Inflation Targets and the Zero Lower Bound

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Introduction

Does a *higher* inflation target *reduce* the risk of hitting the zero lower bound (ZLB) on nominal interest rates?

Prominent economists advocate a higher inflation target, e.g. 4% (Krugman, 2014, Blanchard et al., 2010, Williams, 2009, Ball, 2013). Following the Fisher equation,

$$i^{*}\uparrow = \overline{r}^{*} + \overline{\pi}\uparrow$$

it would provide more room to cut interest rates before the ZLB is reached.

But: I provide an example that a 4% inflation target *increases* the risk of hitting the ZLB compared to a 2% target.

I use a standard New Keynesian model with Calvo (1983) price setting rigidities (Woodford, 2003, Ascari and Sbordone, 2014) and show:

- $\overline{\pi}\uparrow$ changes price-setting behavior of firms
- ***More volatile*** inflation and, thus, nominal interest rates

Hence, two forces:

Level effect vs. Volatility effect

This paper shows that even with more "room-to-manoeuvre" due to a higher inflation target, the higher volatility of the nominal interest rate implies that the economy ends up – on net – more often at the ZLB.

New Keynesian Model ($\overline{\pi} > 0$)

New IS: $\widehat{Y}_t = E_t\,\widehat{Y}_{t+1} - \left[\widehat{i}_t - E_t\,\widehat{\pi}_{t+1}\right] - E_t\widehat{\delta}_{t+1}$

NK Phillips Curve:

$$\widehat{\pi}_t = \beta\,\alpha(\overline{\pi})\,E_t\,\widehat{\pi}_{t+1} + \kappa(\overline{\pi})\,\widehat{Y}_t + \kappa(\overline{\pi})\,\varphi\,\widehat{s}_t + \gamma(\overline{\pi})\,E_t\,\widehat{\psi}_{t+1}$$

$$\widehat{\psi}_t = b_1(\overline{\pi})\,(\varphi\,\widehat{s}_t + (\varphi+1)\,\widehat{Y}_t) + \beta\,b_2(\overline{\pi})\,E_t\left(\widehat{\psi}_{t+1} + \epsilon\,\widehat{\pi}_{t+1}\right)$$

Price dispersion: $\widehat{s}_t = \lambda(\overline{\pi})\,\widehat{\pi}_t + [\theta\,(1+\overline{\pi})^{\varepsilon}]\,\widehat{s}_{t-1}$

Monetary policy: $\widehat{i}_t = \max\{-i, \phi_\pi\,\widehat{\pi}_t + \phi_Y\,\widehat{Y}_t\}$

Exogenous process: $\widehat{\delta}_t = \rho\,\widehat{\delta}_{t-1} + \epsilon_t \quad \epsilon_t \sim \mathcal{N}(0,\sigma^2)\ i.i.d.$

Analytical Results

Assume a two-state Markov chain for $\widehat{\delta}_t$. In the short run, $\widehat{\delta}_t = \widehat{\delta}$ with probability μ and $\widehat{\delta}_t = 0$ with $1-\mu$. Here, $\varphi = 0$.

Iterate the NK PC forward:

$$\widehat{\pi}_t = \sum_{j=0}^{\infty} \beta^j\,\boldsymbol{\alpha(\overline{\pi})^j}\uparrow E_t\left[\boldsymbol{\kappa(\overline{\pi})}\downarrow\widehat{Y}_{t+j} + \boldsymbol{\gamma(\overline{\pi})}\uparrow\beta\,\widehat{\psi}_{t+1+j}\right]$$

Note: $\alpha(\overline{\pi}) \geq 1$, $\frac{\partial\alpha(\overline{\pi})}{\partial\overline{\pi}} > 0$, $\frac{\partial\gamma(\overline{\pi})}{\partial\overline{\pi}} > 0$ and $\frac{\partial\kappa(\overline{\pi})}{\partial\overline{\pi}} < 0$

Solve for Aggregate Supply (AS):

$$\widehat{\pi}_t = \frac{\tilde{\kappa}(\overline{\pi})}{1-\beta\,\tilde{\alpha}(\overline{\pi})\,\mu}\widehat{Y}_t := \boldsymbol{\tilde{K}(\overline{\pi})}\uparrow\widehat{Y}_t$$

Note: $\frac{\partial\tilde{K}(\overline{\pi})}{\partial\overline{\pi}} > 0$ if $\beta\,\alpha(\overline{\pi})\mu \geq \frac{-\frac{\partial\kappa(\overline{\pi})}{\partial\overline{\pi}}/\kappa(\overline{\pi})}{\left[\frac{\partial\alpha(\overline{\pi})}{\partial\overline{\pi}}/\alpha(\overline{\pi}) + \frac{-\partial\kappa(\overline{\pi})}{\partial\overline{\pi}}/\kappa(\overline{\pi})\right]}$

i.e. shock $\widehat{\delta}_t$ needs to be sufficiently persistent (large μ)

Mechanism: $\overline{\pi}\uparrow$

- Firms anticipate that higher inflation will erode expected future real profits
- Price setting becomes more forward-looking
- In a persistent recession, firms cut prices more aggressively

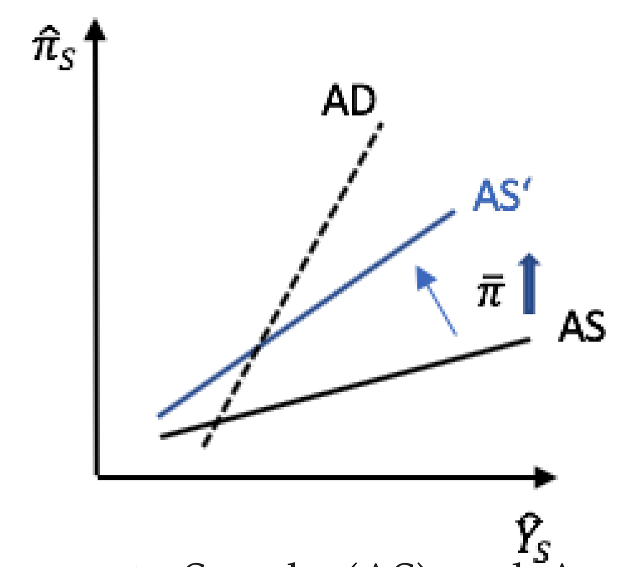


Figure 1: Aggregate Supply (AS) and Aggregate Demand (AD) at ZLB

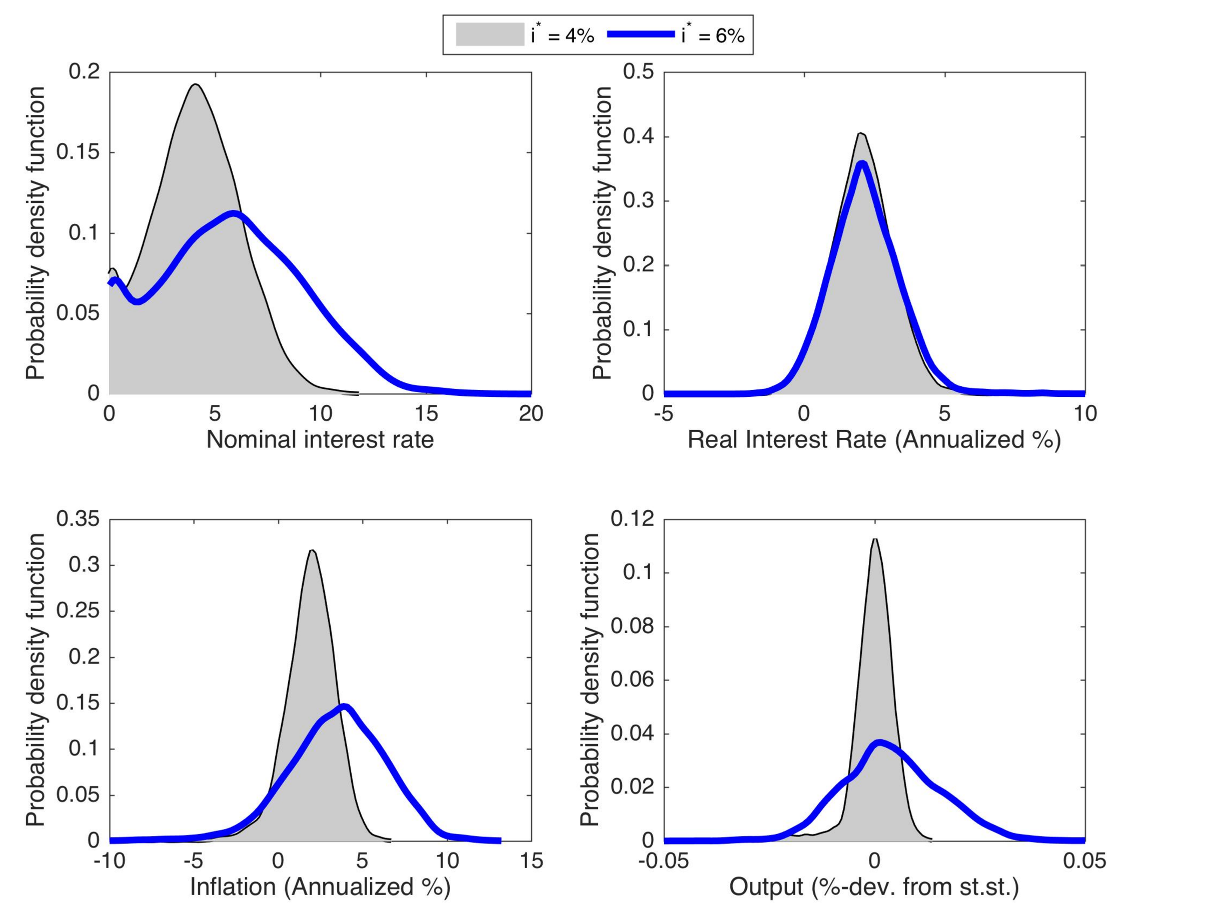
Numerical Results

Assume an AR(1) process for $\widehat{\delta}_t$ and $\varphi > 0$. I solve the model using global solution methods and run stochastic simulations of the model for different $\overline{\pi}$ (6000 samples of 200 quarters initialized at the model's non-stochastic steady state).

	Zero Lower Bound		Standard Deviation (in %)			
$\overline{\pi}$	Prob.	Duration	$\widehat{\pi}$	$\widehat{y}$	$\widehat{i} - E\widehat{\pi}$	$\widehat{i}$
0%	22.86%	4.60	0.60	1.87	0.48	0.29
1%	10.10%	3.15	0.32	0.67	0.27	0.43
2%	**5.14%**	**2.51**	**0.31**	**0.48**	**0.26**	**0.46**
3%	2.16%	2.19	0.32	0.29	0.25	0.49
4%	**7.21%**	**5.07**	**0.56**	**0.90**	**0.30**	**0.67**

Note: Mean duration at ZLB in quarters. $\widehat{\pi}$: inflation, $\widehat{y}$: output, $\widehat{i} - E\widehat{\pi}$: real interest rate, $\widehat{i}$: nominal interest rate

Table 1: Simulation Results



Note: Gray: model with $\overline{\pi} = 2\%$, blue: model with $\overline{\pi} = 4\%$

Figure 2: Simulated Distributions

The volatility effect dominates at a 4% inflation target rate. Monetary policy responds to larger fluctuations of inflation by ***larger cuts*** in the nominal interest rate.

Sensitivity Analysis

Shock persistence ρ and Calvo parameter θ

- The minimum inflation target to replicate the same ZLB probability as at $\overline{\pi} = 2\%$ is ***higher*** for lower shock persistence and more flexible prices

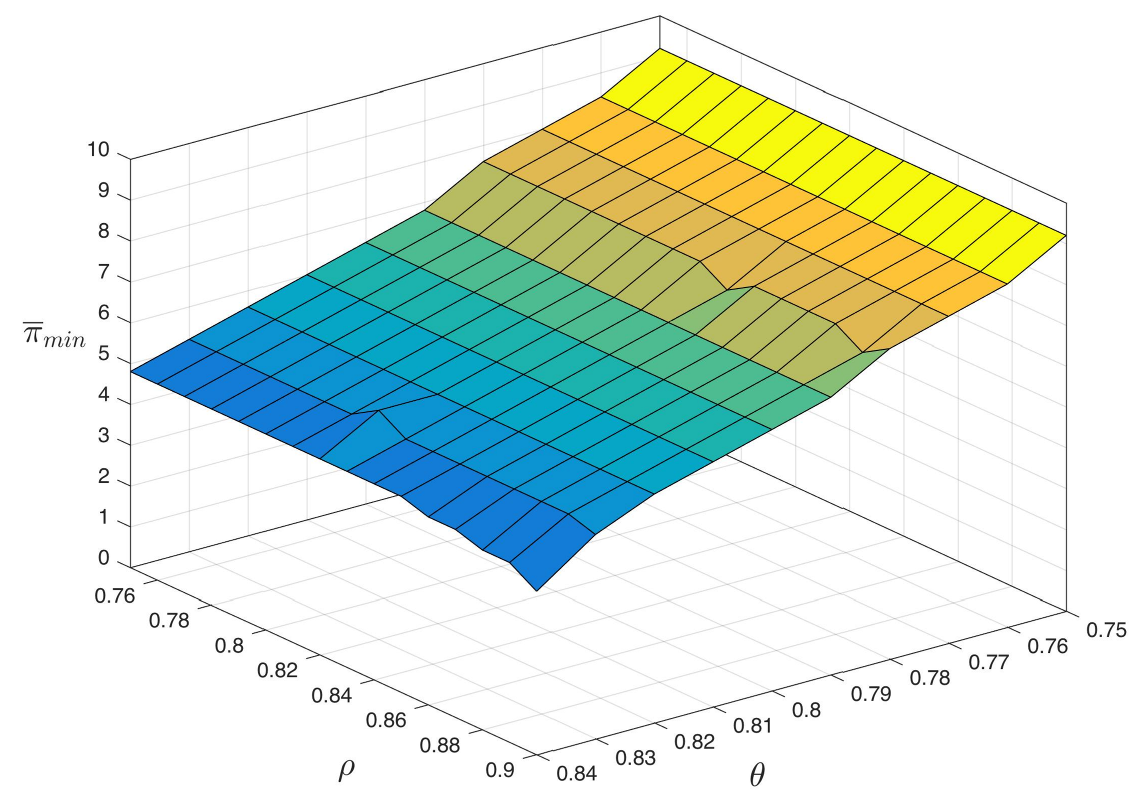


Figure 3: Minimum $\overline{\pi}$

Non-linear Model

- Previous findings are ***robust*** to the solution method
- But the degree of forward-looking behavior is weaker in the non-linear model

Price indexation

- No macroeconomic evidence for price indexation (Cogley and Sbordone, 2008, Ascari and Sbordone, 2014)
- Previous findings are generally ***not robust*** to price indexation to (i) trend inflation and (ii) past inflation

Conclusion

- The paper highlights the role of the level of the inflation target for the volatility of inflation and nominal interest rates
- My results ***caution*** against raising the target rate of inflation while ignoring how this would change the behavior of economic agents