Income Inequality, Financial Crises and Monetary Policy

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The views herein do not reflect those of the Board of Governors of the Federal Reserve System.

Income Inequality and Aggregate Demand

- Heterogeneity of Marginal Propensity to Cosume (MPC):
  - The most affluent with the least MPC (Jappelli and Pistaferri [2014])
  - Income inequality leads to insufficient aggregate demand (Summers [2015]).

"...society was so framed as to throw a great part of the increased income into the control of the class least likely to consume it...And so the cake increased; but to what end was not clearly contemplated... – the virtue of the cake was that it was never to be consumed, either by you nor by your children after you." – Keynes [1919]

Income Inequality and Deflation Pressure

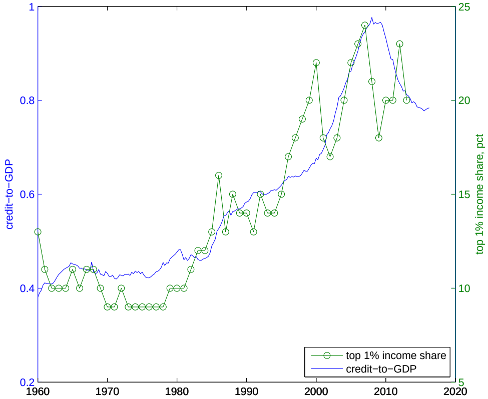
- Labor income share has declined for more than three decades.
  - Elsby, Hobijn and Sahin [2013], Karabarbounis and Neiman [2014]; Koh, Santauelalia and Zheng [2016].
- Solow [2015] points out the declining bargaining power of the U.S. workers as the origin.
- If the trend continues, it is challenging to achieve the inflation target.
  - The labor income share is a measure of real marginal cost.
  - Inflation is nothing but the present value of future real marginal costs.

Income Inequality and Financial Stability

- Unused income of the most affluent group should be stored somewhere.
- Recent research finds a strong link between excessive credit growth and the likelihood of financial crises.
  - Drehmann, Borio, Gambacorta, Jimenez and Trucharte [2010], Adrian,Covitz, and Liang [2015], Jorda, Schularick and Taylor [2012], Schularick and Taylor [2012]
- Some argue for “leaning against the wind” monetary policy.
- If income inequality is behind the financial instability, would you go after income inequality as well?

Income Inequality and Credit Growth

Top 1% Income share and Household Credit-to-GDP ratio.



Inequality and Monetary Policy

- Construct a general equilibrium model in which
  - Inequality results in insufficient aggregate demand and deflation pressure
  - By allocating a greater share of income to a group with the least MPC, and if excessive, can lead to an endogenous financial crisis.
- Financial crisis à la Kumhof, Rancière and Winant [2016]
  - Endogenize the production and income distribution.
  - Introduce nominal rigidity, crucial in breaking the Say's Law.
- Study the implication for monetary policy.
  - The stabilization function during crises paralyzed by the ZLB.
  - Nonlinearity due to crises and the ZLB result in left-skewed distribution for equilibrium prices and quantities
  - Making symmetric monetary policy rules inefficient.

Bird's-Eye View of the Model

Household Block

- A GE with 2 types of agents with segmented asset markets
- Top 5% income earners (capitalists):
  - Own production firms and accumulate physical capital.
  - Accumulate private and government bonds
  - Exhibit *Weberian* "spirit of capitalism" preferences
- Bottom 95% income earners (workers):
  - Can be employed or unemployed (searching for a job)
  - Do not develop preferences over financial wealth
  - Smooth consumption only by borrowing from private bond market

Bird's-Eye View of the Model

New Keynesian Block

- A continuum of monopolistically competitive firms producing differentiated final goods using capital and labor
- Staggered pricing à la Calvo with partial indexation
- Monetary policy: an inertial Taylor rule subject to the ZLB
- Labor markets are subject to search and matching frictions
  - Bargaining power is an important driver of income inequality
- Three aggregate shocks:
  - Technology shock
  - Risk-premium shock
  - Bargaining power shock

The Capitalists

- "*Man is dominated by the making of money, by acquisition as the ultimate purpose of his life. Economic acquisition is no longer subordinated to man as the means for the satisfaction of his material needs.*" – Weber

$$
\begin{aligned}
U_t^T \quad = \quad & \mathbb{E}_t \sum_{t=0}^{\infty} (\beta^T)^t \left[\frac{(c_t^T - s c_{t-1}^T)^{1-1/\sigma_c} - 1}{1 - 1/\sigma_c} \right. \\
& \left. + \psi^B \frac{\left[1 + b_t \left(1 - \chi\right) / \chi\right]^{1-1/\sigma_b} - 1}{1 - 1/\sigma_b} + \psi^G \frac{(1 + b_t^G)^{1-1/\sigma_g} - 1}{1 - 1/\sigma_g} \right]
\end{aligned}
$$

- Per capita budget constraint:

$$
\begin{aligned}
c_t^T \quad = \quad & \frac{b_{t-1}^G}{\pi_t} - \frac{b_t^G}{1 + i_t} + \left[(1 - h\delta_t^B) \frac{b_{t-1}}{\pi_t} - q_t^B b_t \right] \frac{1 - \chi}{\chi} \\
& - q_t^K \left[\frac{k_t}{\chi} - (1 - \delta) \frac{k_{t-1}}{\chi} \right] + r_t \frac{k_{t-1}}{\chi} + \frac{\Pi_t^Y}{\chi} + \frac{\Pi_t^K}{\chi} - \frac{T_t}{\chi}
\end{aligned}
$$

Efficiency Conditions

Top 5 percent Income Earners

- The FOCs of the top 5 percent:

$$q_t^B = \beta^T \mathbb{E}_t \left[\frac{\Lambda_{t+1}^T}{\Lambda_t^T} (1 - hp_{t+1}^{\delta}) \frac{1}{\pi_{t+1}} \right] + \frac{\psi^B}{\Lambda_t^T} \left[1 + b_t \left(\frac{1-\chi}{\chi} \right) \right]^{-1/\sigma_b}$$

$$1 = \beta^T \mathbb{E}_t \left[\frac{\Lambda_{t+1}^T}{\Lambda_t^T} \left(\frac{r_{t+1} + (1-\delta) q_{t+1}^K}{q_t^K \lambda_t} \right) \right]$$

$$\frac{1}{1+i_t} = \beta^T \mathbb{E}_t \left[\frac{\Lambda_{t+1}^T}{\Lambda_t^T} \frac{\lambda_t}{\pi_{t+1}} \right] + \frac{\psi^G}{\Lambda_t^T} (1 + b_t^G)^{-1/\sigma_g}$$

- Pecuniary externality: $\dfrac{\partial p_{t+1}^{\delta}}{\partial b_t} \equiv \dfrac{\partial \mathbb{E}_t[\delta_{t+1}^B]}{\partial b_t} = 0$

The Workers

- "*Workers spend what they get, and capitalists get what they spend*" – Kalecki

$$U_t^B = \mathbb{E}_t \sum_{t=0}^{\infty} (\beta^B)^t \frac{(c^B - sc_{t-1}^B)^{1-1/\sigma_c} - 1}{1 - 1/\sigma_c}$$

- Per capita budget constraint:

$$c_t^B = q_t^B b_t - (1 - h\delta_t^B)\frac{b_{t-1}}{\pi_t} + \frac{1}{1-\chi}\left[w_t n_t + (1 - \chi - n_t)b^U - \nu_t y_t\right]$$

- Default penalty: $\nu_t = \rho_\nu \nu_{t-1} + \gamma_\nu \delta_t^B$
- Efficiency condition: $q_t^B = \beta^B \mathbb{E}_t \left[\frac{\Lambda_{t+1}^B}{\Lambda_t^B}(1 - hp_{t+1}^\delta)\frac{1}{\pi_{t+1}}\right]$

Financial Crises

Values of Default and Non-Default

- Value of non-default:

$$U_t^N = \frac{(c_t^N - sc_{t-1}^B)^{1-1/\sigma_c} - 1}{1 - 1/\sigma_c} + V_t^N$$

$$c_t^N = q_t^B b_t - \frac{b_{t-1}}{\pi_t} + \frac{1}{1-\chi}\left[w_t n_t + (1 - \chi - n_t) b^U - \rho_\nu \nu_{t-1} y_t\right]$$

- Value of default:

$$U_t^D = \frac{(c_t^D - sc_{t-1}^B)^{1-1/\sigma_c} - 1}{1 - 1/\sigma_c} + V_t^D$$

$$\begin{aligned} c_t^D &= q_t^B b_t - (1-h)\frac{b_{t-1}}{\pi_t} \\ &\quad + \frac{1}{1-\chi}\left[w_t n_t + (1 - \chi - n_t) b^U - (\rho_\nu \nu_{t-1} + \gamma_\nu) y_t\right] \end{aligned}$$

Financial Crises

Probability of Crises

- In addition to default penalty, non-pecuniary cost of default: τ_t
- τ_t follows a modified logistic distribution as in KRW :

$$\Xi(\tau_t) = \begin{cases} \dfrac{\varrho}{1+\exp(-\varsigma\tau_t)} & \text{if } \tau_t < \infty \\ 1 & \text{if } \tau_t = \infty \end{cases}, 0 < \varrho < 1, \varsigma > 0$$

- Crisis indicator: $\delta_t^B = \begin{cases} 1 & \text{if } \tau_t \leq U_t^D - U_t^N \\ 0 & \text{if } \tau_t > U_t^D - U_t^N \end{cases}$
- Probability of crisis:

$$p_{t+1}^{\delta} \equiv \text{prob}(\delta_{t+1}^B = 1) = \Xi(U_{t+1}^D - U_{t+1}^N).$$

Monetary Policy: Dealing with the ZLB

- Monetary policy rule:

$$i_t = \max\left\{0, \rho_i i_{t-1} + (1-\rho_i)\left[i^* + \rho_\pi\left(\frac{\pi_t^Y - \pi^*}{4}\right)\right]\right\}$$

  - Not only $i_t \geq 0$, but also $\mathbb{E}_t[i_{t+j}] \geq 0$ for $j = 1, \ldots, n$
  - For a sufficiently large n, $\mathbb{E}_t[i_{t+n+1}] \geq 0$ non-binding

- Use a mix of current ($\epsilon_{m,t}$) and news shocks ($\{\epsilon_{j,t}^N\}_{j=1}^n$):

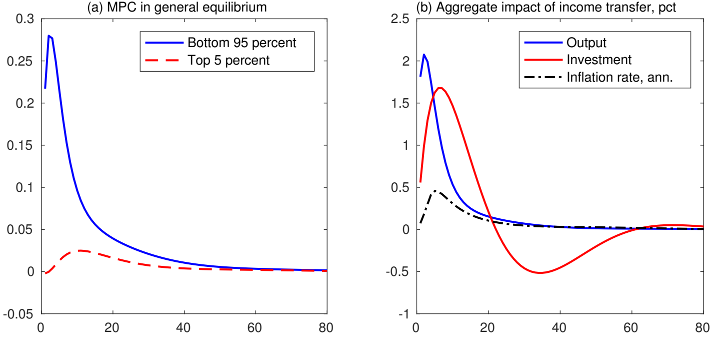
$$i_t = \rho_i i_{t-1} + (1-\rho_i)\left[i^* + \rho_\pi\left(\frac{\pi_t^Y - \pi^*}{4}\right)\right] + \sigma_m \sum_{j=1}^{n} \epsilon_{j,t-j}^N + \sigma_m \epsilon_{m,t}$$

Calibration

- The model is calibrated to hit
  - DTI of bottom 95 income earners = 1.5
  - Income share of top 5 percent income earners = 0.38
  - Labor income share = 57 percent
  - Mean probability of financial crisis 1.3 percent quarterly
  - Default related parameters close to KRW except quarterly adjustment
  - Steady state unemployment rate = 5.9 percent
  - Price stickiness to hit 1 percent standard deviation in inflation rate
  - Real wage rigidity to match volatility of wages in the data
  - b^G is set to hit 2 percent real interest rate in the long run.
- Shocks
  - Technology shock $\rho_z = 0.9$
  - Risk premium shock $\rho_\lambda = 0.9$
  - Bargaining power shock $\rho_\eta = 0.95$
  - $\sigma_z = 0.01$ and set σ_λ and σ_η to hit 1/3-1/3-1/3 var decomp share of output

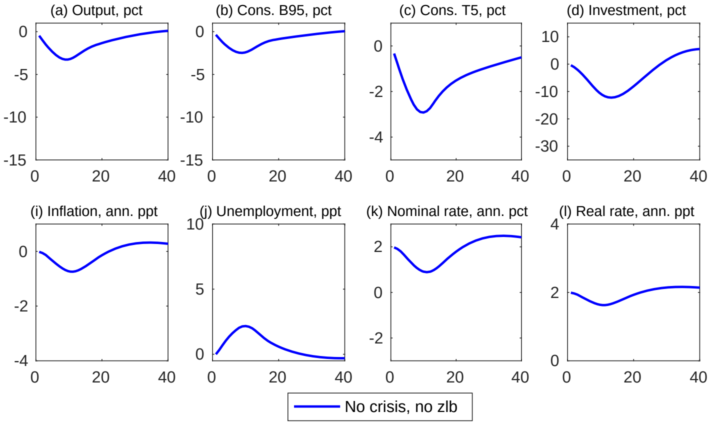
Illustrating The Mechanism

Link b/w Income Inequality and Aggregate Demand



Model Dynamics Under Stress

Crisis and ZLB



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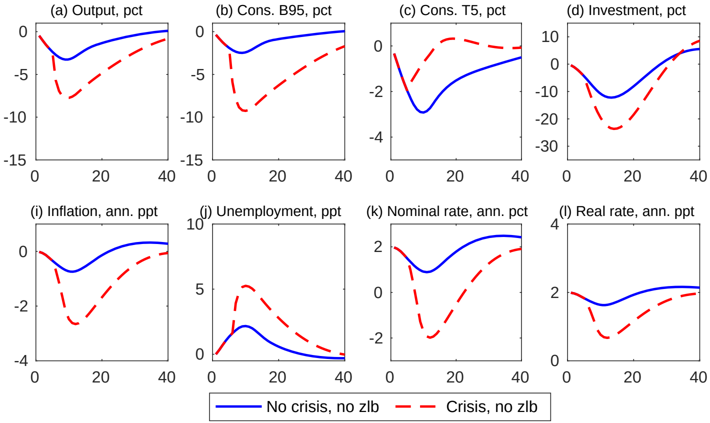

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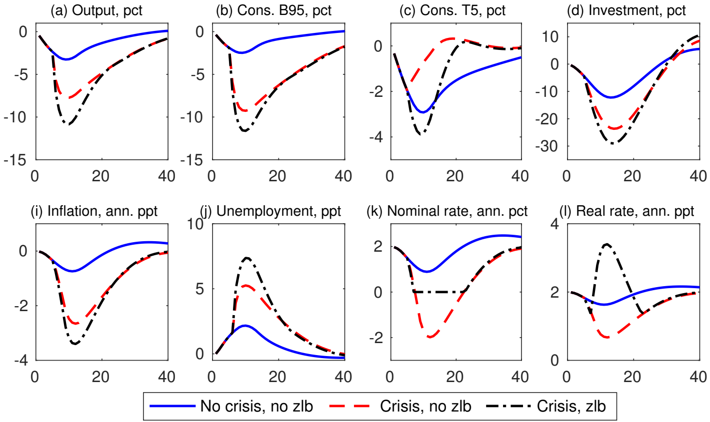


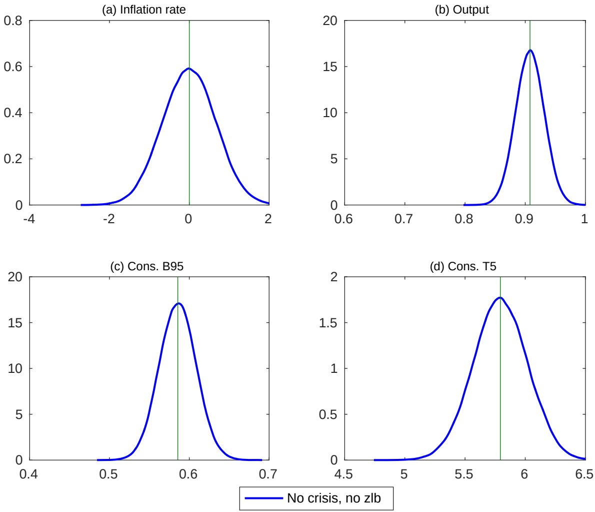
Properties of Simulated Economy

- Negative correlation b/w income inequality and aggregate demand
- Near perfect correlation b/w excess credit and prob. of crises
- Significant deflation bias with negatively skewed distribution

Table: Moments of Key Variables Under Baseline Monetary Policy Rule

	w/o ZLB	w/ ZLB
1. corr(income inequality, y)	-0.633	-0.843
2. corr(income inequality, π)	-0.929	-0.927
3. corr(income inequality, b/y)	0.739	0.697
4. corr(b/y , p^δ)	0.982	0.938
5. $E(p^\delta)$, quarterly, pct	1.307	1.319
6. $E(i)$, quarterly, pct	0.276	0.824
7. $E(\pi)$, quarterly, pct	-0.150	-0.584
8. $E(y)$	0.895	0.856
9. frequency of binding ZLB, pct	–	2.123
10. skewness (i)	-0.034	0.805
11. skewness (π)	-0.046	-0.898
12. skewness (y)	-0.548	-1.315

Endogenously Skewed Distribution



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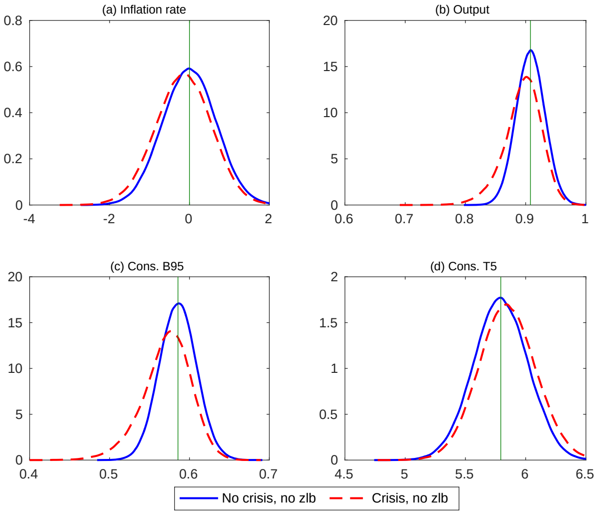

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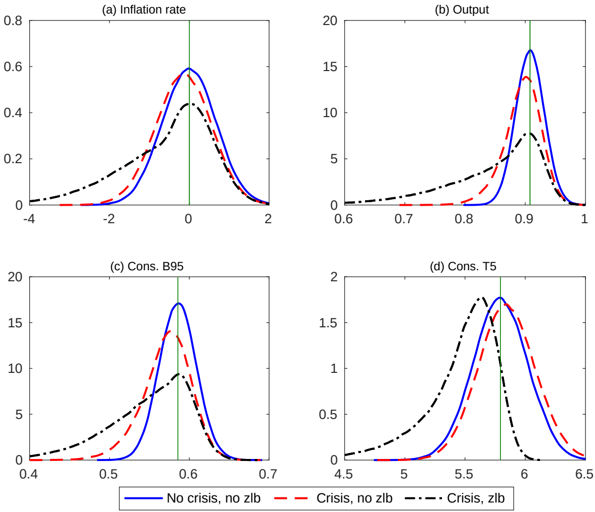


Alternative Monetary Policies

1. Time-Varying Inflation Target:

$$i_t = i^* + \frac{\rho_\pi}{4}(\pi_t^Y - \pi_t^*)$$

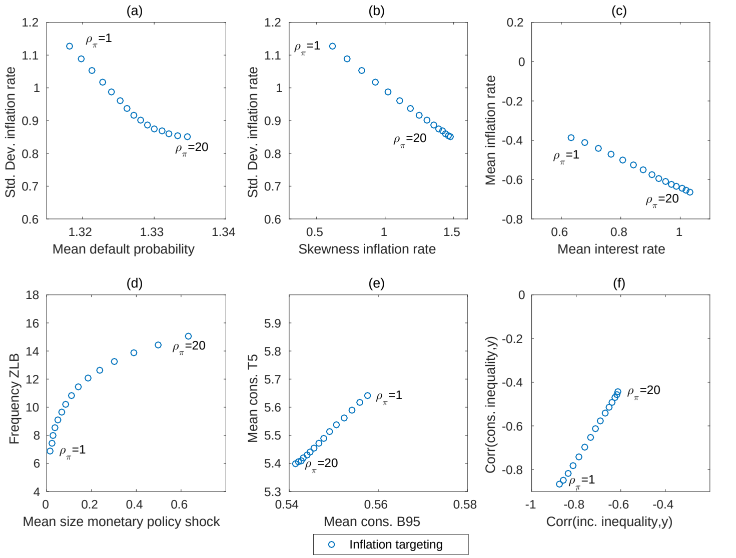
where $\quad \pi_t^* = (1 - \rho_{\pi^*})\pi^* + \rho_{\pi^*}\pi_{t-1}^* + \sigma_{\pi^*}\delta_t^B$

2. Price Level Targeting:

$$i_t = i^* + \frac{\rho_\pi}{4}\Pi_t$$

where $\quad \Pi_t \equiv \sum_{s=0}^{\infty}(\pi_{t-s}^Y - \pi^*) = \log\left(\frac{P_t}{(1+\pi^*)^t P_0}\right).$

Moments Under Alternative Rules



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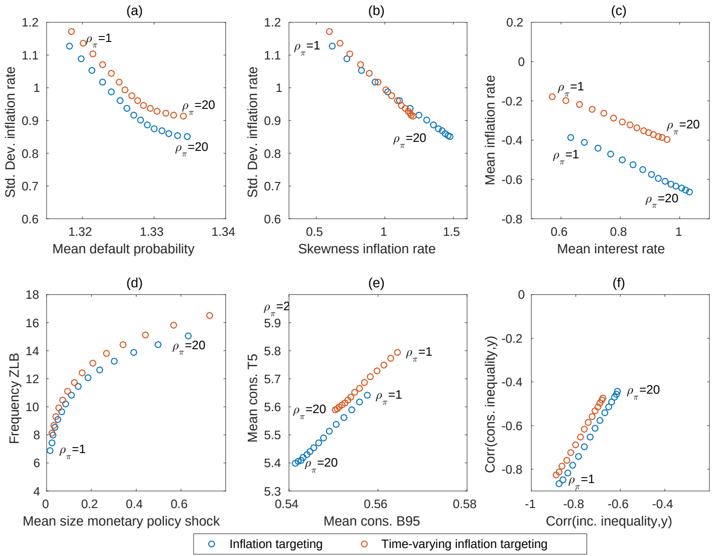

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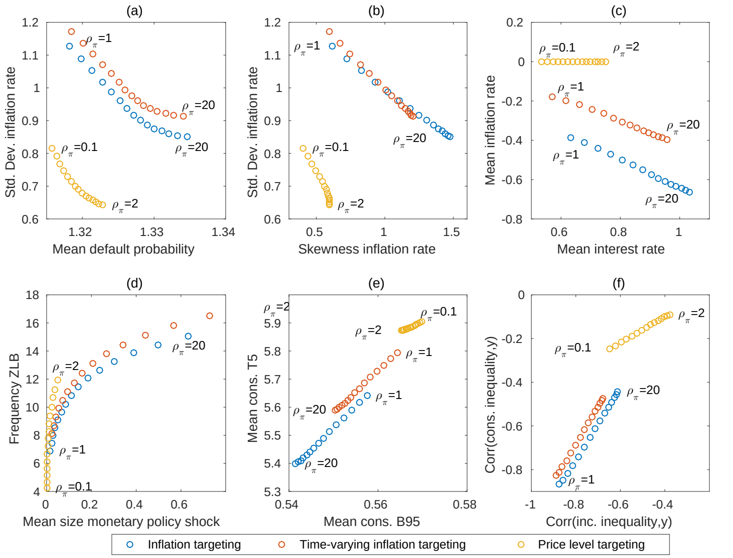
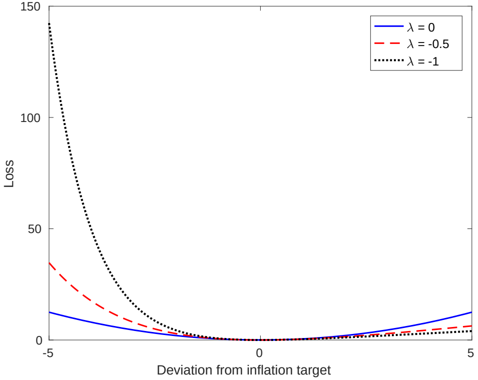


Asymmetric Loss Function

- Varian [1975], Kim and Ruge-Murcia [2009] Fahr and Smets [2010].

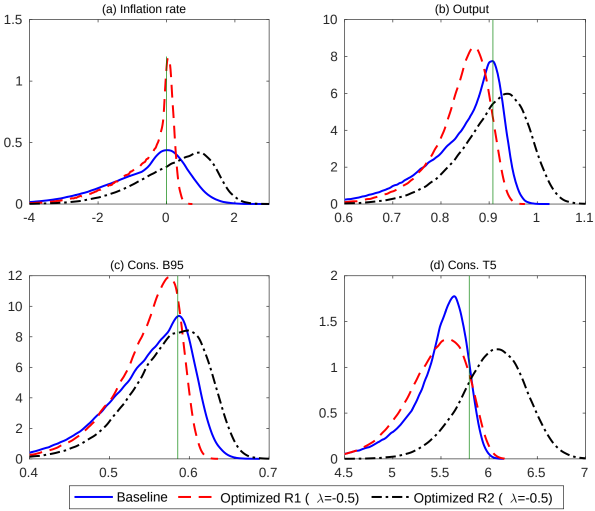
$$\text{Linex: } L = \frac{\exp[\lambda(\pi_t - \pi^*)] - \lambda(\pi_t - \pi^*) - 1}{\lambda^2}$$

- Financial instability represents itself as skewed distribution.
- Asy. loss function may represent the desire for financial stability.



Distributions Under Optimized Rules

Lambda = -0.5 case



Stabilization Policy Can Affect the Means

Table: Moments of Under the Optimized Policy Rules

	$\lambda = -0.1$		$\lambda = -0.3$		$\lambda = -0.5$	
	R1	R2	R1	R2	R1	R2
$E(y)$	0.839	0.838	0.839	0.875	0.839	0.905
Skewness(y)	-1.296	-1.256	-1.301	-1.042	-1.298	-0.793
$E(\pi)$	-0.622	-0.632	-0.621	-0.153	-0.622	0.234
Skewness(π)	-1.407	-1.444	-1.404	-1.045	-1.405	-0.748
$E(p^{\delta})$	1.330	1.330	1.330	1.331	1.330	1.331
Ave. output loss (crisis)	-2.990	-2.883	-3.00	-2.516	-2.995	-1.297
Top 5% income share	0.378	0.378	0.378	0.372	0.378	0.368

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Conclusion

- We show a possibility that income inequality can be behind:
  - Insufficient aggregate demand
  - Deflation pressure
  - Excessive credit growth
  - Financial Instability
- We show that monetary policy's stabilization function during financial crises may be severely distorted due to the ZLB constraint
- An efficient policy rule should take into account the presence of disproportionately large downside risks