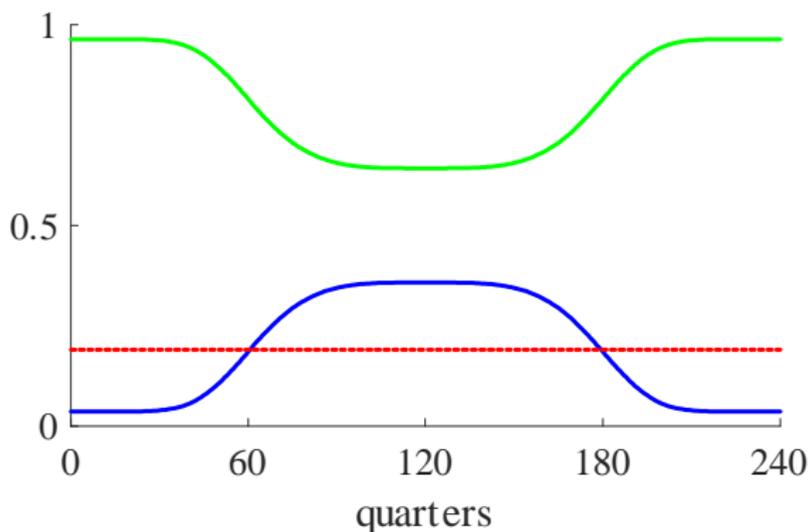


FIGURE: Leisure decisions (green), labor supply (blue) and fraction of work time in U.S. data, 19% (red). The labor/leisure choice depends on the current-to-lifetime average productivity ratio. Productivity profiles of the form $e_{s,i} = x \cdot e_s$ imply labor/leisure choices dependent on age only.

LABOR INCOME MASS

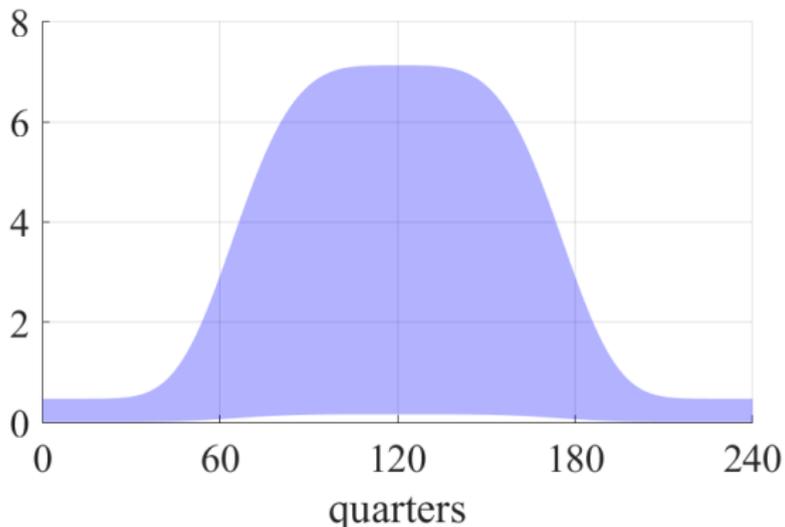


FIGURE: Labor income profiles $e_{s,i} (1 - \ell) w$; $\xi = 6.5$, $\eta = 0.21$, and $w = 1$.

CONSUMPTION MASS

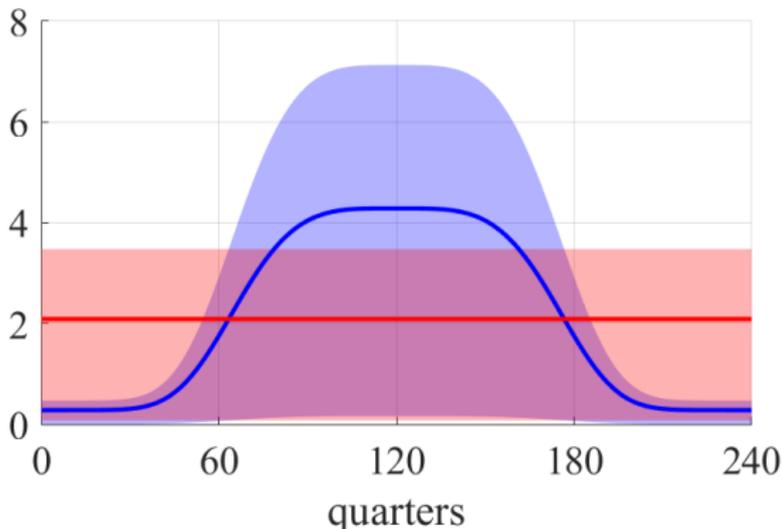


FIGURE: Consumption mass (red) and labor income mass (blue) along the complete markets balanced growth path with $w(t) = 1$. Under optimal monetary policy, the private credit market reallocates uneven labor income into perfectly equal consumption for each productivity profile. The consumption Gini is 31.8%, similar to values calculated from U.S. data.

NET ASSET HOLDING MASS

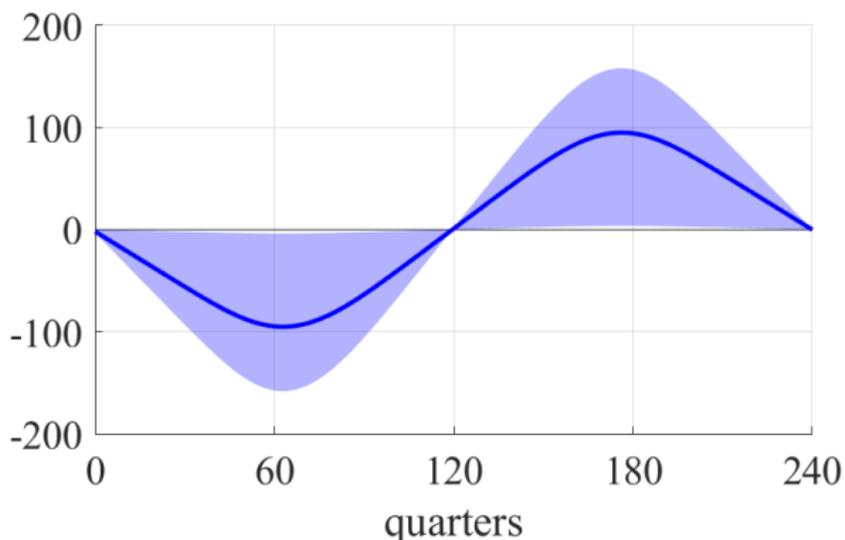


FIGURE: Net asset holding mass by cohort along the complete markets balanced growth path. Borrowing, the negative values to the left, peaks at stage 60 of the life cycle (age ~35), while positive assets peak at stage of life 180 (age ~65). The financial wealth Gini is 72.7%, similar to values calculated in U.S. data.

THREE NOTIONS OF INCOME

- Three notions of income:

- 1 Labor income,

$$Y_1 = e_{s,i} [1 - \ell_t(t+s)] w(t+s),$$

- 2 Labor income plus non-negative capital income,

$$Y_2 = e_{s,i} [1 - \ell_t(t+s)] w(t+s) + \max \left\{ [\lambda(t+s, t+s-1) - 1] \frac{a_{t,i}(t+s-1)}{P(t+s-1)}, 0 \right\},$$

- 3 The non-negative component of total income,

$$Y_3 = \max \left\{ \begin{array}{l} e_{s,i} [1 - \ell_t(t+s)] w(t+s) + \\ + [\lambda(t+s, t+s-1) - 1] \frac{a_{t,i}(t+s-1)}{P(t+s-1)}, 0 \end{array} \right\}.$$

- Gini coefficients of income distributions: $G_{Y_1} = 56.2\%$,
 $G_{Y_2} = 51.6\%$, $G_{Y_3} = 59.6\%$.

LABOR INCOME + NON-NEGATIVE CAPITAL INCOME

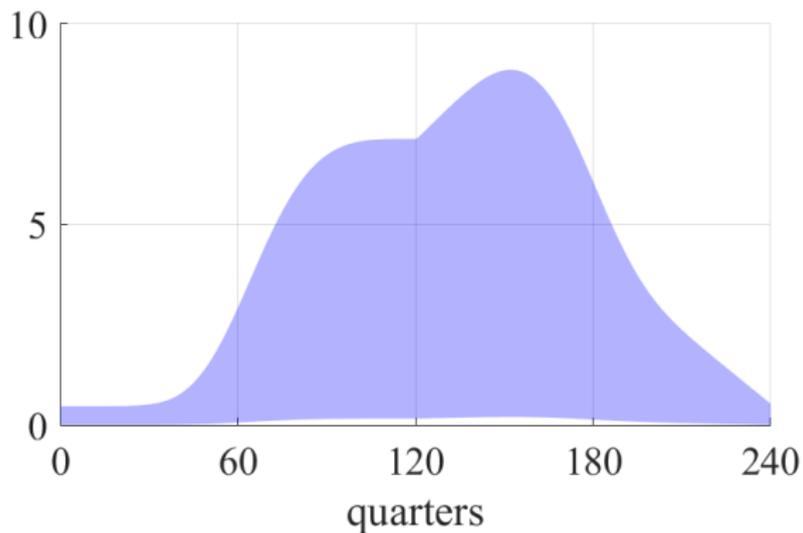


FIGURE: Profiles of labor income and non-negative capital income $e_{s,i} (1 - \ell) w + \max \left\{ (\lambda - 1) \frac{a}{p}, 0 \right\}$; $\bar{\xi} = 6.5$, $\eta = 0.21$, and $w = 1$.

NON-NEGATIVE TOTAL INCOME

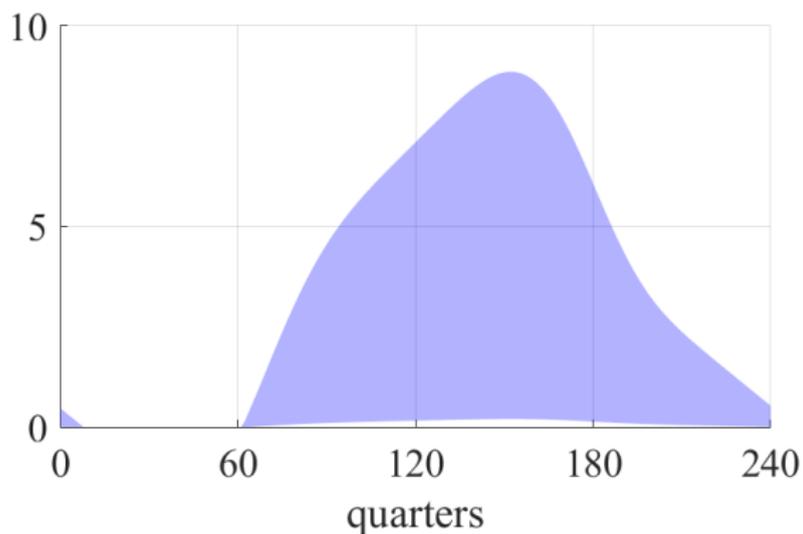


FIGURE: Profiles of non-negative total income
 $\max \left\{ e_{s,i} (1 - \ell) w + (\lambda - 1) \frac{a}{p}, 0 \right\}; \bar{\xi} = 6.5, \eta = 0.21, \text{ and } w = 1.$

Inequality

DENSITIES

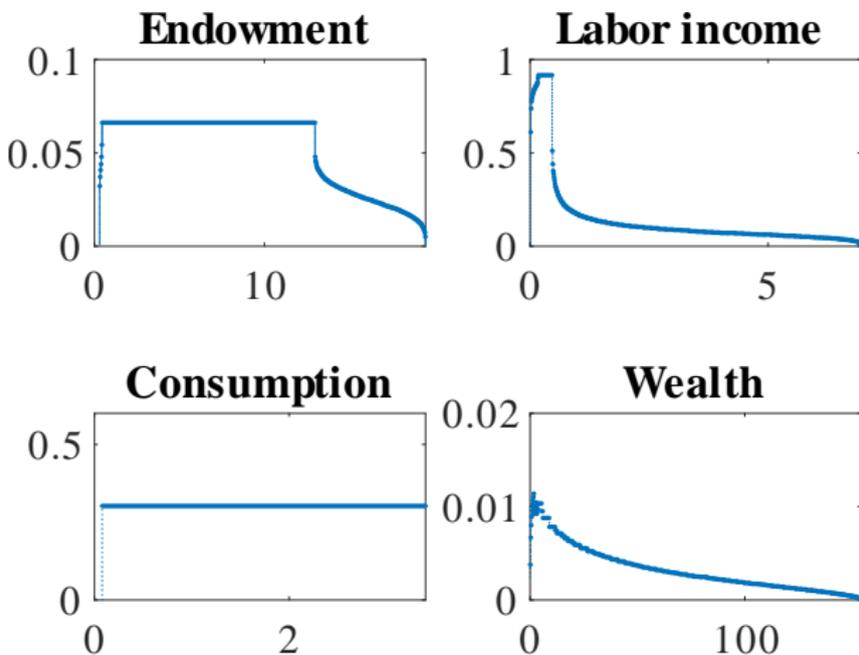


FIGURE: PDFs of endowment, labor income, consumption and wealth. Note: the wealth subplot omits a mass point (121/241) at 0.

DATA ON INEQUALITY IN THE U.S.

- Consumption (Heathcote, Perri and Violante, *RED*, 2010):
 $G_{C,U.S.} = 32\%$.
- Income (CBO, 2016): pre-taxes/transfers $G_{Y,U.S.} = 51\%$;
post-taxes/transfers $G_{Y,U.S.} = 43\%$.
- Financial wealth (Davies, Sandström, Shorrocks and Wolff, *EJ*, 2011): $G_{W,U.S.} = 80\%$.

INEQUALITY IN THE MODEL

- Large amount of heterogeneity that depends in part on life-cycle productivity dispersion.
- Financial wealth is defined as the non-negative part of net assets.
- We also consider lognormal productivity, $\ln(x) \sim \mathcal{N}(\mu, \sigma^2)$:
 - Allows for arbitrarily rich and arbitrarily poor households.
 - All distributions (wealth, income and consumption) are mixtures of lognormals (and δ functions).
 - Gini coefficients can be computed with “paper and pencil.”

GINI COEFFICIENTS

	Wealth W	Y_1	Income Y_2	Y_3	Consumption C
U.S. data	80%		51%		32%
Uniform	72.7%	56.2%	51.6%	59.6%	31.8%
Lognormal	72.4%	55.7%	51.1%	59.0%	32%

TABLE: Gini coefficients in the U.S. data and in the model with uniform and lognormal productivity.

PRODUCTIVITY DISPERSION AND GINI COEFFICIENTS

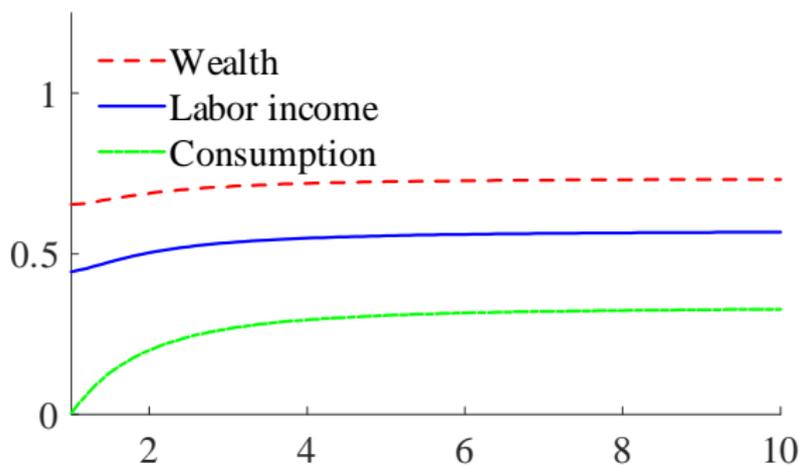


FIGURE: As the dispersion of productivity profiles, ξ , increases, the Gini coefficients increase. The ordering $G_W > G_Y > G_C$ is preserved.

Policy

INTERPRETING MONETARY POLICY

- The price level rule characterizes policy by “countercyclical price level” movements.
- But the policy can also be interpreted more conventionally in interest rate terms.
- Contracts are made understanding policy ...
- And policy is made understanding contracts ...
- Interest rate policy is a fixed point of this process.

POLICY CHARACTERIZATION

- The nominal rate is determined one period in advance as the expected rate of nominal GDP growth.
- Wicksellian natural real rate = aggregate productivity growth rate, λ .
- The nominal rate is always ratified ex post by the policymaker.
- This makes the real rate = aggregate productivity growth rate = Wicksellian natural real rate of interest.
- “Just like the simple NK model.”

NOMINAL GDP TARGETING

- How can we interpret these results as NGDP targeting?
 - No persistence in productivity growth, $\rho = 0$: The expected rate of NGDP growth never changes, and the economy never deviates from the NGDP path. “Perfect NGDP targeting.”
 - Persistence in productivity growth, $\rho > 0$: The expected rate of NGDP growth fluctuates persistently with the shock, and it takes longer to return to the balanced growth NGDP path.
 - Nominal and real rates fall in a recession.

EFFECTS OF A SHOCK

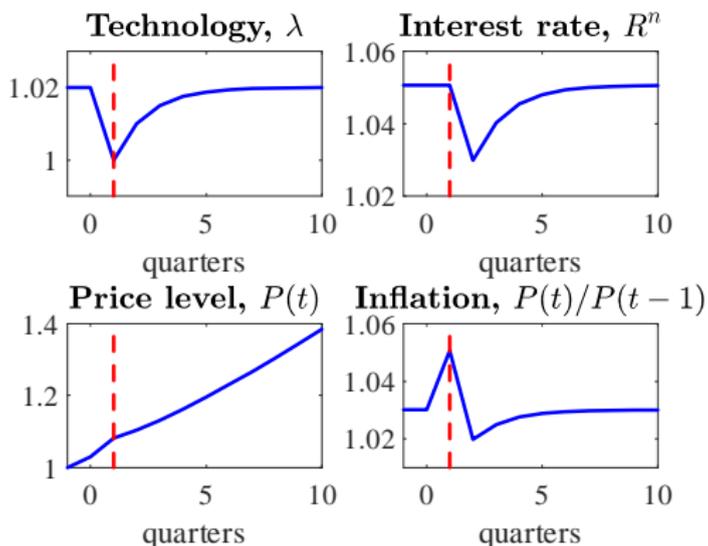


FIGURE: Monetary policy responds to a decrease in aggregate productivity, λ , by increasing the price level in the period of the shock. Subsequently, inflation converges to its BGP value, π^* , from below. The nominal interest rate drops in the period after the shock.

Conclusions

SUMMARY

- This paper attributes observed levels of U.S. inequality to life-cycle effects in conjunction with heterogeneous life-cycle productivity profiles.
- All households in this model, regardless of their assigned life-cycle productivity profile, face a problem of smoothing life-cycle consumption in a world with a credit market friction, “non-state contingent nominal contracting.”
- The monetary authority can remove this impediment to life-cycle consumption smoothing for all households: “optimal monetary policy for the masses.”
- Does monetary policy affect inequality? Yes, it improves consumption allocations, alters the asset holding distribution, and alters the income distribution by altering hours worked.