Should the ECB Adjust its Strategy in the Face of a Lower r*?[1]

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November 2020

[1]The views expressed here do not necessarily represent those of the Banque de France, the Eurosystem, the Federal Reserve Bank of Boston or the Federal Reserve System.

Motivation

- Decline in r^*, possibly permanent
- Implications for monetary policy $\Rightarrow$ higher ELB incidence, given an unchanged strategy
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- This paper: *quantitative* analysis based on an estimated NK model of the euro area economy
- Follow up on the U.S.-based analysis in Andrade et al. (2020)

Preview of Main Findings

- Given the estimated rule, the current inflation target ($\pi^* \lesssim 2\%$) is suboptimal if $r^* < 2\%$
- Keeping that rule unchanged, a 1% decrease in r^* calls for a 0.9% increase in π^* ($1.7\% \Rightarrow 2.6\%$)
- Alternatives to raising the inflation target:

- aggressive countercyclical fiscal policy
- modifying the rule to incorporate a sufficiently strong "make-up" component

Related literature

- Quantitative analyses of π^*: Khan et al. (2003), Schmitt-Grohé and Uribe (2010), Amano et al. (2009), Carlsson and Westermark (2016), Bilbiie et al. (2014), Ascari et al. (2015), Adam and Weber (2019), Lepetit (2018),...
- Quantitative analyses of π^* with a ZLB/ELB constraint: Coibion et al. (2012), Dordal-i-Carreras et al. (2016), Kiley and Roberts (2017), Blanco (2016),...

- Our contribution: explicit analysis of the relation between r^* and π^*
- Main caveat: "within the model" analysis

The Model

- Medium-scale NK model
- Non-zero trend inflation
- Staggered price and wage setting à la Calvo
- Imperfect indexation of prices to lagged price inflation; and of wages to lagged price inflation and productivity.
- Shocks: risk premium, marginal utility of consumption, technology, monetary policy, price and wage markups
- Trend growth $\Rightarrow r^* = \rho + \mu_z$
- Baseline monetary policy rule

$$i_t = \max\{i_t^n, e\}$$

$$i_t^n = (1-\rho_i)i + \rho_i i_{t-1}^n + (1-\rho_i)\left[a_\pi(\pi_t - \pi) + a_x x_t\right] + \zeta_{r,t}$$

with $i = r^* + \pi$ and where π defines the *inflation target* $(\neq \mathbb{E}\{\pi_t\})$

Solution Method

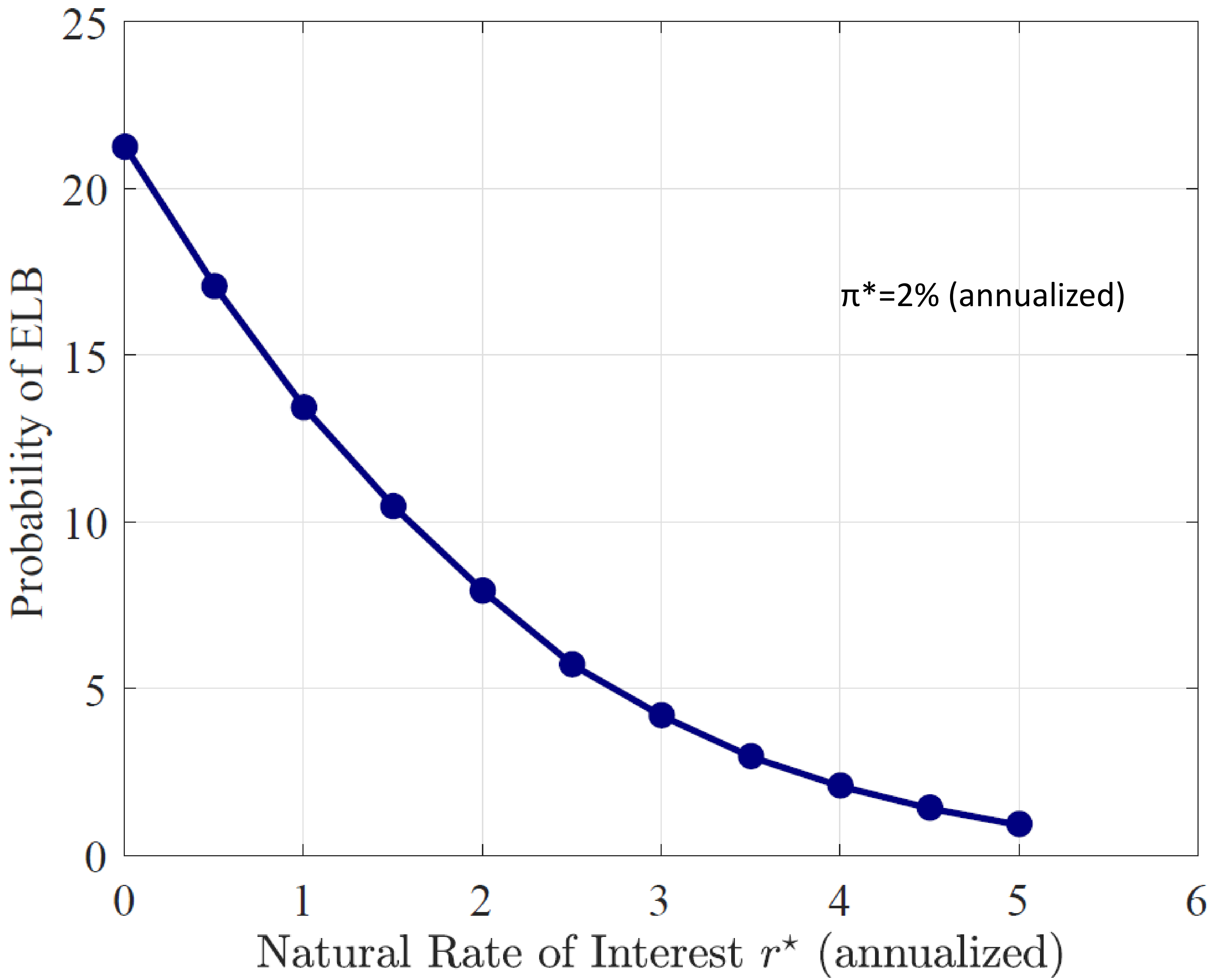
1. Detrending of non-stationary quantities by technology parameter
2. Log-linearization around deterministic steady state.
3. Solution under the ZLB as in Bodenstein et al. (2009) and Guerrieri and Iacoviello (2015)

Calibration and Estimation

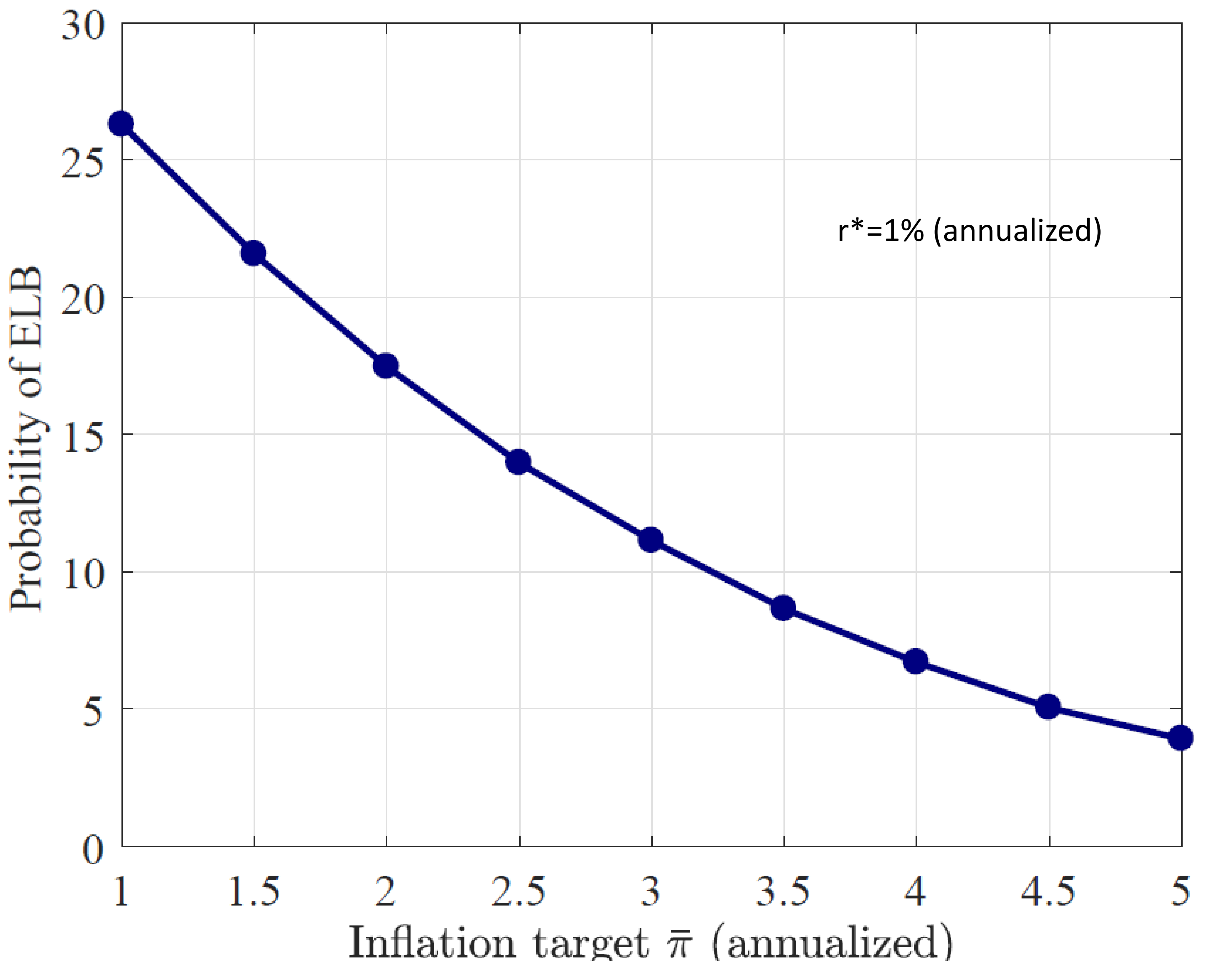
- Calibrated parameters: $1/\phi = 0.7$; $\theta_p = 6$; $\theta_w = 3$; $e = -0.5/4$
- Remaining parameters estimated using Bayesian approach on the model without ZLB and sample period 1985Q1-2014Q4
- Gaussian priors for (ρ, μ_z, π) with means consistent with inflation, GDP growth and real rate averages.
- Vector of observables:

$$x_t = [\Delta \log GDP_t, \Delta \log GDP\ \ Deflator_t, \Delta \log Wage_t, Short\ \ term\ \ rate_t]$$

- Some model properties



25
20
15
10
5
0
Probability of ELB
π*=2% (annualized)
0
1
2
3
4
5
6
Natural Rate of Interest r* (annualized)



r*=1% (annualized)
Probability of ELB
Inflation target $\bar{\pi}$ (annualized)
0
5
10
15
20
25
30
1
1.5
2
2.5
3
3.5
4
4.5
5

The Optimal Inflation Target

- Second order approximation to household expected utility: $\mathcal{W}(\pi;\theta)$
- The *optimal inflation target*

$$\pi^*(\theta) = \arg\max_{\pi} \mathcal{W}(\pi;\theta)$$

with solution obtained via numerical simulations allowing for occasionally binding ZLB, and with θ taken to be the *mean* of the posterior distribution of parameter estimates

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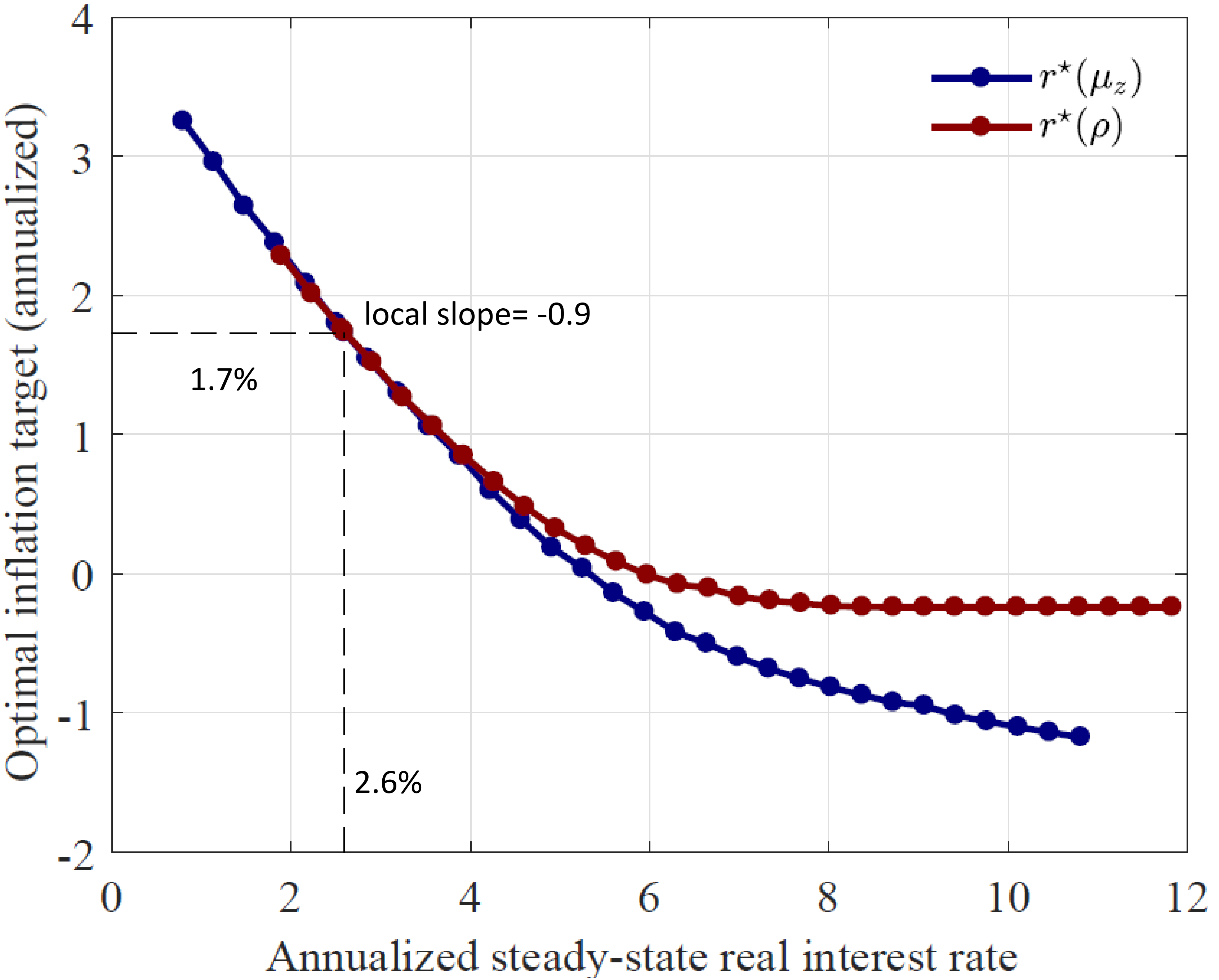
  with solution obtained via numerical simulations allowing for occasionally binding ZLB, and with θ taken to be the *mean* of the posterior distribution of parameter estimates.
- The baseline (r^*, π^*) relation:

(a) varying μ_z
(b) varying ρ
while keeping other parameters at their posterior mean

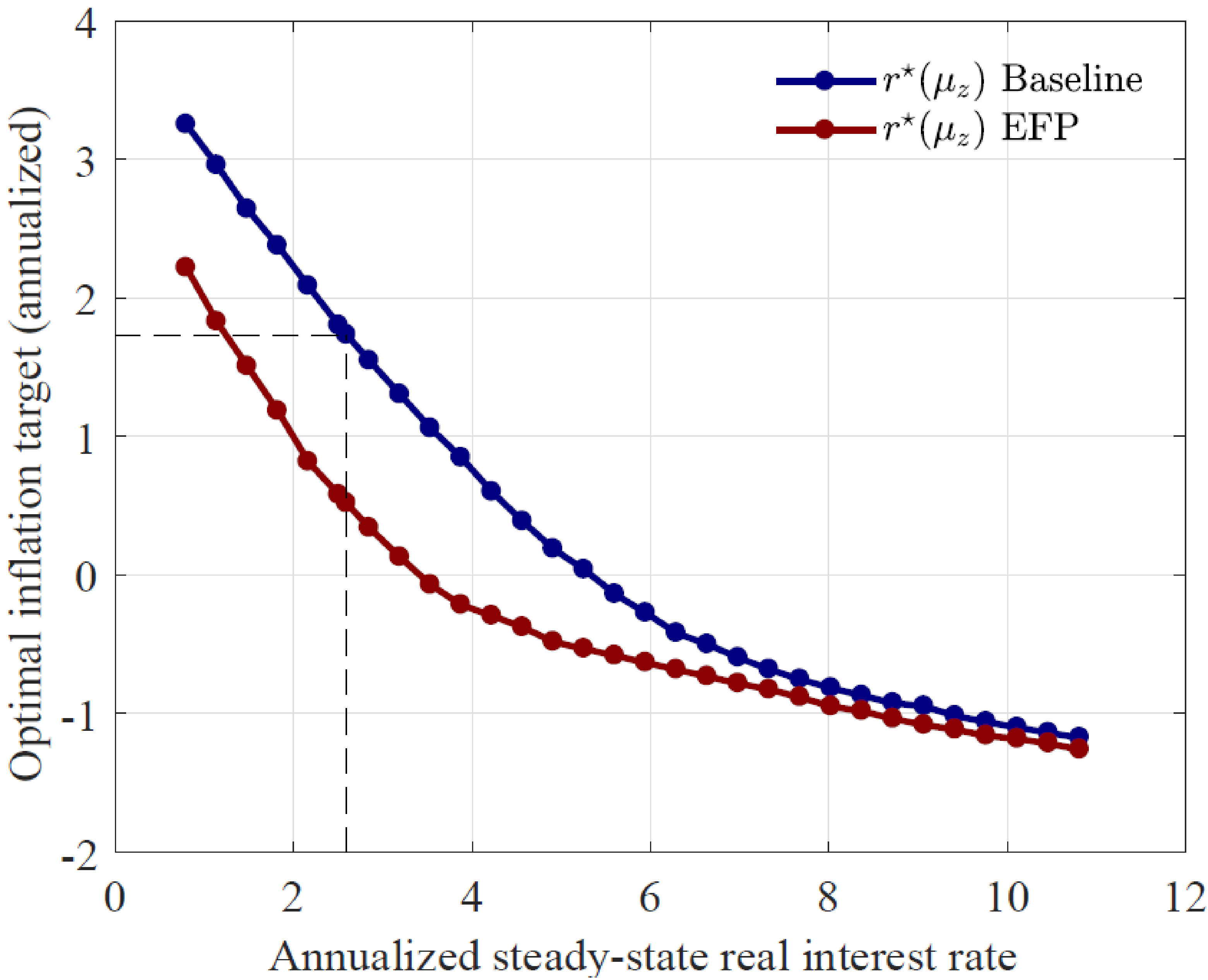


4
3
2
1
0
-1
-2
0
2
4
6
8
10
12
Optimal inflation target (annualized)
Annualized steady-state real interest rate
$r^\star(\mu_z)$
$r^\star(\rho)$
local slope= -0.9
1.7%
2.6%

Alternative Strategies

- Emergency Fiscal Package (4% of output, $\rho_g = 0.85$, triggered when cumulative output gap is -6%)

Emergency Fiscal Package



Alternative Strategies

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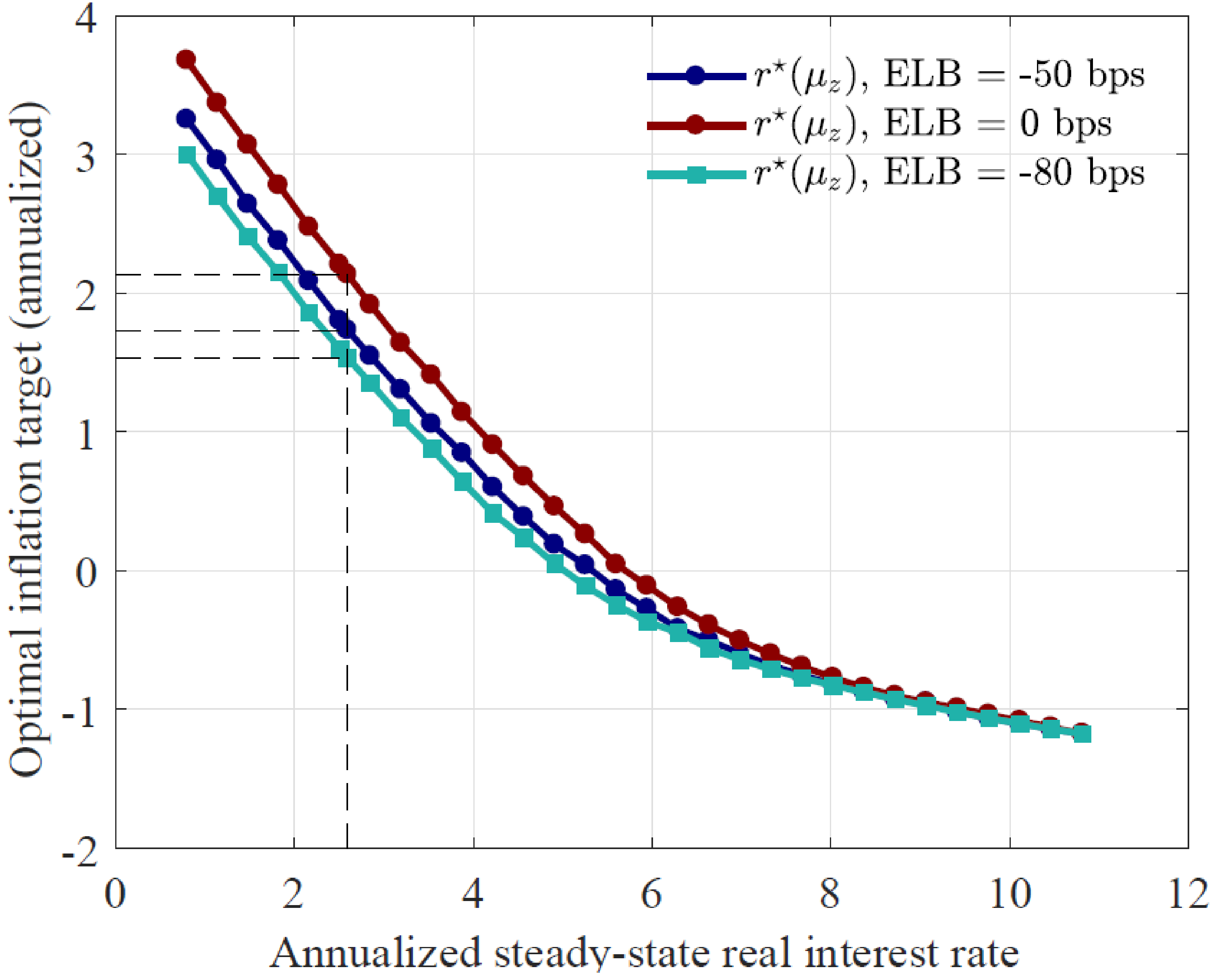
- Alternative Effective Lower Bound: $e \in \{0, \mathbf{-0.5}, 0.8\}$ (annualized)

Alternative Effective Lower Bounds



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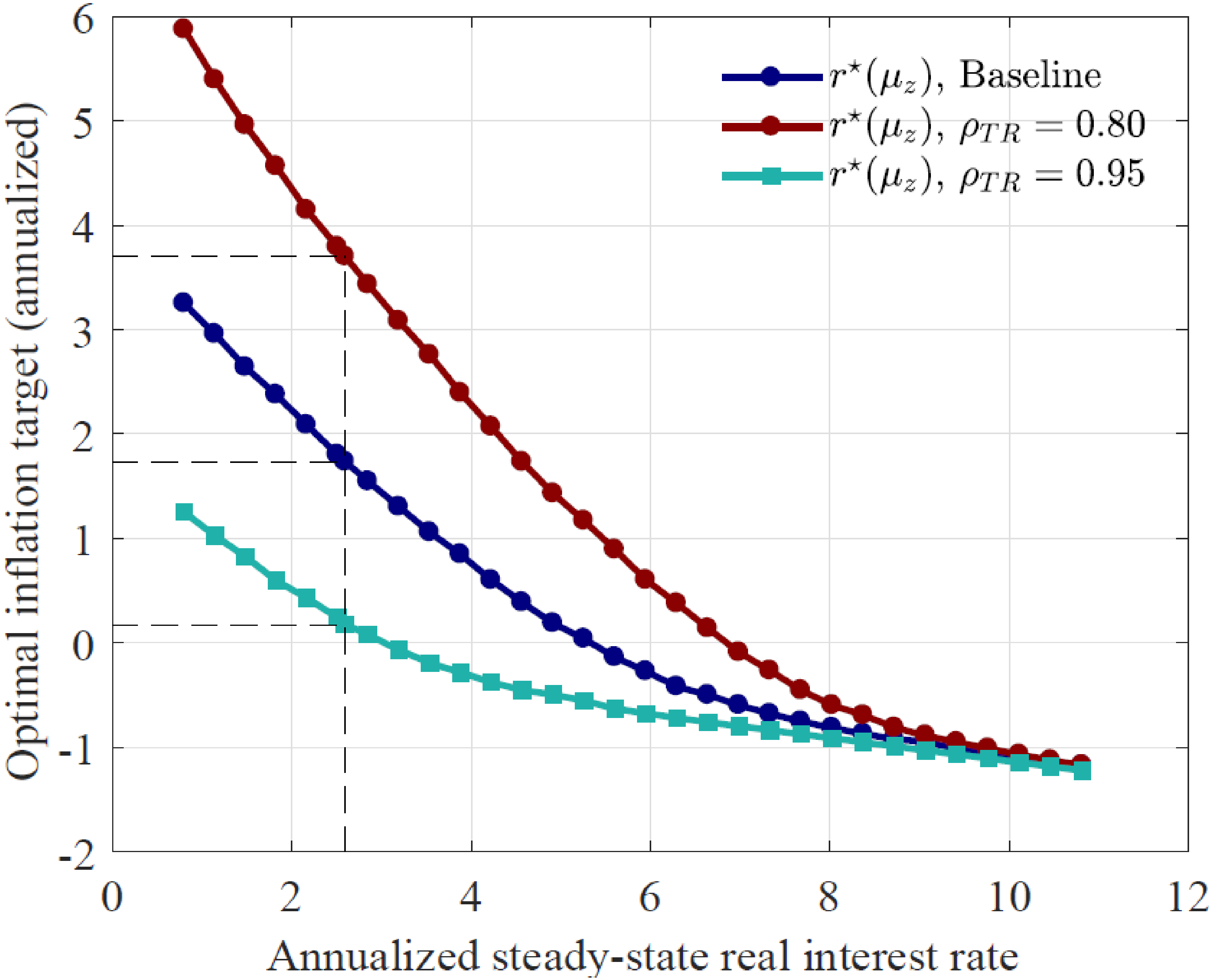
Alternative Inertia Coefficients



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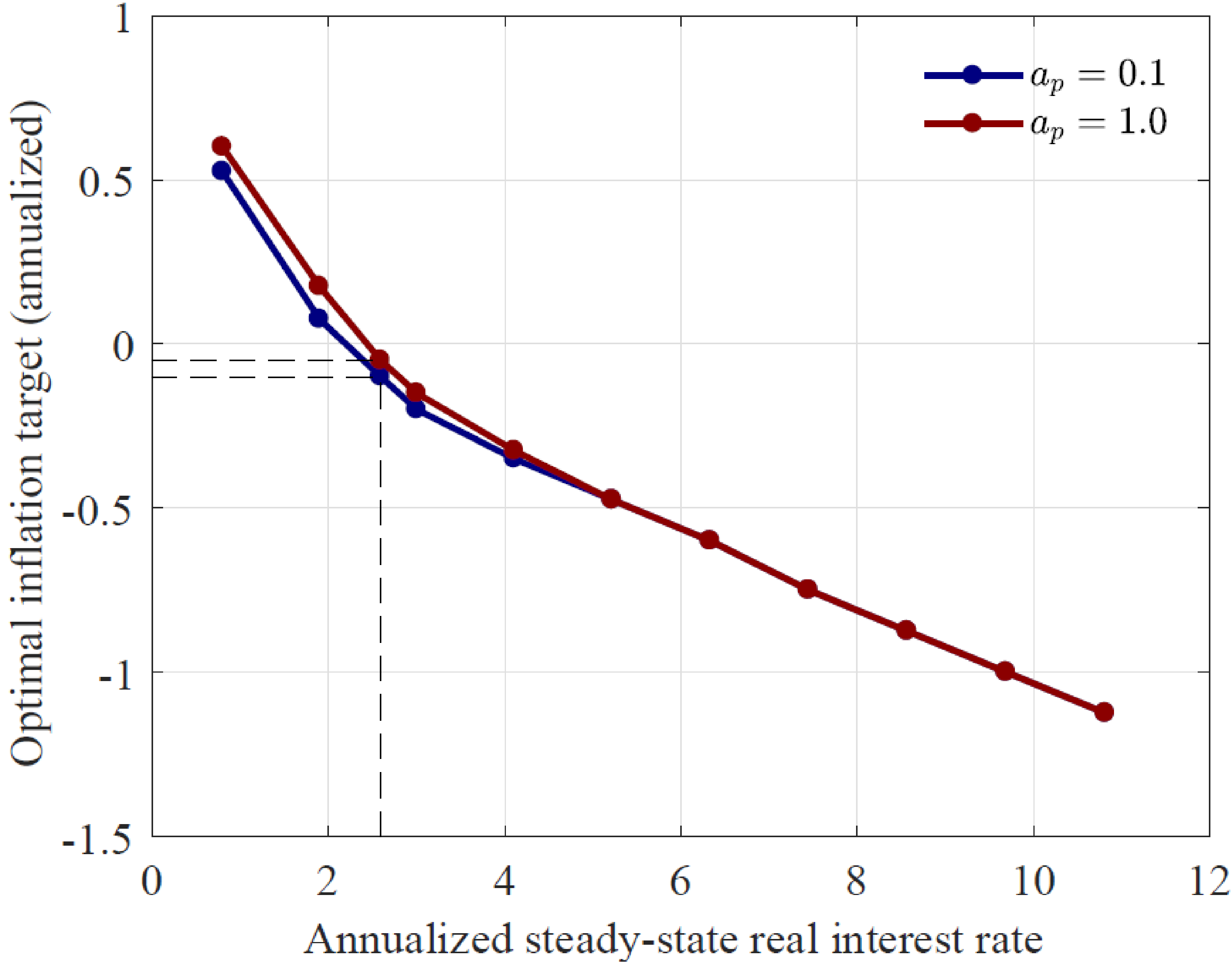
- Price level targeting:

$$i_t^n - i = \rho_i(i_{t-1}^n - i) + (1 - \rho_i)\left[a_p(p_t - p_t^*) + a_x x_t\right] + \zeta_{r,t}$$

where $p_t^* = p_0 + \pi \cdot t$ and $a_p \in \{0.1, 0.5\}$

Price Level Targeting



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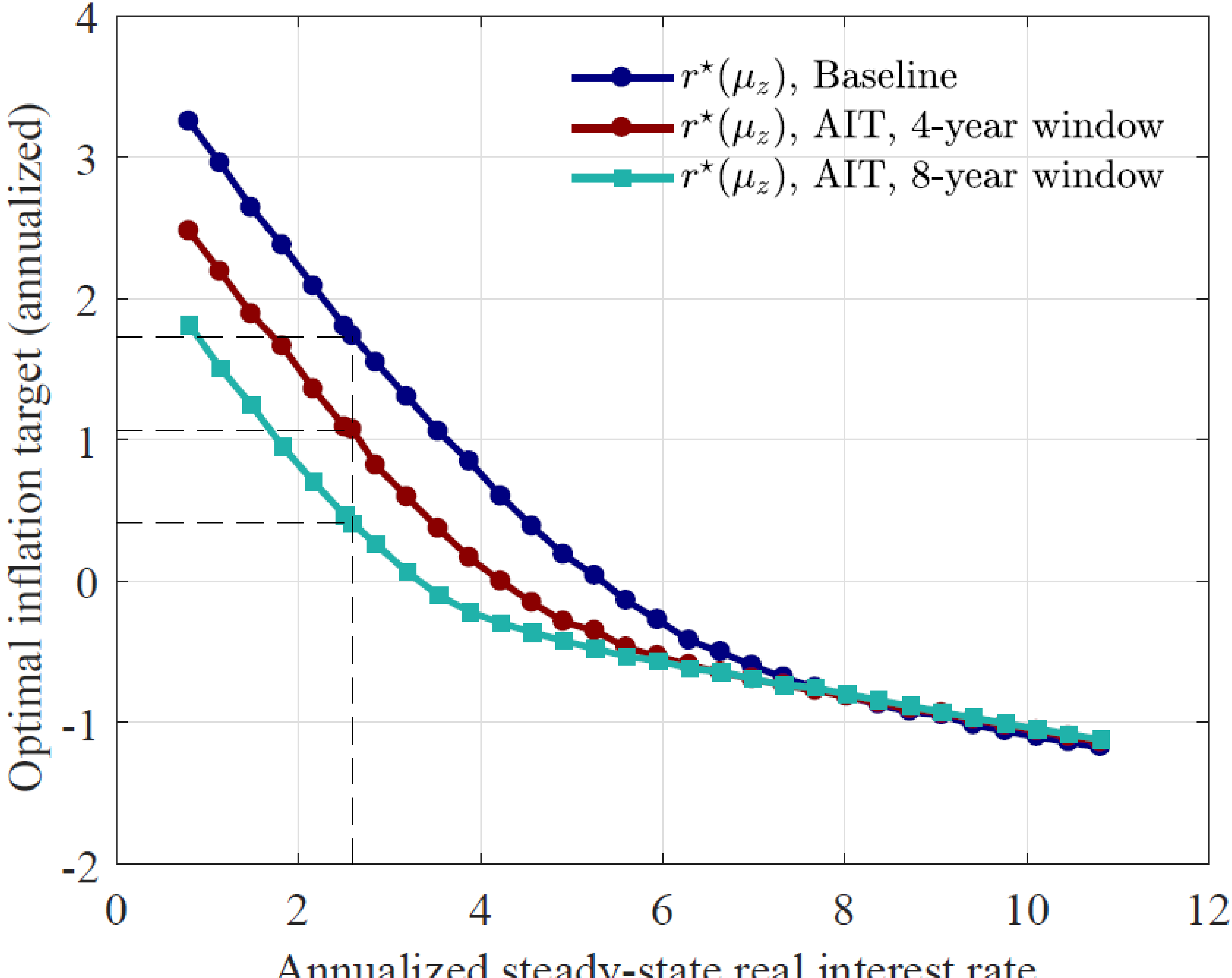
- Average inflation targeting:

$$i_t^n - i = \rho_i(i_{t-1}^n - i) + (1-\rho_i)\left[a_p(\pi_t^a - \pi) + a_x x_t\right] + \zeta_{r,t}$$

where $\pi_t^a = (1/H)\sum_{h=0}^{H-1} \pi_{t-h}$ and $H \in \{\mathbf{1}, 16, 32\}$

Average Inflation Targeting



Summary and Conclusions

- Quantitative assessment of the optimal inflation target in the euro area, as a function of r^* and under an ELB constraint.
- Under the baseline estimated policy rule, a (local) decline in r^* calls for a *close to one-for-one* (0.9) increase in the inflation target $\Rightarrow$ marginal costs of inflation are low compared to the stabilization benefits of a higher nominal rate
- If r^* has declined significantly and the rule is unchanged, the current "below but close to 2%" target is suboptimal
- Alternatives to a higher inflation target:

- more aggressive countercyclical fiscal policies
- more aggressive "lower for longer" forward guidance
- average inflation targeting

The Model

- Representative household with preferences:

$$\mathbb{E}_t \sum_{s=0}^{\infty} \beta^s \left\{ e^{\zeta_{g,t+s}} \log(C_{t+s} - \eta C_{t+s-1}) - \frac{\chi}{1+\nu} \int_0^1 N_{t+s}(h)^{1+\nu} dh \right\}$$

and budget constraint

$$P_t C_t + e^{\zeta_{q,t}} Q_t B_t \leq \int_0^1 W_t(h) N_t(h) dh + B_{t-1} - T_t + D_t$$

- Final goods: perfect competition with technology

$$Y_t = \left(\int_0^1 Y_t(f)^{(\theta_p - 1)/\theta_p} df \right)^{\theta_p/(\theta_p - 1)}$$

- Intermediate goods: monopolistic competition with technology

$$Y_t(f) = Z_t L_t(f)^{1/\phi}$$

where $Z_t = Z_{t-1} e^{\mu_z + \zeta_{z,t}}$

The Model

- Price setting à la Calvo, with stochastic subsidies $\zeta_{u,t}$, and partial indexation

$$P_t(f) = \Pi_{t-1}^{\gamma_p} P_{t-1}(f)$$

- Wage setting à la Calvo, with partial indexation

$$W_t(h) = e^{\gamma_z \mu_z} \Pi_{t-1}^{\gamma_w} W_{t-1}(h)$$

- Interest rate rule:

$$i_t = \max\{i_t^n, 0\}$$

where

$$i_t^n - i = \rho_i (i_{t-1}^n - i) + (1 - \rho_i) \left[a_\pi (\pi_t - \pi) + a_y (y_t - y_t^n) \right] + \zeta_{r,t}$$

with $i = \rho + \mu_z + \pi$ and where π defines the *inflation target*.

An Incorrect Argument

- "The effects of a decline in r^*, independently of its source, can be exactly offset by a commensurate increase in the inflation target π"

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- "The effects of a decline in r^*, independently of its source, can be exactly offset by a commensurate increase in the inflation target π"

- The argument ignores:

(i) An increase in inflation has (permanent) welfare costs of its own.
(ii) Changes in ρ and μ_z have different effects on wage inflation (given π)
(iii) Changes in (ρ, μ_z) affect the equilibrium dynamics independently of π

These are the effects that we seek to evaluate.

Table 1: Estimation Results

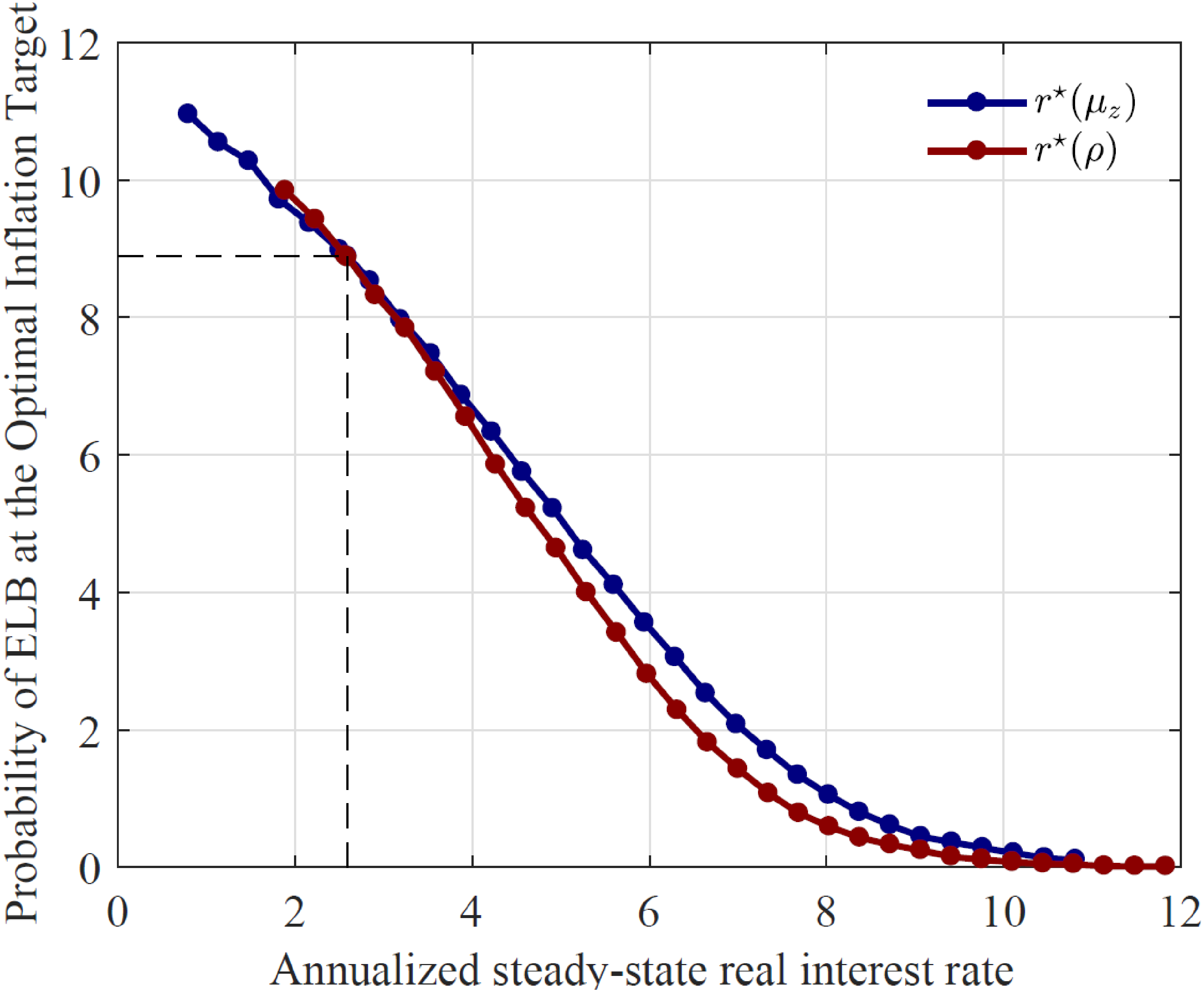
Parameter	Prior Shape	Prior Mean	Priod std	Post. Mean	Post. std	Low	High
ρ	Normal	0.20	0.05	0.20	0.05	0.12	0.27
μ_z	Normal	0.50	0.05	0.45	0.04	0.38	0.52
$\bar{\pi}$	Normal	0.80	0.05	0.79	0.05	0.71	0.86
α_p	Beta	0.66	0.05	0.63	0.04	0.56	0.69
α_w	Beta	0.66	0.05	0.60	0.04	0.54	0.66
γ_p	Beta	0.50	0.15	0.10	0.04	0.03	0.16
γ_w	Beta	0.50	0.15	0.29	0.10	0.12	0.45
γ_z	Beta	0.50	0.15	0.50	0.15	0.26	0.75
η	Beta	0.70	0.15	0.72	0.03	0.67	0.78
ν	Gamma	1.00	0.20	0.95	0.18	0.64	1.24
a_π	Gamma	2.00	0.15	2.10	0.13	1.87	2.31
a_y	Gamma	0.50	0.05	0.50	0.05	0.41	0.58
ρ_i	Beta	0.85	0.10	0.86	0.02	0.84	0.89
σ_z	Inverse Gamma	0.25	1.00	0.87	0.14	0.63	1.10
σ_m	Inverse Gamma	0.25	1.00	0.11	0.01	0.10	0.12
σ_q	Inverse Gamma	0.25	1.00	0.22	0.06	0.14	0.30
σ_c	Inverse Gamma	0.25	1.00	0.24	0.04	0.18	0.31
σ_u	Inverse Gamma	0.25	1.00	0.20	0.11	0.06	0.35
ρ_m	Beta	0.25	0.10	0.37	0.06	0.26	0.47
ρ_z	Beta	0.25	0.10	0.24	0.10	0.09	0.39
ρ_c	Beta	0.85	0.10	0.99	0.00	0.99	1.00
ρ_q	Beta	0.85	0.10	0.95	0.02	0.91	0.98
ρ_u	Beta	0.80	0.10	0.80	0.10	0.66	0.96

Note: 'std' stands for Standard Deviation, 'Post.' stands for Posterior, and 'Low' and 'High' denote the bounds of the 90% probability interval for the posterior distribution. Values for parameters ρ, μ_z, $\bar{\pi}$ are expressed in percent, in quarterly (not annualized) terms.

Table 2: Properties of the Model

Policy Parameters			Moments				
e	$r^\star$	$\bar{\pi}$	$E(\pi^a)$	$std(\pi^a)$	$E(x)$	$std(x)$	P(ELB)
-0.50	1.00	2.00	1.49	4.58	-0.30	2.00	17.47
-0.50	1.00	3.00	2.83	2.91	-0.12	1.14	11.13
-0.50	2.00	2.00	1.84	2.80	-0.11	1.15	10.73
-0.50	2.00	3.00	2.94	2.31	-0.04	0.82	6.25
-0.50	3.00	2.00	1.95	2.25	-0.04	0.84	5.88
-0.50	3.00	3.00	2.98	2.13	-0.01	0.71	3.30

Note: Results from simulations of the model under various values of $r^\star$ and $\overline{\pi}$, an ELB at $e = -.5$, and the remaining model parameters at their estimated posterior mean. π^a denotes the year-on-year inflation rate, x is the output gap, $E(\cdot)$ stands for mean, $std(\cdot)$ stands for Standard Deviation, P(ELB) denotes the unconditional probability of hitting the ELB.



12
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12
Probability of ELB at the Optimal Inflation Target
Annualized steady-state real interest rate
$r^{\star}(\mu_z)$
$r^{\star}(\rho)$