Optimal Monetary Policy for the Masses

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Introduction

Adam Smith and inequality

- The thrust of Adam Smith is to argue that when all households pursue their own self-interest, society as a whole attains the best available allocation of resources.
- Yet Adam Smith also stated that "Wherever there is great property there is great inequality."
- Are these views contradictory?
- The literature on heterogeneity and monetary policy helps to frame answers to this question.

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 model 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.

Additional recent literature

- Bullard and DiCecio (unpublished manuscript, St. Louis Fed, 2018):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.

Outline of the argument

- 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

$$Y(t) = Q(t) L(t), \tag{1}$$

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 $t+1$,

$$Q(t+1) = \lambda(t, t+1) Q(t), \tag{2}$$

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

Stochastic structure

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

$$w(t+1) = \lambda(t, t+1) w(t), \tag{3}$$

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

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

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 is 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

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

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

What monetary policy does

- The countercyclical price-level rule delivers complete markets allocations:

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

  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 $x \sim \mathcal{U}\left[\xi^{-1}, \xi\right]$ and receive a life-cycle productivity profile that is a scaled version of the baseline profile, e_s :

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

  where $\xi \geq 1$ 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.
- We also consider a lognormal distribution for x, creating an economy with arbitrarily rich and poor households.

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

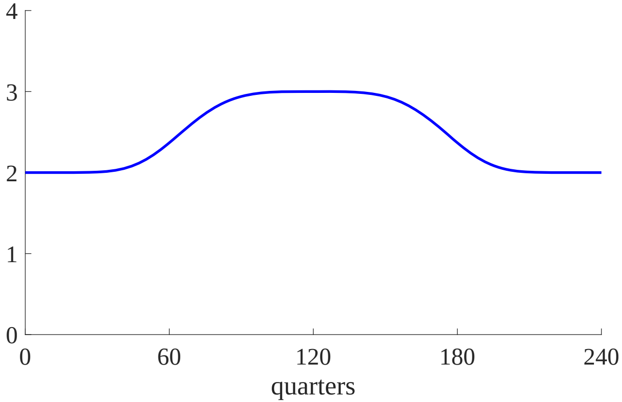

Figure: Baseline endowment profile. The profile is symmetric and peaks in the middle period of the life cycle.

THE MASS OF LIFE-CYCLE PRODUCTIVITY

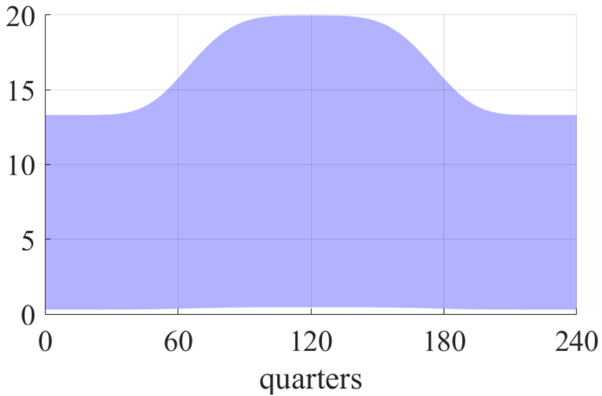

FIGURE: The mass of endowment profiles: $e_{s,i} \sim e_s \cdot \mathcal{U}\left[\xi^{-1}, \xi\right]$, $e_s = 2 + \exp\left[-\left(\frac{s-120}{60}\right)^4\right]$, $\xi = 6.5$.

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.
- The 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

Hours worked over the life cyle

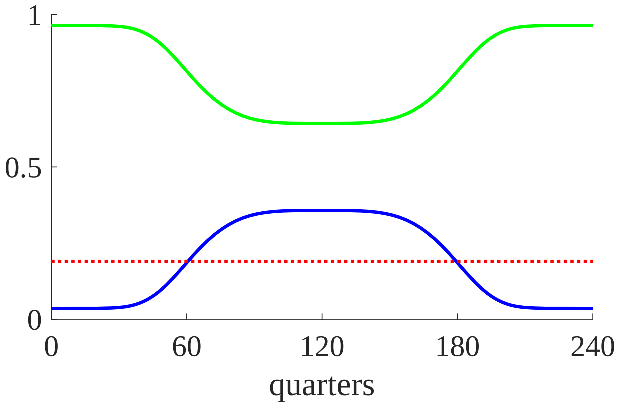

Figure: Leisure decisions (green), labor supply (blue) and fraction of work time in U.S. data, 19% (red). The labor/leisure choice depends on the current-to-lifetime average productivity ratio. Productivity profiles of the form $e_{s,i} = x \cdot e_s$ imply labor/leisure choices depend on age only.

Labor income mass

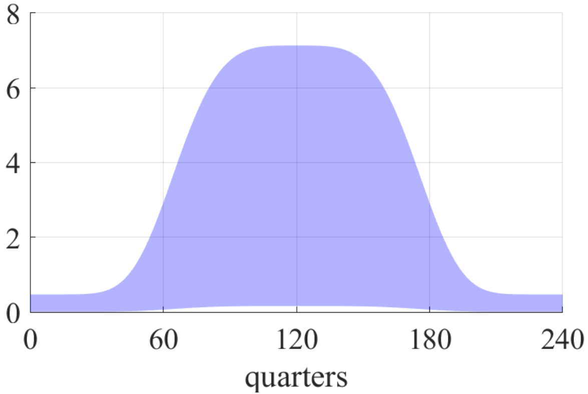

Figure: Labor income profiles $e_{s,i}\,(1-\ell)\,w$; $\xi = 6.5$, $\eta = 0.21$, and $w = 1$.

Consumption mass

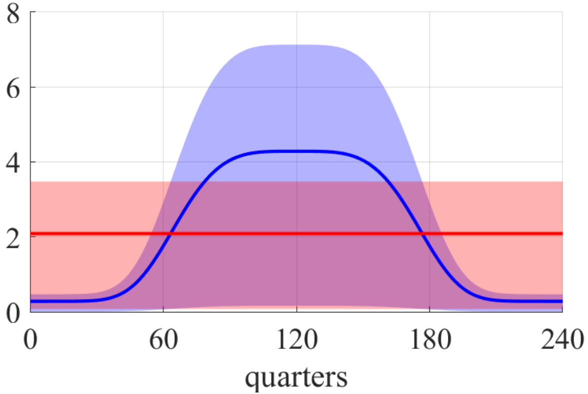

FIGURE: Consumption mass (red) and labor income mass (blue) along the complete markets balanced growth path with $w(t) = 1$. Under optimal monetary policy, the private credit market reallocates uneven labor income into perfectly equal consumption for each productivity profile. The consumption Gini is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

Net asset holding mass

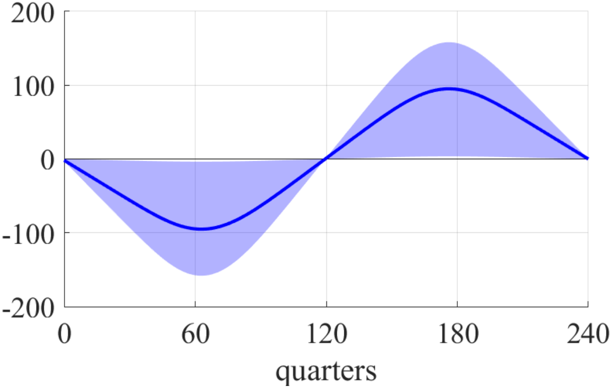

Figure: Net asset holding mass by cohort along the complete markets balanced growth path. Borrowing, the negative values to the left, peaks at stage 60 of the life cycle (age $\sim$ 35), while positive assets peak at stage of life 180 (age $\sim$ 65). The financial wealth Gini is 72.7%, similar to values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

Three notions of income

- Three notions of income:
  1. Labor income,
  $$Y_1 = e_{s,i}\left[1-\ell_t\left(t+s\right)\right] w\left(t+s\right),$$
  2. Labor income plus non-negative capital income,
  $$Y_2 = e_{s,i}\left[1-\ell_t\left(t+s\right)\right] w\left(t+s\right) + \max\left\{\left[\lambda\left(t+s,t+s-1\right)-1\right]\frac{a_{t,i}\left(t+s-1\right)}{P\left(t+s-1\right)},0\right\},$$
  3. The non-negative component of total income,
  $$Y_3 = \max\left\{e_{s,i}\left[1-\ell_t\left(t+s\right)\right] w\left(t+s\right) + \left[\lambda\left(t+s,t+s-1\right)-1\right]\frac{a_{t,i}\left(t+s-1\right)}{P\left(t+s-1\right)},0\right\}.$$
- 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

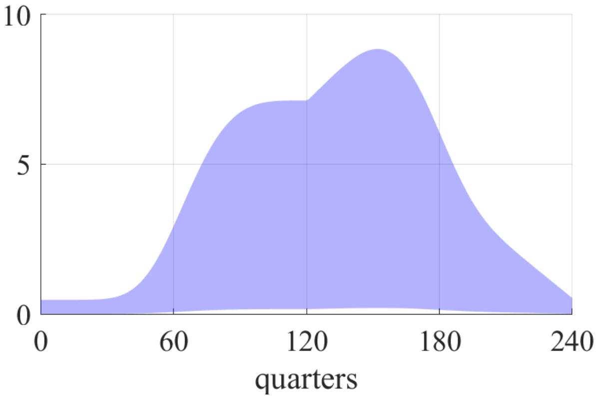

FIGURE: Profiles of labor income and non-negative capital income $e_{s,i}(1-\ell)w + \max\left\{(\lambda-1)\frac{a}{P}, 0\right\}$; $\xi = 6.5$, $\eta = 0.21$, and $w = 1$.

Non-negative total income

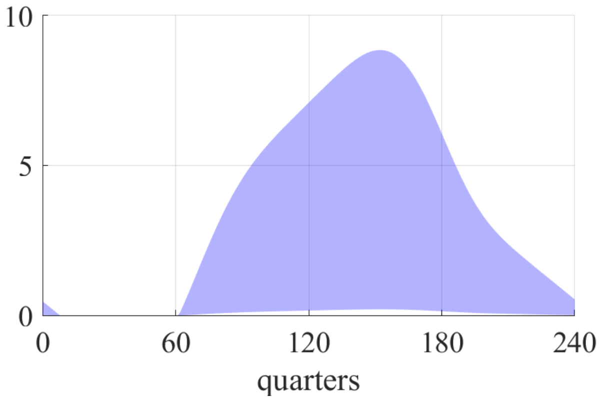

Figure: Profiles of non-negative total income $\max\left\{e_{s,i}\left(1-\ell\right)w+\left(\lambda-1\right)\frac{a}{p},0\right\}$; $\xi=6.5$, $\eta=0.21$, and $w=1$.

Inequality

Densities

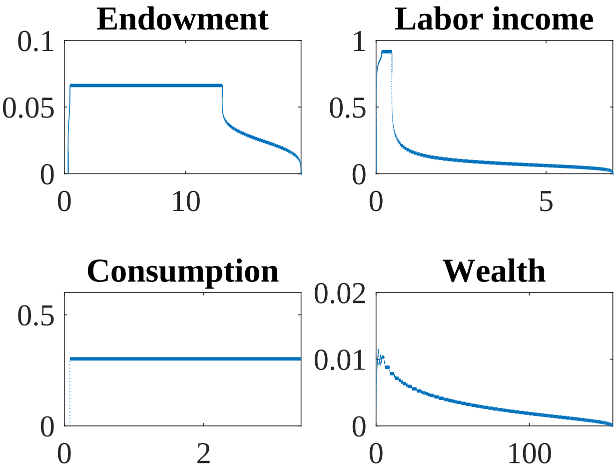

Figure: PDFs of endowment, labor income, consumption and wealth. Note: The wealth subplot omits a mass point (121/241) at 0.

DATA ON INEQUALITY IN THE U.S.

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

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		Income		Consumption
	W	Y_1	Y_2	Y_3	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

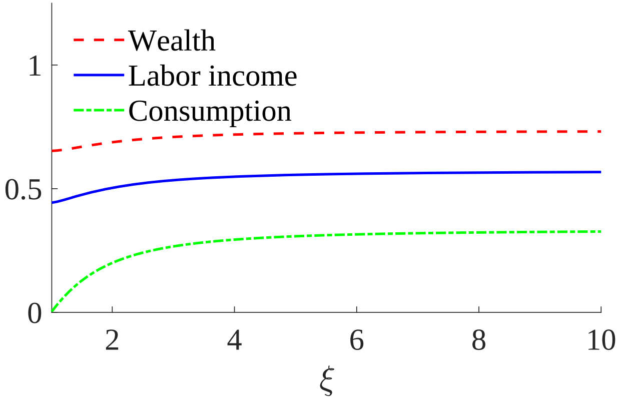

FIGURE: As the dispersion of productivity profiles, ξ, increases, the Gini coefficients increase. The ordering $G_W > G_Y > G_C$ is preserved.

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

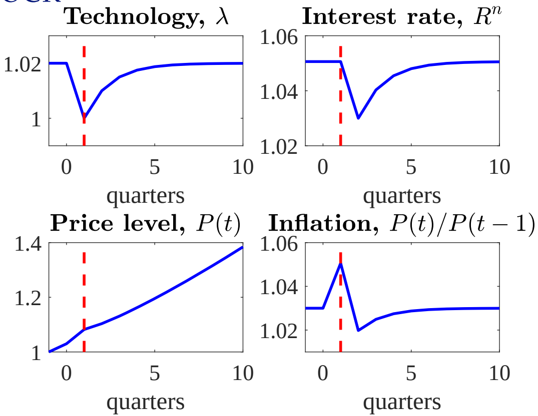

FIGURE: Monetary policy responds to a decrease in aggregate productivity, λ, by increasing the price level in the period of the shock. Subsequently, inflation converges to its BGP value, π^*, from below. The nominal interest rate drops in the period after the shock.

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.