Sticky Discount Rates

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Introduction

Modern Macro

- Price/wage rigidity crucial for fiscal and monetary policy

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Today: Evidence on New Rigidity

- Firm discount rates (required returns to capital) are sticky w.r.t. inflation
- Inflation directly affects real discount rates and investment

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Today: Model with Sticky Discount Rates

- New source of monetary non-neutrality
- Interest rate policy less effective, inflation target more effective
- Demand shocks and fiscal spending "crowd in" investment

Conceptual Overview

Firms invest if

$$\text{nominal expected return} > \delta,$$

where δ = nominal required return = discount rate

Textbook model

- δ = nominal cost of capital = $r + \pi$
  - r = real cost of capital (interest rate)
  - π = expected inflation
  - Dynamic: $\Delta\delta = \Delta r + \Delta\pi$
  - similarly, expected return changes with $\Delta\pi$

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- Implies inflation neutrality
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  - Real investment depends on Δr and not $\Delta\pi$

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Sticky discount rate model

- $\Delta\delta \approx 0 \Rightarrow \Delta\delta^{\text{real}} \approx -\Delta\pi$
- Inflation directly impacts real investment

Data from Corporate Conference Calls

Use data on $\Delta\delta$ from conference calls to study "extreme" stickiness w.r.t. inflation

Example Nasdaq 100 firm Intuit, Q1-2014:
We invest in opportunities that yield 15%-plus. Our weighted average cost of capital is about 9 or 9.5% ... Our IRR hurdle is a 15% rate of return.

- Discount rate: 15%
- Perceived COC: 9.25%

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- 3,200 discount rates, 3,200 perc. COC
- representative of listed firms, except larger firms
- within-firm changes in discount rates predict changes in investment
- repeated, high-stakes interactions, cited in lawsuits (Rogers et al. 2011)
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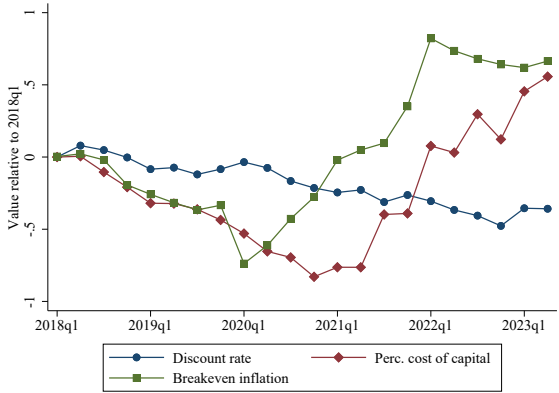
Add 10-year breakeven inflation = fin. markets' exp. inflation

Example of the “Soaring 20s”



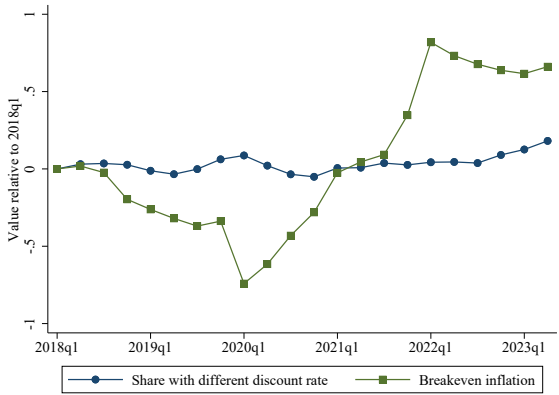
Fin. markets expect inflation

Firms expect inflation (also in Coibion-Gorodnichenko survey) and increase perceived COC

But: discount rates are sticky

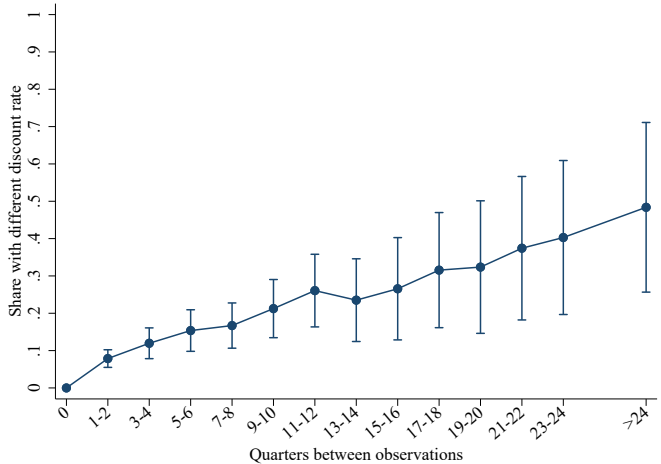
Holds in global sample 2002-23

Share With Different Discount Rate



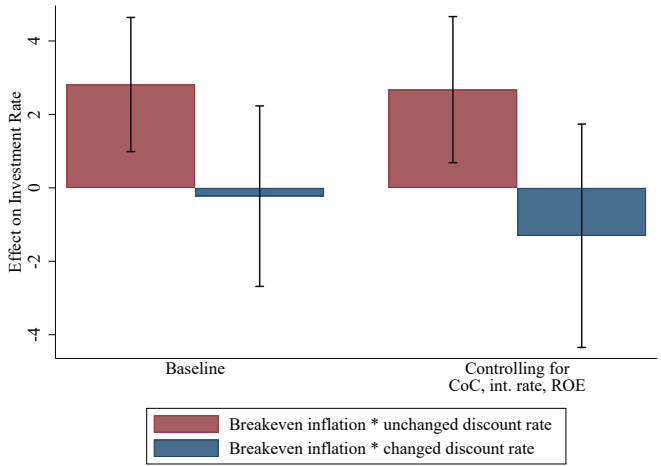
Share adjusting their discount rate relatively constant over time

Changes in Discount Rates Are Rare



$\sim$ 5% of firms change discount rate per quarter

Expected Inflation Raises Investment Only With Sticky Discount Rates



Only firms with unchanged discount rates respond to exp. inflation

Discussion of Evidence

Firm prices, cash flows, COC, investment seem to respond to exp. inflation (Coibion et al. 2018, 2020; Meyer et al. 2021; Andrade et al. 2022; Bunn et al. 2022), but not discount rates

Potential explanations

- Commitment devices against managerial empire building (Jensen 1986)
- Inattention or errors, but only w.r.t. discount rate (Reis 2006; Gorodnichenko 2008; Coibion and Gorodnichenko 2015; Graham 2022)

Next: model with sticky discount rates

Firm Problem with Sticky Discount Rates

Two-step setup: (1) investment, (2) discount rate

(1) Textbook investment problem:

$$V_t^I(k,\delta_t) = \max_{k',I} \Omega_t(k) - P_t(I+\Phi(I,k)) + \frac{1}{1+\delta_t}\mathbb{E}_t V_{t+1}^I(k',\delta_t)$$
$$\text{s.t.} \quad k' = (1-\xi)k + I,$$

Solution: investment policy $I_t(k,\delta_t)$

Firm Problem with Sticky Discount Rates

(2) Random fraction $1-\theta$ can adjust δ_t

Adjusters max. fin. market value:

$$V_t^a(k) = \max_{\delta_t} \Omega_t(k) - P_t(I + \Phi(I,k)) + \frac{1}{1+i_t}\mathbb{E}_t\left[\theta V_{t+1}^n(k',\delta_t) + (1-\theta)V_{t+1}^a(k')\right]$$

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First-order solution:

$$\hat{\delta}_t^* = \frac{1+r-\theta}{1+r}\widehat{coc}_t + \frac{\theta}{1+r}\hat{\delta}_{t+1}^*,$$

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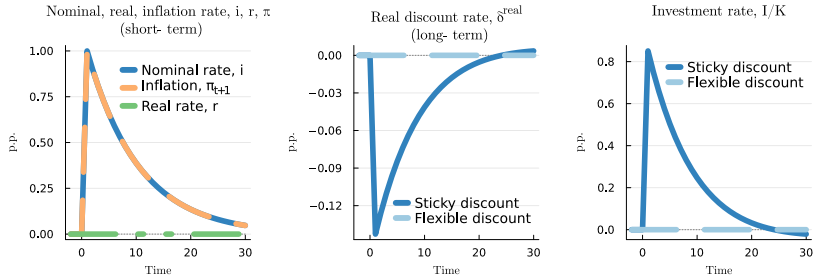
$\theta = 0 \Rightarrow \hat{\delta}_t^* = \widehat{coc}_t \Rightarrow$ textbook solution

$\theta \neq 0 \Rightarrow \hat{\delta}_t^* \neq \widehat{coc}_t \Rightarrow$ investment differs from textbook

$\theta = 0.95$ in data, 5% change per quarter

Key Mechanism 1: Expected Inflation and Investment



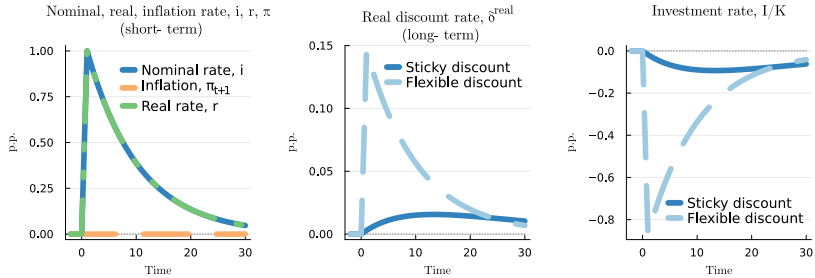
Recall:
$$i = r + \pi$$
$$\delta^{\text{real}} = \delta - \pi$$

Shock only π (partial equilibrium)

Flexible: $\pi \uparrow \Rightarrow i \uparrow \Rightarrow \delta \uparrow \Rightarrow \delta^{\text{real}} \not\downarrow$

Sticky: $\pi \uparrow \Rightarrow i \uparrow \Rightarrow \delta \not\uparrow \Rightarrow \delta^{\text{real}} \downarrow$

Key Mechanism 2: Interest Rate Sensitivity



Recall: $i = r + \pi$

Shock only r (partial equilibrium)

Flexible: $r \uparrow \Rightarrow i \uparrow \Rightarrow \delta \uparrow \Rightarrow \delta^{\text{real}} \uparrow$

Sticky: $\pi \uparrow \Rightarrow i \uparrow \Rightarrow \delta \nearrow \Rightarrow \delta^{\text{real}} \nearrow$

Helps resolve the puzzle of why investment sensitivity is often too high

General Equilibrium

Standard NK model with sticky prices (0.75, Nakamura and Steinsson 2008) and hand-to-mouth households (30%)

Taylor rule with shocks and inflation target

Fiscal spending financed by initial deficit

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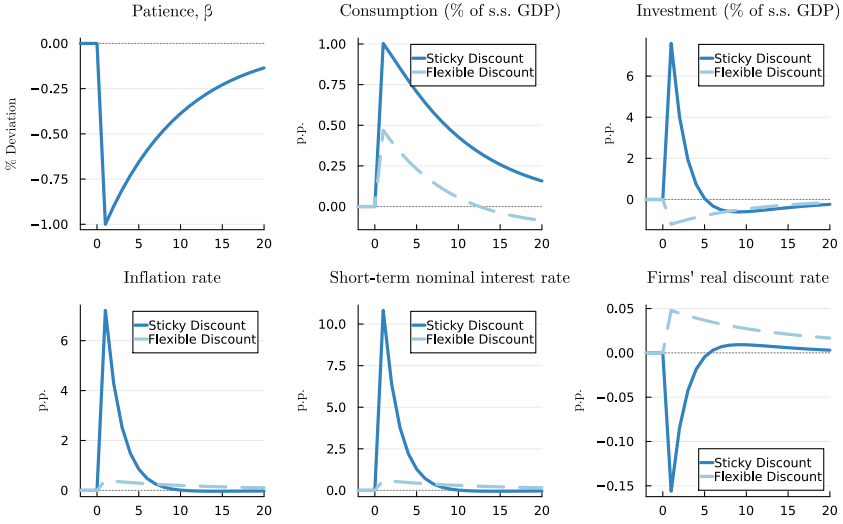
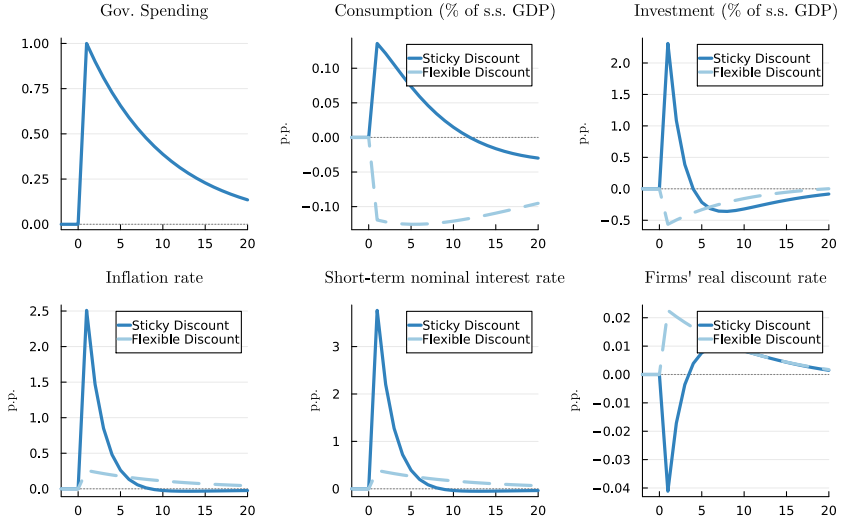
Findings

- Household demand $\uparrow \Rightarrow$ consumption and investment $\uparrow \Rightarrow$ addresses "comovement puzzle" (Barro and King 1984)
- Fiscal spending "crowds in" investment
- Monetary non-neutrality (even with flexible prices): inflation target $\uparrow \Rightarrow$ investment $\uparrow$
- Policy rate shock $\Rightarrow$ investment $\nearrow$ (less than textbook)

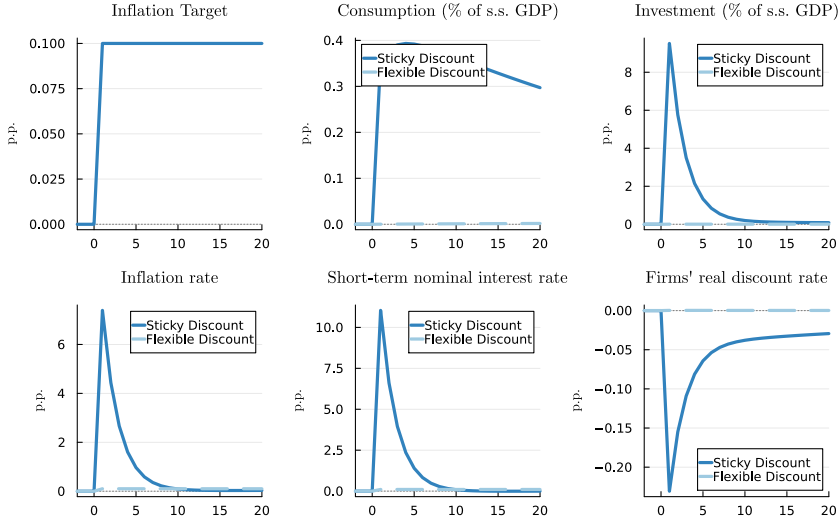
Demand Shocks Generate Comovement



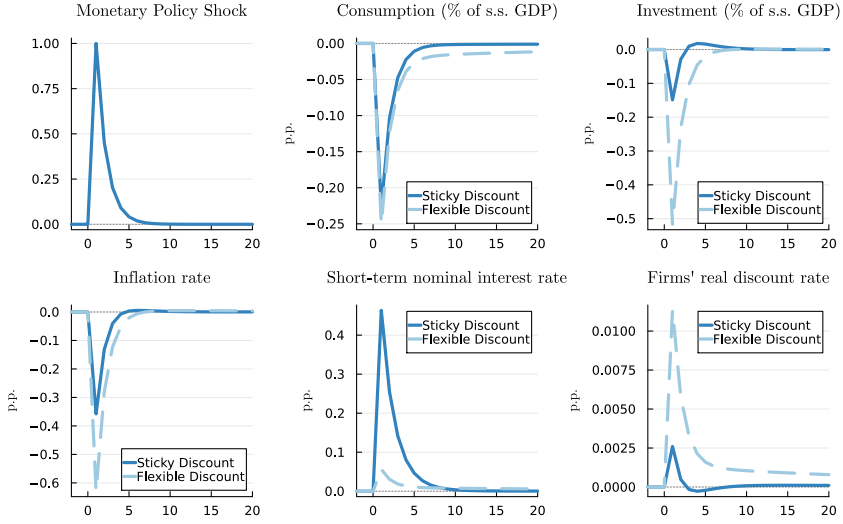
Fiscal Spending Crowds In Investment



Long-Run Inflation Target Raises Investment



Monetary Policy Shocks Work, But Less Strongly



Lessons for Optimal Policy

Sticky discount rates introduce new inefficiencies

1. misallocation across firms: same technology, different investment
2. suboptimal aggregate investment

Central banks with credible future policy

- change long-run target in response to temporary shocks
- most effective way of closing discount rate wedges
- low welfare losses from sticky discount rates, albeit (small) cost due to long-run inflation

Non-credible central banks

- have to rely on less effective short-run rate
- large welfare losses from sticky discount rates

Summary

Discount rates are sticky w.r.t. inflation

Implications for macro

1. Monetary non-neutrality (even with flexible prices)
2. Inflation expectations affect investment
3. Demand shocks generate I-C comovement
4. Fiscal spending becomes more powerful
5. Optimal policy raises inflation target after temporary shocks

Examples of Firm Behavior

Attention to COC

Premier, CFO, Q1-2017: *"We obviously, with changing markets, always reassess what our weighted average cost of capital is and whether that return hurdle needs to change."*

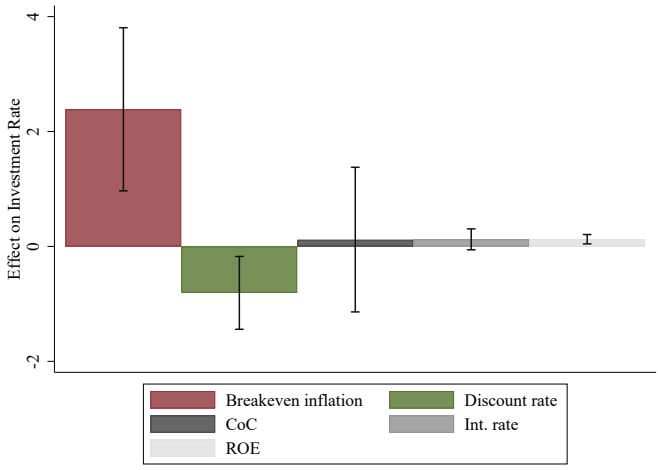
Partial incorporation

Spectra Energy, CFO, Q3-2014: *"We didn't lower our hurdle rates all the way down with long-term rates. We are still looking at returns of, say 10%, on average for our projects."*

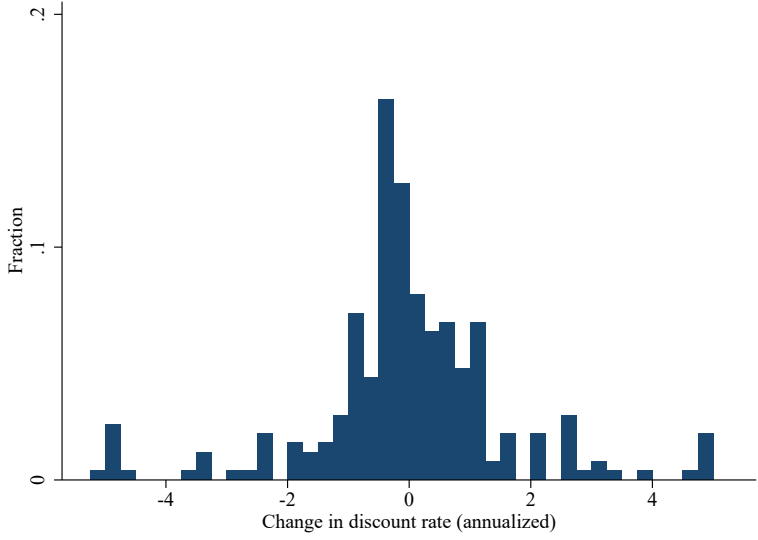
No change

Ball Corporation, CFO, Q3-2015: *"The discount rate has been 9% for a long time. In fact, our weighted average cost of capital is less than 6% now, so people have said: why don't you lower the hurdle rate?"*

Investment Moves With Discount Rates and Exp. Inflation



Non-Zero Annualized Changes in Discount Rates



Infrequent but dispersed changes in discount rates, like in Calvo (1983)

Discount Rates Are Sticky w.r.t. Expected Inflation

	(1) CoC	(2) DiRa	(3) Wedge	(4) Wedge
Breakeven inflation	0.20**	-0.040	-0.28***	-0.23**
	(0.093)	(0.086)	(0.099)	(0.11)
Observations	1,547	1,546	1,546	1,546
FE	Firm	Firm	Firm	Firm/year
Within R^2	0.0054	0.00020	0.0087	0.0033

- Cost of capital moves with expected inflation
- But discount rates do not
- Difference statistically significant

Exp. Inflation Raises Investment

$$\Delta(I_{it}/K_{it}) = \beta_1 \Delta\pi_t^e \times \mathbb{I}(\text{unchanged } \delta)_{it} + \beta_2 \Delta\pi_t^e \times \mathbb{I}(\text{changed } \delta)_{it} + \boldsymbol{X}_{it}'\gamma + \varepsilon_{it}$$

	(1)	(2)	(3)
Change in breakeven inflation	2.36**	2.37**	2.21*
* unchanged discount rate	(1.09)	(1.09)	(1.21)
Change in breakeven inflation	-0.74	-0.40	-1.81
* changed discount rate	(1.56)	(1.48)	(1.99)
Change in discount rate		-0.63**	-0.72*
		(0.30)	(0.43)
Change in ROE (cash flows)			0.14***
			(0.050)
Observations	545	545	426
FE	Country	Country	Country

Only firms with unchanged discount rates respond to exp. inflation

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