# Discussion of "Inequality, Business Cycles and Monetary-Fiscal Policy" by Bhandari, Evans, Golosov and Sargent


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# This paper: a very important question

- How should monetary policy respond to aggregate shocks?
- Standard answers from RANK models:
  - Track the natural real interest rate
  - Lean against the wind of inflationary pressure
- We know from existing HANK literature that adding heterogeneity
  - Large income and wealth inequality
  - Large and heterogeneous MPCs

  substantially changes the positive conclusions of RANK models
- Key outstanding question: how about the normative conclusions?
- **This paper**: normative analysis in a HANK economy
  - a methodological innovation, and some tentative conclusions

# My assessment

- Novel and cool methodology, will likely be influential going forward
- Illustrated in the context of a natural extension of canonical NK model to heterogeneity
- Calibration misses a number of crucial features for HANK models:
  1. Sticky wages
  2. Occasionally binding borrowing constraints
- Potential obstacles for wide adoption and influence: methodology:
  a) (Currently) cannot currently handle 2.
  b) Seems quite complex to implement, even for 2nd order approximation
- **This discussion**: place question in context, explain methodology and results, suggest improvements to calibration

# Optimal monetary-fiscal policy in New Keynesian models

# Optimal policy in the rep agent NK model

- Consider standard NK model with sticky Rotemberg prices & CRS
- Given sequences for productivity $\Theta_t$ and markups $\epsilon_t^{-1}$, planner solves

$$\max_{\{C_t, N_t, \pi_t, \tau_t\}} \mathbb{E}\left[\sum_{t=0}^{\infty} \beta^t \left\{\frac{C_t^{1-\nu}}{1-\nu} - \frac{N_t^{1+\gamma}}{1+\gamma}\right\}\right]$$

subject to the aggregate resource constraint and the Phillips curve

$$C_t = Y_t - \frac{\psi}{2}\pi_t^2 = \Theta_t N_t - \frac{\psi}{2}\pi_t^2$$

$$\begin{aligned}\psi\left(1+\pi_t\right)\pi_t = & \frac{\epsilon_t}{1-\tau_t}\frac{C_t^{\nu} N_t^{\gamma}}{\Theta_t} - \left(\epsilon_t - 1\right) \\ & + \beta \mathbb{E}_t\left[\frac{C_{t+1}^{-\nu}}{C_t^{-\nu}}\psi\left(1+\pi_{t+1}\right)\pi_{t+1}\frac{\Theta_{t+1} N_{t+1}}{\Theta_t N_t}\right]\end{aligned}$$

# Solution: RANK principles of optimal policy

1. If $\tau_t$ can vary, set it such that $\frac{\epsilon_t}{1-\tau_t} = \epsilon_t - 1$. Obtain

$$C_t = \Theta_t^{\frac{1+\phi}{\sigma+\phi}} \quad \pi_t = 0 \quad \forall t$$

   and support by a sequence of nominal rates

$$1 + i_t = \frac{1}{\beta} \frac{C_t^{-\sigma}}{\mathbb{E}_t \left[ C_{t+1}^{-\sigma} \right]}$$

   - Optimal *monetary-fiscal* policy achieves the **first best**
   - If productivity follows a geometric random walk then $i_t$ is constant
   - More generally, $i_t$ should **track the natural real rate**

2. If no markup shocks $\epsilon_t = \epsilon^*$, can achieve this with a constant $\tau$
   - Without cost-push shocks, **monetary policy alone achieves the FB**
3. Only meaningful tradeoff is with constant $\tau$, but $\epsilon_t$ time varying
   - Then policy **leans against the wind** and is time inconsistent

# Introducing incomplete markets

- What is different in an incomplete markets economy?
  - Redistribution [Auclert 2015]. Budget constraint in BEGS:

$$c_{it} + \frac{1}{1+i_t} b_{it} = (1-\tau_t) W_t \theta_{it} n_{it} + T_t + s_i D_t + \frac{b_{it-1}}{1+\pi_t}$$

$$\theta_{it} = \Theta_t e_{it} F(e_{it}, \Theta_t)$$

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1. **Shocks** do not affect all agents equally
   - $\Theta_t \uparrow$ redistributes towards agents with relatively sensitive $\theta_i$ (high $F_\Theta$)
   - $\Theta_t \uparrow$ increases wages $W_t$ and dividends $D_t$, redistribute to agents with high $\theta_{it}$ and high $s_i$
   - $\epsilon_t \downarrow$ increases markups, causes $W_t \downarrow$ and $D_t \uparrow$, redistribute from high $\theta_{it}$ to high $s_i$ agents

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1. **Shocks** do not affect all agents equally
2. **Policy changes** do not affect all agents equally
   - Assets are nominal. $\pi_t \uparrow$ redistributes from high-$b_{it-1}$ to low-$b_{it-1}$ agents (Fisher effect)
   - Agents are trading. $i_t \downarrow$ redistributes from high-$b_{it}$ agents to low-$b_{it}$ agents (real interest rate exposure effect)
   - In sticky-price GE, $i_t \downarrow$ also causes $W_t \uparrow$ and $D_t \downarrow$, redistributes from high $\theta_{it}$ to high $s_i$ agents
   - Taxes have redistributive effects. $T_t \uparrow$ mostly benefits low-$\theta_{it}$, $\tau_t \uparrow$ mostly hurts high-$\theta_{it}$ agents

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1. **Shocks** do not affect all agents equally
2. **Policy changes** do not affect all agents equally
3. The planner cares about distribution, so uses policy instruments to undo the redistributive effect of shocks
   - eg, $i \downarrow$ in response to $\epsilon_t^{-1} \uparrow$ to undo labor-to-capital redistribution
   - contrast with $i \uparrow$ in RANK to counter inflation by imposing recession
   - both forces are there: which one dominates is a quantitative question

# Why is this problem difficult?

- The distribution $\Omega$ of agents over individual states $(b_{it-1}, e_{it}, s_i)$ is part of the state space
- Shocks and policy responses influence affect agent decisions $b_{it}$, and therefore the evolution of $\Omega$
- Already a nontrivial problem for positive analysis
  - Well-developed solutions methods exist here (see next)
- Normative analysis even more complex.

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- Already a nontrivial problem for positive analysis
  - Well-developed solutions methods exist here (see next)
- Normative analysis even more complex. Competing alternatives:
  - Simplified, tractable models [Gali and Debortoli 2017; Challe 2017]
  - State-space truncation [Le Grand and Ragot 2017]
  - Continuous time (KF in planner constraints) [Nuño and Thomas 2017]
  - Most of these came before. Should discuss differences, both in terms of methodology and substantive conclusions.

# The BEGS methodology

# Understanding the BEGS methodology

- Paper emphasizes its methodological contribution
- Explains the method by showing how it handles a simple problem:
  - Flex-price equilibrium of a Huggett model
  - (Solve for path of real rate given TFP)
- **Next**: relate to and contrast with a well-established alternative
  - Sometimes known as "MIT-shock" solution method
  - For simplicity, take out endogenous labor supply and markups

# A simple Huggett model

- Aggregate income is

$$\ln Y_t = \rho_{agg} \ln Y_{t-1} + \sigma_{agg} \mathcal{E}_t \quad \mathrm{Var}\left(\mathcal{E}_t\right) = 1$$

individual skills follow

$$\ln e_t = \rho_{id} \ln e_{t-1} + \sigma_{id} \epsilon_t \quad \mathrm{Var}\left(\epsilon_t\right) = 1$$

- Distribution $\Omega\left(b, e\right)$. Initial conditions: $\Omega_{-1}$ and $Y_{-1}$. Agents solve

$$V\left(b, e; \Omega, Y\right) = \max_{c, b'} \left\{ u\left(c\right) + \beta \mathbb{E}\left[ V\left(b', e'; \Omega', Y'\right) | e, \Omega, Y \right] \right\}$$

$$c + \frac{b'}{R\left(\Omega, Y\right)} = eY + b$$

Note **no borrowing constraint**. Goods market clears:

$$\int c\left(b, e; \Omega, Y\right) d\Omega\left(b, e\right) = Y$$

# MIT shock approach

- A classic approach: [Auerbach-Kotlikoff 1987, and many many others...]
  - Set $\sigma_{agg} = 0$
  - $\Rightarrow Y_t$ follows known path, $\ln Y_t = \rho^{t+1} \ln Y_{-1} = \rho^{t+1}\Theta$
- Use "factorization theorem": agents only care about distributions $\Omega_t$ *through* their effect on aggregate paths $\{R_t\}$. Given $\Omega_{-1}$ and $\Theta$,
  - Agent policies at $t$ depend only on $\{R_\tau\}_{\tau \geq t}$
  - Aggregate consumption $C_t$ depends only on $\{R_\tau\}_{t \geq 0}$
  - Obtain a nonlinear system:

$$C_t\left(\{R_\tau\}_{t\geq 0}\right) = Y_t \quad \forall t$$

- Truncate at $T \simeq 500$ periods: $T$ equations in $T$ unknowns $\{R_t\}$.
- Can solve very rapidly with pseudo-Newton methods [Auclert-Rognlie]

# BEGS approach

- BEGS approach: [Fleming 1971, Anderson-Hansen-Sargent, Evans]
  - Set $\sigma_{agg} = \sigma \cdot \overline{\sigma_{agg}}$ and $\sigma_{id} = \sigma \cdot \overline{\sigma_{id}}$ (same $\sigma$)
- For any $\sigma$, equilibrium policies satisfy functional equations

$$\begin{aligned}
c\left(b,e;\Omega,Y,\sigma\right)^{-\nu} &= \beta R\left(\Omega,Y,\sigma\right)\mathbb{E}\left[c\left(b',e';\Omega',Y',\sigma\right)^{-\nu}|e,\Omega,Y\right] \\
c\left(b,e;\Omega,Y,\sigma\right)+\frac{b'\left(b,e;\Omega,Y,\sigma\right)}{R\left(\Omega,Y,\sigma\right)} &= eY+b \\
\int c\left(b,e;\Omega,Y,\sigma\right)\pi\left(e\right)d\Omega\left(b\right) &= Y \\
\Omega'\left(b',e';\Omega,Y,\sigma\right) &= \int 1_{\{b'(b,e;\Omega,Y)\leq b'\}}\pi\left(e'|e\right)d\Omega\left(b,e\right)
\end{aligned}$$

- Make repeated use of the implicit function theorem to approximate policies at increasing orders of $\sigma$ (requires $=$ in Euler)
- Use factorization theorem to reduce "$\frac{\partial c}{\partial \Omega}$" to "$\frac{\partial c}{\partial R}\frac{\partial R}{\partial \Omega}$"

# BEGS vs MIT shocks

- MIT shock approach
  - 1st order approx wrt aggregate risk, $\infty$ wrt idiosyncratic risk
  - Handles occasionally binding constraints perfectly
  - Cannot handle higher orders for aggregate risk
- BEGS (current) approach
  - 2nd order wrt aggregate, 2nd wrt idiosyncratic
  - Cannot handle occasionally binding constraints
  - Can be scaled up to any order! (just requires a *lot* of algebra)

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  - Can be scaled up to any order! (just requires a *lot* of algebra)
- My view:
  - Since calibrated idiosyncratic uncertainty $\gg$ aggregate uncertainty, MIT approach probably okay for most positive questions
  - Jury is out on what the differences are. An interesting question!
    - The BEGS method promises to finally deliver an answer
  - BEGS essentially only game in town for optimal policy today
    - Nuño-Thomas: MIT shock approach, but much simpler problem

# Substantive calibration issues

# Matching MPCs and MPEs: problem with flexible wages

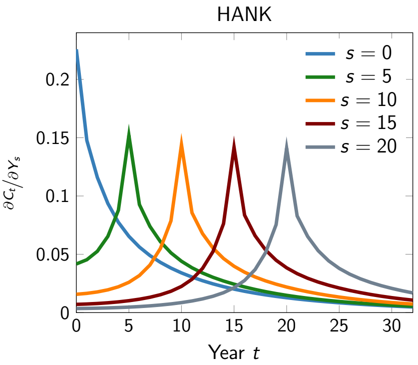
- Baseline model has a natural borrowing limit
- Authors correctly note that MPCs are important for monetary policy transmission mechanism [Auclert, Kaplan-Moll-Violante]
  - Fix with permanent hand to mouth agents (see next)
- Raises another issue: flexible wages + separable preferences:
  - Implies MPCs and marginal propensities to earn (MPEs) are related:

$$MPE_i = -\frac{w_i \theta_i n_i}{c_i} \frac{\nu}{\gamma} MPC_i$$

  - Problem: in the data, $MPE_i \simeq 0$ for everyone
    - cf Swedish lotteries [Cesarini et al]
  - Cannot fix this with nonseparable preferences [Auclert-Rognlie]
  - Our solution: sticky wages

# Matching intertemporal MPCs: problem with HTM

- Empirical evidence from lottery receipts suggest that agents spread spending over time on average [Fagereng et al]
  - Occasionally binding constraints are important [Auclert-Rognlie-Straub]




- The method's influence will depend on its ability to handle those

# Factors affecting economic conclusions

- BEGS: debt is nominal and short term and stocks are nontraded
- This is likely to substantially affect optimal policy conclusions
- Long maturities imply that

1. Real interest rate cuts create capital gains that redistribute towards savers, so are less redistributive than model implies
2. Conversely, inflation has more redistributive power than model implies, since it erodes real value of long lived nominal assets

- Flexible wages make dividends highly countercyclical wrt monetary shocks, implying implausibly large redistribution between capital and labor. If stocks were tradable, agents would likely hedge this.

# Conclusion

- Ambitious paper, interesting new insights
- Methodology will be very influential if it can
    a) handle occasionally binding constraints
    b) prove easy to implement, and a substantial benefit over alternatives
- A model with sticky wages, tradable stocks, and long maturities would deliver more credible substantive conclusions

# Thank you!

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