Optimal Monetary Policy for the Masses

James Bullard (FRB of St. Louis)
Riccardo DiCecio (FRB of St. Louis)

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Introduction

Inequality and monetary policy

- Interest in income, financial wealth, and consumption inequality has increased in the last decade.
- Can monetary policy 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

- Conference on "Monetary Policy and the Distribution of Income and Wealth," held at the St. Louis Fed on September 11 and 12, 2015. Program available online.
- Kaplan, Moll, and Violante (*AER*, 2018): new Keynesian macro with uninsurable idiosyncratic risk and multiple assets ("HANK"). Produces reasonable Gini coefficients. The monetary transmission mechanism is altered relative to the representative agent case. Also provides a good discussion of the literature.
- This paper also produces reasonable Gini coefficients, and features incomplete markets due to a friction, with strictly limited idiosyncratic risk. The policymaker is able to repair the distortion caused by the friction for all households.

Household credit in a DSGE model

- We study an economy with a large private credit market essential to good macroeconomic performance.
- This market has an important friction: Non-state contingent nominal contracting (NSCNC).
- The role of monetary policy will be to keep this large credit market functioning properly (i.e., complete).
- We ignore ZLB issues in this talk. See the companion paper by Azariadis, Bullard, Singh and Suda (2015).

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, will be to re-allocate uneven income profiles across the life cycle into perfectly equal consumption shares by cohort, appropriately scaled by life cycle productivity.
- The model equilibrium will naturally rank:
  - wealth Gini $>$ income Gini $>$ consumption Gini.

The monetary policy implications

- 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 or 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.*
- Could 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 $t+1$, and where

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

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 avoided.

TIMING PROTOCOL

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

Nominal interest rate contracts

- 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 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 which 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.
- Life cycle productivity profiles are deterministic.
- 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.
- 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

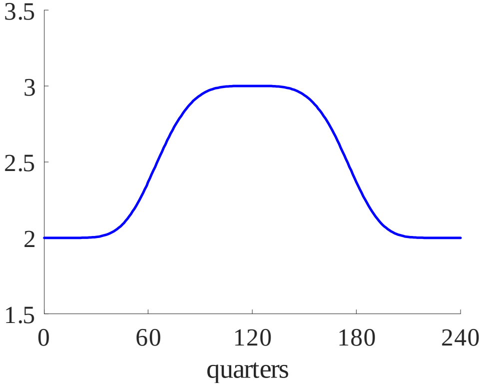

Figure: Baseline endowment profile. The profile is symmetric and peaks in the middle period of the life cycle.

THE MASS OF LIFE-CYCLE PRODUCTIVITY

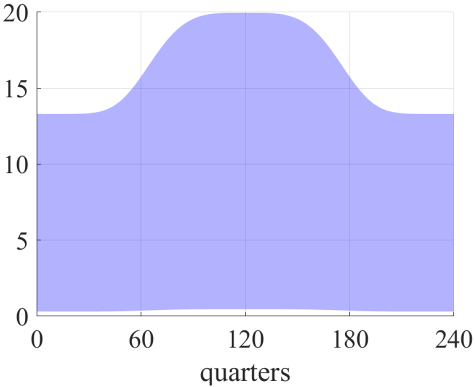

FIGURE: The mass of endowment profiles: $e_{s,i} \sim e_s \cdot \mathcal{U}\left(\xi^{-1}, \xi\right)$,
$e_s = 2 + \exp\left[\left(-\frac{s-120}{60}\right)^4\right]$, $\xi = 6.5$.

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.
- 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,* $R\left(t-1,t\right)$, *is equal to the gross rate of aggregate productivity growth, and hence the real growth rate of the economy,* $\lambda\left(t-1,t\right)$, $\forall t$.

COROLLARY

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

Characterizing the Equilibrium

LABOR/LEISURE

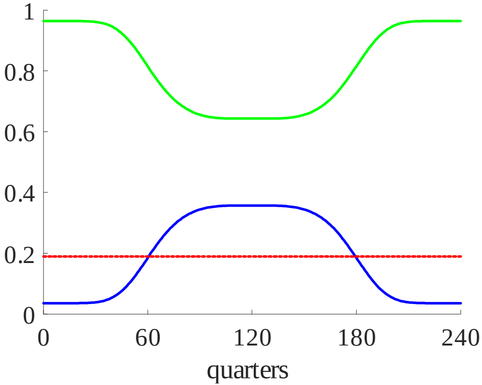

FIGURE: Leisure decisions by age (green), labor supply by age (blue) and fraction of work time in U.S. data, 19% (red). The labor/leisure choice depends on the current-to-lifetime average productivity ratio. Productivity profiles of the form $e_{s,i} = x \cdot e_s$ imply labor/leisure choices dependent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

LABOR INCOME MASS

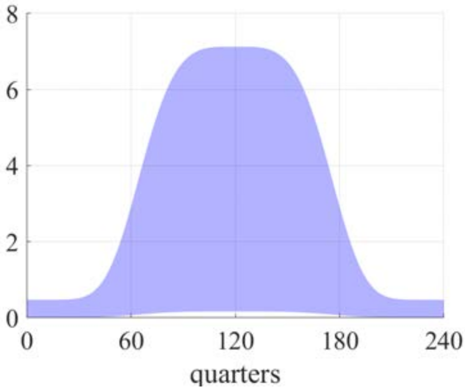

FIGURE: Labor income profiles $e_{s,i}(1-\ell)w$; $\xi = 6.5$, $\eta = 0.21$, and $w = 1$.

Consumption mass

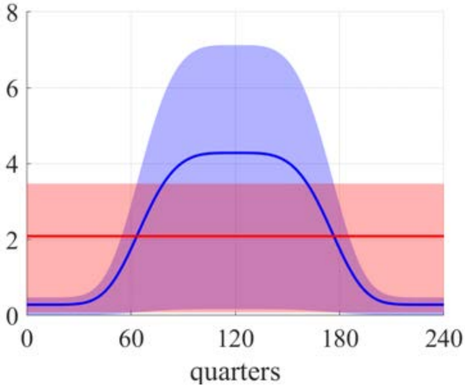

Figure: Consumption mass (red) and labor income mass (blue) along the complete markets balanced growth path with $w(t) = 1$. Under optimal monetary policy, the private credit market reallocates uneven labor income into perfectly equal consumption for each productivity profile. The consumption Gini is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

NET ASSET HOLDING MASS

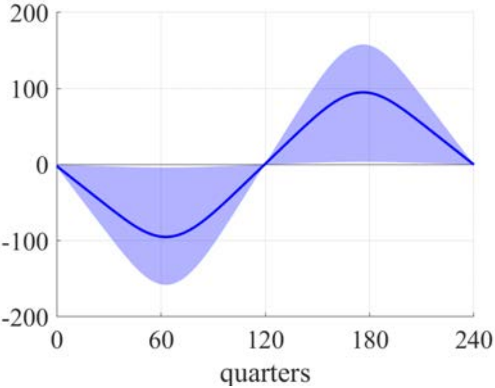

FIGURE: Net asset holding mass by cohort along the complete markets balanced growth path. Borrowing, the negative values to the left, peaks at stage 60 of the life cycle (age ~35), while positive assets peak at stage of life 180 (age ~65). The financial wealth Gini is 72.7%, similar to values calculated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

THREE NOTIONS OF INCOME

- Three notions of income:
  1. Labor income,

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

  2. Labor income plus non-negative capital income,

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

  3. The non-negative component of total income,

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

- 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

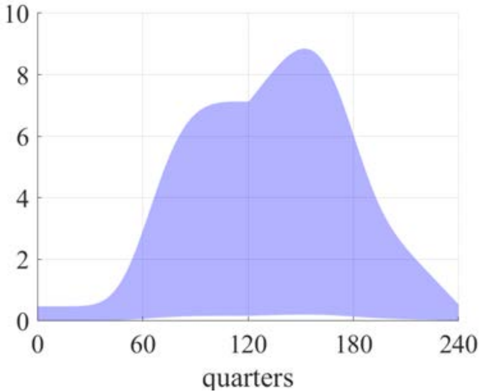

FIGURE: Profiles of labor income and non-negative capital income $e_{s,i}(1-\ell)w + \max\left\{(\lambda-1)\frac{a}{P}, 0\right\}$; $\xi = 6.5$, $\eta = 0.21$, and $w = 1$.

NON-NEGATIVE TOTAL INCOME

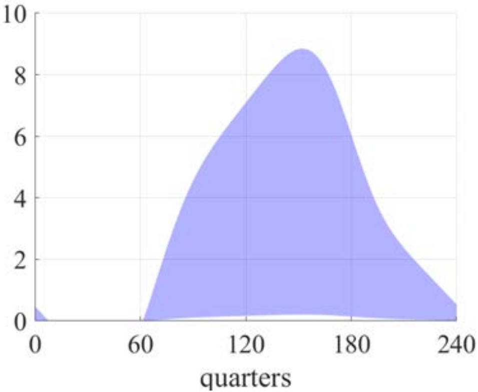

FIGURE: Profiles of non-negative total income
$\max\left\{e_{s,i}\left(1-\ell\right)w+\left(\lambda-1\right)\frac{a}{P},0\right\}$; $\xi=6.5$, $\eta=0.21$, and $w=1$.

Inequality

Densities

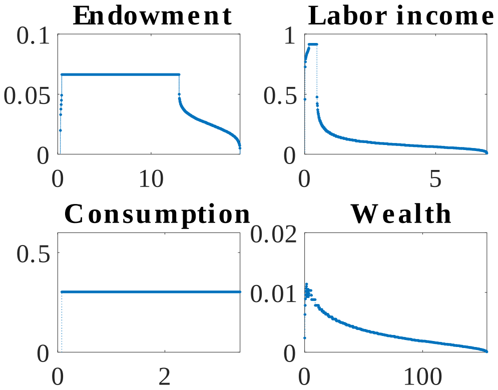

Figure: PDFs of endowment, labor income, consumption and wealth. Note: the wealth subplot omits a mass point (121/241) at 0.

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 which depends in part on life cycle productivity dispersion.
- Financial wealth is defined as the non-negative part of net assets.
- Denote G_W, G_Y, and G_C as the financial wealth, income, and consumption Gini coefficients, respectively, in the model.
- For $\xi = 6.5$ and $\eta = 0.21$

$$G_W = 72.7\% > G_{Y_2} = 51.6\% > G_C = 31.8\%,$$

versus U.S. data

$$G_{W,\text{U.S.}} = 80\% > G_{Y,\text{U.S.}} = 51\% > G_{C,\text{U.S.}} = 32\%.$$

PRODUCTIVITY DISPERSION AND GINI COEFFICIENTS

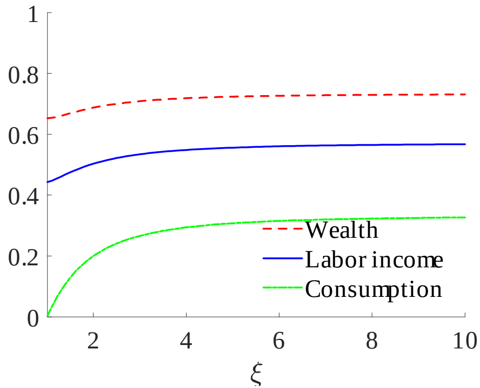

FIGURE: As the dispersion of productivity profiles, ξ, increases, the Gini coefficients increase. The ordering $G_W > G_Y > G_C$ is preserved.

Policy

INTERPRETING MONETARY POLICY

- The price level rule characterizes policy by "counter cyclical 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 contract nominal rate is the expected rate of nominal GDP growth.
- Wicksellian natural real rate = λ.
- The contract nominal rate is always ratified ex post.
- This makes the real rate = λ.
- "Just like the simple NK model."

Nominal GDP targeting

- Suppose $\rho = 0$: Then the expected rate of NGDP growth never changes, and the economy never deviates from the NGDP path. "Perfect NGDP targeting."
- Suppose $\rho > 0$: Then the expected rate of NGDP fluctuates persistently with the shock, and it takes longer to return to the NGDP path.
- Nominal and real rates fall in a recession.

Effects of a shock

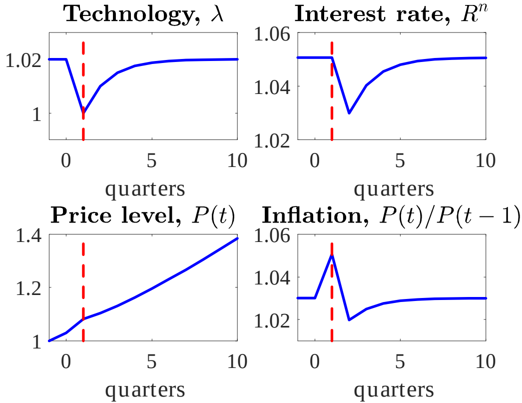

Figure: Monetary policy responds to a decrease in aggregate productivity, λ, by increasing the price level in the period of the shock. Subsequently, inflation converges to its BGP value, π^*, from below. The nominal interest rate drops in the period after the shock.

Conclusions

ALL HOUSEHOLDS FACE A CONSUMPTION SMOOTHING PROBLEM

- 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 NSCNC friction.
- The monetary authority can remove this impediment to life-cycle consumption smoothing for all households.