A Macroeconomic Model of Equities and Real, Nominal, and Defaultable Debt

Eric T. Swanson

University of California, Irvine

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Motivation

Goal: Show that a simple macroeconomic model (with Epstein-Zin preferences) is consistent with a wide variety of asset pricing facts

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- long-term bond premium puzzle (nominal and real)
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- rare disasters: Rietz (1988), Barro (2006), et al.
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- rare disasters: Rietz (1988), Barro (2006), et al.
- long-run risks: Bansal-Yaron (2004) et al.
- heterogeneous agents: Mankiw-Zeldes (1991), Guvenen (2009), Schmidt (2015), et al.
- financial intermediaries: Adrian-Etula-Muir (2013)

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Two key ingredients:

- Epstein-Zin preferences
- nominal rigidities

Households

Period utility function:

$$u(c_t, l_t) \equiv \log c_t - \eta \frac{l_t^{1+\chi}}{1+\chi}$$

- additive separability between c and l
- SDF comparable to finance literature
- log preferences for balanced growth, simplicity

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$$a_{t+1} = e^{i_t} a_t + w_t l_t + d_t - c_t$$

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Calibration: (IES $= 1$), $\chi = 3$, $l = 1$ ($\eta = .54$)

Generalized Recursive Preferences

Household chooses state-contingent $\{(c_t, l_t)\}$ to maximize

$$V(a_t;\theta_t) \;=\; \max_{(c_t,l_t)} u(c_t, l_t) - \beta\alpha^{-1} \log\left[E_t \exp(-\alpha V(a_{t+1};\theta_{t+1}))\right]$$

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Calibration: $\beta = .992$, RRA $(R^c) = 60 \quad (\alpha = 59.15)$

Firms

Firms are very standard:

- continuum of monopolistic firms (gross markup λ)
- Calvo price setting (probability $1 - \xi$)
- Cobb-Douglas production functions, $y_t(f) = A_t k^{1-\theta} l_t(f)^{\theta}$
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Calibration: $\lambda = 1.1$, $\xi = 0.8$, $\theta = 0.6$, $\sigma_A = .007$, $(\rho_A = 1)$, $\frac{k}{4Y} = 2.5$

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Calibration: $\phi_\pi = 0.5$, $\phi_y = 0.75$, $\overline{\pi} = .008$, $\rho_{\bar{y}} = 0.9$

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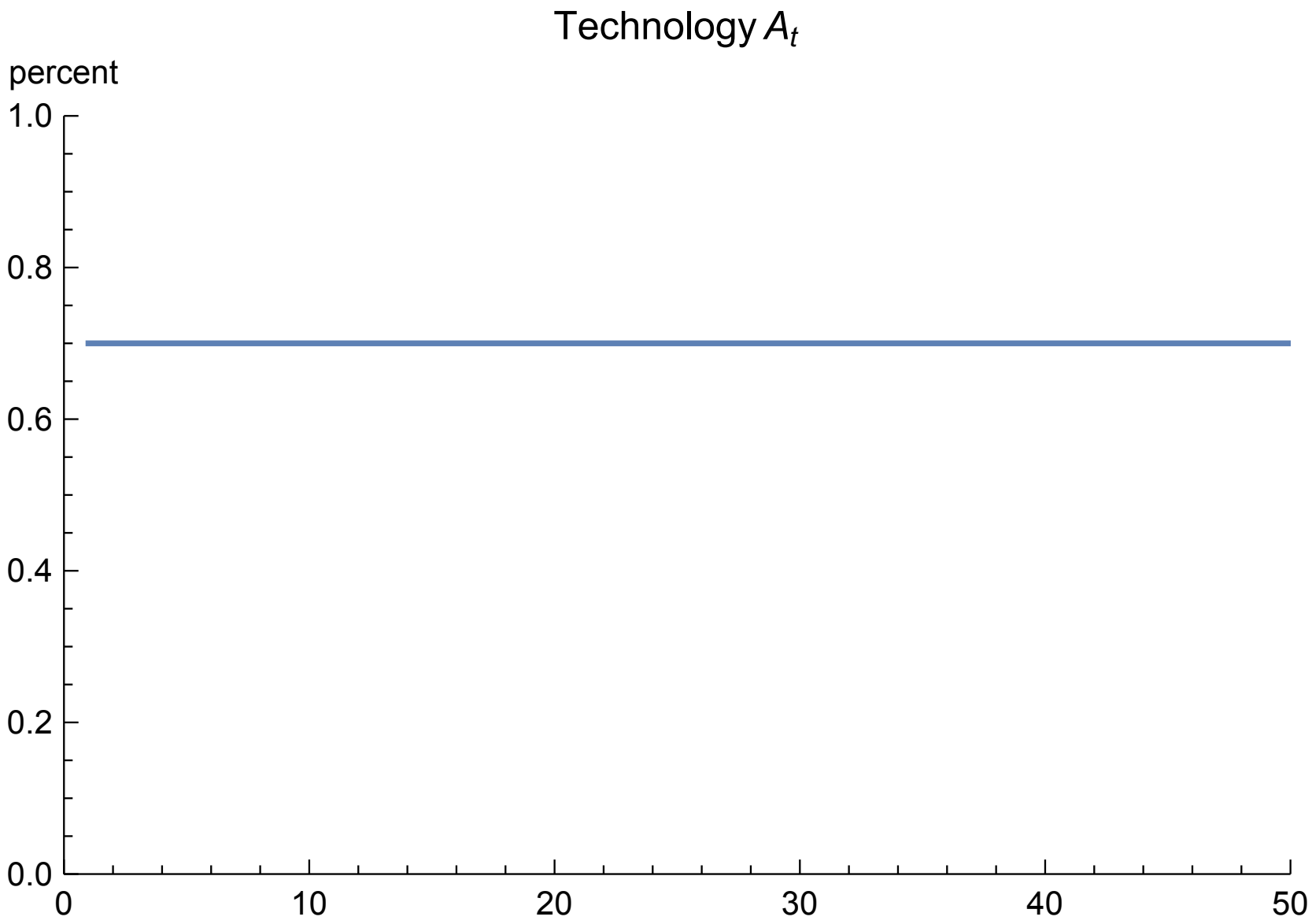
Model has 2 state variables ($\bar{y}_t$, Δ_t), one shock (ε_t)

Impulse Responses



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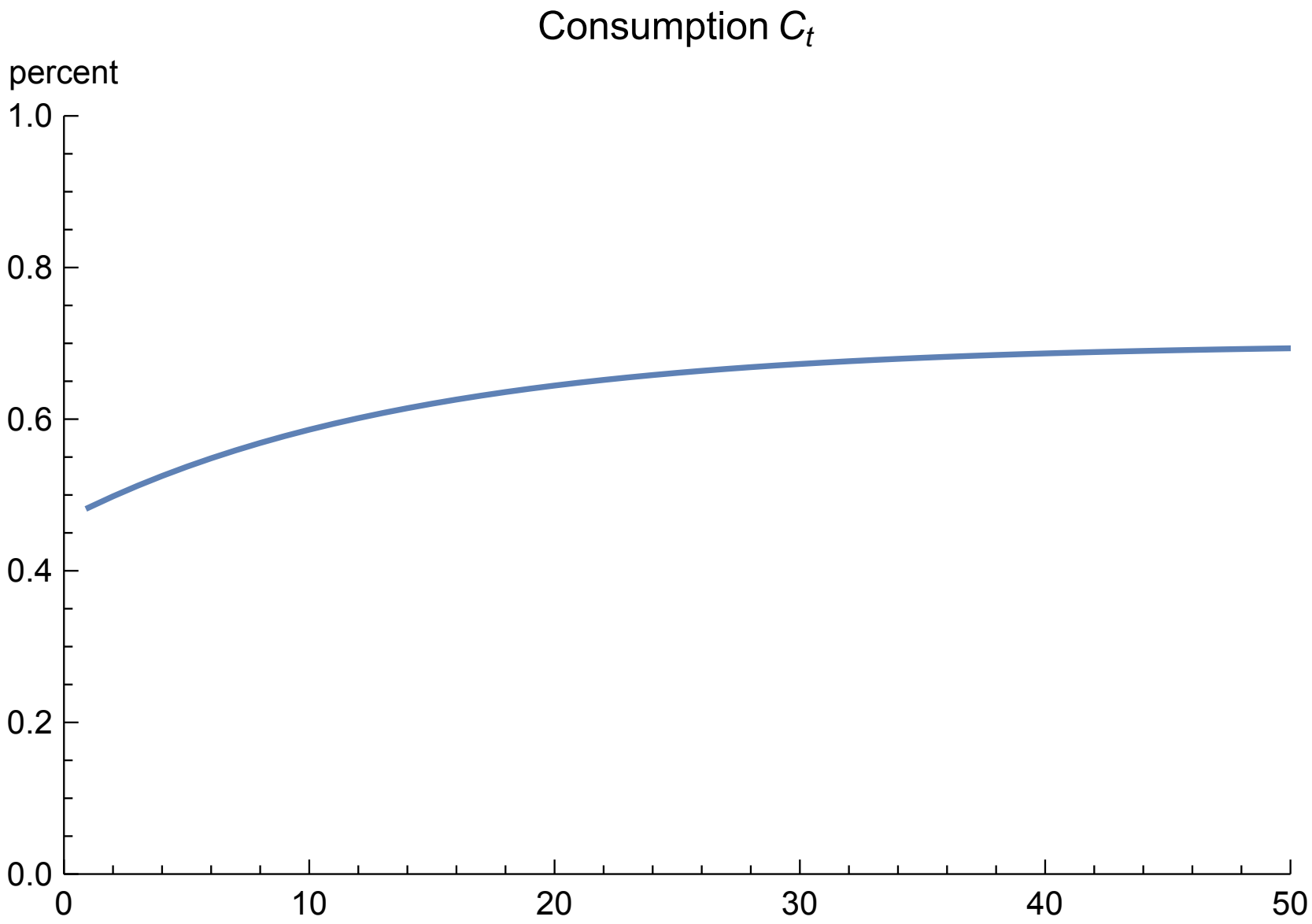

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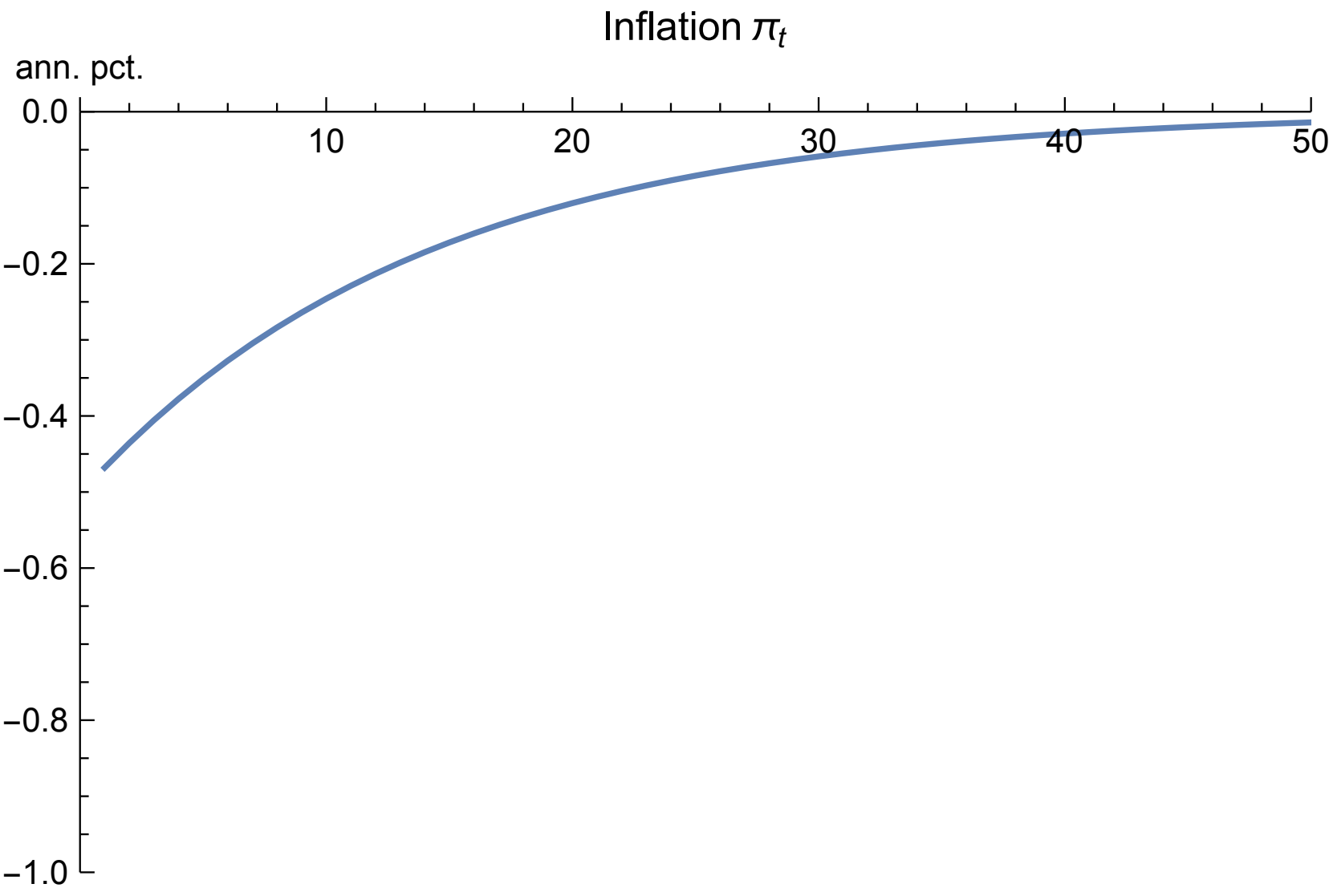

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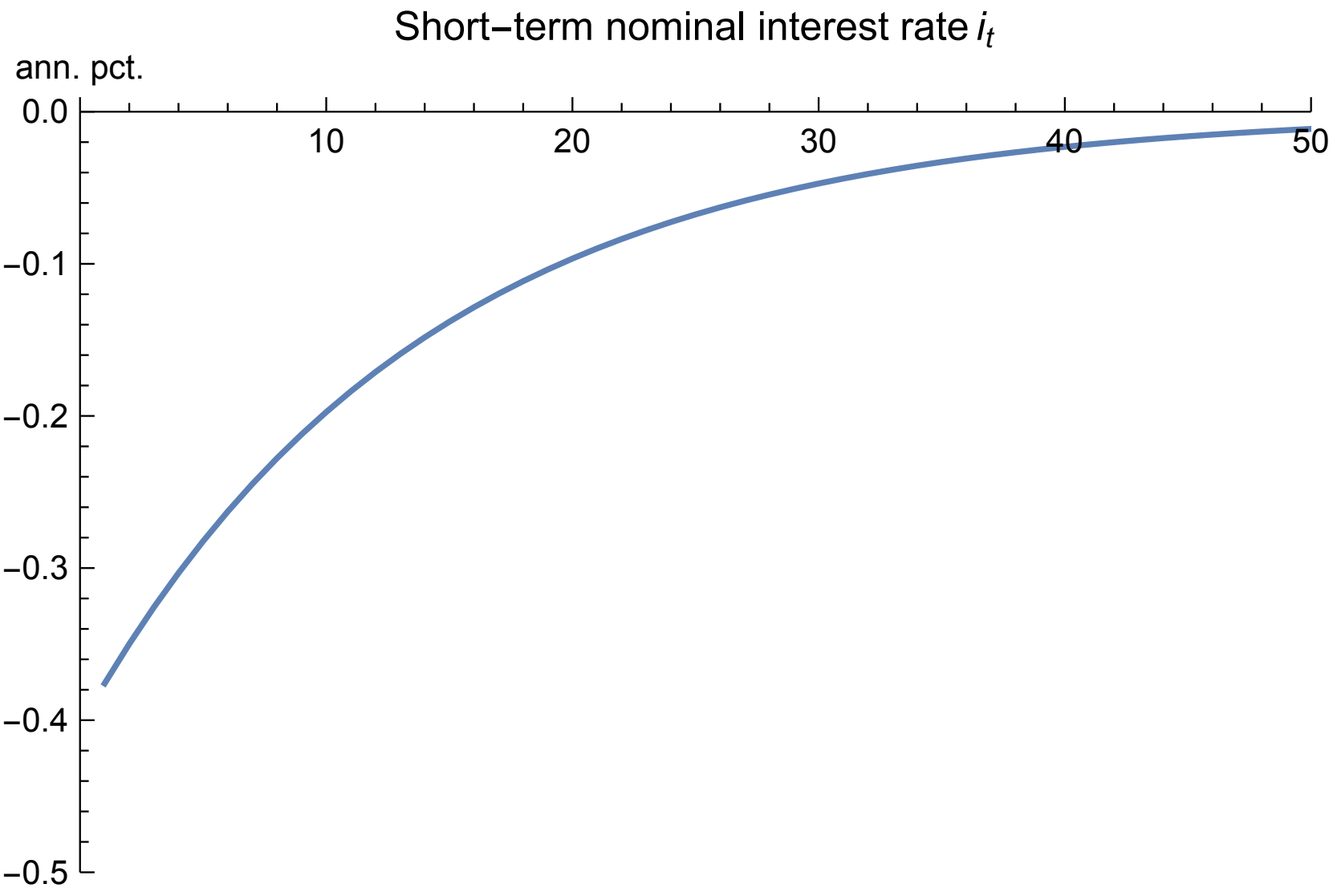

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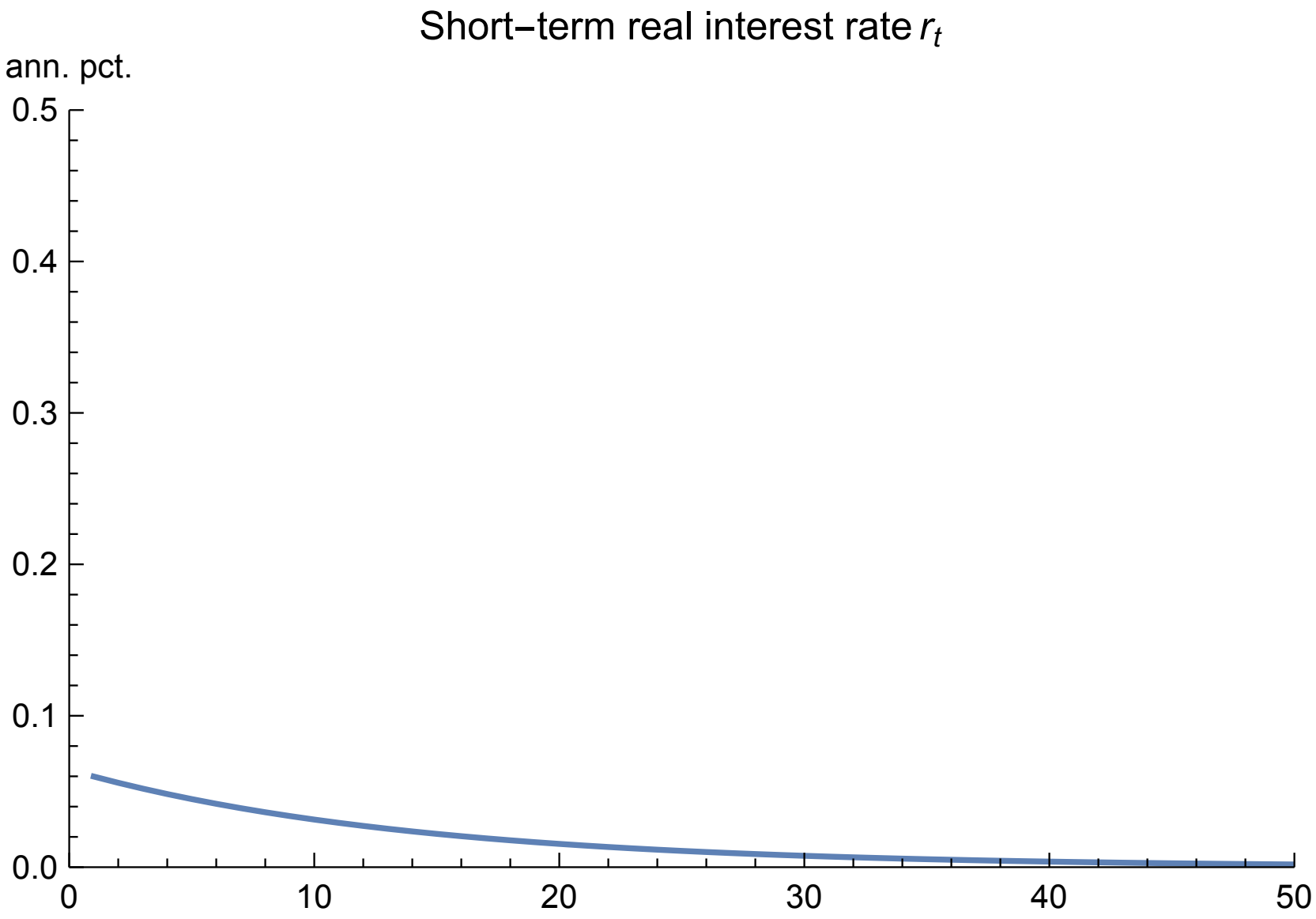

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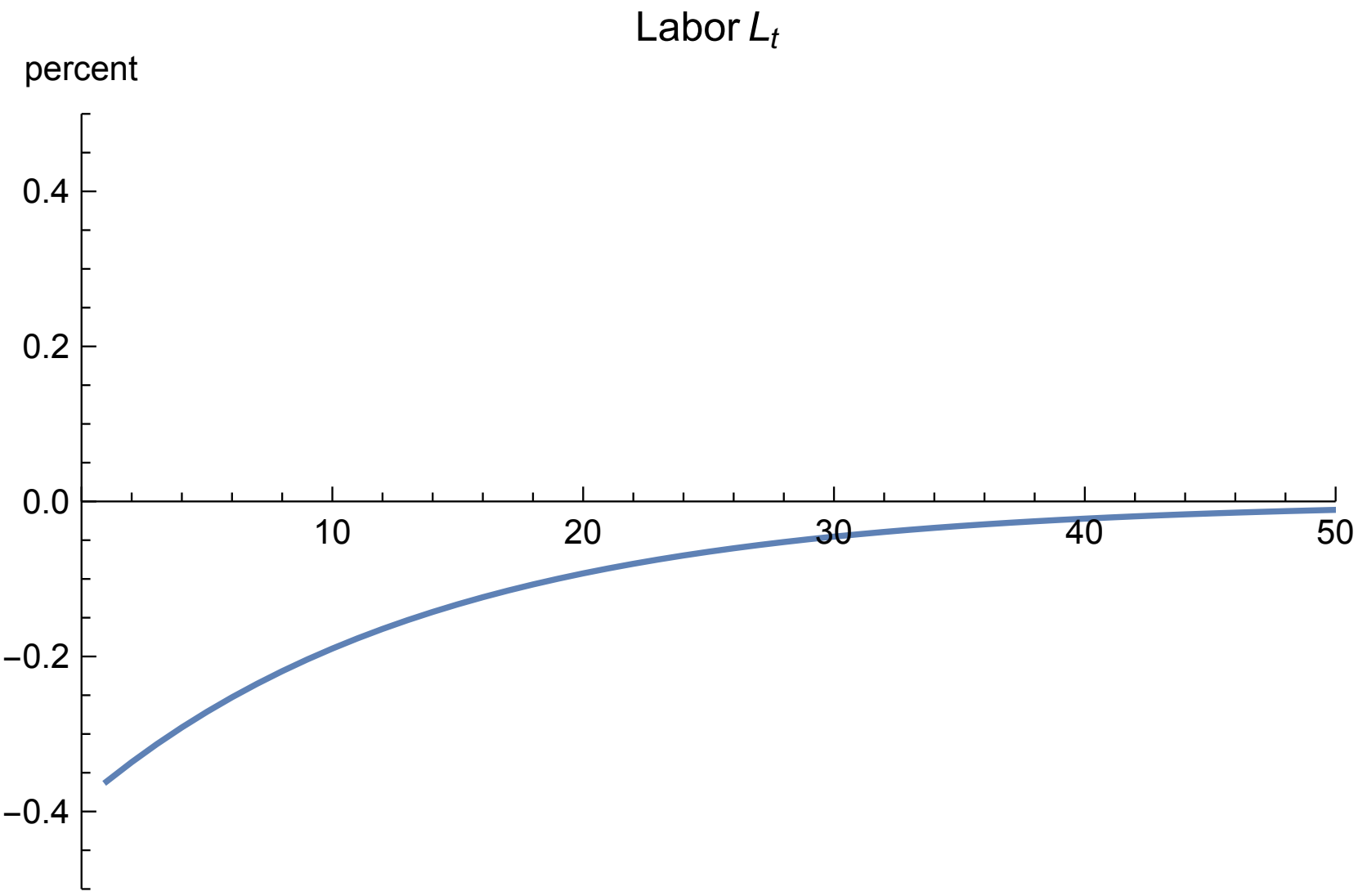

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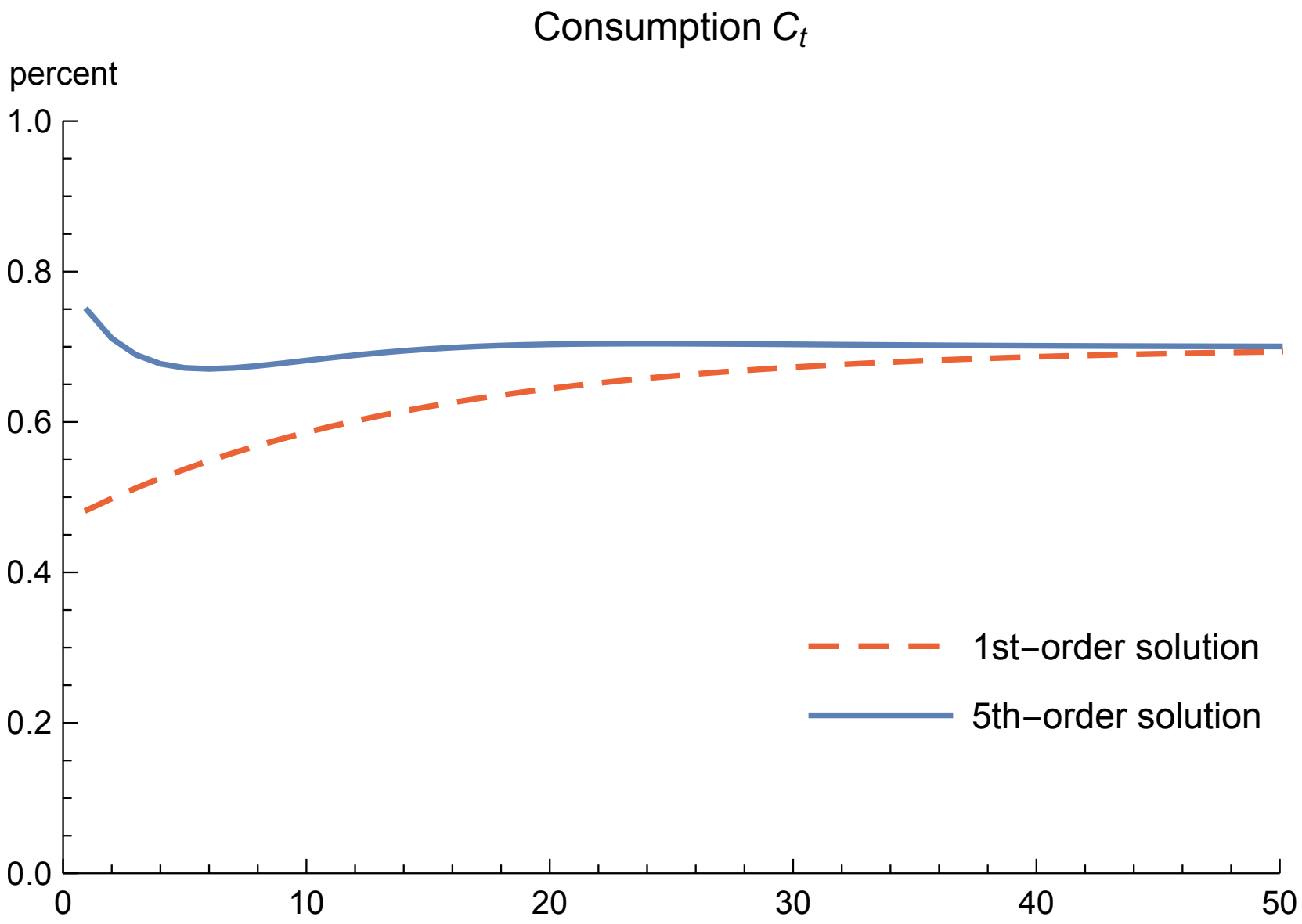

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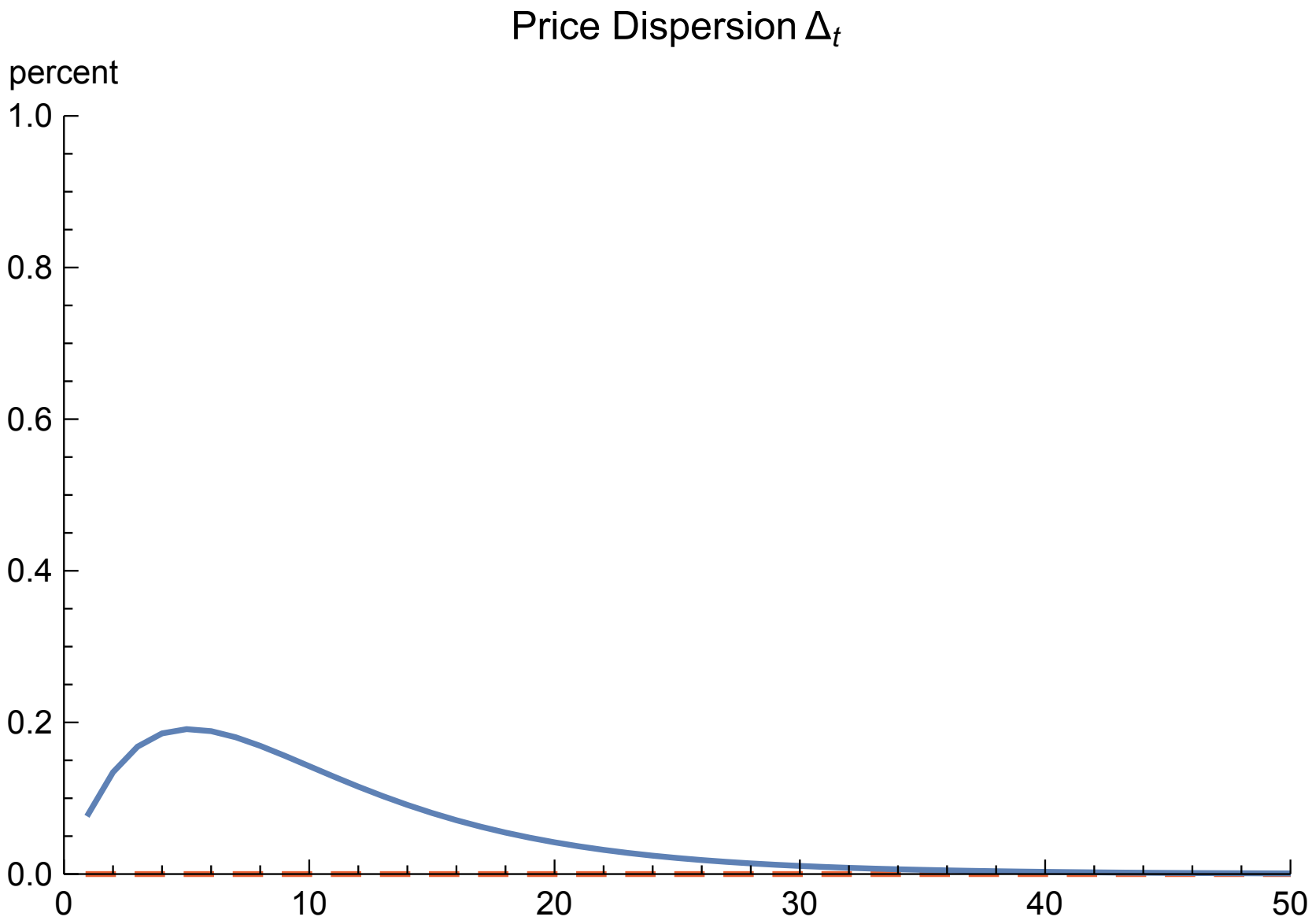

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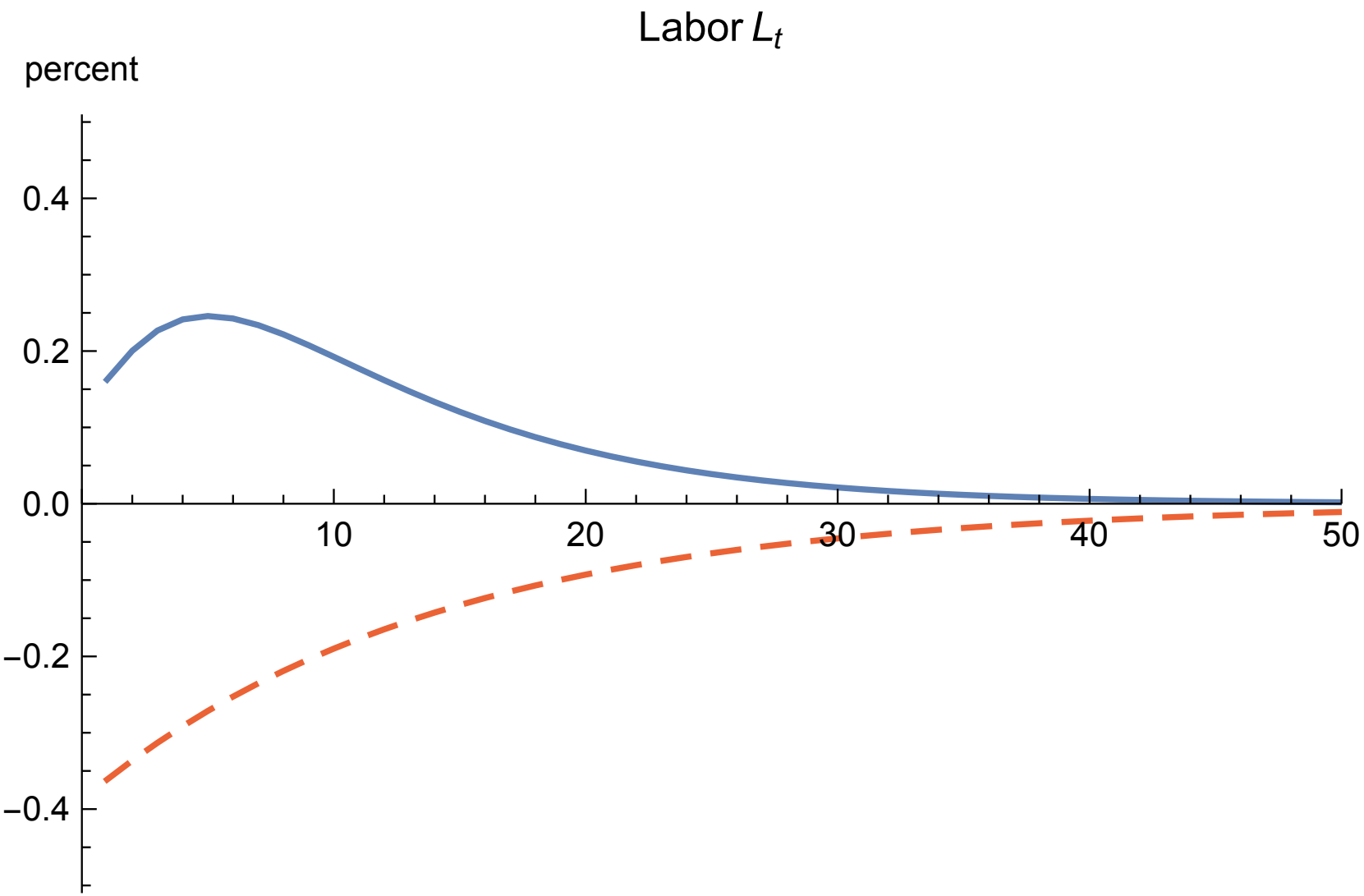

Equity: Levered Consumption Claim

Equity price

$$p_t^e = E_t m_{t+1}(C_{t+1}^{\nu} + p_{t+1}^e)$$

where ν is degree of leverage

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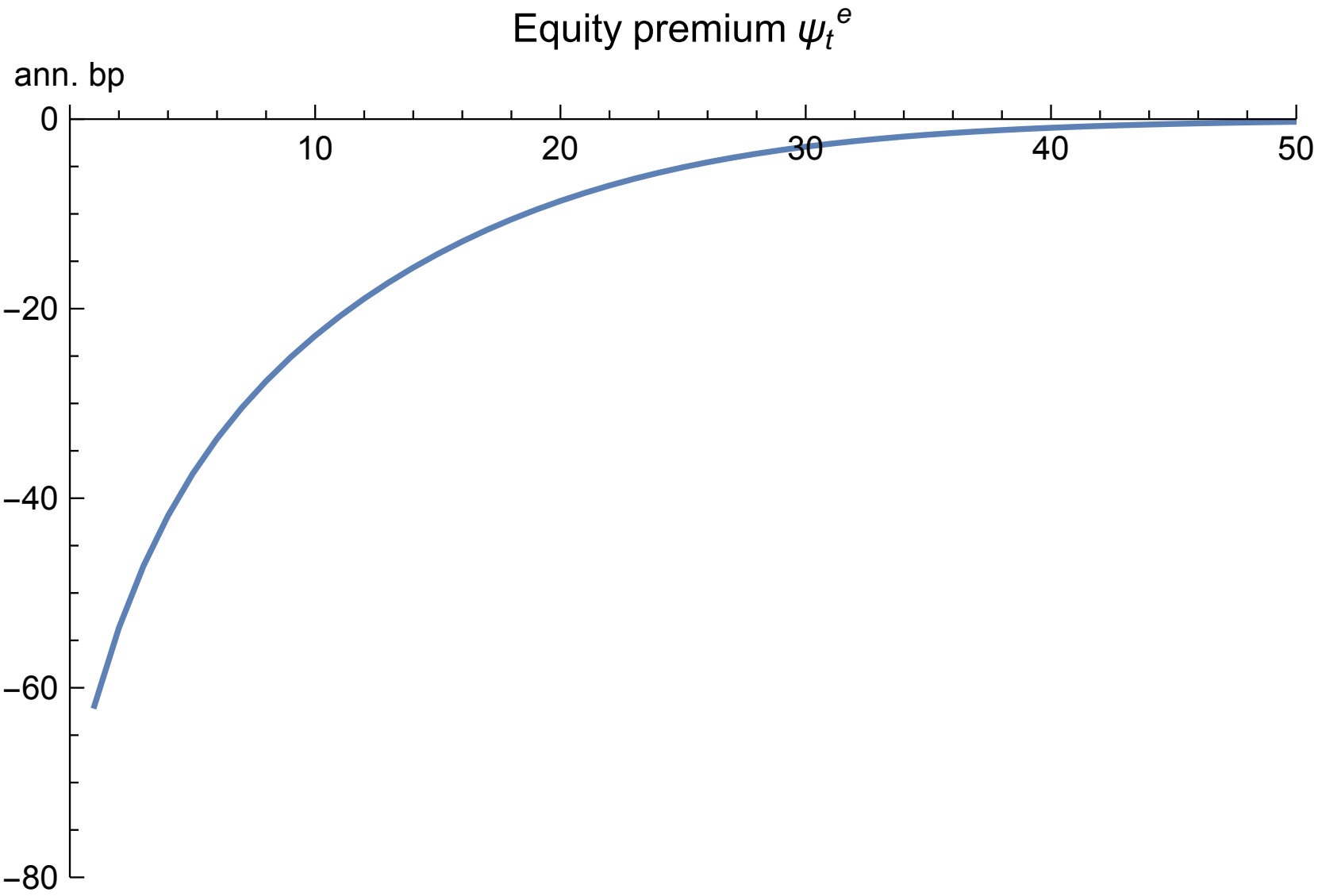

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Real Yield Curve

Table 3: Real Zero-Coupon Bond Yields

	2-yr.	3-yr.	5-yr.	7-yr.	10-yr.	(10y)−(3y)
US TIPS, 1999–2014[a]			1.37	1.63	1.90	
US TIPS, 2004–2014[a]	0.19	0.32	0.65	0.95	1.28	0.96
US TIPS, 2004–2007[a]	1.39	1.52	1.74	1.91	2.09	0.57
UK indexed gilts, 1983–1995[b]	6.12	5.29	4.34		4.12	−1.17
UK indexed gilts, 1985–2014[c]		2.02	2.16	2.26	2.35	0.33
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macroeconomic model	1.94	1.93	1.93	1.93	1.93	0.00

[a]Gürkaynak, Sack, and Wright (2010) online dataset
[b]Evans (1999)
[c]Bank of England web site

Nominal Yield Curve

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US Treasuries, 1961–2014[a]	5.36	5.59	5.77	6.05	6.26		
US Treasuries, 1971–2014[a]	5.53	5.77	5.97	6.29	6.54	6.81	1.28
US Treasuries, 1990–2007[a]	4.56	4.84	5.06	5.41	5.68	5.98	1.42
UK gilts, 1970–2014[b]	7.07	7.25	7.41	7.65	7.84	8.02	0.95
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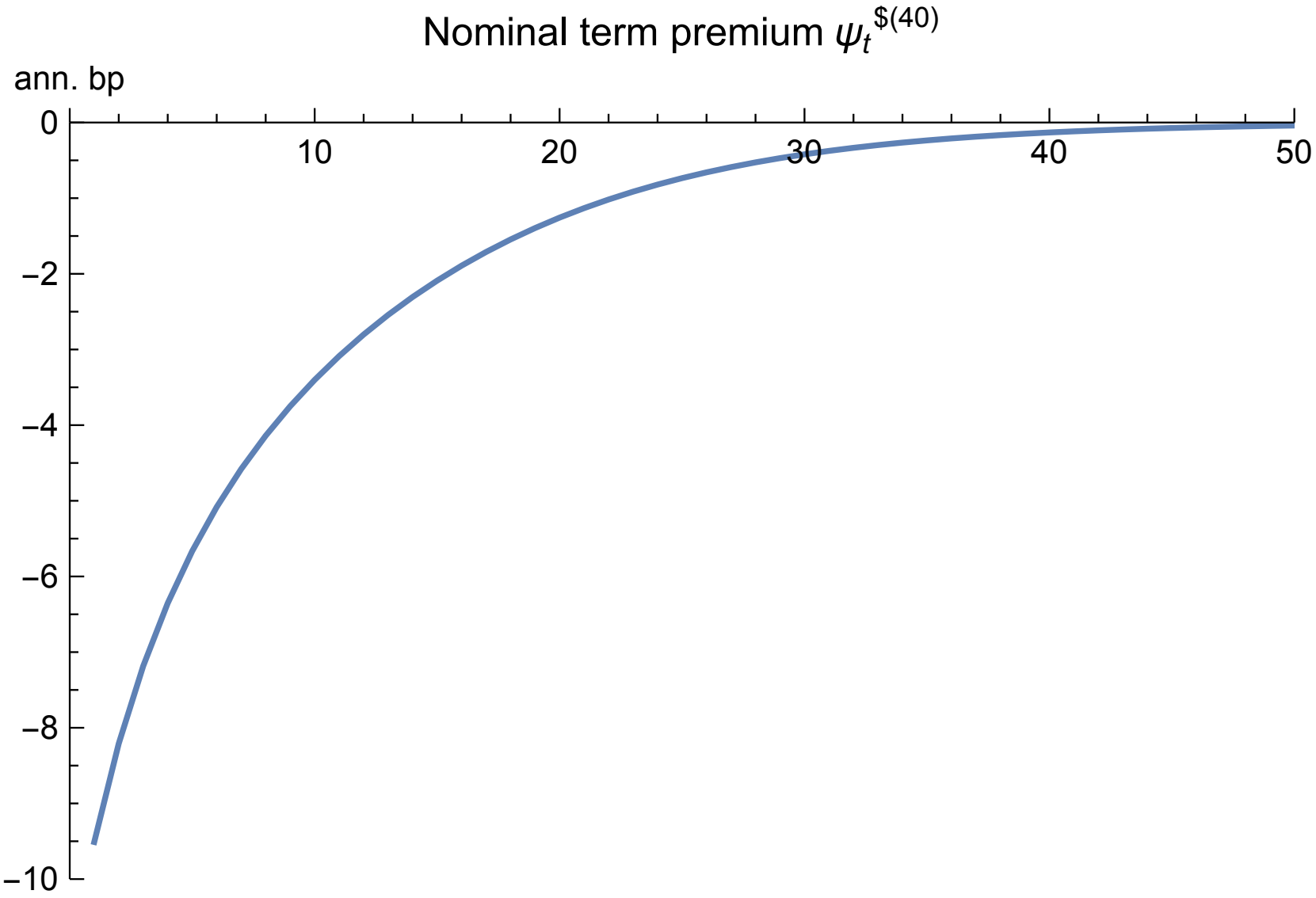
Supply shocks make nominal long-term bonds risky: inflation risk

Nominal Term Premium



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Nominal consol with default:

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The credit spread is $i_t^d - i_t^c$

Table 5: Credit Spread

average ann. default prob.	cyclicality of default prob.	average recovery rate	cyclicality of recovery rate	credit spread (bp)
.006	0	.42	0	34.0

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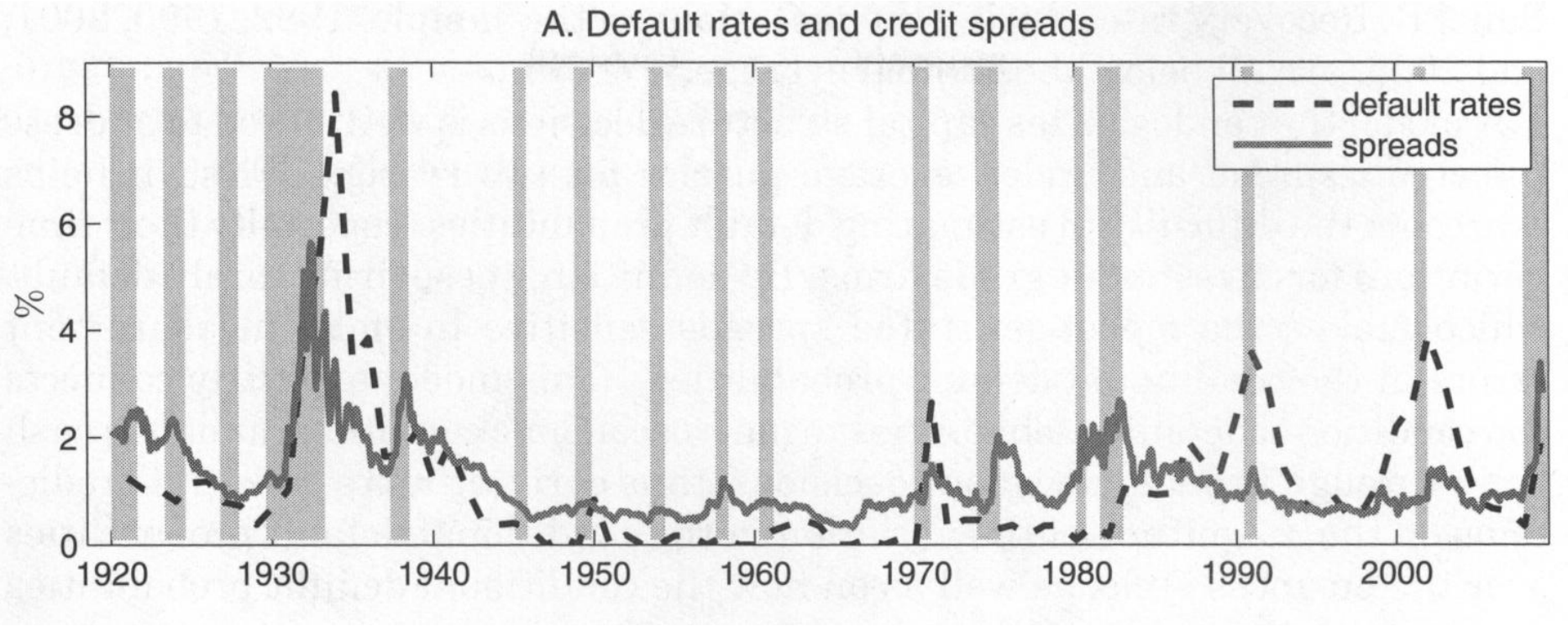
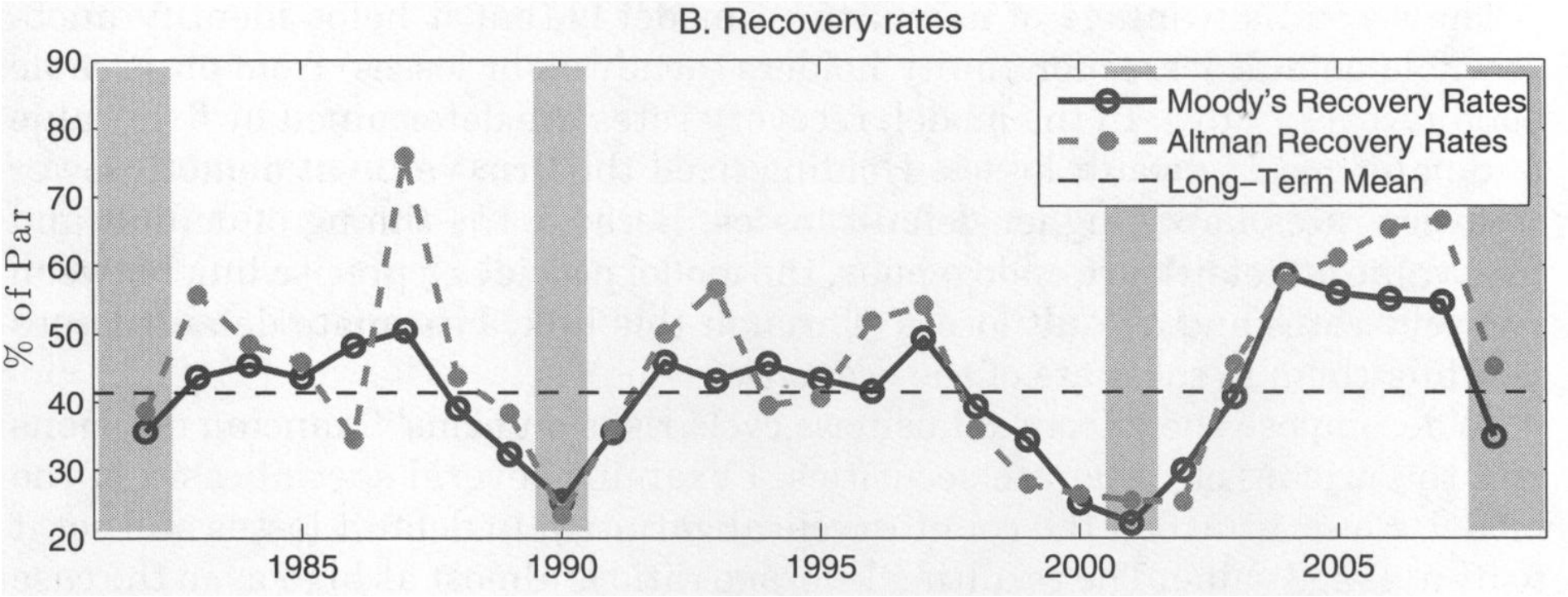
If default is not cyclical, then it's not risky

Default Rate is Countercyclical



source: Chen (2010)

Recovery Rate is Procyclical



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Discussion

1. Endogenous conditional heteroskedasticity
2. IES ≤ 1 vs. IES > 1
3. Volatility shocks
4. Monetary and fiscal policy shocks
5. Financial accelerator

Endogenous Conditional Heteroskedasticity

Note that

$$\psi_t^e \equiv E_t R_{t+1}^e - e^{r_t}$$

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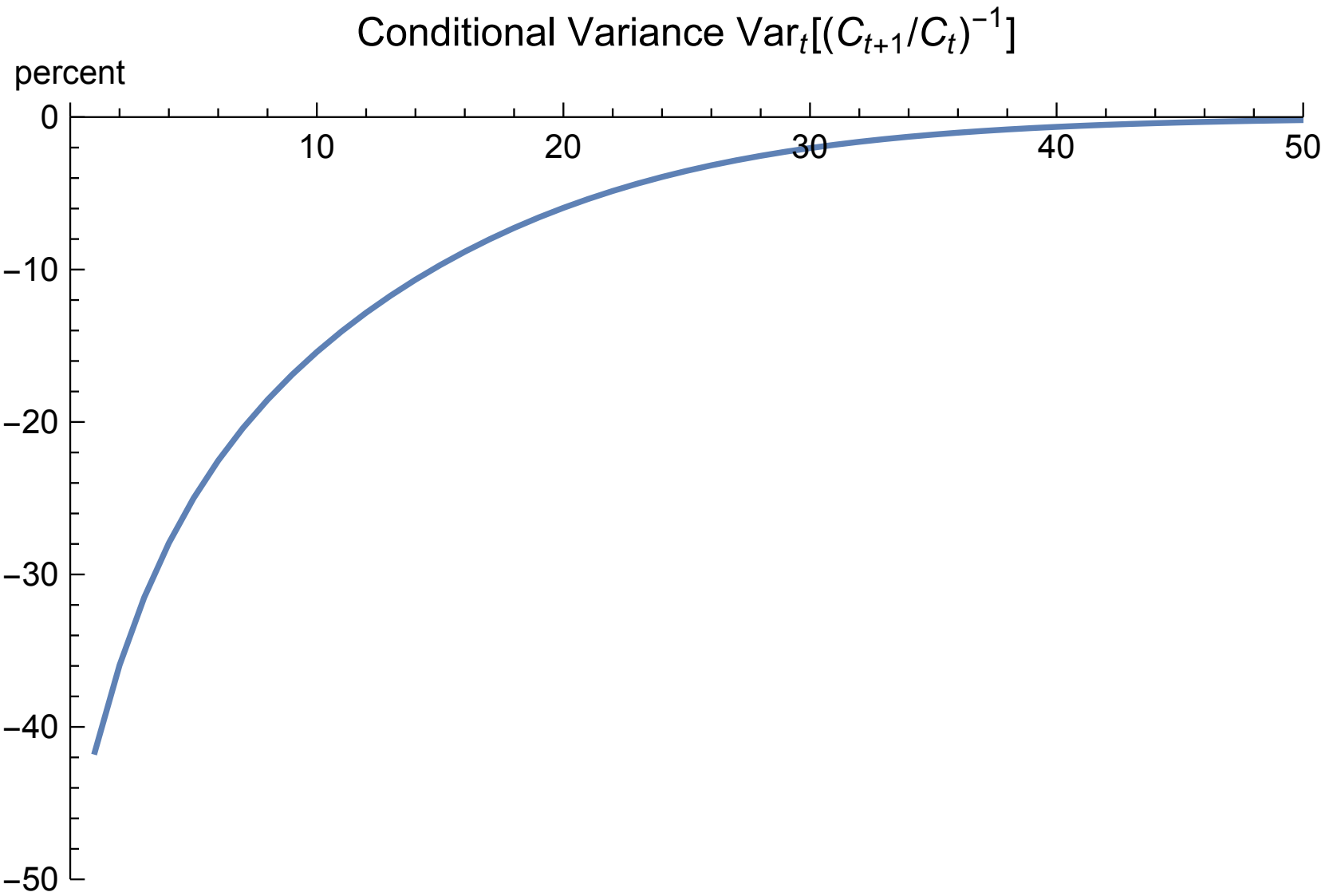
Nonlinear solution contains terms of form

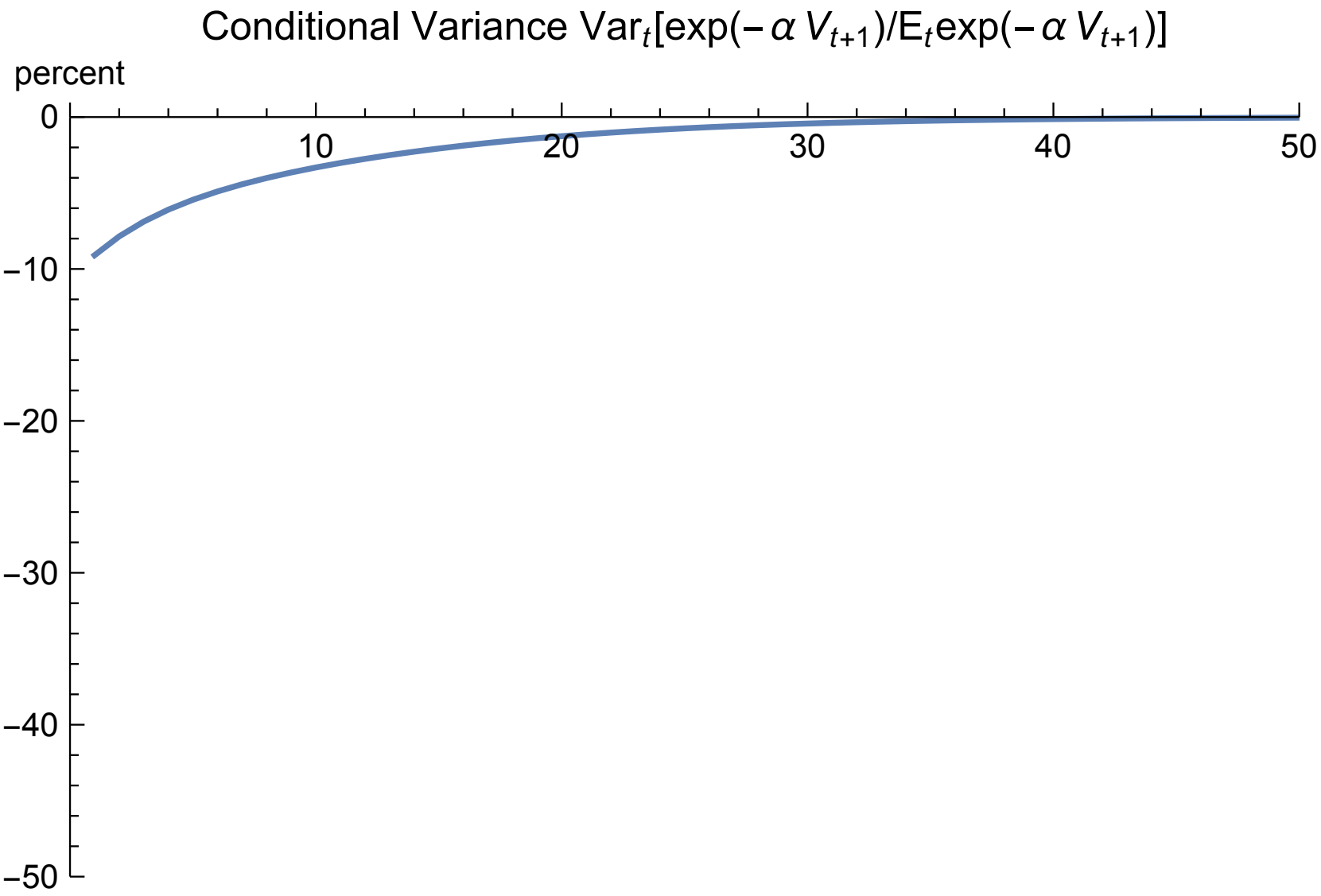
$$x_t \varepsilon_{t+1}$$

so covariance Cov_t depends on state x_t

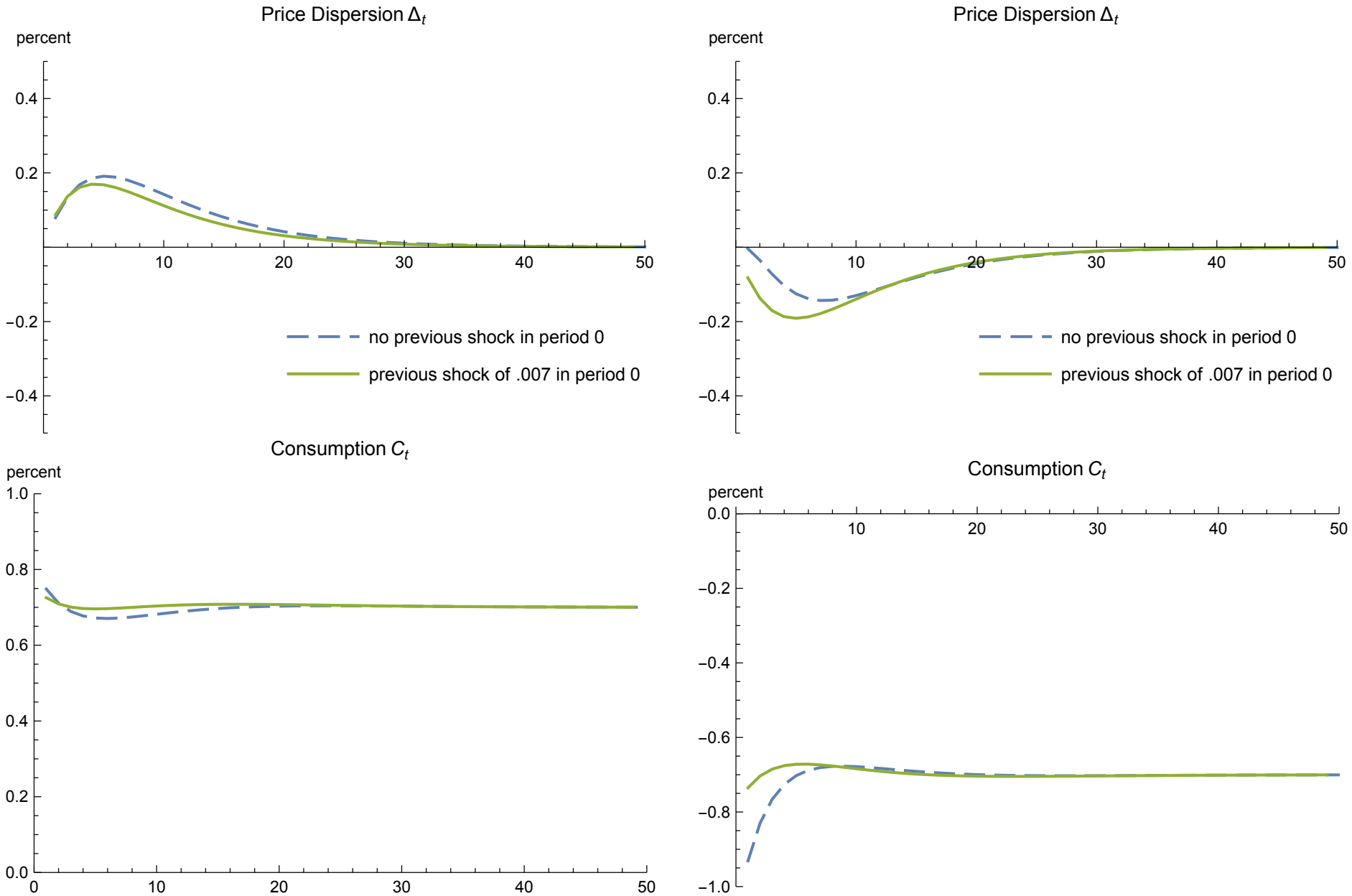
Impulse Responses for Conditional Variance



Impulse Responses for Conditional Variance



Impulse Responses to Pos. and Neg. Tech. Shocks



Intertemporal Elasticity of Substitution

Long-run risks literature typically assumes IES > 1, for two reasons:

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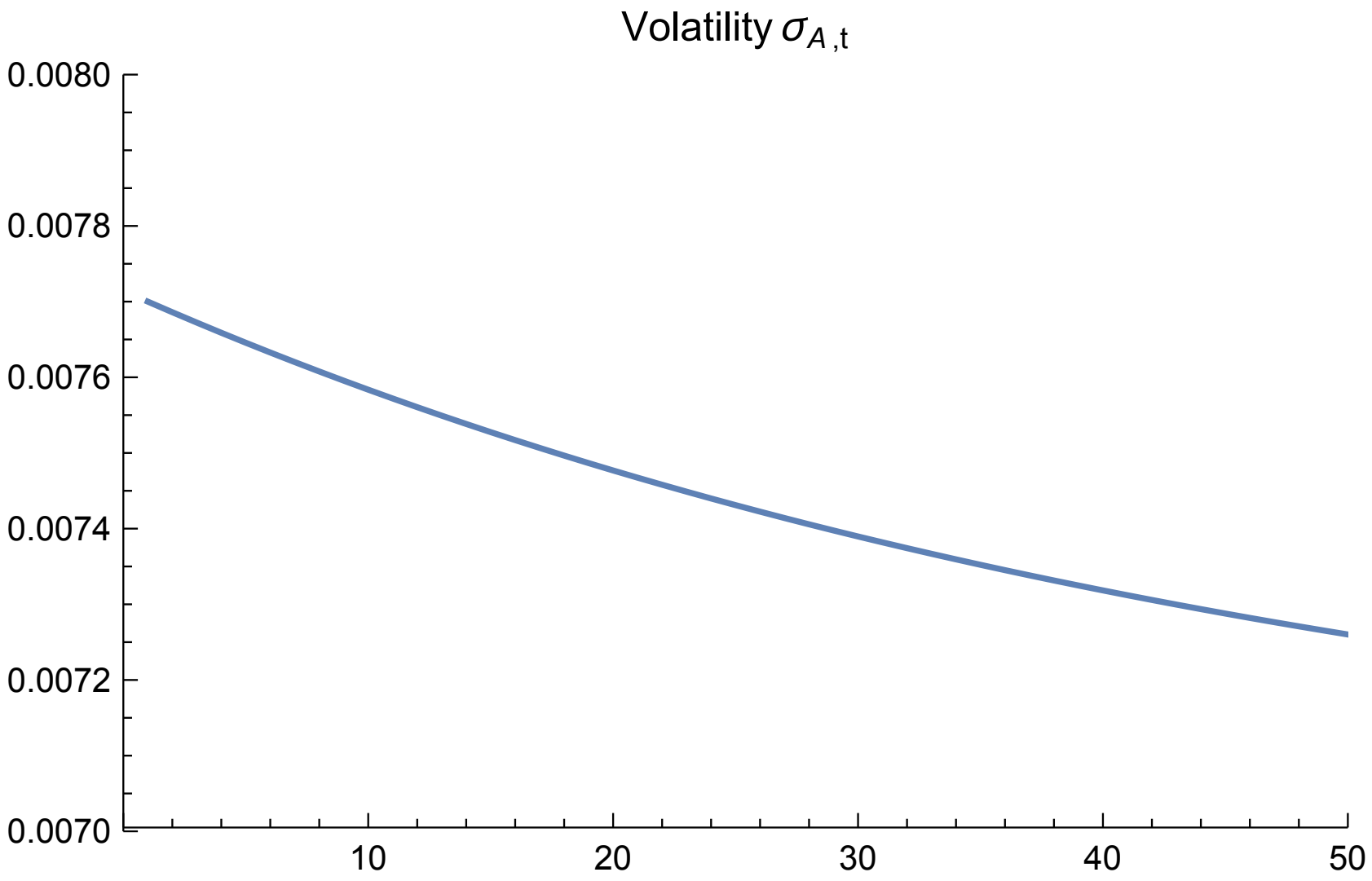
Calibration: $\rho_\sigma = .98$, $\text{Var}(\varepsilon_t^\sigma) = (0.1)^2$

Impulse Responses to Volatility Shock



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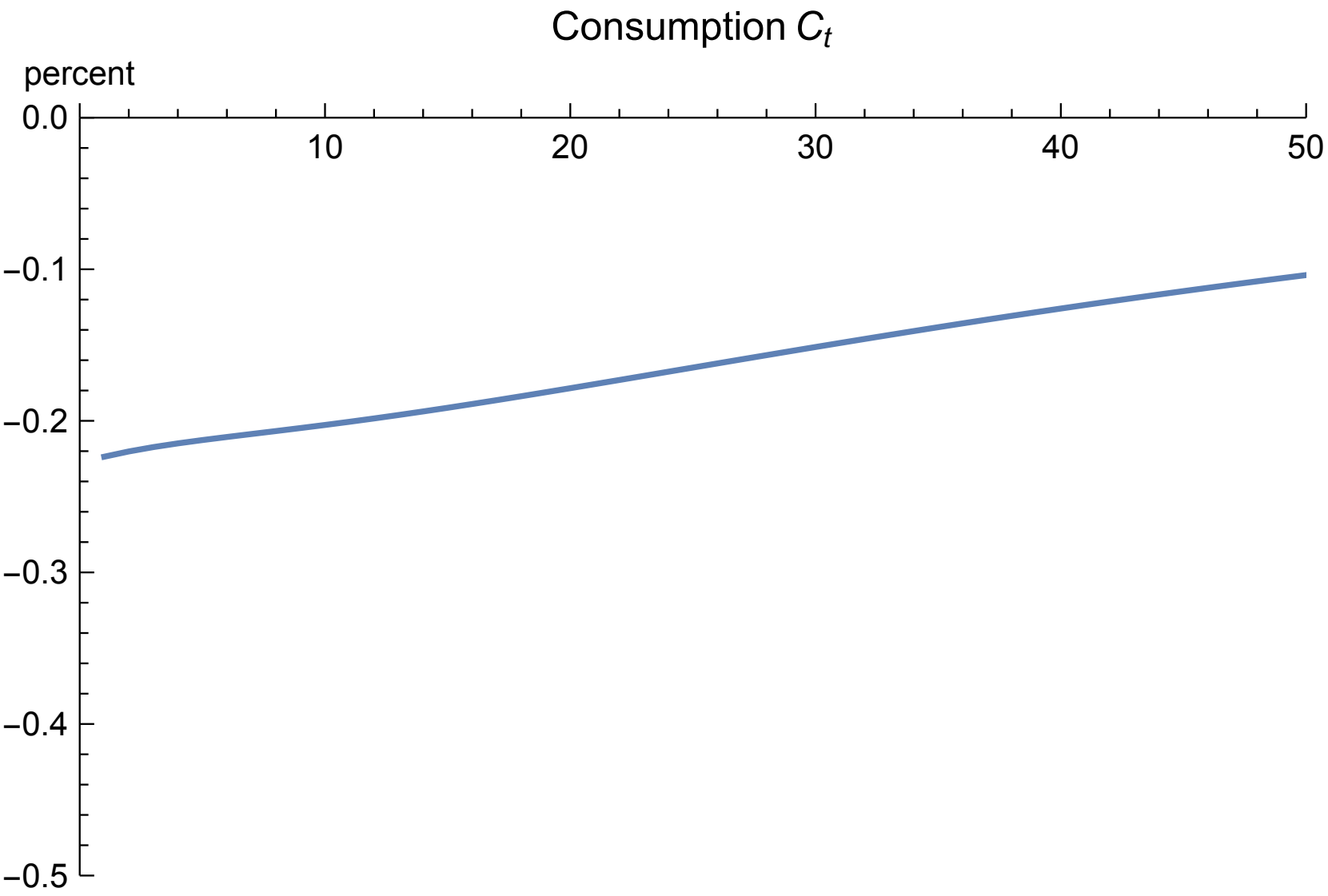

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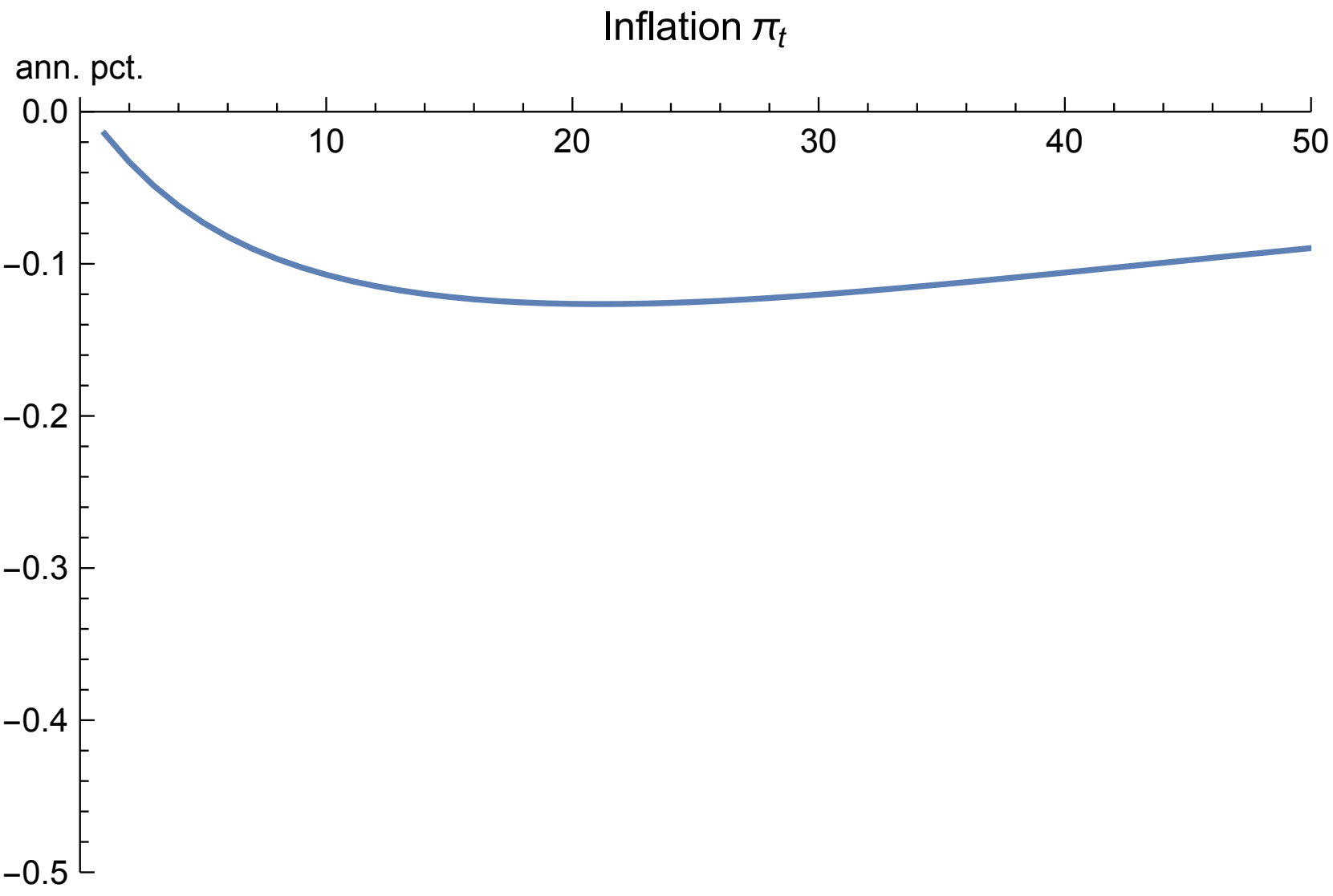

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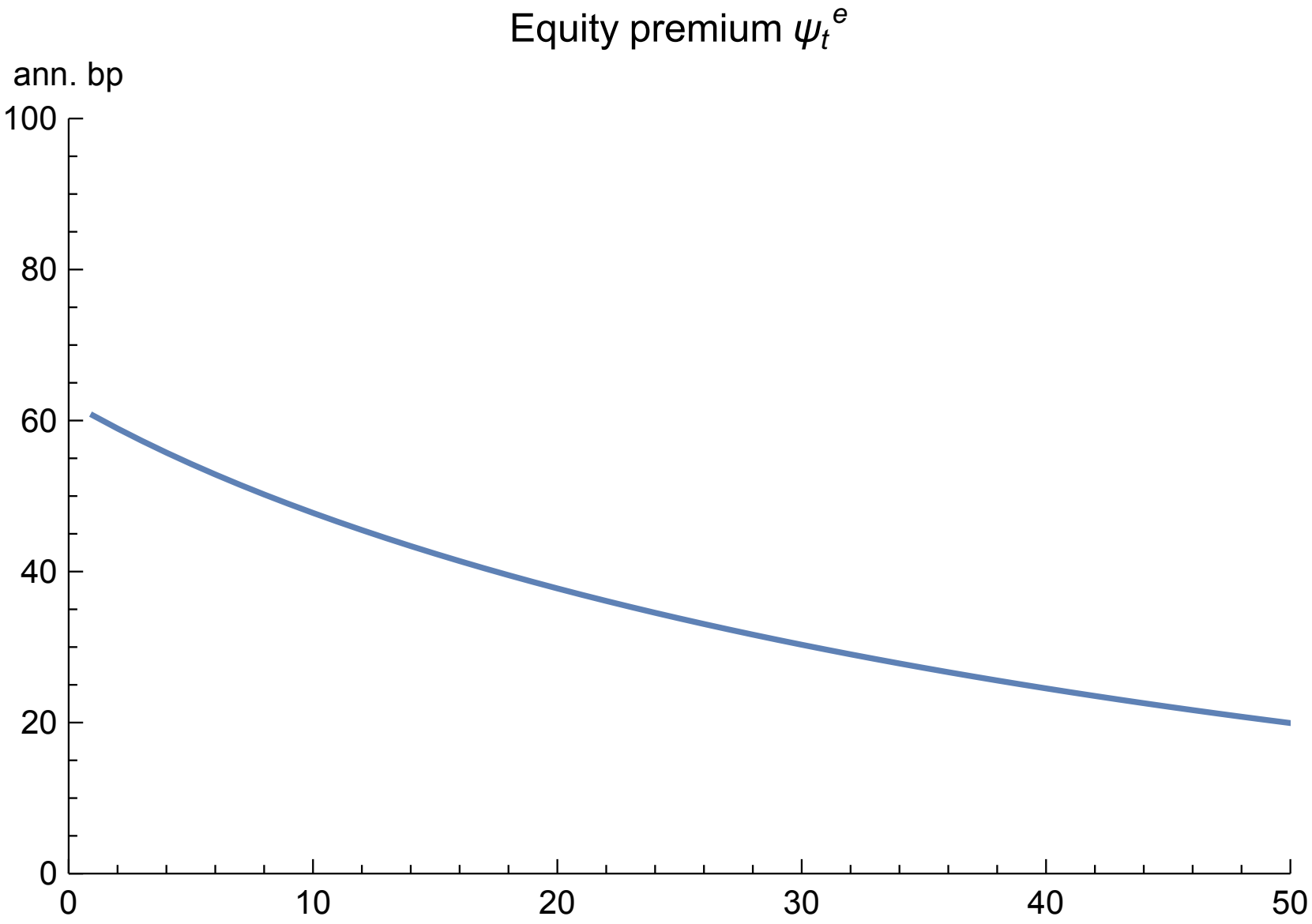

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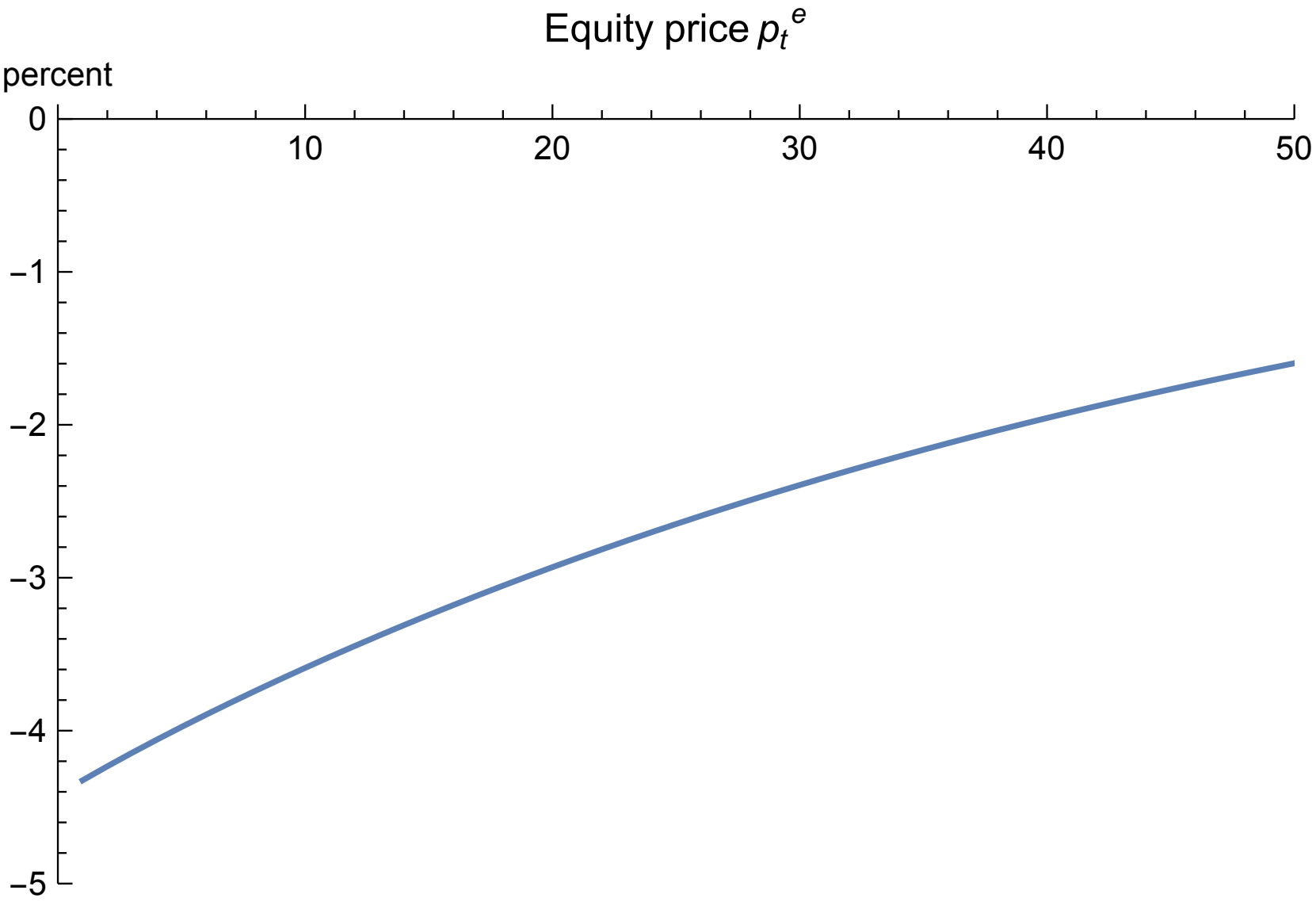

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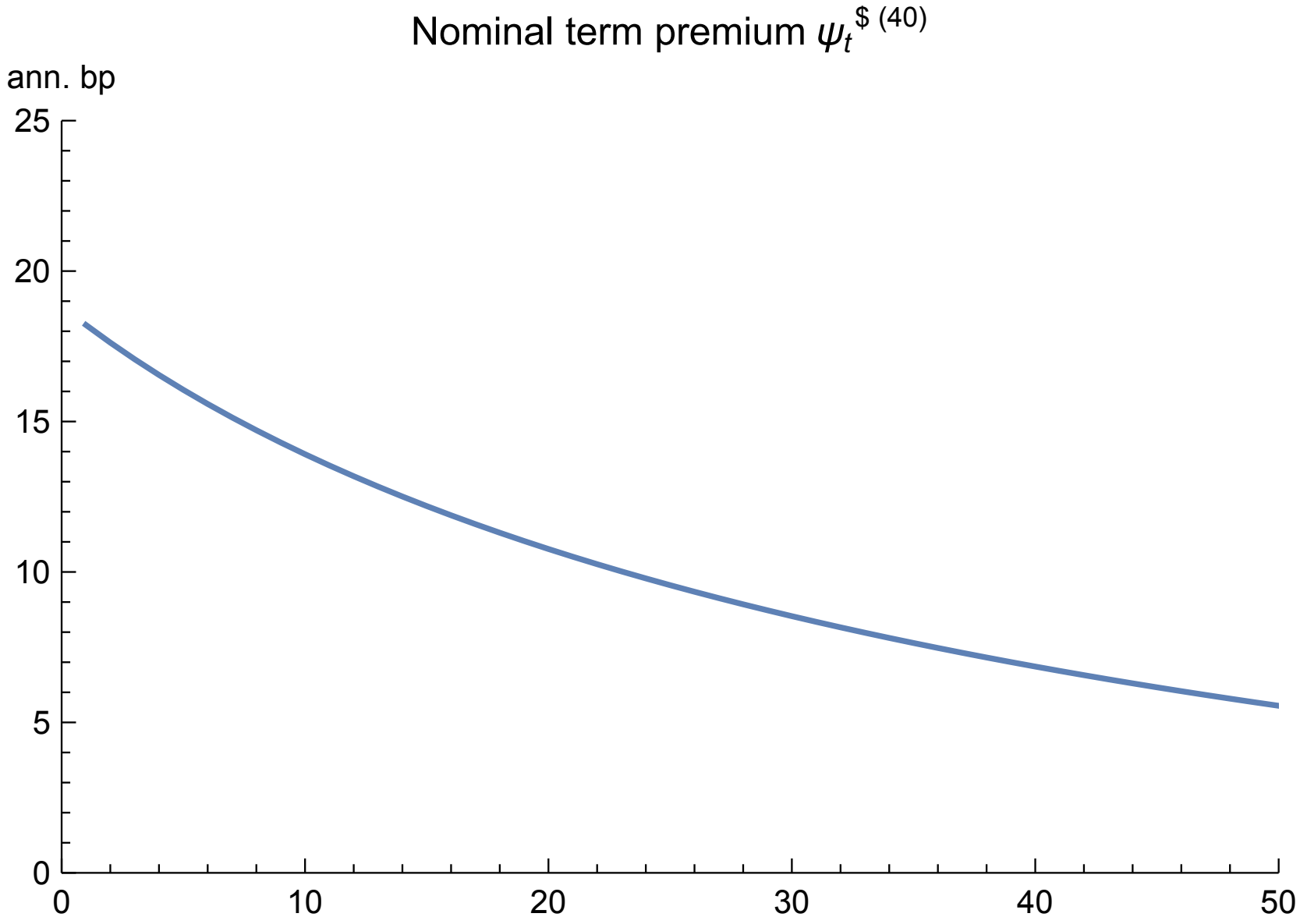

Monetary and Fiscal Policy Shocks

Rudebusch and Swanson (2012) consider similar model with

- technology shock
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All three shocks help the model fit macroeconomic variables

But technology shock is most important (by far) for fitting asset prices:

- technology shock is more persistent
- technology shock makes nominal assets risky

No Financial Accelerator

With model-implied stochastic discount factor m_{t+1}, we can price any asset

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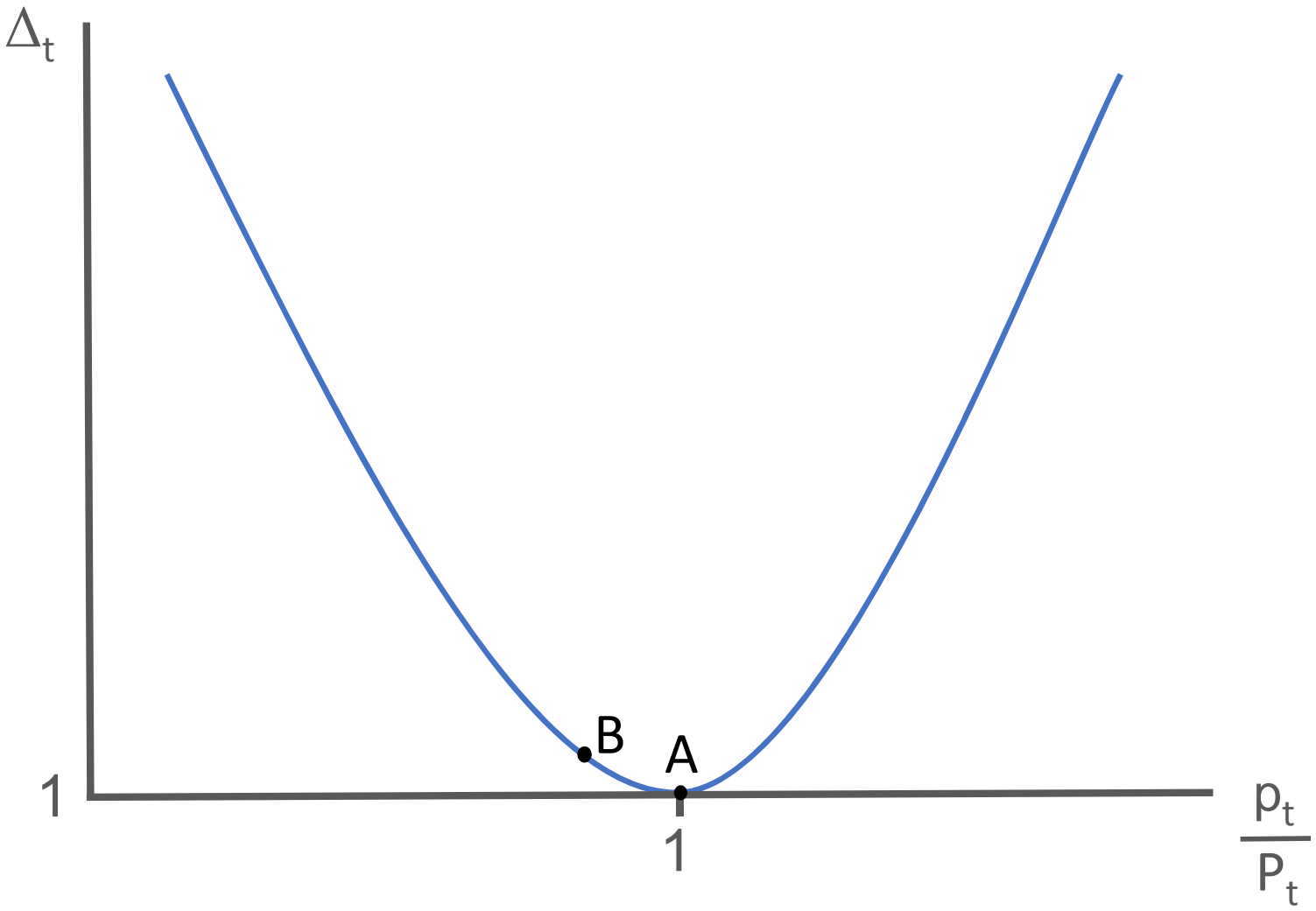
...but not in this paper

Conclusions

1. The standard textbook New Keynesian model (with Epstein-Zin preferences) is consistent with a wide variety of asset pricing facts/puzzles
2. Unifies asset pricing puzzles into a single puzzle—Why does risk aversion in macro models need to be so high?
   (Literature provides good answers to this question)
3. Provides a structural framework for intuition about risk premia
4. Suggests a way to model feedback from risk premia to macroeconomy


Δ_t
B
A
1
1
$\frac{p_t}{P_t}$