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Macroeconomics for the Masses with 37% Luck Included

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Introduction

Acknowledgements

- Thank-you very much for the opportunity to speak today.
- This talk is based on joint work-in-progress with **Talha Samil Cakir** (Central Bank of Türkiye).
    - Earlier versions of this talk were given at Purdue University, Texas A&M University, the Marleau Lecture at the University of Ottawa, the 2025 Caribbean Macro Conference in Nassau, The Bahamas, a keynote address at the 2025 Behavioral Macroeconomics Workshop at the University of Bamberg, Germany, at the St. Louis Fed, the International Monetary Fund, and the Reserve Bank of Australia Annual Research Conference 2025. We thank the participants at these events as well as John Cochrane for useful and constructive feedback.

EXECUTIVE SUMMARY

- The paper presents a **benchmark** macroeconomic model with **stochastic growth** as well as **uninsurable idiosyncratic risk**.
- The model features **high levels of inequality** in financial wealth, income, and consumption driven by life cycle effects as well as idiosyncratic risk.
- There is a nominal friction in the model: non-state contingent nominal contracting (NSCNC).
- A monetary policymaker can **completely mitigate** the distortionary effects of the friction.
- This optimal monetary policy has **no impact on inequality**, in **contrast** to some existing literature.
- The model has empirical support in "ordinary times."

Recommended monetary policy and reality

- In the baseline NK literature (e.g., Woodford [2003, *Interest and Prices*], Gali [2015, *Intro to NK Framework*]) ...
  - ... optimal monetary policy has the monetary policymaker setting the short-term nominal interest rate to achieve the **Wicksellian natural real rate of interest**—the rate that would occur if there was no nominal friction.
  - But this result was developed in models with **no inequality** (Gini coefficients all zero), whereas actual measured Gini coefficients in the U.S. are large—approximately 0.78 for financial wealth, 0.55 for income, and 0.32 for consumption.
- Does this wide disparity between model and data mean that the monetary policy recommendations from the earlier literature are wrong?

Recent macro literature and inequality

- Some recent macro literature argues that standard monetary policy recommendations **may be wrong**.
- The literature builds macroeconomic models with substantial inequality included.
- In many of these models, Aiyagari (1994, *QJE*)-type inequality is due mostly to uninsurable idiosyncratic labor income risk (luck):
  - People start out the same, but good things happen for some people and bad things happen for others, leading to financial wealth, income, and consumption differences.
- A **Ramsey planner might be tempted to use monetary policy** to try to insure people against this risk.

This paper

- We construct a model economy with aggregate shocks and macroeconomic **inequality on a grand scale** driven both by life cycle effects and uninsurable idiosyncratic risk.
- We show that the **monetary authority can still achieve the Wicksellian natural real rate** of interest in this economy, and hence the first-best allocation of resources.
  - In this model, the existence of massive **inequality does not alter the baseline characterization of optimal monetary policy** developed in the earlier literature.
  - The monetary policymaker wants to provide a smoothly functioning credit market as the best contribution to macroeconomic performance.
- The model has some empirical support as it matches some key features of U.S. macroeconomic data since 1995.

What is being said in the literature?

What is being said in the literature?

- Some recent literature:
    - J. Bullard, A. Singh, and J. Suda (2024, *IMF Economic Review, Special Issue on "The Future of Macroeconomic Policy"*).
    - **A. Bhandari, D. Evans, M. Golosov, and T. Sargent (2021, Econometrica).**
    - F. Bilbiie, *The Harry Johnson Keynote Lecture* at the MMF Conference, Manchester, UK, September 2024.
    - F. Bilbiie, T. Monacelli, and R. Perotti, "Stabilization vs Redistribution: The Optimal Fiscal-Monetary Mix," (*JME*, forthcoming).
    - Debortoli, D., and J. Gali. 2024. "Heterogeneity and Aggregate Fluctuations: Insights from TANK Models." Manuscript. May. UPF.
    - F. Ravenna and C. Walsh. 2024. "Inclusive Monetary Policy in a Model with Heterogeneous Workers." Working paper, UC-Santa Cruz.
    - Bence Bardóczy and Mateo Velásquez-Giraldo (July 2024, working paper) "HANK Comes of Age."

THE HANK LITERATURE AND REDISTRIBUTION

- Comments by T. Sargent (2023, "HAOK and HANK Models," manuscript, NYU):

  [The] HANK project has an electric charge and is bound to be controversial because it challenges the neoclassical synthesis and a widely-believed prescription for separating macro policy design from policies to redistribute income and wealth. Because they undermine single- and dual-mandates for monetary policies, HANK research is bound to attract attention from constituencies that today want to assign goals to Central Banks that involve redistribution and reallocation. Some of these goals are so foreign to what Keynes (1924, 1936) advocated that perhaps we should remove the K from HANK.

Environment

Environment basics

- At each date t, a **new continuum** of households enters the economy, makes economic decisions over $T + 1 = 241$ dates, then exits the economy.
  - This corresponds to an agent entering the economy as a decision-maker at age 20 and exiting as a decision-maker at age 80, inclusive of end points, and making economic decisions at a quarterly frequency.
  - Results are perfectly general for the choice of T, with higher values corresponding to decision-making at more frequent intervals.
- We make enough assumptions to generate a **paper-and-pencil competitive equilibrium solution**.
  - **Larger goal**: Provide a relatively simple **baseline model for heterogeneous-agent macroeconomies with both aggregate shocks and idiosyncratic risk**.

Nominal assets

- All assets in the model are **nominal debt contracts**: privately-issued debt, publicly-issued debt and privately-issued claims to capital.
  - We think of these as abstract representations of U.S. data counterparts: (1) mortgage-backed securities, (2) federally-issued debt and (3) corporate debt, respectively.
  - In the U.S. data, MBS net out, but federally-issued debt and claims to capital are in **positive net supply**.
  - We think of firms as being entirely bond-financed.

The Doepke-Schneider friction

- The credit market friction is **non-state contingent nominal contracting (NSCNC)**:
  - All debt contracts are stated in nominal terms, with a stated nominal interest rate, and repayment is not state-contingent.
  - The friction **motivates a role for monetary policy**, which is to adjust the price level each period in order to convert these nominal, non-state contingent contracts into (optimal) real, state-contingent contracts (a.k.a., "equity share contracting.")
- This friction is inspired by Doepke and Schneider (2006, *JPE*).

Household types

- Household types: “life cycle” (LC) and “hand-to-mouth” (HTM).
- The life-cycle households are assigned a **hump-shaped productivity profile** at the beginning of their life cycle. Accordingly, they need to use credit markets (hold assets) to smooth life-cycle consumption.
- The hand-to-mouth households are assigned a **perfectly flat productivity profile** as they enter the economy. Accordingly, they never need to use credit markets and instead **consume their labor income** each period.

Preferences and technology

- Household preferences are **standard** log-log in consumption and leisure.
- The aggregate production technology is also **standard** Cobb-Douglas.
- There are **three aggregate shocks**, one in the growth rate of aggregate demand, another in the growth rate of technological prowess, and a third in the growth rate of the labor force.
- Details on these specifications are given in J. Bullard, A. Singh, and J. Suda (2024).

Productivity profile endowments

Productivity profiles and the HVY shock

- Agents i entering the economy each draw a **scaling factor** x_i from a lognormal distribution and receive a productivity profile that is a scaled version of a baseline profile, $e = \{e_s\}_{s=0}^{240}$:

$$e_{s,i} = x_i \cdot e \qquad (1)$$

- For LC agents, the baseline profile is **hump-shaped**.
- For HTM agents, the baseline profile is **flat**.
- The scaling feature x_i is inspired by Huggett, Ventura and Yaron (*AER*, 2011), who argue that differences in initial conditions are more important than differences in shocks for lifetime earnings.
    - Accordingly, we sometimes call the scaling factor x_i the "HVY shock."

THE MASS OF LIFE-CYCLE PRODUCTIVITY

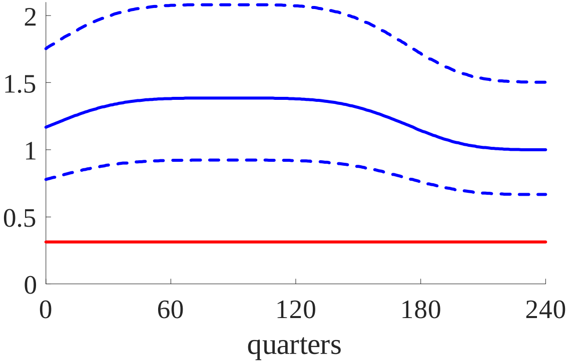

FIGURE: Productivity profiles: life-cycle agents (blue) and hand-to-mouth agents for $h = 0.25$ (red). The dashed lines denote the 25th and the 75th percentiles of the lognormal endowment scaling distributions.

Introducing uninsurable idiosyncratic risk

INTRODUCING UNINSURABLE IDIOSYNCRATIC RISK

- In the literature, agents in the economy are subject to uninsurable risk (*a.k.a.* "luck") at the individual level each period.
- How should we introduce this into the model while maintaining **pencil-and-paper solution simplicity?**

Introducing luck

- Our solution:
  - Give each agent entering the economy an **initial endowment of luck** denoted $\mathcal{L} \equiv \xi_i(-1) > 1$. All i receive the same value.
  - Multiply each productivity endowment of each agent at every period in their life cycle by an **idiosyncratic shock** $\xi_i(t+s)$ for $s = 0, ..., 240$ and $i \in (0,1)$.
  - The idiosyncratic shock follows a **random walk** process for each agent i as

$$\xi_i(t+1) = \xi_i(t) + \epsilon_i(t+1) \tag{2}$$

    where ϵ_i is *iid*, has mean zero and is appropriately bounded, and where the initial value is denoted $\xi_i(-1)$.

Interpreting luck

- The random walk means that each idiosyncratic shock is **expected to permanently affect** agent i productivity for the remainder of the life cycle.
- The initial endowment will be calibrated as $\mathcal{L} = 1.59$, so that $(1.59 - 1)/1.59 = 0.37$.
  - Interpretation: The **"perfectly average" agent** that receives $\epsilon_i = 0$ all through the life cycle **will have** 37% **of lifetime earnings due to luck**, matching HVY (2011).
  - A candidate distribution for ϵ_i is $U[a, b]$ with $a = 0.9 \cdot \xi_i(t)$ and $b = 1.1 \cdot \xi_i(t)$.

Luck and borrowing constraints

- A **hallmark** of the literature on macroeconomic inequality that relies extensively on luck is that agents are assumed to be borrowing constrained.
  - One issue is that an agent that received bad draws all through the life cycle might try to borrow extensively and then **die in debt**, depriving others who were relying on repayment. This would not be an equilibrium.
- In our model, life cycle agents will want to hold **positive net assets** for life cycle reasons at all points in the life cycle.
  - If they are lucky or unlucky, this will affect the level of positive net assets held (and the level of consumption), but they will not hold negative net assets.
- The **HTM agents** are affected by idiosyncratic risk but **hold no assets** at any time.

Monetary policy and social welfare

NOMINAL CONTRACTING AND MONETARY POLICY

- Agents in this model will **contract on a nominal interest rate** at date t, maturing at $t+1$, given by

$$R^{n}\left(t,t+1\right)^{-1}=E_{t}\left[\frac{\tilde{c}_{t,i}\left(t\right)}{\tilde{c}_{t,i}\left(t+1\right)}\frac{P\left(t\right)}{P\left(t+1\right)}\right]. \tag{3}$$

  - For **small noise**, the contract interest rate is approximately the **expected nominal gross rate of consumption growth**.

- At date $t+1$, the monetary authority controls the price level directly and implements a **targeting criterion**

$$P\left(t+1\right)=\frac{R^{n}\left(t,t+1\right)}{\delta\left(t,t+1\right)\lambda\left(t,t+1\right)\nu\left(t,t+1\right)}P\left(t\right). \tag{4}$$

- This targeting criterion calls for **countercyclical price level movements** relative to the expectation embodied in the contract rate $R^{n}\left(t,t+1\right)$.

Competitive equilibrium and social welfare

- Solution: **Guess and verify** that there is a competitive equilibrium in which the **real rate of interest is always equal to the stochastic rate of real output growth**.
  - The "**Wicksellian natural real rate** of interest" for this economy.
- In such a competitive equilibrium, agents will be able to make date t decisions **without reference to future uncertainty**.
  - The monetary authority is providing a **type of insurance** against aggregate shocks.
- A social planner would conclude that the allocation of resources is a **social optimum** provided (i) the planner places equal weight on all households for all time, (ii) the planner discounts backward and forward in time at the stochastic real rate of interest, and (iii) the planner cannot alter the distribution of productivity profiles.

A heuristic interpretation of optimal monetary policy

A MONETARY POLICY RULE IMPLEMENTATION

- The targeting criterion can be rearranged as:

$$R^n(t, t+1) = G(t, t+1)\frac{P(t+1)}{P(t)} \tag{5}$$

  where $G(t, t+1) = \delta(t, t+1)\,\lambda(t, t+1)\,\nu(t, t+1)$ is the gross rate of real output growth between dates t and $t+1$.

- **Heuristically**, we can think of the monetary policymaker at date t "recommending" that the private sector contract on a gross nominal interest rate $R^n(t, t+1)$ based on the expectation of the RHS, that is, the expected gross rate of growth of nominal output.

- A Taylor-type rule to implement this would be (in net terms)

$$r^n(t, t+1) - r^\star = \varphi_\pi E_t(\pi_{t+1} - \pi^\star) + \varphi_g E_t(g_{t+1} - g^\star) \tag{6}$$

The nature of optimal monetary policy

- The policymaker "recommended" contract rate involves central bank expectations both of what nature will do (the $G(t, t+1)$) and also what it expects of its own future policy (the $P(t+1)/P(t)$).
- *The policy rate can be thought of heuristically as a promised rate of nominal output growth.*
- Optimal policy sets the price level to always deliver on the promise, no matter what nature chooses for $G(t, t+1)$.
- We sometimes call this a "**nominal certainty model**."
  - *Reality check*: The $Q1$ 2025 U.S. policy rate was $R^n(t, t+1) = 1.0433$, consistent with $Q1$ 2025 nominal growth expectations of $G(t, t+1) = 1.02$ and $P(t+1)/P(t) = 1.024$.

What do agents do?

Decision rules

- For $s = 0, ..., 240$ and $i \in (0, 1)$, decision rules for both LC and HTM are

$$\tilde{c}_{t-s,i}(t) = \eta \xi_i(t) w(t) x_i \bar{e}, \tag{7}$$

$$\ell_{t-s,i}(t) = (1-\eta) \frac{\bar{e}_i}{e_{s,i}}, \tag{8}$$

$$\frac{a_{t-s,i}(t)}{P(t)} = \xi_i(t) w(t) x_i \left\{ \sum_{j=0}^{s} e_j - \frac{s+1}{T+1} \sum_{j=0}^{T} e_j \right\}. \tag{9}$$

Notes: (1) The $\xi_i(t)$ is the idiosyncratic shock; (2) The real wage $w(t)$ is stochastic and reflects the aggregate shocks; (3) The x_i is the realization of the HVY shock; (4) Net assets are always positive in our calibration. (5) Leisure (hours worked) is independent of the shocks. (6) To the agent, $\xi_i(t)$ and $w(t)$ both represent uncertainty and enter decision rules together.

Calibration

Mapping to the Data

- Adjust the cohort size based on data from the U.S. Census Bureau.
- Set the baseline hump-shaped life-cycle productivity profile such that life cycle **households endogenously choose to work the hours worked by age in the U.S. data**.
- Choose η to match the average time devoted to market work across the economy.
- Set the fraction of HTM households (who do not hold assets) to the share of unbanked U.S. households, 4.5% in 2021 according to the FDIC.

The HVY shock

- Huggett, Ventura, and Yaron (2011, AER) found that 63% of lifetime earnings could be explained based on characteristics known at age 23 in their data.
- In our model, we take this to be the portion of earnings inequality due to the HVY shock along with life cycle effects.
- This leaves the remainder, 37%, to be explained by idiosyncratic risk ("luck").
- We set the luck endowment $\mathcal{L}$ to 1.59, so that the "extra" idiosyncratic risk is 37% of the total for the agent experiencing average luck, that is, $0.59/1.59 = 0.37$.
  - *Reality check*: See Borella, De Nardi, Yang, and Torres Chain (2025) "Why do households save and work?" NBER WP #33874, for additional estimates.

Hours worked by age

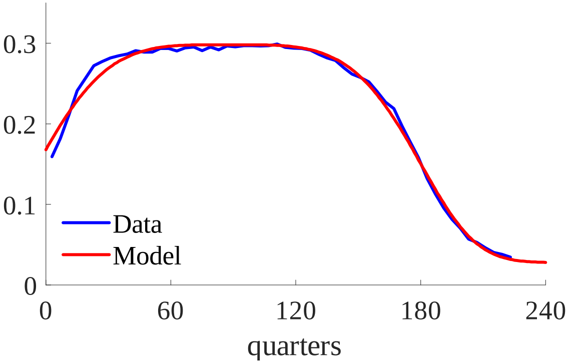

Figure: Hours worked by age for life-cycle households: U.S. data (blue) and calibrated model (red).

Aggregate assets and Gini coefficients

	BSS Model 2	BC Model	U.S. data
σ_{lc}	0.52	0.52	–
$\bar{\xi}$	–	1.59	1.59
$A/(4Y)$	3.79	3.79	4.52
$A^{lc}/(4Y)$	3.79	2.39	–
$A^{id}/(4Y)$	–	1.40	–
G_W	0.55	0.63 (?)	0.78
G_Y	0.41	0.49 (?)	0.63
G_C	0.32	0.40 (?)	0.32

TABLE: Gini coefficients in the model equilibrium compared to BSS (2024, model 2).

Model fit to U.S. data

AGGREGATE CONSUMPTION GROWTH

- The model is characterized by **explicit stochastic growth—**no detrending!
- The model equilibrium states that real output growth will be **perfectly correlated** with real aggregate consumption growth, and their nominal counterparts will be similarly correlated.
- In the data, it is not clear what the real-world counterpart is to "output" since the model does not have an international sector or other important dimensions (e.g., inventories and a "large" government sector).
- Accordingly, we follow BSS (2024) and consider a variety of output measures.
- Bottom line: The correlations are **close to one**.

AGGREGATE CONSUMPTION GROWTH

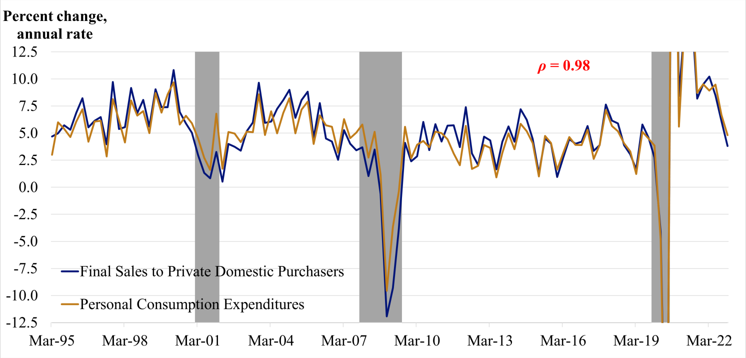

FIGURE: The model equilibrium under the optimal policy suggests that the nominal output growth rate and the nominal aggregate consumption growth rate should be equal. This chart shows one measure of nominal output growth and one measure of nominal consumption growth, and the raw correlation is 0.98.

Consumption growth across households

- The model also predicts that average consumption growth rates **across** cohorts will be equalized, but consumption growth rate correlations **within** a cohort will not be equal.
- Our calibration puts **most of the emphasis on the equalization** of consumption growth rates.
- We follow BSS (2024) and consider weekly data from January 2020 to March 2023 on credit card expenditure by zip code, with median income in the various zip codes distinguishing between rich and poor.
- The spending growth week-by-week in the lowest income quartile of zip codes is highly correlated with spending growth week-by-week in the highest income quartile, consistent with the model equilibrium.

CONSUMPTION GROWTH ACROSS HOUSEHOLDS

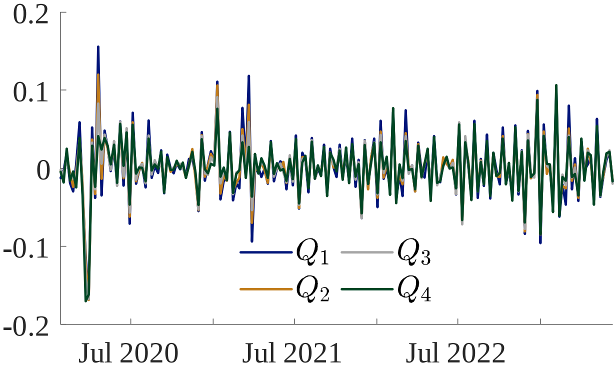

FIGURE: Credit card spending by income group, weekly, January 2020 to March 2023. The model equilibrium predicts that nominal spending growth rates across society should be equalized. The correlation in consumption growth between the groups is indeed very high, as predicted by the model.

Consumption growth across households

Correlations in growth rates

Household zip code income distribution

	Q_1	Q_2	Q_3	Q_4
Q_1	1.000	0.980	0.957	0.901
Q_2	–	1.000	0.984	0.940
Q_3	–	–	1.000	0.972
Q_4	–	–	–	1.000

TABLE: Correlation in consumption growth rates across the household zip code income distribution, January 2020 to March 2023, as measured by credit card expenditure indexed to the home address of the credit card. The correlations between the richest and poorest quartiles are high, close to the model prediction of 1.0.

Conclusions

A BENCHMARK MODEL

- We studied a benchmark macroeconomic model with “massive” inequality in income, financial wealth, and consumption.
- The inequality is generated jointly by life cycle effects and idiosyncratic risk.
- **Even with the massive inequality, the model recommends a conventional monetary policy** like that practiced in many OECD countries in recent decades.
- This is contrary to some recent literature concerning optimal monetary policy and inequality.
- The model also provides an **attractive baseline** for the study of heterogeneous agent economies with monetary policy.