Optimal Monetary Policy for the Masses

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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.
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).
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 $\lambda$ is defined on the next slide.
STOCHASTIC STRUCTURE

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

\[
    w(t + 1) = \lambda(t, t + 1) w(t),
\]

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

\[
    \lambda(t, t + 1) = (1 - \rho) \bar{\lambda} + \rho \lambda(t - 1, t) + \sigma \epsilon(t + 1),
\]

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 contract by fixing the nominal interest rate one period in advance.
- The non-state contingent nominal interest rate, “the contract rate,” is given by

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

- 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 \( \lambda^r \) 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.
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: $e_{s,i} \sim e_s \cdot \mathcal{U}(\xi^{-1}, \xi)$,

$$e_s = 2 + \exp \left[ \left( -\frac{s-120}{60} \right)^4 \right], \quad \xi = 6.5.$$
**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, \( R(t - 1, t) \), 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
**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 $e_{s,i} (1 - \ell) w; \bar{\zeta} = 6.5, \eta = 0.21, \text{ and } w = 1.$
**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,

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

2. Labor income plus non-negative capital income,

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

3. The non-negative component of total income,

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

Gini coefficients of income distributions: 
\[ G_{Y_1} = 56.2\%, \quad G_{Y_2} = 51.6\%, \quad G_{Y_3} = 59.6\%. \]
**L**abor income + non-negative **C**apital income

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

**Figure:** Profiles of non-negative total income

\[
\max \left\{ e_{s,i} (1 - \ell) w + (\lambda - 1) \frac{a}{p}, 0 \right\} ; \xi = 6.5, \eta = 0.21, \text{ and } w = 1.
\]
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 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 $\zeta = 6.5$ and $\eta = 0.21$

\[ G_W = 72.7\% > G_Y = 51.6\% > G_C = 31.8\%, \]

versus U.S. data

\[ G_{W, U.S.} = 80\% > G_{Y, U.S.} = 51\% > G_{C, U.S.} = 32\%. \]
As the dispersion of productivity profiles, $\xi$, increases, the Gini coefficients increase. The ordering $G_W > G_Y > G_C$ is preserved.
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.
The contract nominal rate is the expected rate of nominal GDP growth.

Wicksellian natural real rate = $\lambda$.

The contract nominal rate is always ratified ex post.

This makes the real rate = $\lambda$.

“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**

**Technology, $\lambda$**

![Graph showing Technology, $\lambda$](image1)

**Interest rate, $R^n$**

![Graph showing Interest rate, $R^n$](image2)

**Price level, $P(t)$**

![Graph showing Price level, $P(t)$](image3)

**Inflation, $P(t)/P(t-1)$**

![Graph showing Inflation, $P(t)/P(t-1)$](image4)

**Figure:** Monetary policy responds to a decrease in aggregate productivity, $\lambda$, by increasing the price level in the period of the shock. Subsequently, inflation converges to its BGP value, $\pi^*$, 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.