Makeup Monetary Policy Strategies in an Unequal World

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Introduction

- The low interest rate environment in North America and Europe as well as the experience during the aftermath of the Global Financial Crisis of 2008 has created a lot of interest in alternative monetary policy strategies.

- One intensely debated suggestion to soften the ELB-induced limitations of monetary policy calls for a shift away from inflation targeting towards 'makeup strategies' such as price-level or nominal GDP targeting.

- In rational expectation representative agent New Keynesian (RANK) models makeup strategies have been shown to possibly yield great stabilization gains.

- Recent literature on heterogeneous agent New Keynesian (HANK) models suggests different forces that might weaken or strengthen the RANK conclusions, but a systematic analysis of the effects of such rules in HANK models is missing.

Introduction

- In this project we construct a HANK model with idiosyncratic unemployment risk, incomplete markets, illiquid assets, and matching frictions.

- We calibrate the model to match basic features of the U.S. business cycles and use it as a laboratory.

- While in our model the intertemporal transmission channel of monetary policy is weaker, indirect effects, working through income effects and precautionary motives, might be strong enough to offset this dampening.

Introduction

- Using impulse response functions and longer simulations we show that the stabilization gains depend, among other things, on the availability of liquid wealth/credit/transfers to unemployed and 'at-risk' households - suggesting that the effects of alternative policy strategies are state dependent.

- In a low liquidity calibration closer to current U.S. household level data we find larger gains from makeup strategies in terms of stabilizing inflation and reducing average unemployment.

Literature

- **Forward Guidance and Price Level Level Targeting:**
  - Price Level Targeting without ZLB: Svensson (1999), Vestin (2006)
  - Price Level Targeting with ZLB: Woodford & Eggertsson (2003), Nakov (2008), Coibion et al (2012)
  - Surveys: Ambler (2009), Hatcher & Minford (2016)

- **Monetary Policy in HANK:**
  - Monetary Transmission/Forward Guidance in HANK: McKay et al (2016), Bilbiie (2019), Werning (2015), Hagedorn et al (2019), Kaplan et al (2018)
  - Optimal Policy (Rules) in HANK/TANK: Archarya & Dogra (2019), Bilbiie (2018), Cairo & Sim (2018), Gornemann et al (2016)

Model: Overview

- Workers work to earn wages, face unemployment risk and self-insure by trading nominal bonds subject to a borrowing constraint.
- Entrepreneurs own all the firms and insure each other against employment risk. They trade bonds with workers.
- Monopolists produce consumption and investment good using hired labor, subject to price adjustment costs.
- Firms hire worker subject to matching frictions.
- Monetary authority sets interest rate following a simple rule.

Model: Employed Worker

$$
\begin{aligned}
W_t(1, a_{j,t-1}) &= \max_{a_{j,t}} \frac{\left(\frac{c_{j,t}}{c_{t-1}^{-\sigma_h}}\right)^{1-\sigma}}{1-\sigma} + \sigma_b a_{j,t} \\
&+ \beta_H \mathbb{E}\left[(1-\rho+\rho p_{t+1}) W_{t+1}(1, a_{j,t}) + \rho(1-p_{t+1}) W_{t+1}(2, a_{j,t})\right] \\
\text{s.t.} \quad & c_{j,t} + a_{j,t} = \frac{R_{t-1}}{\pi_t} a_{j,t-1} exp(\lambda_{t-1}) + (1-\tau) w_t + N_t + T_{a_{j,t-1},t} \\
& a_{j,t} \geq \underline{a}.
\end{aligned}
$$

- W_t value function worker, $a_{j,t}$ bond holdings;
- $c_{j,t}$ worker consumption, c_{t-1} aggregate lagged consumption - habit forming;
- p_{t+1} job finding rate, w_t wages;
- R_t interest rate, π_t inflation;
- N_t income from illiquid asset, T_t transfer;
- λ_t liquidity shock.

Model: Unemployed Worker

$$
\begin{aligned}
W_t(2, a_{j,t-1}) &= \max_{a_{j,t}} \frac{\left(\frac{c_{j,t}}{c_{t-1}^{-\sigma_h}}\right)^{1-\sigma}}{1-\sigma} + \sigma_b a_{j,t} \\
&+ \beta_H \mathbb{E}\left[(p_{t+1} W_{t+1}(1, a_{j,t}) + (1 - p_{t+1}) W_{t+1}(2, a_{j,t}))\right] \\
\text{s.t.} \quad & c_{j,t} + a_{j,t} = \frac{R_{t-1}}{\pi_t} a_{j,t-1} exp(\lambda_{t-1}) + (1-\tau)b + N_t + T_{a,t} \\
& a_{j,t} \geq \underline{a}.
\end{aligned}
$$

Model: Entrepreneur

$$
\begin{aligned}
max \quad & \mathbb{E}_t \sum_{i=0}^{\infty} \beta_E^i \frac{\left(\frac{c_{E,t+i}}{c_{t-1+i}^{-\sigma_h}}\right)^{1-\sigma}}{1-\sigma} + \sigma_b a_{E,t+i} \\
\text{s.t.} \quad & c_{E,t} + a_{E,t} + \phi_A (a_{E,t} - \bar{a}_E)^2 \\
= \quad & \frac{R_{t-1}}{\pi_t} a_{E,t-1} exp(\lambda_{t-1}) + (1-\tau)\left(n_{E,t} w_t + (1-n_{E,t}) b\right) \\
+ \quad & (1-\tau)\Pi_t + T_{a_{E,t-1},t}.
\end{aligned}
$$

- $a_{E,t}$ bond holdings;
- $c_{E,t}$ entrepreneur consumption;
- Π_t Firm Profits;
- $n_{E,t}$ employed share of the entrepreneur family;

Model: Retailer

$$\begin{aligned} \underset{(y_{i,t})_{i\in[0,1]}}{max} \quad & y_t - \int_0^1 p_{i,t} y_{i,t} di \\ \text{s.t.} \quad & y_t = \left[\int y_{i,t}^{\frac{\gamma_t - 1}{\gamma_t}} di \right]^{\frac{\gamma_t}{\gamma_t - 1}} . \end{aligned}$$

- y_t final good used for government expenditures, consumption, hiring costs, fixed costs;
- $y_{i,t}$ intermediate good use of variety i;
- $p_{i,t}$ price of intermediate good i;
- γ_t elasticity of substitution, subject to shock;

Model: Production/Intermediate Good Producer

$$
\begin{aligned}
J_{P,t}(P_{i,t-1}) \quad &= \max_{P_{i,t}} \left\{ \left[\left(\frac{P_{i,t}}{P_t} \right)^{1-\gamma_t} - h_t n_{i,t} - \frac{\theta_p}{2} \left(\frac{P_{i,t}}{P_{i,t-1}} \frac{1}{\pi_{t-1}^{\chi} \bar{\pi}^{1-\chi}} - 1 \right)^2 \right] y_t \right. \\
&\quad \left. + \mathbb{E} m_{t+1|t} J_{P,t+1}(P_{i,t}) \right\} \\
\text{s.t.} \quad &\quad y_{i,t} = \left(\frac{P_{i,t}}{P_t} \right)^{-\gamma_t} y_t = z_t n_{i,t}.
\end{aligned}
$$

- $J_{P,t}$ value function intermediate good producer;
- $m_{t+1|t}$ stochastic discount factor;
- $P_{i,t}$ price intermediate good i;
- h_t shadow value worker;
- π_t inflation;
- P_t aggregate price level;
- $n_{i,t}$ employed used by firm i;
- z_t TFP Level;

Model: Labor Market Flows

- Unemployed after separations:

$$\tilde{u}_t = u_{t-1} + (1 - u_{-1})\rho.$$

- Matching function:

$$m_t := m(\tilde{u}_t, v_t) = \frac{\tilde{u}_t v_t}{(\tilde{u}^l + v_t^l)^{\frac{1}{l}}}.$$

- Unemployment end of period:

$$u_t = \tilde{u}_t - m_t.$$

- Job finding rate: $p_t = \frac{m_t}{\tilde{u}_t}$, Job filling rate: $q_t = \frac{m_t}{v_t}$

Model: Vacancy posting

- Value of a match to producer:

$$J_t = h_t - w_t + (1-\rho)\mathbb{E}_t\left[m_{t+1|t}J_{t+1}\right].$$

- Free Entry:

$$J_t = \frac{\varphi}{q_t}.$$

Model: Wage Setting

- Wages are determined through Nash bargaining between the labor agency and a representative labor union upon matching.
- Value of labor union: $U_t = w_t - \underline{w}_t + (1-\rho)\mathbb{E}_t[m_{t+1|t}U_{t+1}]$
- Outside option union: $\underline{w}_t = b + (1-\rho)\mathbb{E}_t[m_{t+1|t}p_{t+1}U_{t+1}]$
- Wage set by wage splitting rule: $w_t = \arg\max_{w_t} W_t^{\kappa} J_t^{1-\kappa}$
- Resulting wage rule: $w_t = \kappa h_t + (1-\kappa)b + \kappa(1-\rho)\mathbb{E}_t\left[m_{t+1|t}\varphi\frac{p_{t+1}}{q_{t+1}}\right]$

Model: Government Policy

- Government budget balance: $T_t =$
  $\bar{g} + \left(\frac{R_{t-1}}{\pi_t} - 1\right)(A - I) + (R-1)I + (1-n_t)b - \tau\left(w_t n_t + b(1-n_t) + \Pi_t\right)$

- Monetary policy rule:
  $R_t = max(\bar{R} + (1-\rho_R)\left[\phi_\pi(\pi_t - \bar{\pi}) + \phi_y(y_t - \bar{y}) + \phi_m m_t\right] + \rho_R R_{t-1}, 1)$

  - Under inflation targeting $m_t = 0$
  - Under price level targeting $m_t = (\pi_t - \bar{\pi}) + m_{t-1}$
  - Under nominal GDP targeting $m_t = \left((\pi_t - \bar{\pi}) + \left(\frac{y_t}{y_{t-1}} - 1\right)\right) + m_{t-1}$

Transmission Intuition 1

- Prices are sticky so reducing nominal rates will reduce real rates.
- Firms in our model are forward looking - price setters respond to lower future rates and higher expected inflation by raising prices today. Labor agencies respond to future higher GDP by posting more vacancies today.
- The consumption of entrepreneurs in our model mainly responds to current and future interest rates and changes in permanent income. In our environment, the former dominates in magnitude.

Transmission Intuition 2

- The wealth-poorer a worker is, the less his consumption will respond to current and future interest rates and the more he will respond to current income (wages/transfers) and to current unemployment risk. More inflation reduces cost of servicing debt.
- The direct stimulus from promising rate cuts is, therefore, lower in the HANK environment.
- However, higher consumption and labor demand today will raise income and reduce unemployment risk, triggering a stronger indirect effect.
- Quantitative question which one dominates.

Solution Method

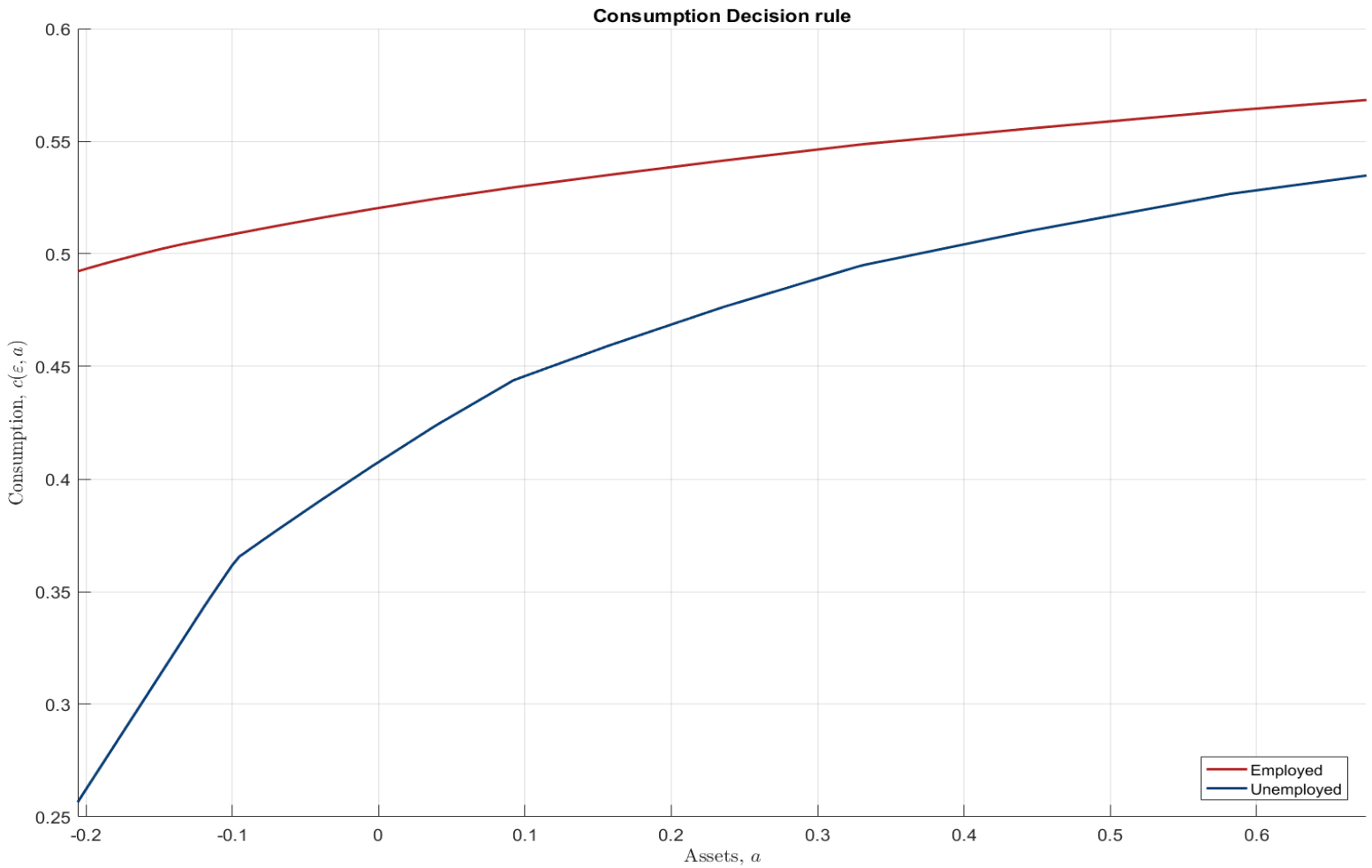
- Following Winberry (2018) we solve the steady state of the model using policy function iteration and approximate the household distribution using a flexible family of distributions.
- We then linearize the model equations around the steady state.
- To solve the model with the effective lower bound we use Occbin as in Iacoviello & Guerrieri (2014).
- We checked robustness using the method of Reiter (2010).
- We calibrate the model by matching steady state targets for most parameters. We estimate the shock processes using maximum likelihood and data on U.S. inflation, output, unemployment, and the federal funds rate.

Calibration

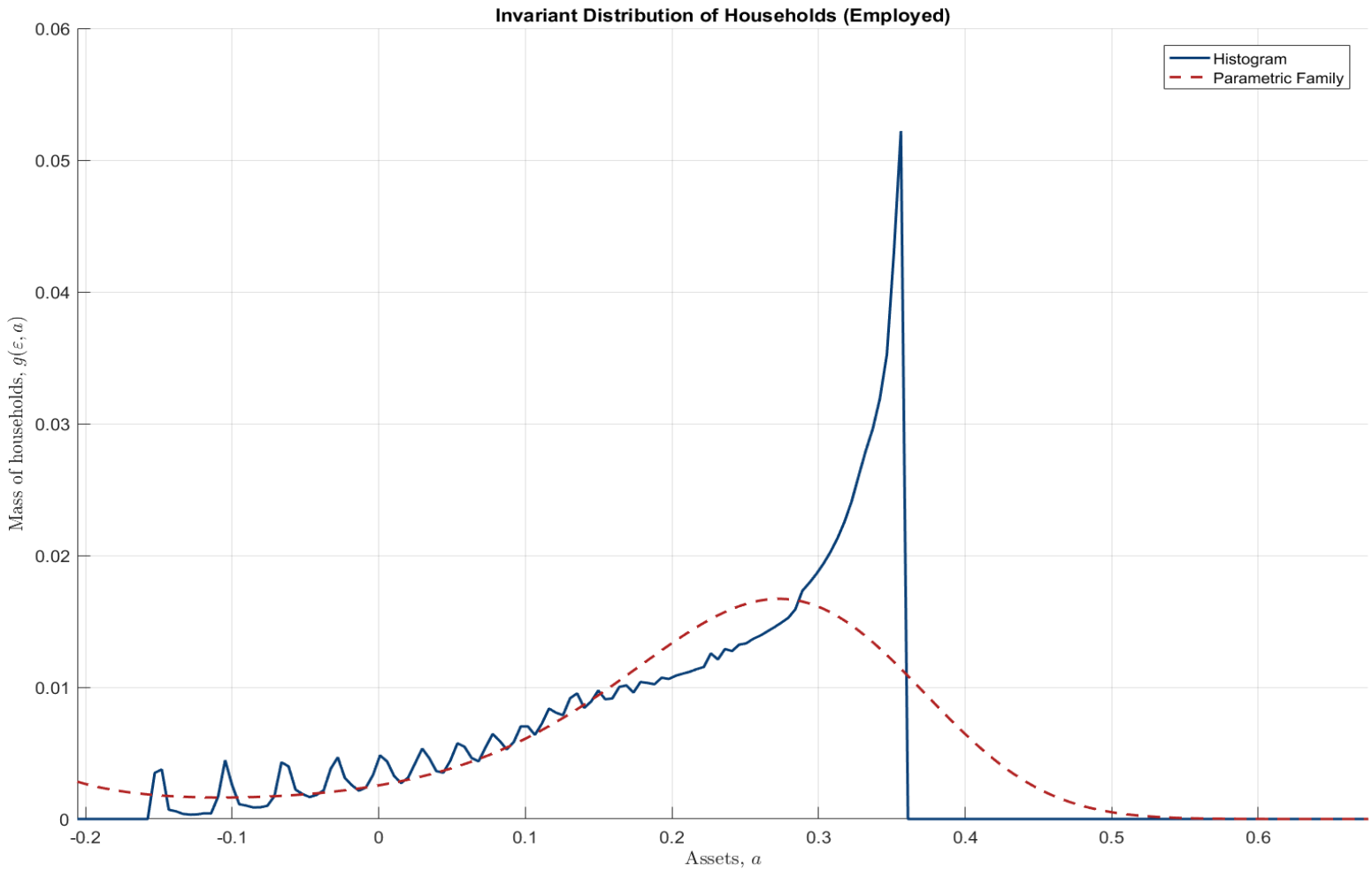
σ	1	Risk Aversion	
σ_h	0.85	Habit	
σ_b	0	Bond in Utility Function	
ρ	0.1	Job Loss Rate	Quarterly Job Destruction Rate
θ_p	683	Rotemberg Cost	Slope Phillips Curve
χ	0.5	Price Indexation	
β_E	0.995	Discount Entrepreneur	Real Rate 2 percent
β_H	0.991/0.994	Discount Worker	Liquid Savings $\approx$ \$4000 or \$16000
$\bar{a}$	0.3	Borrowing Limit	Unsecured Credit $\approx$ \$4000
b	0.36	UI Benefits	45 percent Average Wage
ϕ_π	1.5	Inflation Response	
ϕ_y	1	Output Response	
ρ_R	0.85	Lagged Interest Rate	

- Target unemployment rate of 6 percent.
- Wage set to match the labor share.

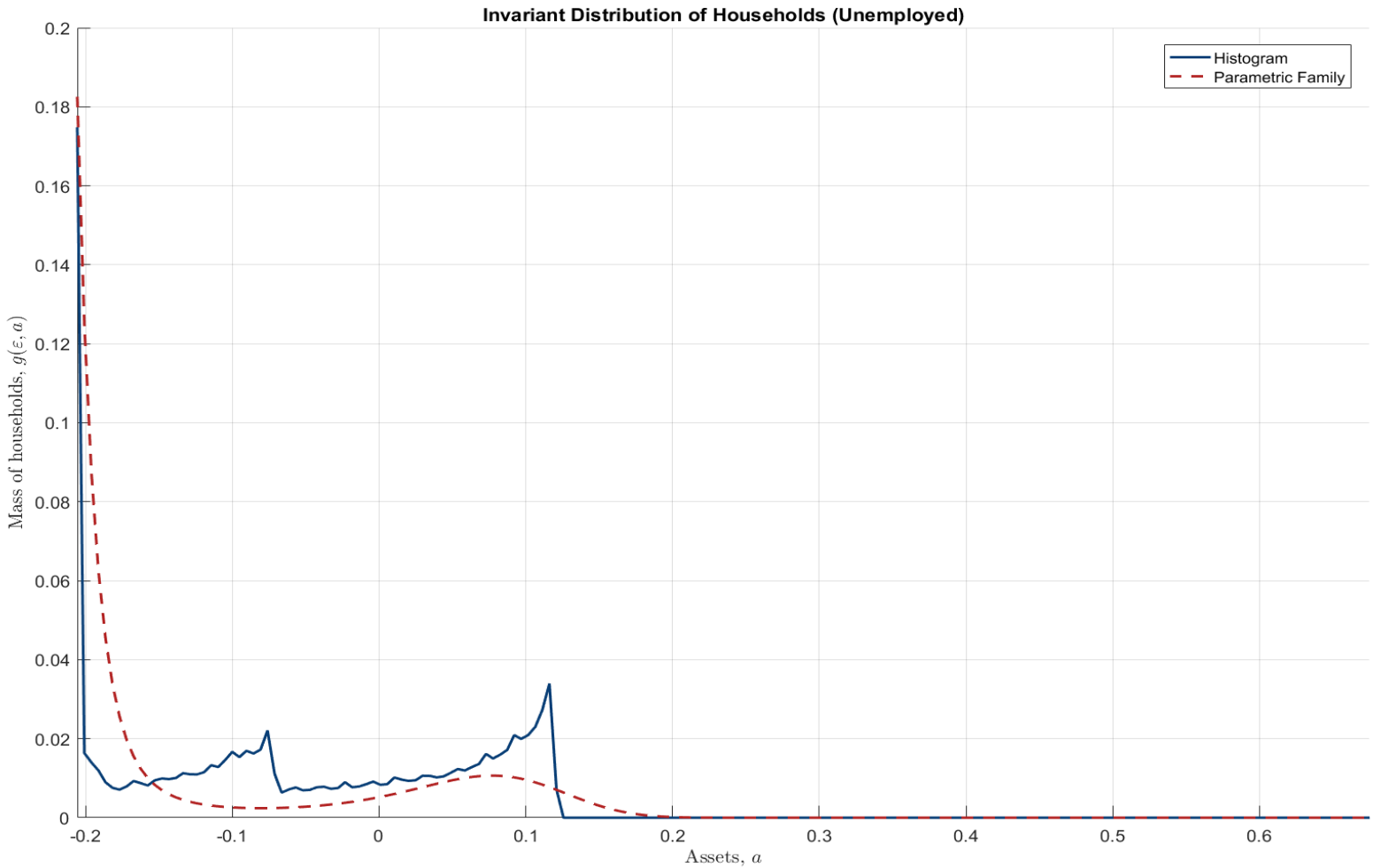
Consumption Function - Low Liquidity



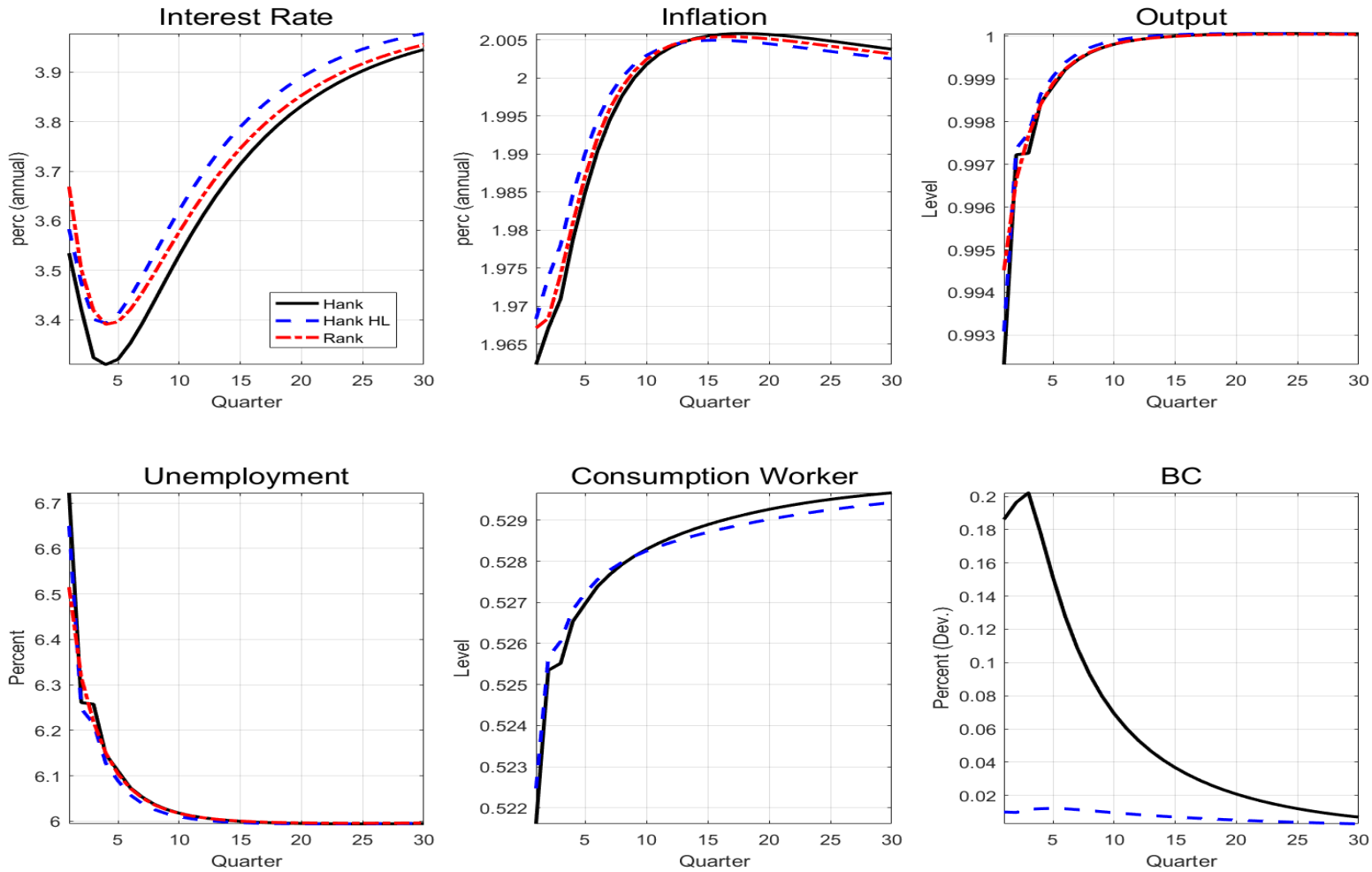
Wealth Distribution: Employed - Low Liquidity



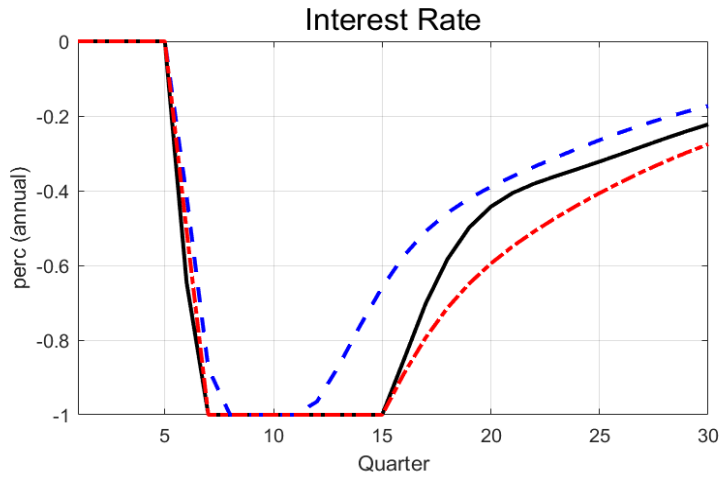
Wealth Distribution: Unemployed - Low Liquidity

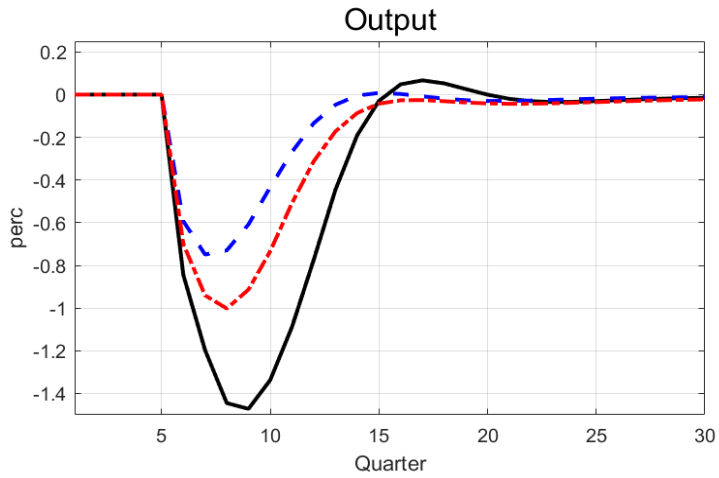


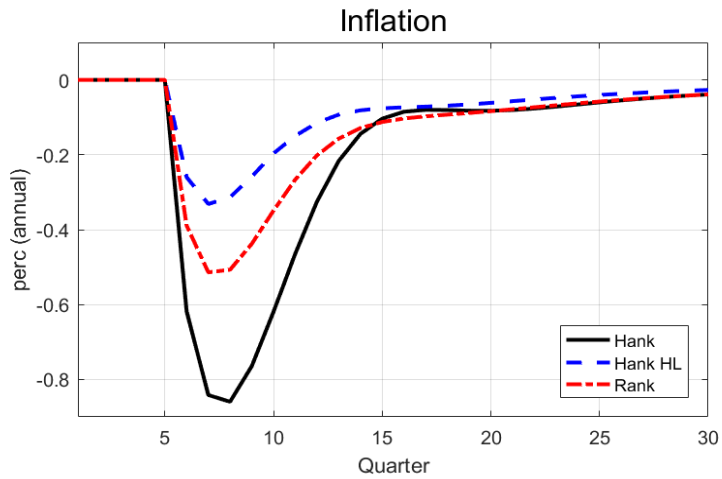
IRF Risk Premium Shock

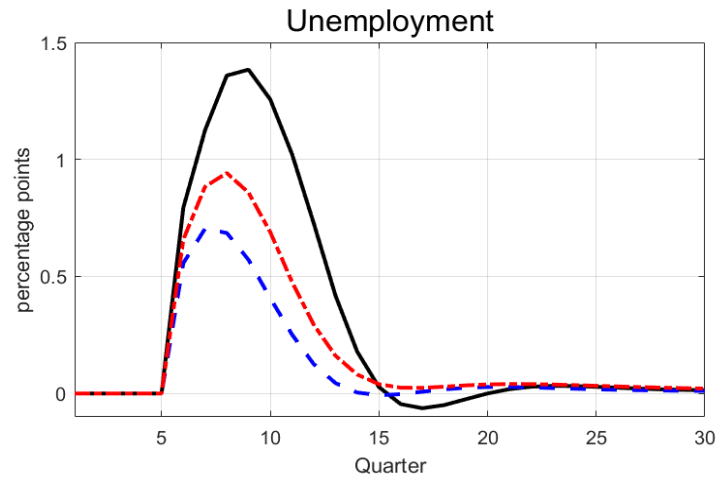


IRF Risk Premium Shock ZLB 1

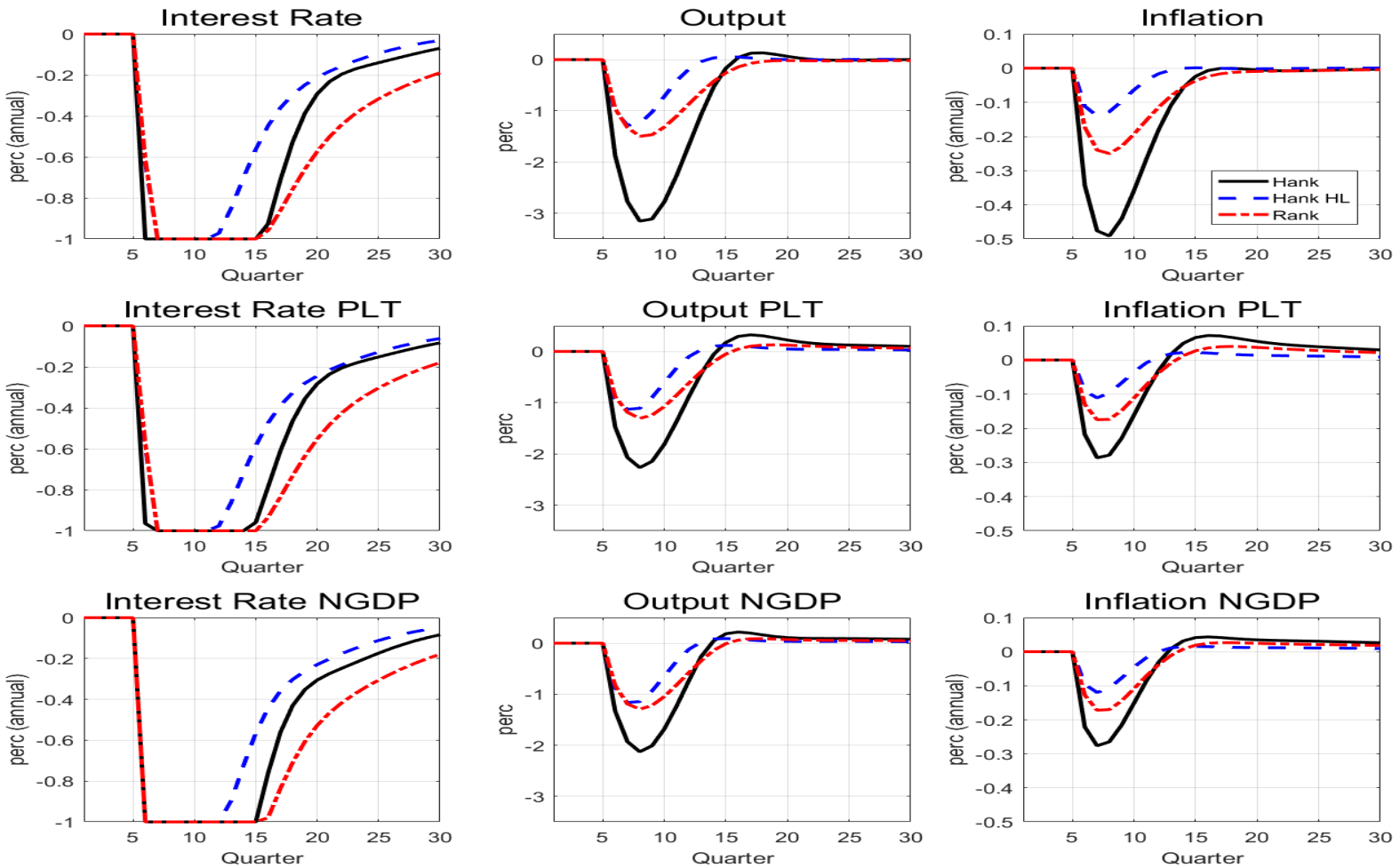








IRF Risk Premium Shock ZLB 2



Moments

	Mean(π)	Mean(u)	std(π)	std(u)	Frequency	Duration	mean($std_i(c_i)$)
HANK	1.93	6.43	0.96	2.59	12.91	7.64	0.425
HANK PLT	2.01	6.11	0.83	2.19	13.36	7.95	0.421
HANK NGDP	2.01	6.15	0.87	2.06	16.30	8.19	0.421
RANK	1.98	6.15	0.92	1.83	12.92	9.59	0
RANK PLT	2.01	6.07	0.83	1.75	12.04	8.65	0
RANK NGDP	2.01	6.08	0.86	1.53	15.18	9.26	0

Notes: The Table reports average inflation ('Mean(π)') and unemployment ('Mean(u)'), the standard deviation of inflation ('std(π)') and unemployment ('std(u)'), the frequency and average duration of ELB episodes ('Frequency' and 'Duration'), and the average cross-sectional standard deviation of logged consumption mean($std_i(c_i)$).

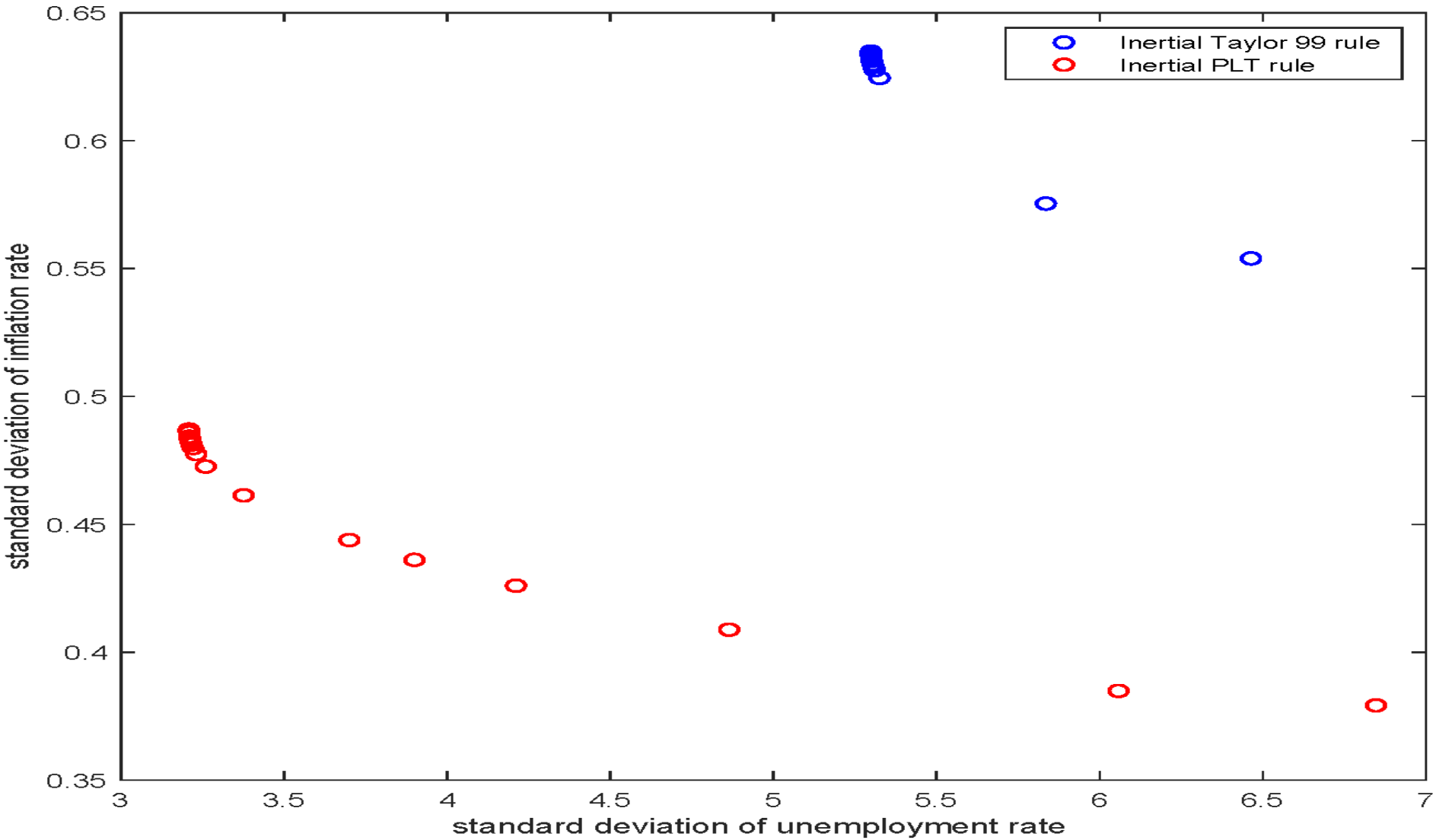
- Alternative strategies stabilize both inflation and unemployment volatility in all model configurations.
- Stronger effects on averages in HANK.

'Optimal' Makeup Strategies 1

- Next, we look at the inflation-unemployment volatility frontier of the inflation and the price-level targeting strategies.

- Computed by finding the rule that minimizes a weighted loss function in inflation and unemployment volatility.

'Optimal' Makeup Strategies 2



Conclusion

- We constructed a HANK model to study stabilization gains from makeup strategies.
- We found, consistent with the literature on forward guidance, that the gains, relative to a RANK model depend on the amount of liquid assets, among other things.
- In preferred calibration, gains likely larger than in the RANK case.
- Future extensions: long term debt, dependence on fiscal policy and state of the business cycle/credit cycle.