Inflation Indexation and Zero Lower Bound

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Introduction

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- Nominal loan contracts can cause destabilization through unexpected inflation. This can be amplified
  1. at the ZLB,
  2. under limited insurance.

- Inflation-indexed loan contracts may be a solution, as real interest rates remain unaffected by inflation fluctuations.

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2. An occasionally binding ZLB constraint
   - Aggregate fluctuation can be amplified.
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3. **Inflation indexed government bonds.**
   - Real interest rate is affected by the contract.

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3. **Running Horse Races: Inflation indexing is better for**
   - reducing ZLB frequency (vs. Higher infl. target),
   - correcting deflationary bias (vs. Asymmetric rule).

Related Literature

- HANK models with ZLB
  - *Nakamura and Steinsson (2016); Schaab (2020); Fernandez-Villaverde et al. (2023)*
- Inflation effect or nominal contracts
  - *Redistributive effects of inflation shocks (Doepke and Schneider, 2006a; Adam and Zhu, 2016) ,*
  - *Household net nominal position (Doepke and Schneider, 2006b; Meh et al., 2010)*
  - *Debt deflation channel (Iacoviello, 2005; Kuncl and Ueberfeldt, 2023)*
  - *Fiscal multiplier under nominal contracts (Carrillo and Poilly, 2013)*
- Deflationary bias
  - *Gust et al. (2017b), Nakata and Schmidt (2019), Mertens and Williams (2019)*
- **Contribution: the first to study analyze both the aggregate and disaggregate effects of inflation indexation**

Model

Households *Heterogeneity*

- Labor productivity shocks: Households face idiosyncratic labor productivity shocks, z, which follows AR(1) process in logs:

$$\log z' = \rho_z \log z + \varepsilon_z, \quad \varepsilon_z \overset{iid}{\sim} \mathcal{N}(0, {\sigma_z}^2).$$

- Incomplete asset market: Households cannot issue any assets contingent on their future idiosyncratic risks.

Households *Problem*

- A household maximizes her expected lifetime utility consumption, c_t, and hours of work, h_t :

$$\max_{\{c_t, h_t, b_{t+1}\}_{t=0}^{\infty}} \mathbb{E}_0 \left[\sum_{t=0}^{\infty} \beta^t \zeta_t \left(\frac{c_t^{1-\sigma} - 1}{1-\sigma} - \Xi \frac{h_t^{1+1/\gamma}}{1+1/\gamma} \right) \right]$$

$$c_t + b_{t+1} = (1 + \boldsymbol{r_t}) b_t + w_t z_t h_t - T_t + d_t,$$

$$b_{t+1} \geq \underline{b}.$$

- ζ_t: *aggregate preference shock*
- r_t: *contract real interest rate*

Firms

- Intermediate good firm j production:

$$y_t(j) = n_t(j) - f.$$

- Maximization problem under quadratic price adjustment costs:

$$\max_{p_{t+s}(j)} \mathbb{E}_t \left[\sum_{s=0}^{\infty} \left(\prod_{i=0}^{s} \frac{1}{1+r_{t+i}} \right) \left\{ \left(\frac{p_{t+s}(j)}{P_{t+s}} - mc_{t+s} \right) y_{t+s}(j) - \frac{\theta}{2} \left(\frac{p_{t+s}(j)}{p_{t+s-1}(j)} - \overline{\Pi} \right)^2 Y_{t+s} \right\} \right].$$

- NKPC:

$$\theta \left(\Pi_t - \overline{\Pi} \right) \Pi_t + \epsilon \left(\frac{\epsilon - 1}{\epsilon} - mc_t \right) = \theta \mathbb{E}_t \left[\frac{1}{1+r_t} \left\{ \Pi_{t+1} - \overline{\Pi} \right\} \Pi_{t+1} \frac{Y_{t+1}}{Y_t} \right].$$

Central Bank and Government

- The CB operates under a ZLB constraint:

$$R_t = \max\left\{1, \widetilde{R}_t\right\},$$

$\widetilde{R}_t$: *desired (or shadow) interest rate.*

- Taylor rule:

$$\log \widetilde{R}_t = \log \overline{R} + \phi_\pi \left(\log \Pi_t - \log \overline{\Pi}\right) + \phi_y \left(\log Y_t - \log \overline{Y}\right).$$

- The government:
  - i) collects taxes from households, and ii) issues public bonds.

Inflation Indexed Bonds

- Nominal public debt is indexed to inflation:

$$r_t = \log\left(\frac{R_{t-1}}{\Pi_t}\left(\frac{\Pi_t}{\overline{\Pi}}\right)^{\chi}\right),$$

  - $\chi \in [0,1]$: *indexation parameter.*

Results

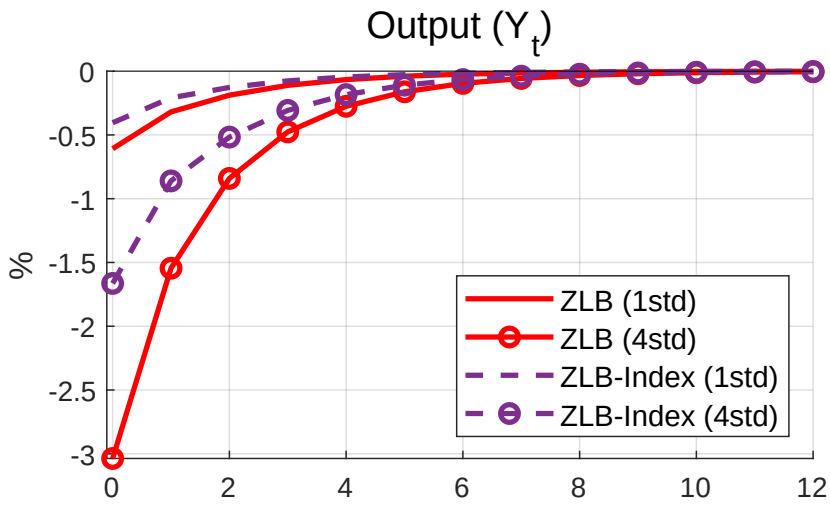
Result *Cross-sectional Distributions*

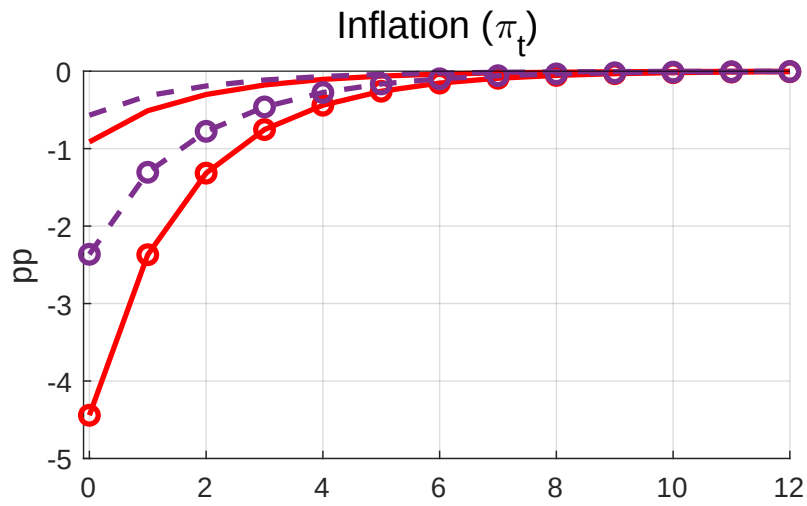
	Quintile					Gini
	1st	2nd	3rd	4th	5th	
U.S. Data						
Share of Income	2.8	6.7	11.3	18.3	60.9	0.58
Share of Wealth	-0.2	1.1	4.5	11.2	83.4	0.82
Model Economy						
Share of Income	3.1	8.0	8.9	19.7	60.4	0.56
Share of Wealth	0.0	0.1	1.7	11.6	86.6	0.82

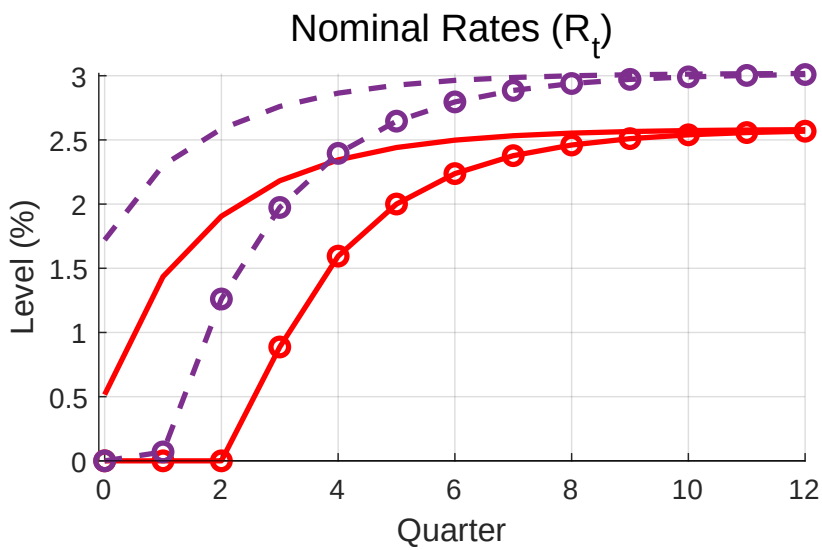
Result *Business Cycle Statistics*

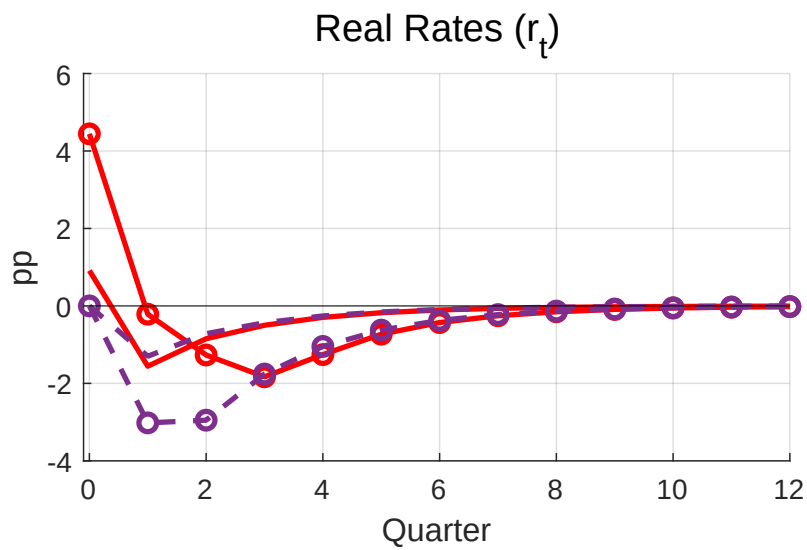
	Std(Y)	Std(Π)	Pr(ZLB)	E[$\tilde{R}$]	E[r]	E[Π]
Steady state	-	-	-	3.00	1.00	2.00
(1) ZLB	**0.61**	**0.24**	**10.55%**	**2.58**	**0.79**	**1.79**
(2) No ZLB	0.53	0.20	8.30%	2.90	0.95	1.95
(3) ZLB + Index	**0.41**	**0.15**	**2.80%**	**2.98**	**0.98**	**2.00**

Result *IRFs*


Output (Y_t)
%
ZLB (1std)
ZLB (4std)
ZLB-Index (1std)
ZLB-Index (4std)


Inflation (π_t)
pp


Nominal Rates (R_t)
Level (%)
Quarter


Real Rates (r_t)
pp
Quarter

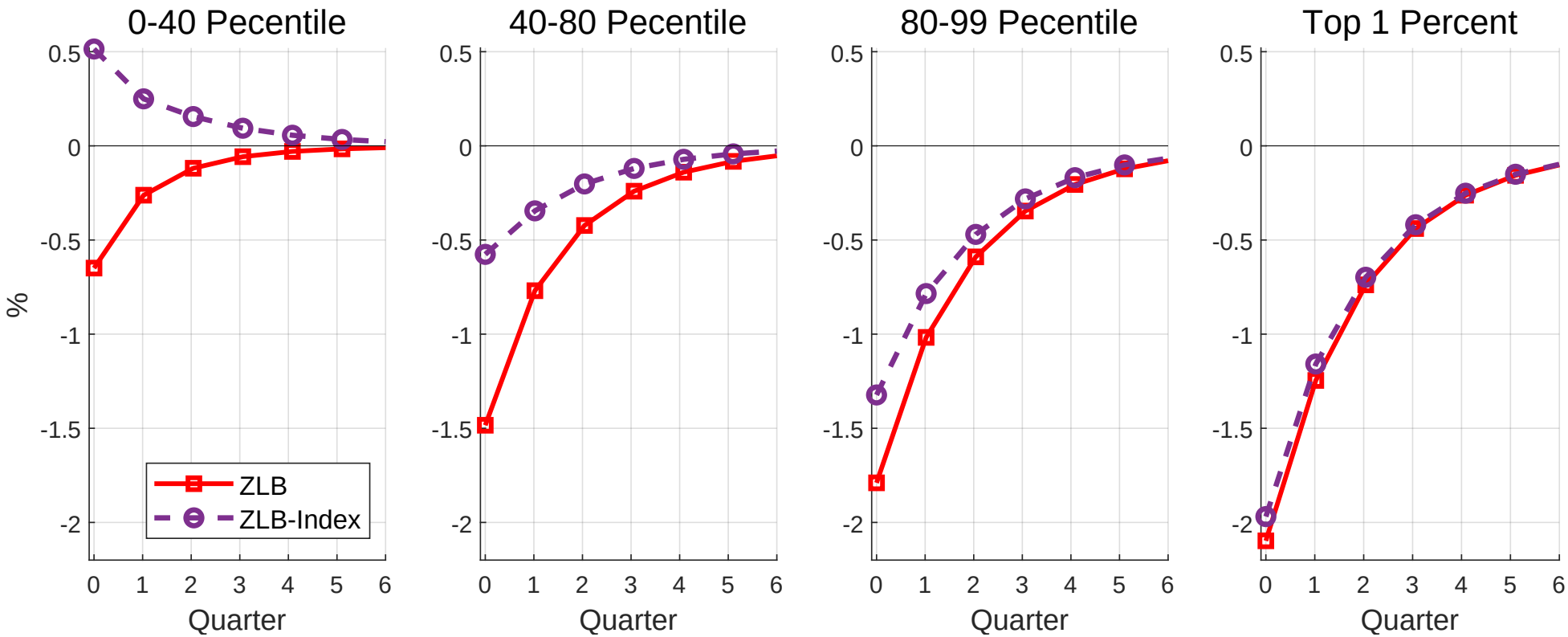
Result *Welfare Implications*

- Transitioning from nominal contracts to indexation:

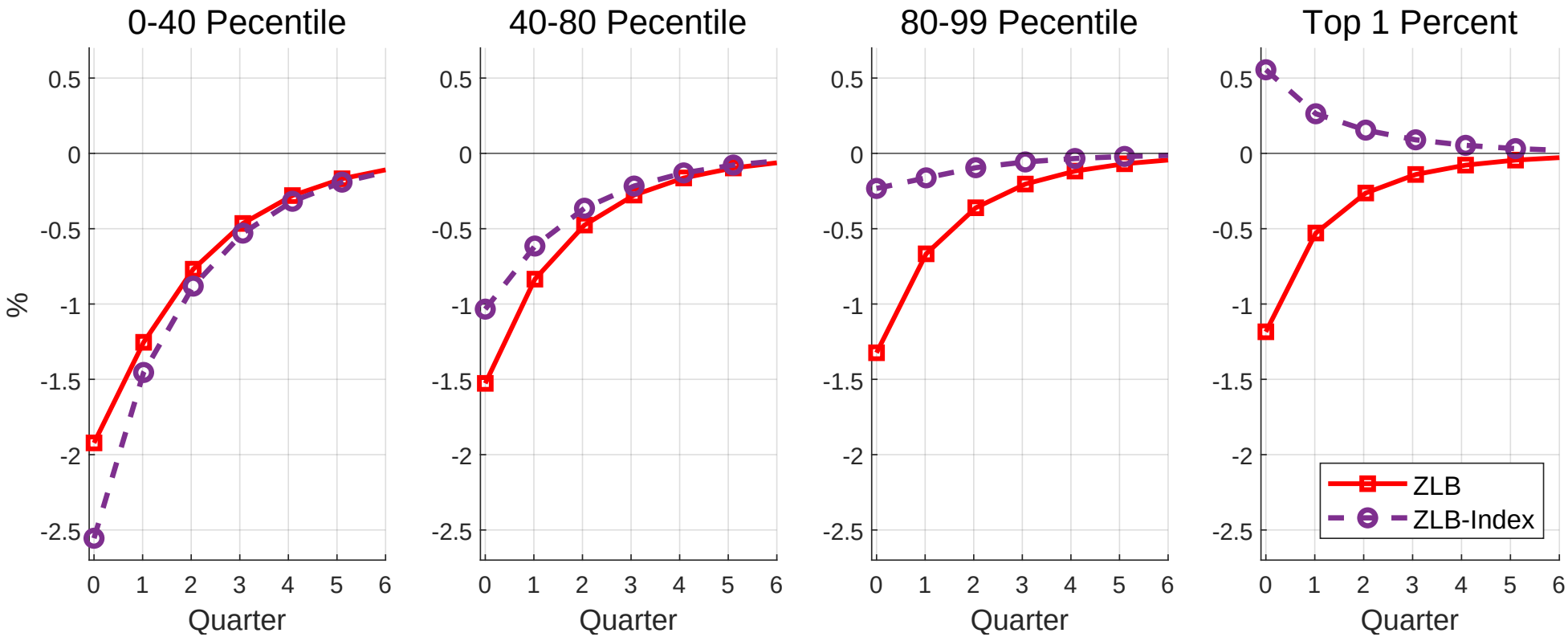
Wealth Percentile				Total
1-40	40- 80	80-99	99-100	
0.4460	0.2675	-0.3127	-0.9028	0.2189

- Indexation improves welfare, **benefiting the poor but disadvantaging the wealthy.**

Result *Disaggregate Consumption Response*



Result *Disaggregate Hours Response*



Horse Race *Indexation vs. High Inflation Target*

- Indexation decreases the likelihood of encountering the ZLB.
- Another possible policy to consider is **"increasing the inflation target."**

- **Question: Which policy is better in terms of stabilization and welfare effects?**

Horse Race *Indexation vs. High Inflation Target*

	Std(Y)	Std(Π)	**Pr(ZLB)**	Welfare
ZLB + Infl. target	0.52	0.20	**2.80%**	0.1324
ZLB + Index	0.41	0.15	**2.80%**	0.2189

- Indexation is better for stabilization and welfare.

Horse Race *Indexation vs. Asymmetric Rule*

- Indexation can address deflationary bias, another significant issue caused by the ZLB.
  - Deflationary Bias: $E[\Pi] < \overline{\Pi}$.
- Another potential policy to address this is **"the asymmetric rule"** *(Bianchi et al., 2021):*

$$\log \widetilde{R}_t = \begin{cases} \log \overline{R} + \phi_\pi^N \left(\log \Pi_t - \log \overline{\Pi} \right) + \phi_y \left(\log Y_t - \log \overline{Y} \right) & \Pi_t < \overline{\Pi} \\ \log \overline{R} + \phi_\pi^P \left(\log \Pi_t - \log \overline{\Pi} \right) + \phi_y \left(\log Y_t - \log \overline{Y} \right) & \Pi_t \geq \overline{\Pi} \end{cases},$$

  - $\phi_\pi^P < \phi_\pi^N$: CB responds less aggressively to above-target inflation.
- Question: Which policy is better in terms of stabilization and welfare effects?

Horse Race *Indexation vs. Asymmetric Rule*

	Std(Y)	Std(Π)	**E**[Π]	Welfare
S.S	-	-	**2.00**	-
ZLB + Asymm.	0.62	0.24	**2.00**	0.0274
ZLB + Index	0.41	0.15	**2.00**	0.2189

- Indexation, again, is better for stabilization and welfare.

Conclusion

- This study investigates the effect of inflation indexation on business cycles and welfare.
- To this end, we develop a HANK model which incorporates ZLB and inflation indexation.

- We find that inflation indexation
  1. reduces the output volatility and welfare improving (the poor gain);
  2. is better for reducing ZLB frequency and correcting deflationary bias.