Sticky Discount Rates*

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Abstract

In standard macro-finance models, expected inflation on its own does not affect the real investment decisions of firms unless the real financial cost of capital or real investment opportunities also change. We highlight a new mechanism that breaks this inflation neutrality: because firms' nominal discount rates (i.e., their required returns) are sticky, increases in expected inflation directly lower real discount rates. Firms with sticky discount rates should therefore raise real investment in response to higher expected inflation, and we find empirical evidence consistent with this prediction. Sticky discount rates generate theoretical predictions that are consistent with stylized empirical facts but distinct from those in finance textbooks and standard models: increases in expected inflation directly raise real investment; demand shocks generate investment-consumption comovement; and the sensitivity of investment to real interest rates is low. Sticky discount rates imply monetary non-neutrality, even when all other prices are flexible.

Keywords: macro-finance, corporate finance, interest rate, cost of capital, capital markets, discount rate

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Essentially all existing macro-finance models assume that expected inflation on its own does not directly affect real investment. Imagine that expected inflation increases, but the economy is otherwise unchanged in real terms. The real interest rate is also unchanged. Higher expected inflation raises the nominal returns generated by firms' investment projects, which makes investing seem more attractive in nominal terms. However, expected inflation also raises the nominal interest rate and thus the nominal cost of capital. In standard models, firms incorporate both the higher nominal returns and the higher nominal cost into their investment decisions. On net, this implies that investment responds only to real funding costs and investment opportunities, not to pure increases in expected inflation.

The main contribution of this paper is to uncover a new mechanism that generates a direct link from expected inflation to real investment. This mechanism arises because the standard assumption on how firms incorporate the cost of capital is at odds with reality. In both standard models and in reality, firms use a nominal discount rate to determine which investment projects they undertake. In standard models, the discount rate moves one-to-one with the cost of capital, which generates the inflation neutrality. In reality, the chief executives of firms adjust their nominal discount rates infrequently, which implies that higher expected inflation directly lowers the real discount rate and raises investment. Hence, real investment can rise in response to expected inflation, even when the real cost of capital and investment opportunities have not changed.

The new mechanism linking expected inflation and investment has consequences for our understanding of business cycles and can account for long-standing puzzles in the literature. The mechanism is broadly relevant because most macroeconomic shocks affect expected inflation. For instance, in general equilibrium, the mechanism implies that household demand shocks increase both investment and consumption, addressing the well-known "comovement puzzle." Moreover, the mechanism implies a distinct form of monetary non-neutrality, even when all other prices are fully flexible. It can also explain empirical results on the link between expected inflation and investment found in micro data. These theoretical predictions differ from those of standard models, but are broadly consistent with stylized empirical facts (Drechsel et al. 2026). Sticky discount rates may thus be a generally useful tool to help researchers understand investment and business cycles, complementing existing work on financial constraints (e.g., Gilchrist and Himmelberg 1995, Lian and Ma 2021, Drechsel 2023, Auclert et al. 2025).

We begin the paper with empirical evidence on discount rate changes and their association with investment. We use a panel dataset of listed firms' discount rates for the period 2002 to 2024. The data are hand-collected from corporate conference calls where firms discuss their discount rates with financial analysts. In standard models, firms' investment depends on their discount rate. Intuitively, the discount rate is the minimum nominal return that firms accept from new investment projects and directly determines firms' nominal marginal product of capital (together with the depreciation rate). In practice, firms similarly use discount rates in their decision processes to evaluate the expected cash flows of potential projects. The cash flows are typically calculated by the divisions in charge of the project using a capital budgeting spreadsheet, while the discount rate is set by the chief executives and does not directly depend on the cash flow calculations. Changes in the discount rate strongly affect firm-level investment. Indeed, we verify in the data that firm-level changes in the reported discount rates predict future investment and returns on capital.

We additionally measure changes in expected inflation using long-run breakeven inflation, which is the difference between the yields of nominal and inflation-protected government bonds.[1] We find that changes in breakeven inflation are strongly correlated with changes in firms' inflation expectations, as reported in surveys, and with firms' expected prices and cash flows, as reported on the conference calls. In addition, changes in breakeven inflation are associated with changes in the nominal financial cost of capital, which is natural given that both are set in financial markets. The financial cost of capital is the appropriate measure of firms' funding cost in a world with risk and multiple sources of financing (i.e., debt and equity).[2]

The standard assumption, maintained in essentially all models in economics and finance, is that firms move their nominal discount rate one-to-one with breakeven inflation, conditional on the real cost of capital. The data reject this assumption over short horizons. Over 80% of firms do not change their discount rate at all over horizons below 1.5 years. However, the incorporation of breakeven inflation into discount rates increases over time and is relatively strong in the long run. The short-run incorporation is similar when the incentives to change the discount rate are stronger, for example, when the absolute change in breakeven inflation is large or firm investment is high. Firms often only change their discount rate by a small amount, suggesting that firms do not wait to adjust until a large change is necessary. We observe substantial variation in breakeven inflation in our sample, due to both common international shocks and heterogeneous shocks across

[1] A comparable breakeven measure is available for ten countries. The ten-year horizon is the natural benchmark for breakeven inflation because the cost of capital is the cost of long-run investments and firms typically use ten-year interest rates in their internal calculations. The results throughout the paper are similar using alternative horizons.

[2] The financial cost of capital is conceptually equivalent to the interest rate in simple models where firms only rent capital. Intuitively, one can interpret all the mechanisms that affect the financial cost of capital in this paper as affecting the interest rate in such a model.

countries. The results do not depend on any particular period and are similar when we exclude the years 2020-21.

We find substantial heterogeneity in the degree of incorporation across firms. We define two groups, splitting roughly at the median of the observed discount rate stickiness. Less than 1% of "sticky firms" adjust their discount rate over horizons below two quarters, whereas 20% of "flexible firms" do so. Both groups incorporate breakeven inflation and the real cost of capital less than the one-to-one relation assumed in standard models, but sticky firms take especially long to adjust.

The heterogeneity between sticky and flexible firms allows us to test the new mechanism linking expected inflation and real investment. Breakeven inflation reduces the real discount rates of sticky firms by more than those of flexible firms, suggesting that sticky firms should invest more when breakeven inflation is high. Indeed, we find that the investment rates of sticky firms are 3 percentage points higher, relative to flexible firms, when breakeven inflation is 1 percentage point higher. The association is only present in periods during which sticky firms keep their discount rates unchanged and disappears entirely in the rare periods during which sticky firms change their discount rates. This finding suggests that the association is driven by the stickiness of discount rates, rather than time-invariant differences between sticky and flexible firms. Moreover, the association is not explained by differences in the business cycle exposure of firms, the real cost of capital, Tobin's Q, and other firm characteristics.

Our evidence suggests that firms are aware of changes in expected inflation. They strongly incorporate expected inflation into the price projections and cash flow forecasts that are relevant to investment decisions. The price projections, as reported on the conference calls, are much less sticky than discount rates. We find that a 1 percentage point increase in breakeven inflation raises the expected price change by 0.8 percentage points and we do not reject one-to-one incorporation. The incorporation is similar for firms with sticky versus flexible discount rates and for input prices versus output prices.

Inspired by the empirical evidence, we incorporate sticky discount rates into a textbook model of firm investment. We are interested in examining whether the new mechanism linking expected inflation and investment can be large enough to affect business cycles. Our approach is inspired by the New Keynesian literature that explored whether frictions in wages and prices could influence business cycles (e.g., Mankiw 1985, Romer 1993). We similarly develop a tractable model with a friction affecting discount rate setting and analyze the macroeconomic implications.[3]

[3] We briefly discuss the forces determining how firms set their discount rates. Crucially, there exists no accepted method that tells firms how to change their individual cost of capital (Fama and French 1997,

In textbook models, including New Keynesian ones, the nominal discount rate always moves with the nominal cost of capital. In contrast, in our model, only a random share of firms is allowed to update their discount rate every period, as in Calvo. Firms that can update set their nominal discount rate to maximize the market value of the firm, which is the same objective as in textbook models. Firms that cannot update use the previous period's nominal discount rate. Once firms have their nominal discount rate, they optimally choose investment to maximize firm value. We allow for heterogeneity in discount rate stickiness and calibrate the model using two groups, "sticky" and "flexible" firms, as observed in the data. The Calvo friction is consistent with the evidence (e.g., the fact that discount rates do not adjust by more following larger changes to breakeven inflation). Another advantage is that this approach allows us to highlight the impact of sticky discount rates using a transparent and tractable model, without potentially obscuring the role of the new mechanism behind more complex assumptions, following the example of the New Keynesian literature.

We show that the firm's problem with sticky discount rates generates the key new mechanism: a shock to expected inflation directly lowers the real discount rate, lowers the real marginal product of capital, and raises real investment. We initially focus on a partial equilibrium model of firms, since the mechanism is driven by firm behavior and independent of the general equilibrium environment. We verify the mechanism by showing that the effect of breakeven inflation on the investment of "sticky" firms in the model is quantitatively close to our empirical estimate. In addition, a second mechanism is that the real interest rate has weaker effects on investment in the model with sticky discount rates than in the textbook, a prediction consistent with the arguments in Rognlie (2019) and Koby and Wolf (2020). If we allow firms in the model to choose discount rates flexibly, we get the textbook results of expected inflation neutrality (unless the real cost of capital or investment opportunities change) and a high sensitivity to the real interest rate.

To study the macroeconomic implications of sticky discount rates, we embed the firm's problem into a textbook New Keynesian model with sticky prices. The central bank follows a nominal interest rate rule and sets a long-run inflation target, while households are Ricardian. We later show that the new mechanisms due to sticky discount rates also operate in neoclassical investment models without any price rigidity and in models with borrowing-constrained households (e.g., Auclert et al. 2020).

Frank and Shen 2016), even when they know the change in the expected inflation rate. It may be costly or difficult for firms to constantly absorb new information, re-calculate their cost of capital, and implement the textbook approach. Other forces that may influence firms' discount rate setting are that firms may use sticky discount rates as a simplification device, a disciplining device for divisions (Rajan et al. 2000), or a commitment device to prevent managerial empire building (Jensen 1986).

We study the aggregate effects of monetary policy and household demand shocks. Regarding monetary policy, sticky discount rates imply a distinct form of monetary non-neutrality: the central bank's long-run inflation target has real effects. A permanent increase in the inflation target increases expected inflation. Under sticky nominal discount rates, this directly lowers the real marginal product of capital and raises investment and output. In comparison, under flexible discount rates, the effects of the inflation target on investment are much smaller (and exactly zero when prices are flexible or indexed to inflation). Conventional monetary shocks to the short-term interest rate are less effective under sticky discount rates, compared to the textbook, because of the weak real interest rate sensitivity. Monetary and inflationary shocks thus operate through non-traditional channels, complementing recent work (e.g., Kekre and Lenel 2022, Guerreiro et al. 2026).

Sticky discount rates also change the propagation of household demand shocks. In textbook models, household demand shocks (e.g., due to decreases in household patience) raise consumption but crowd out investment as the interest rate rises. In the model with sticky discount rates, demand shocks increase both consumption and investment. Intuitively, the household demand shock generates expected inflation, which then raises investment through the direct investment-inflation link, whereas the higher interest rate dampens investment only weakly. Explaining the procyclical investment-consumption comovement observed in the data has been a long-standing challenge. The model with sticky discount rates generates it naturally as a result of demand shocks.

Sticky discount rates generate distinct predictions from alternative models. In models with high adjustment costs, firms respond slowly to shocks in general, relative to the textbook. In the model with sticky discount rates, the strength of the investment response depends on the shock: investment responds identically to cash flow shocks, more strongly to expected inflation, and less strongly to real interest rates, relative to the textbook.

Finally, we explore the Ramsey optimal monetary policy problem under sticky discount rates. We find that a central bank that can credibly commit to future policies permanently changes its inflation target in response to transitory shocks, in contrast to the textbook recommendation. Intuitively, by changing the inflation target, the central bank directly affects inflation expectations and reduces the extent of misallocation caused by sticky discount rates. Frequent changes in the inflation target may not be implementable given political and central bank credibility constraints. However, our finding suggests a novel mechanism through which periods of high or low inflation targets, openly pursued by the central bank, can be powerful policy tools.

This paper contributes to our understanding of how firms make investment decisions. The optimization problems of unconstrained firms in standard models as well as the NPV calculations made by firms in practice depend on two objects: first, firms' expectations about the cash flows of potential projects (e.g., expected future demand and profitability), and second, firms' discounting of these expected cash flows. A large literature has focused on the first object, the formation and effect of firms' cash flow expectations (e.g., Greenwood and Hanson 2015, Angeletos and Lian 2018, Bordalo et al. 2025). We focus on the second object: discount rates.

The literature on discount rates has already shown that nominal discount rates are sticky with respect to the cost of capital and that, as a result, the sensitivity of investment with respect to the cost of capital is low (e.g., Rognlie 2019, Gormsen and Huber 2025). It is therefore not the main point of this paper to discuss what we above call the "second mechanism" (weak effect of real interest rates). The point of this paper is describing a new mechanism that had gone completely unnoticed in previous work, namely, the direct link from expected inflation to investment due to sticky discount rates. This new mechanism has first-order effects on our understanding of business cycles. To uncover this mechanism, we provide several new pieces of analysis. Conceptually, we analyze the workings and effects of the inflation-investment mechanism using the first general equilibrium model with sticky discount rates. Empirically, we show two key facts: the investment rates of "sticky" firms increase more in response to expected inflation and their discount rates are stickier than price projections.

This paper complements the large literature on financially constrained firms (e.g., see recent work by Asriyan et al. 2025, Auclert et al. 2025, and Drechsel et al. 2026), since sticky discount rates operate also within unconstrained firms and generate very different mechanisms from financial constraints. The money illusion in Modigliani and Cohn (1979) assumes that some financial stock investors incorrectly value real cash flows. In comparison, we focus on real firms' investment rules, instead of financial investors' valuations. The two models are consistent with each other but deliver distinct predictions: expected inflation lowers firms' real discount rates in our model, whereas it raises investors' real expected return in Modigliani and Cohn.[4]

[4]Our approach is consistent with Modigliani and Cohn, since even in their model, only some stock market investors incorrectly value cash flows, whereas bond investors correctly understand expected inflation. We find that real firms seem to understand expected inflation, but that alone is not sufficient to know how discount rates should be set. The hypothesis in Modigliani and Cohn speaks to investors' pricing of the stock market when inflation is high; our model can analogously explain firms' investment when inflation is high.

1 Conceptual Overview

In theoretical macro-finance models, firms typically make investment decisions through an optimization problem that involves a discount rate. Intuitively, this discount rate can be interpreted as the minimum long-run return that the firm is willing to accept on new investment projects. It is also known as a firm's required return on capital and it determines the expected marginal revenue product of capital in models. Formally, the discount rate enters the firm's optimization problem as the relative value of future cash flows relative to current cash flows.

In practice, most large firms report in surveys that they rely on methods based on a discount rate in their investment decisions (e.g., Trahan and Gitman 1995, Poterba and Summers 1995). Firms employ the discount rate in one, or both, of two investment rules. The first rule is to invest in projects where the expected internal rate of return (IRR) is above the discount rate. The second rule is to invest in projects where the net present value (NPV), as calculated based on the discount rate, is positive. The NPV rule is the practical equivalent to how firms make optimal decisions in formal models. However, the difference between the IRR and NPV rules is not material in the context of standard models. The two rules lead to equivalent investment decisions as long as the NPV of the firm's investment projects declines smoothly in the discount rate, which is the case in standard models.[5] Hence, our analysis takes as given the classical way that large firms make investment decisions—both in standard theory and in practice—but argues that the practical setting of discount rates differs from previous standard assumptions.

To illustrate the practical role of discount rates, we display an example of a capital budgeting spreadsheet that firms use to evaluate investment projects in Figure A1. This spreadsheet is based on classic teaching material and a simplified version of a spreadsheet actually employed by an S&P 500 firm. The spreadsheet calculates the IRR and the NPV of a potential project, given the expected nominal cash flows of the project and a nominal discount rate. The project is then evaluated on whether the expected return is higher than the discount rate provided by the chief executives of the firm (i.e., whether the IRR is higher than the discount rate and whether the NPV is positive). While the discount rate is determined by the chief executives of the firm and independent of other variables on the spreadsheet, the division managers forecast and enter the expected cash flows. A lower discount rate affects a firm's total investment because it means that more projects

[5]See Brealey et al. (2011), pages 109–113 for details. Investment problems based on the stochastic discount factor can also be represented using a discount rate. We explain the relation between discount rate methods (NPV and hurdle), the stochastic discount factor, and the cost of capital in Appendix C.

have expected returns above the discount rate.[6]

Essentially all models used by academics and policymakers assume that firms' discount rates change one-to-one with the financial cost of capital. This assumption is present, for example, in the real business cycle model, the New Keynesian model, and finance textbooks. The financial cost of capital is a firm's funding cost, defined as the return required by financial investors in exchange for providing capital to the firm. In models without risk, the cost of capital is simply the risk-free interest rate. In more complex settings with risk and different types of liabilities (i.e., debt and equity), the appropriate cost of capital incorporates risk premia and is the weighted average cost of debt and equity (known as WACC, Modigliani and Miller 1958). This weighted average cost of capital is unobserved because the risk premia depend on the unobserved risk perceptions of financial investors (returns on debt and equity are often not paid out directly by firms to investors but earned through changes in financial prices). Even if firms knew how expected inflation changed, they would still not know how their individual cost of capital changed. Firms themselves have to estimate their cost of capital using noisy financial market data, which they often find difficult (Fama and French 1997, Frank and Shen 2016, Gormsen and Huber 2026). We denote a firm's nominal discount rate by δ and its nominal financial cost of capital by i.

Standard models assume that firms perfectly know their financial cost of capital and constantly update their discount rate so the discount rate always changes one-to-one with the cost of capital: $\Delta i = \Delta\delta$. This way of setting discount rates maximizes the financial market value of firms in standard models. For instance, in a simple model without risk, the firm maximizes its value by changing the marginal product of capital one-to-one with the interest rate. In more complex models with risk and multiple liabilities, this decision is analogous to moving the discount rate one-to-one with the cost of capital.[7]

The standard assumption has implications for how expected inflation affects firm discount rates and investment. The change in the nominal cost of capital is approximately $\Delta i = \Delta r + \Delta\pi$, the sum of changes in the real cost of capital r and the expected inflation

[6] Textbooks recommend that firms should use multiple discount rates that vary with the risk of the projects they are considering. In practice, the vast majority of firms in the conference call data and in previous surveys report using just one discount rate that is based on a firm's typical project. Our empirical and theoretical findings do not depend on the number of discount rates used by firms, since we focus on changes in the firm's representative discount rate.

[7] Using the cost of capital as the discount rate leads to the same investment decision as a complex decision rule based on the stochastic discount factor, as long as the projects under consideration have the same risk as the firm's existing investments and the model is otherwise standard, as we explain in Appendix C. This holds, for instance, in macroeconomic models with one type of capital. In such standard models, firms find it optimal to move the discount rate one-to-one with the cost of capital, even if they expect the cost of capital to change in the future.

rate π. According to the standard assumption, firms should incorporate expected inflation into their nominal discount rate exactly to the same extent as it affects their nominal cost of capital, so that $\Delta\delta = \Delta r + \Delta\pi$. Under this standard benchmark, the change in the real discount rate (given by $\Delta\delta^{\text{real}} \equiv \Delta\delta - \Delta\pi$) only depends on the real cost of capital and not directly on expected inflation (i.e., $\Delta\delta^{\text{real}} = \Delta i - \Delta\pi = \Delta r$). As a result, this benchmark implies no direct effect of expected inflation on real investment through the real discount rate channel.

However, in practice, firms may not change their discount rates regularly, in contrast to the standard assumption. Imagine a firm chooses a "sticky" nominal discount rate, so that in the short run $\Delta\delta = 0$. The real discount rate now depends directly on expected inflation: $\Delta\delta^{\text{real}} \equiv \Delta\delta - \Delta\pi = -\Delta\pi$. With sticky discount rates, there is thus a direct link between expected inflation and real investment: increases in expected inflation lower real discount rates and therefore raise real investment, even when the real cost of capital and investment opportunities remain unchanged.

2 Data

2.1 Data on Firms' Discount Rates

Standard datasets do not report the discount rates used in firms' investment decisions. We rely on data from corporate conference calls. Relative to data initially collected by Gormsen and Huber (2025), we extend the sample, so that it spans the years 2002 to 2024. We briefly summarize the measurement and data here. More details are in Gormsen and Huber (2025), including a range of evidence that changes in discount rates reported on conference calls capture changes in firms' required returns. A unique feature of these data is that they contain repeated discount rate observations for the same firm over time, allowing within-firm analyses of changes over time.

Listed firms typically organize quarterly conference calls where they inform analysts and investors about their investment strategy. On these calls, firms occasionally report their discount rate and perceived cost of capital. Discount rates are reported as minimum required internal rates of return on new investments, whereas the perceived cost of capital is the firm's estimate of its weighted average cost of capital (i.e., its estimate of the fundamentally unobserved funding cost). Most firms report only one discount rate for the whole firm. In case there are multiple reported discount rates, the data contain the discount rate that is most representative of the firm's projects.

The data are based on call transcripts from the databases Refinitiv and FactSet for the period Q4-2001 to Q1-2024. We identify 160,000 paragraphs from the calls that contain at least one keyword related to capital budgeting. A team of research assistants manually read through all the paragraphs to identify relevant numbers. The final data are based only on non-hypothetical statements by firm managers (i.e., excluding statements such as "imagine that the discount rate were x%"). The perceived cost of capital is based on only statements referring to the cost of capital for the firm's total debt and equity (i.e., excluding statements such as "the yield for this bond was x%"). Essentially all firms report nominal numbers, except a handful of utility firms whose cost of capital is set by governments.[8]

To estimate how discount rates change over time, we analyze only the actual discount rates reported by firms throughout the paper. We make no assumption on the discount rates in periods where we do not observe a discount rate for a firm.

We merge firm-level characteristics and investment rates from Compustat by manually matching firm names from Compustat to the conference calls.

2.2 Discount Rates in the Sample

Several pieces of evidence suggest that the discount rates reported on the calls influence firms' investment behavior. For instance, within-firm changes in reported discount rates predict changes in future investment and within-firm changes in the perceived cost of capital broadly reflect time variation in the cost of capital from financial models (as shown by Gormsen and Huber 2025). We also present evidence for the real importance of the discount rates in our sample in Table 5. Statements from calls often appear as evidence in securities lawsuits (Rogers et al. 2011) and analysts and investors ask detailed questions about previously reported rates, incentivizing managers to report these ex post verifiable numbers accurately.

Almost all large firms use a discount rate in their investment decisions (e.g., Trahan and Gitman 1995, Poterba and Summers 1995, Graham 2022). We do not observe discount rates every quarter for every firm because many firms discuss their strategy using alternative financial figures related to discount rates. However, we are conservative and only record explicit discount rates reported by firms, since they provide unambiguous

[8] Some firms report discount rates that are adjusted upward to compensate for the fact that certain overhead costs, such as the costs to the headquarters of administering new projects, are omitted from the cash flow analyses. However, this does not affect our analysis because we always record the same type of discount rate for each firm across all time periods, making discount rates of the same firm recorded in different periods cleanly comparable. Managers often explicitly compare current to previously reported discount rates, further facilitating a clean comparison over time. For a detailed analysis of the level of discount rates, see Gormsen and Huber (2025).

information and can be directly linked to the required returns in models. We discuss the reporting behavior of firms in more detail in Appendix D.

In total, we observe a discount rate for 1,617 distinct firms. We analyze the characteristics of firms in the sample statistically in Appendix E. To summarize, firms with reported discount rates are disproportionately larger, in part because large firms hold more conference calls. Of the 100 largest U.S. firms (by book assets), 40 appear in our discount rate sample at least once. Apart from size, the sample is largely representative of the characteristics of listed firms. For instance, firm growth, leverage, market valuation, profitability, and cash flows are not associated with the propensity to report a discount rate (Table A1). Moreover, firms are not more likely to report discount rates when they are affected by unusual shocks or face extreme outcomes, suggesting the times when we observe discount rates are not skewed (Table A2).

Firms in the sample invest regularly, as 99% of firm-year gross investment observations are greater than zero. Firms use discount rates to explain why they are investing in some projects, to defend why they are not undertaking other projects, and to explain times of high or low investment. Hence, discount rates are mentioned in all types of situations. For instance, firms are not more likely to report a discount rate in periods when their investment or profitability is high or low (see Appendix E and Table A2).

2.3 Data on Breakeven Inflation

We measure long-run expected inflation using breakeven inflation rates (annualized over a ten-year horizon). Breakeven inflation is the difference in the yields between nominal and real government bonds, measured at quarterly frequency. Changes in breakeven inflation therefore partly capture changes in the inflation rate expected by financial markets. The ten-year horizon is appropriate because firms typically discuss long-run investments and use ten-year yields as a basis when estimating their perceived cost of capital and discount rates.

We rely on breakeven inflation since a consistent quarterly measure exists for several countries (Australia, France, Germany, Italy, Japan, New Zealand, Spain, Sweden, the U.K., and the U.S.), which we access through Bloomberg. In our baseline analysis, we measure breakeven inflation in the country in which the firm is listed, which is typically also the country where the firm gets most of its funding. The results throughout the paper are very similar if we use alternative approaches to measuring the breakeven inflation relevant for the firm, including using a weighted average of breakeven inflation weighted by where the firm has plants or earns the majority of its sales.

Firm inflation expectations tend to comove with breakeven inflation. For instance, the correlation between changes in U.S. breakeven inflation and changes in the Coibion-Gorodnichenko survey is 0.8. U.S. breakeven inflation rose by 1 percentage point between 2020 and 2021 and U.S. firms' long-run expected inflation in the Coibion-Gorodnichenko survey rose by 0.9 percentage points. The results throughout the paper are similar using the Coibion-Gorodnichenko survey measure when it is available.[9] In addition, we show in Section 3.4 that firms' price forecasts, both on the revenue and cost sides, move with expected inflation.

2.4 Data on the Financial Cost of Capital

The financial cost of capital is the cost of funding for firms in financial markets. It is defined as the return required by financial investors in exchange for providing capital to firms (Modigliani and Miller 1958). The returns required by investors are unobserved because they depend on expected risk premia and default probabilities, so the financial cost of capital needs to be estimated. We rely on standard techniques from the literature to estimate the financial cost of capital at the country level. The advantage of using a country-level measure is that firm-level estimates are prone to measurement error (e.g., Fama and French 1997), whereas changes in country-level measures likely suffer from less error and predict firms' perceptions more accurately (e.g., as shown in Gormsen and Huber 2025). Moreover, using a country-level cost of capital is consistent with our use of country-level breakeven inflation rates.

We estimate the nominal financial cost of capital at the quarterly level. The standard definition of the cost of capital is the average cost of debt and equity, weighted by leverage (known as WACC). We measure the cost of debt using the ten-year yield on government debt provided by the OECD plus a 2 percentage point risk premium. We assume that debt payments are tax deductible at a corporate tax rate of 20%.

We measure the cost of equity using the balanced growth model. For each country in our sample, we calculate trailing average five-year dividend yields (based on all firms listed in the country) and add ten-year breakeven inflation plus an expected growth rate of 4% to arrive at the cost of equity. Finally, we use a leverage ratio of 1/3.

To calculate a real financial cost of capital, we subtract ten-year breakeven inflation from the nominal financial cost of capital.

[9] The Coibion-Gorodnichenko survey contains annual data on long-run firm expectations starting in 2018. The level of firm expectations is higher than breakeven inflation, but changes, which are the focus of our paper, are highly correlated. Similarly, firms' perceived inflation tends to be higher than true inflation, but their changes are highly correlated (Savignac et al. 2024).

VARIABLES	(1) N	(2) mean	(3) sd	(4) p5	(5) p50	(6) p95
Discount rate change	7,378	-0.48	1.76	-3.41	0	0.65
Breakeven (10-year) change	7,378	-0.010	0.55	-0.81	-0.035	0.86
Real CoC change	7,378	-0.15	0.58	-1.12	-0.084	0.64
Difference in years	7,378	3.63	3.40	0.25	2.50	10.8

Table 1: Summary Statistics

2.5 Summary Statistics

We create a panel dataset by combining the data on discount rates with breakeven inflation and the real financial cost of capital. In our main analyses, we study all within-firm changes in discount rates that we can construct in our dataset (i.e., all differences between different discount rate observations of the same firm). We show summary statistics for this main sample in Table 1. 75% of firms in this sample are listed in the U.S., 9% in the U.K., and the remainder in Australia, Germany, Spain, France, Italy, Japan, and Sweden.

The median discount rate change in the sample is 0, reflecting that firms often leave their discount rate unchanged. The within-firm discount rate changes we construct are based on observations that, on average, lie 3.6 years apart and include a wide range of differences, as shown in the last row of Table 1.

There is substantial variation in breakeven inflation in our sample. The standard deviation of breakeven changes is close to that of changes in the real cost of capital, as shown in Table 1. The variation comes not just from the period 2020-21, but also from the 2001-02 recession, the run-up and unfolding of the 2007-09 financial crisis, the subsequent recovery, and the Euro crisis, as detailed in Section 3.1. Moreover, all these developments had heterogeneous effects across countries, adding to the variation in our sample.

3 Evidence on Sticky Discount Rates and Investment

We present evidence that firms' discount rates hardly respond to expected inflation over short horizons, but firms' price forecasts move with expected inflation. We then show that the investment rates of firms with stickier discount rates move with expected inflation.

3.1 Motivating Evidence from the 2020s Inflation

As motivating evidence, we focus on the "soaring 20s," the period 2020 to 2022 during which inflation expectations surged and drove up the nominal cost of capital.

We display the evolution of breakeven inflation (as measured in Section 2.3), the financial cost of capital (measured using financial market data, as in Section 2.4) as well as firms' perceived cost of capital, firms' discount rates, and the share of firms changing their discount rate (all three using conference call data) in Figure 1. All series are nominal. We plot only within-firm variation over time, so differences in sample composition across time do not affect the results. We subtract the 2018-Q1 value from each series and plot a three-quarter moving average.

Panel A of Figure 1 shows that breakeven inflation declined between 2018 and 2020 and rose sharply from early 2020 until late 2021. The nominal financial cost of capital increased by a similar magnitude from 2020 to 2021, suggesting that breakeven inflation was an important driver of the financial cost of capital over this period.

Since the financial cost of capital is not directly observed, firms need to form their own internally perceived cost of capital. Using the conference calls, we measure firms' perceived cost of capital, which is a distinct object from the discount rates used in firms' investment decisions. Gormsen and Huber (2025, 2026) show that the average firm changes its perceived cost of capital with the financial cost of capital, although with a lag. Indeed, firms' perceived cost of capital trended upward between 2021 and 2023, with a lag relative to the financial cost of capital. Hence, firms knew that the financial cost of capital had increased and could have incorporated this increase into their discount rates.

Firms' nominal discount rates did not increase between 2020 and 2023, as shown in Panel B of Figure 1.[10] The share of firms that changed their discount rate, compared to the last observed value for the same firm, also remained relatively stable over this period, as shown in Panel B of Figure 1.[11] These findings sharply contrast with the standard assumption of one-to-one comovement between discount rates and the financial cost of capital.

The period between 2020 and 2021 is a useful example because discount rates were

[10] The slight decline in the average discount rate between 2020 and 2023 may be explained by the fact that the financial cost of capital had secularly declined since 2010. Hence, firms that had not adjusted their discount rate for several years before 2020 still decreased their discount rate after 2020, relative to the previous value. In Figure A2, we plot a model-implied average discount rate series assuming that firms set discount rates following Proposition 2 where they face a Calvo friction in discount rate setting. Feeding in the historical evolution of the cost of capital, we find a similar slight decline between 2020 and 2023 in the model-implied discount rate series.

[11] We only include firm observations in this series where the last observed discount rate was observed at most two years ago, but this restriction does not affect the stability of the series over time.

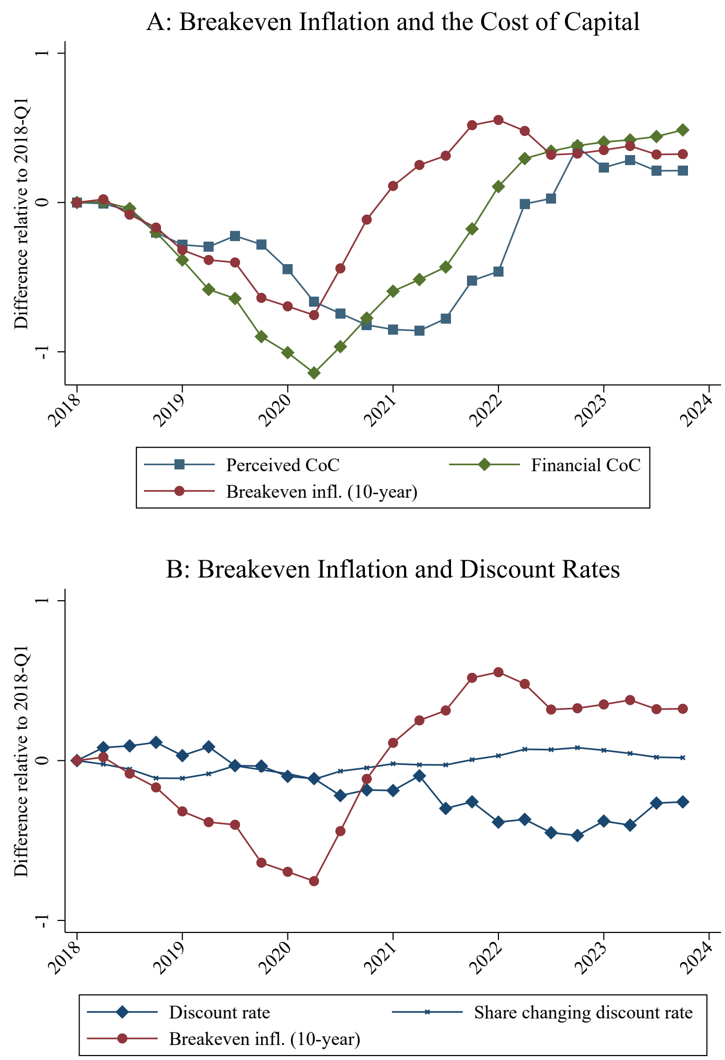

Figure 1: Breakeven Inflation, the Cost of Capital, and Discount Rates 2018-23

The figures plot within-firm time variation in breakeven inflation, the nominal cost of capital in financial markets, firms' nominal perceived cost of capital, and firms' nominal discount rates between 2018-Q1 and 2023-Q4. Breakeven inflation is the annualized breakeven rate (ten-year horizon) in percent in the main listing country of the firm from Bloomberg. The cost of capital in financial markets is measured in percent using financial market data, as described in Section 2.4. Firms' perceived cost of capital and firms' discount rates are based on statements by managers on the conference calls and measured in percent. The share of firms changing their discount rate is based on an indicator for whether a firm has changed its discount rate relative to the last observed discount rate for the same firm (restricting the sample to discount rate observations at most two years apart). The data are at the firm-quarter level. The samples for breakeven inflation and the financial cost of capital include all observations where we observe either a perceived cost of capital or a discount rate. For each series, we subtract the 2018-Q1 value so that each series starts at 0. We measure only within-firm variation in each series over time, which means that we control for time-invariant differences across firms and analyze only the extent to which values for the same firm changed over time. Specifically, for each series, we regress the firm-level value on quarter and firm fixed effects. We then plot a three-quarter moving average of the estimated quarter fixed effects.

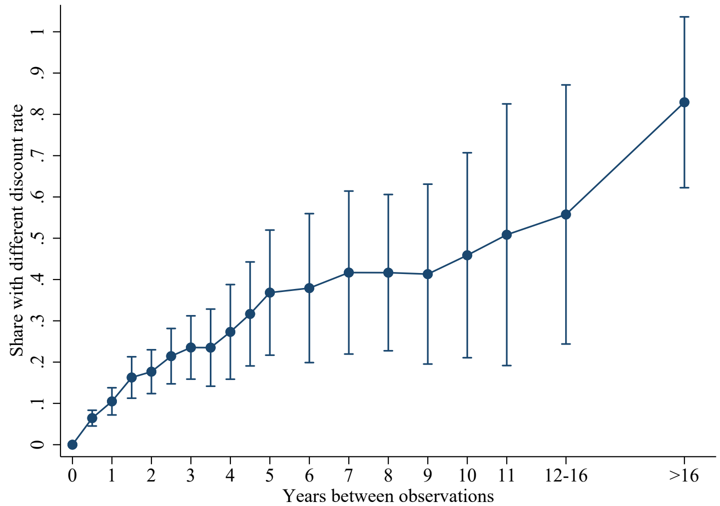

Figure 2: The Share of Firms With Adjusted Discount Rates

The figure plots the share of firms that have changed their discount rate at different time horizons. We analyze a dataset of firm-level changes in discount rates, measured using conference calls. The horizontal axis measures the difference in years between the two observations of discount rates for the same firm. The bin at 0.5 is for differences up to 0.5 years, the bin at 1 for differences greater than 0.5 and up to 1 year, the bin at 1.5 for differences greater than 1 and up to 1.5 years, the bin at 2 for differences greater than 1.5 and up to 2 years, and so on. We regress an indicator for whether the discount rate changed between the two observations on fixed effects for bins measuring the number of years between observations. Standard errors are clustered by firm and quarter-by-year-by-country. The vertical bars denote 90% confidence intervals.

sticky even though breakeven inflation strongly increased. This period accounts for 11% of country-quarter observations in our full sample and for 18% of the total within-country variation in breakeven inflation. Hence, this period drives neither the majority of variation in our sample nor the conclusions. We analyze variation from the full sample next.

3.2 Discount Rates Are Initially Sticky, but Adjust in the Long Run

Firms often use exactly the same discount rate in periods that are relatively far apart, as shown in Figure 2. We analyze the panel dataset of within-firm changes described in Section 2.5. We plot the share of firms that have a different discount rate over various horizons, measured as the gap in years between two discount rate observations for the same firm. Around 15% of firms have a different discount rate over a 1.5-year horizon and around 40% over a 5-year horizon.

To explore the implications of unchanged discount rates, we regress the change in a firm's nominal discount rate on the change in the two components of the nominal financial cost of capital over the same period: breakeven inflation and the real financial cost of capital. We interact both regressors with bins for the horizon, so we can test whether dis-

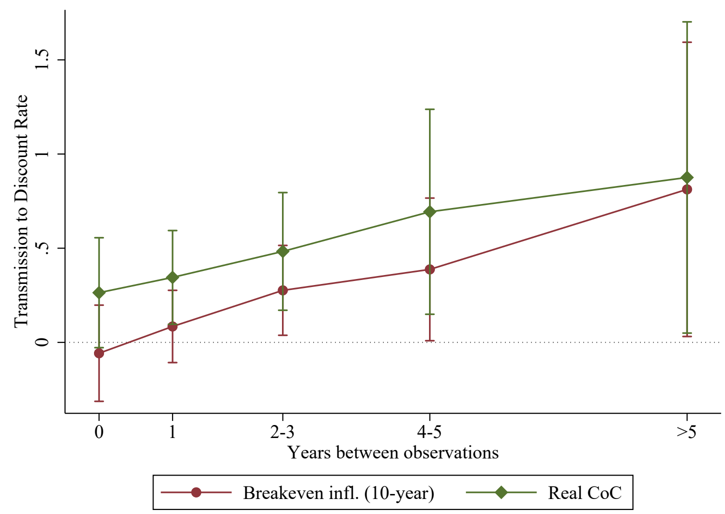

Figure 3: The Horizon-Dependent Incorporation of Breakeven Inflation and the Cost of Capital Into Discount Rates

The figure shows that firms weakly incorporate changes in breakeven inflation and the real cost of capital into discount rates in the short run, but increasingly over time. We analyze a dataset of firm-level changes in discount rates (as measured in Section 2.1), breakeven inflation (as measured in Section 2.3), and the real financial cost of capital (measured using financial market data, as described in Section 2.4). We regress the firm-level change in the discount rate on two main regressors: the change in breakeven inflation over the same period and the change in the real cost of capital over the same period. We interact the two main regressors with indicators measuring the difference in years between the two observations of discount rates for the same firm. The bin at 0.5 is for differences up to 0.5 years, the bin at 1 for differences greater than 0.5 and up to 1.5 years, the bin at 2-3 for differences greater than 1.5 and up to 3.5 years, the bin at 4-5 for differences greater than 3.5 and up to 5.5 years, and the bin at >5 for differences greater than 5.5 years. The controls include fixed effects for: quarter-by-year and the difference between observations in quarters. Standard errors are clustered by firm and quarter-by-year-by-country. The vertical bars denote 90% confidence intervals.

count rates respond more in the long run than in the short run. Standard models assume one-to-one incorporation at all horizons, implying that all coefficients should equal 1.

The results in Figure 3 suggest that firms incorporate changes in breakeven inflation into discount rates only weakly over horizons below two years. The coefficients for horizons up to half a year (0 on the horizontal axis of the figure) and horizons from half a year up to 1.5 years (1 on the horizontal axis) are close to zero and statistically insignificant. In comparison, the coefficients for longer horizons (2-3, 4-5, and >5 on the horizontal axis) are significantly different from zero and increasing over time. The highest bin includes horizons of, on average, almost 10 years, so it captures relatively long-run changes in discount rates. The coefficients for the horizons 2-3, 4-5, and >5 years are statistically different at the 10% level from the coefficient for the horizon up to half a year.

We find a similar pattern of incorporation for the real financial cost of capital as for breakeven inflation. The coefficients for the real cost of capital are slightly larger than

	(1)	(2)	(3)
		Discount rate change	
Breakeven change	-0.046	0.28*	0.39*
	(0.13)	(0.16)	(0.22)
Breakeven change * year diff. ≥ 1.5	0.44**		
	(0.22)		
Breakeven change * year diff.		0.12**	
		(0.057)	
Breakeven change * log year diff.			0.38*
			(0.19)
Real CoC change	0.25	0.56**	0.65**
	(0.18)	(0.24)	(0.29)
Real CoC change * year diff. ≥ 1.5	0.39*		
	(0.22)		
Real CoC change * year diff.		0.11*	
		(0.058)	
Real CoC change * log year diff.			0.37*
			(0.21)
Observations	7,378	7,378	7,378
Controls	Yes	Yes	Yes
Within R^2	0.020	0.030	0.027

Table 2: The Horizon-Dependent Incorporation of Breakeven Inflation and the Cost of Capital Into Discount Rates

The table shows that firms do not incorporate changes in breakeven inflation and the real cost of capital into discount rates in the short run, but increasingly over time. We analyze a dataset of firm-level changes in discount rates, breakeven inflation, and the real cost of capital. Firms' discount rates are measured using conference calls. Breakeven inflation is the annualized breakeven rate (ten-year horizon) in the main listing country of the firm from Bloomberg. The real cost of capital in financial markets is measured as described in Section 2. We regress the firm-level change in the discount rate on two main regressors: the change in breakeven inflation over the same period and the change in the real cost of capital over the same period. In column 1, we interact the main regressors with an indicator for whether the difference in years between the two observations of discount rates is at least 1.5 years. In column 2, we interact the main regressors with the linear difference in years. In column 3, we interact the main regressors with the log difference in years. In columns 2 and 3, the difference in years is normalized by 4 (the mean difference) so that the coefficients without interactions (in rows 1 and 5) capture the average association for 4-year changes. The controls include fixed effects for: quarter-by-year; the difference between observations in quarters; and year-by-country-by-industry (2-digit). Standard errors are clustered by firm and quarter-by-year-by-country. Statistical significance is denoted by *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

those for breakeven inflation, but the differences are not statistically significant.[12]

[12] In unreported results, we do not reject that, conditional on a non-zero discount rate change, firms incorporate changes in the nominal financial cost of capital one-to-one into discount rates. The point estimates are slightly above one, which is consistent with firms anticipating that they do not change their discount rates frequently and therefore preemptively incorporating expected future changes in the cost of capital (e.g., the secular decline from 2010 to 2019). This could also explain why some of the point estimates for the real cost of capital incorporation in Figure 3 are slightly larger than the share of firms adjusting over the comparable horizon in Figure 2. However, the coefficients in Figures 2 and 3 are not significantly different from each other, so we do not emphasize this possibility.

We explore the horizon-dependent incorporation of breakeven inflation into discount rates further in Table 2. In column 1, we report that changes in breakeven inflation are not incorporated over horizons below 1.5 years, but that the degree of incorporation is significantly higher for horizons greater than 1.5 years. In column 2, we interact the change in breakeven inflation with the horizon (i.e., the difference in years between the observations). We normalize the horizon so that the baseline coefficient on breakeven inflation captures the degree of incorporation over a 4-year horizon, the average horizon in the sample. The baseline point estimate in column 2 suggests that a 1 percentage point change in breakeven inflation leads to a 0.3 percentage point change in discount rates over a 4-year horizon. The linear interaction implies that the degree of incorporation increases by roughly 0.1 percentage points per year, such that the incorporation is close to zero over horizons below 1.5 years. In column 3, we use the log difference in years for the interaction and find similar results.

The specifications in Table 2 control for fixed effects for the horizon (i.e., the difference between the observations) in quarters, the quarter in which the discount rate is reported, and year-by-country-by-industry. These controls imply that generic differences in firm behavior over different horizons and trends in specific industries or countries do not explain the results. The results are similar when we exclude the years 2020 and 2021 from the sample in Table A4, implying the patterns are not driven by the "soaring 20s."

Firms may have greater incentives to incorporate breakeven inflation and the real cost of capital into discount rates when the potential benefits to firm value are larger, for example, when breakeven inflation and the real cost of capital change by a lot or when firm-level investment is high. In Table A5, we continue to find small and insignificant coefficients over horizons below 1.5 years when the change in breakeven inflation or the change in the real cost of capital in absolute terms is relatively large. Similarly, the incorporation is not larger when the investment rate in the current year, over the upcoming three years, or in the past three years is in the top 20% of the same firm's investment rates between 2001 and 2024, as reported in Table A6.

Based on survey data, Poterba and Summers (1995), Rognlie (2019), Sharpe and Suarez (2021), and Graham (2022) discuss the extent to which discount rates respond to financial prices. However, the existing survey data cannot be used to test whether discount rates are sticky with respect to the cost of capital or expected inflation. No clear pattern emerges from comparing averages of different surveys, as shown in Figure A8. We discuss the reasons in detail in Appendix G. To summarize, surveys ask about different types of discount rates, so survey averages can vary mechanically because they account differently for overhead costs, tax allowances, and so on. Moreover, each survey contains a different sample of firms, so differences across surveys could be driven by varying sample composition. In contrast, our conclusions rely on within-firm data and are not sensitive to different types of discount rates or firms entering the sample in different years.

3.3 Heterogeneity: "Sticky" and "Flexible" Firms

We document substantial heterogeneity in how frequently firms adjust their discount rates. This heterogeneity allows us to show that the real effects of breakeven inflation depend on firm-level stickiness in Section 3.5 and to calibrate the model in Section 4.2.

We construct a firm-level measure of stickiness equal to the share of a firm's discount rate observations that are unchanged relative to the last discount rate observed for the same firm. We group firms into two bins. Firms with firm-level stickiness above the median (weighted by capital, i.e., property, plant, and equipment) are "sticky firms" and those below the median are "flexible firms." Over horizons below two quarters, fewer than 1% of sticky firms and around 20% of flexible firms adjust their discount rate.[13]

The average relation between breakeven changes and discount rate changes is close to zero and statistically insignificant for sticky firms in column 1 of Table 3. In comparison, the relation is 0.71 for flexible firms and statistically significant. Sticky firms only weakly increase the degree of incorporation with the horizon, as indicated by the marginally positive but statistically insignificant coefficient on the interaction of the horizon with the breakeven change in column 2. Flexible firms, on the other hand, strongly increase incorporation with the horizon, as revealed by the positive and significant coefficient of 0.18 on the interaction (which captures the additional incorporation after an extra year) and the positive and significant baseline coefficient of 0.57 for flexible firms (which captures the incorporation after 4 years). Using the log horizon in column 3 yields similar results. The incorporation of the real cost of capital follows a similar pattern.

The standard assumption requires that firms immediately incorporate changes in expected inflation into their discount rates. Hence, for both sticky and flexible firms, the baseline coefficient on breakeven inflation should be close to 1 and the coefficient on the interaction with the horizon should be close to 0. Even flexible firms do not follow the standard assumption because they take several years to incorporate changes in breakeven inflation, indicated by the significant coefficient on the interaction with the horizon.

[13] We use this grouping in the baseline analyses because it is simple. In unreported robustness checks, we have used alternative groupings. For example, we have defined stickiness controlling for the quarter in which discount rates are observed and/or the difference in quarters between the observed discount rates. Using these alternative definitions, we find similar results in all the sections analyzing sticky firms (e.g., Sections 3.3 and 3.5).

	(1)	(2)	(3)
		Discount rate change	
Breakeven change * sticky firm	0.043	-0.018	-0.024
	(0.062)	(0.063)	(0.060)
Breakeven change * flexible firm	0.71**	0.57**	0.79***
	(0.27)	(0.26)	(0.27)
Breakeven change * year diff. * sticky firm		0.0023	
		(0.015)	
Breakeven change * year diff. * flexible firm		0.18***	
		(0.042)	
Breakeven change * log year diff. * sticky firm			-0.015
			(0.044)
Breakeven change * log year diff. * flexible firm			0.63***
			(0.18)
Real CoC change * sticky firm	0.091	0.080	0.10
	(0.16)	(0.17)	(0.19)
Real CoC change * flexible firm	0.99***	0.89***	1.04***
	(0.31)	(0.28)	(0.30)
Real CoC change * year diff. * sticky firm		0.055	
		(0.054)	
Real CoC change * year diff. * flexible firm		0.13*	
		(0.067)	
Real CoC change * log year diff. * sticky firm			0.10
			(0.13)
Real CoC change * log year diff. * flexible firm			0.49
			(0.32)
Observations	7,378	7,378	7,378
Controls	Yes	Yes	Yes
Within R^2	0.024	0.039	0.035

Table 3: The Incorporation by Sticky Firms and Flexible Firms

The table shows that "sticky" firms with infrequent discount rate changes incorporate breakeven inflation and the real cost of capital into discount rates less than "flexible" firms with more frequent discount rate changes. For sticky firms, the proportion of observations where the discount rate is identical to the previous observation is at least 90%, which is roughly the capital-weighted median of the firm distribution. For flexible firms, the proportion is below 90%. We analyze a dataset of firm-level changes in discount rates, breakeven inflation, and the real cost of capital. We regress the firm-level change in the discount rate on two main regressors: the change in breakeven inflation over the same period and the change in the real cost of capital over the same period. In column 1, we interact the main regressors with a sticky/flexible firm indicator. In column 2, we additionally interact the regressors with the linear difference in years. In column 3, we additionally interact the regressors with the log difference in years. In columns 2 and 3, the difference in years is normalized by 4 (the mean difference) so that the coefficients without interactions (in rows 1, 2, 7, and 8) capture the average association for 4-year changes. The controls include fixed effects for: quarter-by-year; the difference between observations in quarters; year-by-country-by-industry (2-digit); the sticky/flexible indicator interacted with the difference between observations in quarters; and the sticky/flexible indicator interacted with year. Standard errors are clustered by firm and quarter-by-year-by-country. Statistical significance is denoted by *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

3.4 Firms' Price Expectations and Breakeven Inflation

Firms' projections of their output and input prices, used in cash flow forecasts, are not as sticky as discount rates. Hence, firms are broadly aware of changes in expected inflation and incorporate them into their cash flow forecasts (as exemplified in the spreadsheet in Figure A1).

We systematically collect firms' future price expectations reported on conference calls. We manually identify clear statements of firms' expected future prices in paragraphs preselected by ChatGPT, as detailed in Appendix F. Firms typically discuss expected prices when describing revenue and cost projections, which in turn inform their cash flow forecasts for investment projects. The price expectations in our data cover 71 goods (e.g., oil, gold, cheese blocks, corn), so we also record the specific good subtype and time horizon of the expectation. To calculate the price change implied by the expected price, we measure the spot price at the time of the conference call using commodity prices from Bloomberg and FRED as well as hand-collected prices reported on the same conference call as the expected price or in news articles. We manually harmonize units and currencies for each observation to make changes over time comparable.

We test the extent to which firms raise their price expectations when breakeven inflation increases. The outcome variable in Table 4 is the expected price change. The main regressor is the breakeven rate in the country of the firm, measured cumulatively over the same horizon as the firm's expected price change (e.g., the 5-year cumulative breakeven inflation rate if the expected price change is over a 5-year horizon). The specification in column 1 controls for country fixed effects and quarter-by-year fixed effects, so that the coefficients measure how changes in breakeven inflation over time in a country are associated with expected price changes. We find that the average expected price change is 0.8 percentage points higher when breakeven inflation is 1 percentage point higher. We reject a coefficient of 0 but not 1, which would imply full incorporation. The coefficient remains similar in column 2 where we additionally control for good-by-year-by-country fixed effects, so subgroups of goods do not drive the results.

We find no significant difference in how expected input prices, as opposed to output prices, respond to breakeven inflation, as shown in column 3 of Table 4. "Sticky" discount rate firms, measured as in Table 3, also move their price expectations with breakeven inflation, indicated by the insignificant interaction coefficient in column 4 of Table 4. This result stands in sharp contrast to the fact that sticky firms incorporate breakeven inflation into discount rates only weakly (column 1 of Table 3).

In columns 5 and 6, we test whether the coefficients change with the horizon of the expected price change (i.e., how many years into the future is the date of the price ex-

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)
Breakeven infl.	0.84***	0.87***	0.87***	0.84***	0.79**	0.87**
	(0.25)	(0.23)	(0.22)	(0.26)	(0.33)	(0.35)
Breakeven infl. * input price			-0.020			
			(0.39)			
Breakeven infl. * sticky firm				0.19		
				(0.63)		
Breakeven infl. * year diff.					0.044	
					(0.10)	
Breakeven infl. * log year diff.						-0.0036
						(0.51)
Observations	2,883	2,883	2,883	2,883	2,883	2,883
Base Controls	Yes	Yes	Yes	Yes	Yes	Yes
Full Controls	No	Yes	Yes	Yes	Yes	Yes
Within R^2	0.011	0.016	0.016	0.016	0.016	0.016

Table 4: The Incorporation of Breakeven Inflation into Firms' Price Expectations

The table shows that firms incorporate changes in breakeven inflation into their expectations of future prices of their output and inputs. The firm's expected price change is the percentage difference between the price expectation of the firm and the current spot price. In columns 1 and 2, we regress the firm's expected price change on the cumulative breakeven inflation rate in the main listing country of the firm, measured over the same horizon as the expected price change using Bloomberg. In column 3, we interact cumulative breakeven inflation with an indicator for whether the reported price change refers to an input of the firm, as opposed to the firm's output. In column 4, we interact cumulative breakeven inflation with an indicator for sticky firms, defined as in Table 3. In column 5, we interact the main regressors with the linear difference in years. In column 6, we interact the main regressors with the log difference in years. In columns 5 and 6, the difference in years is normalized by 4 (the mean difference) so that the baseline coefficient without interaction (in row 1) captures the average association for 4-year changes. The base controls include fixed effects for: quarter-by-year of the firm's statement on the expected price change and country. The full controls additionally include fixed effects for: year-by-country-by-goods type (71 categories of goods); an indicator for firms with sticky discount rates; and an indicator for whether the price expectation is for the price of an input. Standard errors are clustered by firm and quarter-by-year-by-country. Statistical significance is denoted by *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

pectation). We use the linear and the log horizon in years, as in Table 2. The interaction coefficients are small and statistically insignificant. The finding suggests that firms' expected price changes do not move differently depending on the horizon.

The conclusion that firms change expected prices and cash flows when expected inflation changes is consistent with the existing literature. In surveys, firms report that they increase their price and revenue forecasts when expected inflation rises (Meyer et al. 2021, Bunn et al. 2022) and their inflation expectations respond to news about inflation (Gorodnichenko et al. 2025, Yotzov et al. 2025). Moreover, firms raise their current output prices, and anticipate higher future input and output prices, in response to information about higher expected inflation (Coibion et al. 2020, Andrade et al. 2022, Baumann et al. 2024).

Taken together, the findings suggest that both sticky and flexible firms incorporate breakeven inflation into their expected prices and cash flow forecasts. Combined with the fact that discount rates are sticky, the findings support a mechanism directly linking expected inflation to investment.

3.5 Breakeven Inflation and Investment With Sticky Discount Rates

If firms maintain sticky nominal discount rates, breakeven inflation directly affects their real discount rates and thus their real investment rates. A key empirical test of the new mechanism is thus whether the investment rates of sticky firms increase by more when breakeven inflation increases. We regress a firm's net investment rate on breakeven inflation (ten-year horizon) interacted with an indicator for firms with sticky discount rates, measured as in Table 3. The observations in this sample account for 14% of the aggregate capital (property, plant, and equipment) of listed firms in countries where we observe breakeven inflation.

The results in Table 5 suggest that sticky firms invest more in years when breakeven inflation is higher. The coefficient in column 4 implies that a 1 percentage point increase in breakeven inflation raises the investment rate of sticky firms by 3.3 percentage points, relative to that of flexible firms. The coefficient is significant at the 5% level.

The results are robust to a host of control variables. By including year fixed effects in column 2, we ensure that common shocks to all firms do not drive the results. In column 3, we condition on the real cost of capital, Tobin's Q, log assets, and industry fixed effects, all interacted with year fixed effects. Hence, shocks to financial markets, investment opportunities priced in equity markets, size-specific shocks, and industry-specific shocks do not bias the coefficients on breakeven inflation.

One potential concern is that sticky firms are more exposed to macroeconomic shocks

	(1)	(2)	(3)	(4)	(5)
	Net investment rate				
Breakeven infl. * sticky firm	3.65*	3.81**	3.41**	3.32**	
	(1.87)	(1.83)	(1.58)	(1.62)	
Breakeven infl. * sticky firm * discount rate unchanged					3.22**
					(1.60)
Breakeven infl. * sticky firm * discount rate changed					-1.83
					(5.43)
Observations	8,251	8,251	8,251	8,251	8,251
Breakeven infl.	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes
Year FE	No	Yes	Yes	Yes	Yes
Firm controls	No	No	Yes	Yes	Yes
Country controls	No	No	No	Yes	Yes
Breakeven infl. * discount rate changed	No	No	No	No	Yes
R^2	0.60	0.62	0.64	0.66	0.66

Table 5: Breakeven Inflation and the Investment of Sticky Firms
The table reports regressions of the net investment rate on the interaction of breakeven inflation (ten-year) in the firm's country with an indicator for "sticky" firms. The dataset is at the firm-year level. The net investment rate is capital expenditures minus depreciation, divided by lagged property, plant, and equipment and multiplied by 100. For sticky firms, the proportion of observations where the discount rate is identical to the previous observation is at least 90%, which is roughly the capital-weighted median of the firm distribution. All specifications control for breakeven inflation and firm fixed effects, so the reported coefficients capture to what extent sticky firms change their investment by more than flexible firms in response to changes in breakeven inflation. Firm controls include the interaction of year fixed effects with the following variables: the real cost of capital; Tobin's Q (the market-to-book value of debt and equity); log assets; and fixed effects for firm industry (2-digit). Country controls include fixed effects for country-by-year; the indicator for sticky firms interacted with the change in real GDP; and the indicator for sticky firms interacted with the change in the unemployment rate. In column 5, we interact the main regressor with an indicator for whether we observe that the firm has changed its discount rate in the year of the observation or the previous year (and we additionally control for the indicator for changed discount rate as well as that indicator interacted with breakeven inflation). Standard errors are clustered by firm and country-by-year. Statistical significance is denoted by *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

or more cyclical. In column 4, we find a similar coefficient when we include country-by-year fixed effects as well as an indicator for sticky firms interacted with two cyclical variables, GDP growth in percent and the change in the unemployment rate. Hence, the result is not driven by heterogeneous exposure to the business cycle.

Sticky firms occasionally change their discount rate, although rarely. In column 5 of Table 5, we find no significant difference between sticky and flexible firms when sticky firms have changed their discount rate in the year of the observation or in the previous year. (If anything, the coefficient on sticky firms is negative.) Hence, sticky firms increase investment by more in response to breakeven inflation only when they have kept their discount rate unchanged.[14] This finding suggests that sticky firms do not always behave differently than flexible firms. Instead, the relation depends on the behavior of discount rates. Sticky discount rates, rather than other firm-level characteristics, account for the relation between breakeven inflation and sticky firms' investment.

In robustness checks, we find similar results excluding the years 2020 and 2021 in Table A7 and using total asset growth as a measure of investment in Table A8.[15]

4 Model of Firm Investment with Sticky Discount Rates

One contribution of this paper is to show that sticky discount rates generate new mechanisms, relative to the textbook models used widely in economics and finance: (i) a direct link from expected inflation to investment and (ii) a weaker sensitivity of investment to the real cost of capital. To illustrate the mechanisms, we incorporate sticky discount rates into a textbook model of firm investment. Our model deviates from the textbook in two dimensions: (i) firms make investment decisions based on discount rates that may differ from the cost of capital and (ii) firms endogenously set optimal discount rates subject to an adjustment friction.

In this section, we present a partial equilibrium model of firm investment, since the two key mechanisms are driven by firm behavior independent of the general equilibrium environment. A general equilibrium model follows in Section 5.

We use the model to ask whether the new mechanisms can, in principle, have meaningful implications for firm-level and aggregate investment. It is a natural first step for this paper (given this is the first model of discount rate changes over time) to analyze whether the new mechanisms can be important in a simple framework. We introduce a friction to discount rate setting that is tractable and isolates the new mechanisms, without potentially obscuring the role of the mechanisms behind more complex, non-standard assumptions. In that sense, our approach is inspired by the large New Keynesian literature that takes wage or price stickiness as given and then studies the macroeconomic implications of shocks. (In case the reader would like more context, we summarize potential firm-level frictions that may lead to sticky discount rates in Appendix B and leave the formal derivation to future work.)

[14] We include the previous year in the definition of "discount rate changed" since investment decisions are often made a year in advance, but we find similar results only using the year of the observation.

[15] The results are consistent with Coibion et al. (2018) who show that New Zealand firms reduced investment by more when an information treatment lowered their inflation expectations without shifting their growth expectations. The information treatment in Coibion et al. (2020) raised Italian firms' inflation expectations but also worsened growth expectations and uncertainty, making it less comparable to our analysis.

4.1 The Problem of the Firm

Production Technology. There is a continuum of firms, indexed by $i \in [0,1]$, that own capital and hire labor to produce intermediate goods using the production function

$$y_{it} = F_t(k_{it}, l_{it}) = A_t (k_{it})^{\alpha} (l_{it})^{1-\alpha}, \tag{1}$$

where k_{it} denotes the capital stock, l_{it} denotes labor, A_t is Hicks-neutral technology, and y_{it} is output at time t. Time is continuous and the time horizon is infinite, $t \in [0, \infty)$. The capital stock evolves according to the law of motion

$$\partial_t k_{it} = (\iota_{it} - \xi) k_{it}, \tag{2}$$

where ι_{it} is the investment rate and ξ is the depreciation rate. Throughout, we use the shorthand notation of $\partial_t k_{it} \equiv \frac{\partial k_{it}}{\partial t}$. We assume all firms have the same technology.

Firms hire labor at nominal wage W_t and sell their output at price p_t in a competitive goods market. The consumer price index in the economy is P_t. In this section, we analyze a partial equilibrium model and therefore take W_t, p_t, and P_t as exogenous. We analyze a general equilibrium model with endogenous W_t, p_t, and P_t in Section 5.

A firm's static profit function is

$$\Omega_t(k_{it}) = \max_{l_{it}} p_t F_t(k_{it}, l_{it}) - W_t l_{it} \equiv P_t \omega_t k_{it}, \tag{3}$$

where

$$\omega_t \equiv \alpha (1-\alpha)^{\frac{1-\alpha}{\alpha}} \left(\frac{p_t A_t}{P_t} \right)^{\frac{1}{\alpha}} \left(\frac{W_t}{P_t} \right)^{\frac{\alpha-1}{\alpha}} \tag{4}$$

is real profit per unit of capital. Firms invest in capital subject to adjustment costs with constant returns to scale $\Phi(\iota_{it}, k_{it}) = \varphi(\iota_{it}) k_{it}$. The adjustment cost function satisfies $\varphi(\iota) = \varphi'(\iota) = 0$ and its curvature in steady state is $\phi \equiv \varphi''(\iota)$, where $\iota \equiv \xi$ is the steady state investment rate. Investment and adjustment costs are both paid in the final good and P_t equals the final good price.

Overview of the Firm's Decision. We model the firm's decision-making in two parts. We first determine how the firm chooses investment, taking as given its nominal discount rate. We then analyze how the firm sets its discount rate, subject to adjustment frictions and taking as given its investment policy.

Our approach to modeling the investment decision in two steps reflects how most firms operate in practice, as described in existing work (e.g., Jagannathan et al. 2016, Edwards et al. 2021, Graham 2022, Gormsen and Huber 2025). Internal divisions of firms typically receive a nominal discount rate from the headquarters. Divisions then take the discount rate as given and apply it in NPV-based or hurdle-based decisions, but do not internalize how it is set. This approach is also reflected in the spreadsheets used by firms to evaluate potential investment projects, as shown in Figure A1.[16]

Optimal Investment Given Discount Rates. To determine investment at time t, the firm maximizes the value of discounted future profits,

$$\max_{\iota_{it}} \mathbb{E}_t \int_t^\infty e^{-\delta_{it}(s-t)} \left[\Omega_s(k_{is}) - P_s \iota_{is} k_{is} + \varphi(\iota_{is}) k_{is}\right] ds, \tag{5}$$

subject to the capital law of motion (2), taking the firm's future investment policies ($\{\iota_{is}\}_{s>t}$) as given. The long-run discount rate δ_{it} is the firm's long-run required return, a metric that firms in practice use in their real investment decisions and report on conference calls. The firm's problem in period t is to choose its investment rate ι_{it} given the discount rate at time t (δ_{it}) and the firm's future investment policies ($\{\iota_{is}\}_{s>t}$). In the textbook log-linearized model without risk, the standard assumption is that the firm's discount rate δ_{is} equals the cost of capital, given by a weighted average of expected short-term interest rates. This choice of discount rate maximizes the value of the firm in financial markets.[17]

We substitute the capital law of motion (2) into (5), allowing us to write firm value as $q_t^\delta(\delta_{it}; \{\iota_{is}\}_{s>t}) P_t k_{it}$, where $q_t^\delta(\delta_{it}; \{\iota_{is}\}_{s>t})$ is the unit value of capital in the eyes of the firm, given its discount rate δ_{it} and future investment policies. The unit value of capital

[16] Managers on conference calls consistently indicate that divisions accept discount rates as given and use them in investment decisions, as discussed by Gormsen and Huber (2025). Surveys by Jagannathan et al. (2016), Edwards et al. (2021), and Graham (2022) support this view. Evidence that sticky discount rates determine actual investment decisions is in Gormsen and Huber (2025), Shah et al. (2025), and Section 3.5. Our model of the investment decision is related to the anticipatory utility approach (Kreps 1998).

[17] An alternative formulation of the objective function in (5) is

$$\mathbb{E}_t \int_t^\infty e^{-\int_0^s d_{i,u+t} du} \left[\Omega_s(k_{is}) - P_s \iota_{is} k_{is} - P_s \varphi(\iota_{is}) k_{is}\right] ds, \tag{6}$$

where the firm uses discount rate d_{it} to discount firm value between t and $t + dt$. The textbook assumption in this formulation is that the sequence of discount rates used by the firm $\{d_{is}\}_{s=t}^\infty$ equals the sequence of expected short-term interest rates $\{i_{is}\}_{s=t}^\infty$. There always exists a discount rate δ_{it} such that the firm makes the identical investment decision in problems (6) and (5).

is then

$$q_t^{\delta}(\delta_{it};\{\iota_{is}\}_{s>t}) = \max_{\iota_t} \mathbb{E}_t \int_t^{\infty} e^{-\delta_{it}(s-t)+\int_t^s [\pi_u + (\iota_{iu}-\xi)]du} \left[\omega_s - \iota_{is} + \varphi(\iota_{is})\right] ds. \tag{7}$$

The first-order condition that determines the optimal investment rate, taking as given δ_{it} and future investment policies $\{\iota_{is}\}_{s>t}$, is:

$$\varphi'(\iota_{it}) = q_t^{\delta}(\delta_{it};\{\iota_{is}\}_{s>t}) - 1. \tag{8}$$

This solution mirrors the standard q-theory of investment, except that the firm uses a sequence of discount rates δ_{is} which may not equal the cost of capital in every period s.

Optimal Investment in First Order. The first-order condition in (8) is complex because the optimum today depends on future investment policies. However, a first-order approximation around the deterministic steady state where $q = 1$ and $\iota = \xi$ simplifies the optimal investment policy. We define the net short-term real interest rate as $r_t \equiv i_t - \pi_t$ and denote all variables without time subscripts as those evaluated at the steady state. We also define coc_t as the long-run nominal cost of capital:

$$coc_t = r\int_t^{\infty} e^{-r(s-t)} i_s ds = r\int_t^{\infty} e^{-r(s-t)}(r_s + \pi_s) ds. \tag{9}$$

The cost of capital is thus the discounted average of current and future short-term interest rates. When the short-term interest rate is invariant over time (i.e., $i_t = i$ for all t), we simply have $coc_t = i$.

We can now characterize the first-order solution to the firm's investment problem. Variables with hats are log deviations from steady state values (i.e., $\hat{x}_t = \log(x_t/x)$).

Proposition 1 (Optimal Investment Given Discount Rates). *To a first-order approximation around the steady state, the investment rate of a firm i, given its current discount rate δ_{it}, is $\iota_{it} = \iota_t(\delta_{it})$, where*

$$\iota_t(\delta_{it}) = \xi + \frac{1}{\phi}\left[\hat{q}_t - \frac{1}{r}(\delta_{it} - coc_t)\right] \tag{10}$$

and q_t is marginal Q:

$$\hat{q}_t = \int_t^{\infty} e^{-r(s-t)}(\omega_s - r_s - \xi) ds. \tag{11}$$

The aggregate investment rate is

$$\iota_t = \xi + \frac{1}{\phi}\left[\hat{q}_t - \frac{1}{r}(\delta_t - coc_t)\right], \tag{12}$$

where $\iota_t = \int_0^1 \iota_{it} di$ *and the aggregate discount rate is* $\delta_t = \int_0^1 \delta_{it} di$*.*

The proposition shows that investment can be summarized by a modified version of the textbook q-theory of investment. The modification comes from the discount rate wedge, $\delta_{it} - coc_t$, in equation (10). The investment rate is lower than what the textbook would predict when the discount rate wedge is higher. If $\delta_{it} = coc_t$ in every period, then investment is the same as in the textbook.[18]

Friction in Discount Rate Setting. Next, we analyze how the firm sets its discount rate. The textbook assumes that firms can change their discount rate in every instance. We instead assume that firms can only change their discount rate subject to an adjustment opportunity in the style of Calvo (1983). Hence, the discount rate may deviate from the cost of capital in our model, in contrast to the textbook.

We allow for heterogeneity in the arrival rate of the adjustment opportunity, motivated by the cross-firm heterogeneity in discount rate stickiness observed in the data. Each firm i belongs to an ex ante heterogeneous group $f \in \{1, \ldots, F\}$. The mass of each group f is given by ℓ_f and we normalize the total mass of firms to one, $\sum_{f=1}^{F} \ell_f = 1$. A firm in group f receives the opportunity to adjust its discount rate at a Poisson arrival rate θ_f^δ.

Since firms cannot change their discount rate in every instance, they can no longer simply adopt the current cost of capital as their discount rate. Instead, firms that get the opportunity to adjust their discount rate have to solve for an optimal discount rate, knowing that they have to keep using the chosen discount rate until they get a chance to adjust it again in the future.

We assume that firms choose their discount rate to maximize their value in financial markets, following the textbook assumption that firms maximize market value. The firm's market value is

$$\mathbb{E}_t \int_t^\infty e^{-\int_0^s [i_{t+u} - \pi_{t+u} - (\iota_{it+u} - \xi)] du} \left[\omega_s - \iota_{is} + \varphi(\iota_{is})\right] ds, \tag{13}$$

where firm value is discounted using the sequence of short-term interest rates $\{i_s\}_{s=t}^{\infty}$ set

[18] The optimal investment rate in Proposition 1 is solely a function of the current discount rate δ_t and marginal Q. This tractability is a result of the envelope theorem. As steady state investment policies are optimal, any deviation does not have first-order effects on future firm value and investment.

by investors in financial markets.

Optimal Discount Rate in First Order. We consider a linear-quadratic approximation to the firm's choice of discount rate. In Supplement A.2, we show that the approximation is

$$\max_{\delta^*} \int_t^\infty e^{-(r+\theta_f^\delta)(s-t)} \left[-\frac{\phi}{2}(\iota_s(\delta^*) - \iota)^2 - \hat{q}_s(\iota_s(\delta^*) - \iota) \right] ds \tag{14}$$

for a firm in group f, where $\iota_s(\delta)$ is given by (10) and $\hat{q}_s$ is given by (11). The firm's discount rate in this problem is the short-term real interest rate plus an extra term given by the arrival rate of the adjustment opportunity θ_f. The extra term captures that the current choice of discount rate only affects future cash flows if the firm is unable to adjust its discount rate in the following period.

Taking the first-order condition, we obtain the evolution of discount rates.

Proposition 2 (Optimal Discount Rates). *To a first-order approximation around the steady state, the optimal nominal discount rate for a firm in group f that can adjust its discount rate is*

$$\delta^*_{ft} = (r + \theta_f^\delta) \int_t^\infty e^{-(r+\theta_f^\delta)(s-t)} coc_s ds. \tag{15}$$

The average discount rate of a firm in group f is

$$\delta_{ft} = \int_0^t \theta_f^\delta e^{\theta_f^\delta (s-t)} \delta^*_{fs} ds. \tag{16}$$

The aggregate discount rate is

$$\delta_t = \mathbb{E}_f[\delta_{ft}], \tag{17}$$

where $\mathbb{E}_f[x_f] \equiv \sum_f \ell_f x_f$ is the cross-sectional mean of variable x_f.

Equation (15) captures the forward-looking nature of how the firm sets its discount rate, once it gets the opportunity to adjust. The firm takes into account that it may not be able to change its discount rate in the future, so it incorporates the cost of capital not only today, but also in future periods. The weight on the future cost of capital is higher when the adjustment friction is stronger (θ_f is lower). An analogous mechanism determines price setting in Calvo (1983).

Equation (16) shows that the average discount rate in group f depends on discount rates set in the past because firms that cannot adjust their discount rate have to keep using their previous discount rate. Equation (17) aggregates across groups to determine the average discount rate in the economy. By inserting the distribution of discount rates characterized in Proposition 2 into the investment rate characterized in Proposition 1, we can determine the distribution of investment.[19]

Discussion of the Calvo Friction. The conceptual overview in Section 1 shows that the specific Calvo (1983) friction is not needed to generate the new mechanisms linking expected inflation and investment. The mechanism operates whenever discount rates are sticky. The Calvo friction is a useful first step to incorporating sticky discount rates in a formal model and to understanding the real implications, just like the common assumption of sticky prices/wages can be a useful tool in the New Keynesian literature.

We choose the Calvo friction because it is broadly consistent with the evidence. In particular, the short-run incorporation of the cost of capital into discount rates is not higher when the potential benefits of incorporation appear larger, such as when there are large absolute changes in breakeven inflation and the real cost of capital (Table A5 and Figure 1) and when firm investment is high (Table A6). Similarly, for firms that do change their discount rate, there is a large mass of small changes (Figure A3). Finally, the real outcomes of firms with stickier discount rates differ (Section 3.5). Taken together, these empirical patterns resemble the predictions of Calvo-based models (Cavallo et al. 2024). Our Calvo assumption can be interpreted as a reduced-form way of modeling within-firm frictions that lead firms to maintain sticky discount rates, with the severity of frictions and thus the adjustment probability differing across firm groups.

4.2 Calibration of the Firm's Problem

We calibrate the firm's problem as summarized in Panel A of Table 6. One period in the model corresponds to a year. We set the annual depreciation rate to 10%, $\xi = 0.1$. The adjustment cost parameter is set to match the semi-elasticity of investment with respect to the price of capital of 7.2, based on an estimate from Zwick and Mahon (2017) that is largely driven by cash flow shocks due to tax changes. This leads to $\phi = 1/(7.2 \times \xi) \approx 1.38$.

We set the steady state real interest rate to 9%, $r = 0.09$. This choice matches the average real discount rate used by firms (Gormsen and Huber 2025). If we used a lower

[19] Our model implies that firms would choose a zero discount rate wedge if the nominal financial cost of capital were constant (see Proposition 2). There is some evidence in Gormsen and Huber (2025) that firms would maintain a permanently positive wedge if the cost of capital were constant. We do not incorporate a permanent wedge in our analysis, since our aim is to study the implications of limited time variation in discount rates (i.e., stickiness), which to a first order do not depend on the level of discount rates.

Parameter	Description	Value
A. Parameters for the firm's problem		
r	Steady state real interest rate	0.09
ξ	Depreciation rate	0.10
ϕ	Capital adjustment cost	1.38
$(\theta_1^\delta, \theta_2^\delta)$	Discount rate adjustment arrival rate	(0.04,0.89)
(ℓ_1, ℓ_2)	Mass of firm type	(0.50,0.50)
α	Capital share	1/3
B. Parameters for the general equilibrium model		
$1/\sigma$	Elasticity of intertemporal substitution	0.5
$1/\nu$	Frisch elasticity of labor supply	0.5
θ^p	Price flexibility	0.5

Table 6: Parameter Values

The table reports the calibration of parameter values used in model simulations. One period in the model corresponds to a year.

value for the real interest rate, we would get stronger effects of sticky discount rates on investment. Our calibration is therefore conservative for the purpose of this paper. We set the capital share α to 1/3, a standard value in the literature.

We calibrate the frequency of discount rate adjustments based on the evidence from Section 3.3. We sort firms into two groups, $F = 2$: a "sticky" group with a quarterly adjustment probability of 1% and a "flexible" group with a quarterly adjustment probability of 20%. The calibration is somewhat conservative as the adjustment probabilities in the data are slightly lower for both groups. We convert the probabilities into Poisson arrival rates by setting $\theta_1 = -4\log(1-0.01) \approx 0.04$ and $\theta_2 = -4\log(1-0.2) \approx 0.89$. The two groups are evenly sized, since in the data we approximately use the capital-weighted median to determine the grouping, so $\ell_1 = 0.50, \ell_2 = 0.50$.

4.3 Key Mechanisms due to Sticky Discount Rates

The model with sticky discount rates generates two key mechanisms, compared to a textbook model with fully flexible discount rates. The first mechanism is that expected inflation directly raises investment, unlike in the textbook. The second mechanism is that real interest rate shocks have weaker effects on investment compared to the textbook.

In this section, we present thought experiments illustrating the two key mechanisms. We use the partial equilibrium model of the firm's problem developed in Sections 4.1 and 4.2, where firms take prices and wages as given. We then study exogenous shocks to expected inflation and the real interest rate. We compare a textbook model where all firms have fully flexible discount rates to the model of sticky discount rates where two groups of firms face heterogeneous degrees of discount rate stickiness. For each type of shock, we analyze how investment, aggregated over all firm groups in the economy, responds.

By using the partial equilibrium model, we want to emphasize that the two key mechanisms operate independently of the general equilibrium structure of the model and are driven by firms' sticky discount rates. We show in Section 5 that the mechanisms are also important in a general equilibrium model.

Mechanism 1: Direct Effects of Expected Inflation. We first consider an exogenous shock to inflation, holding real interest rates and future cash flows constant. We analyze a shock at $t = 0$ that decays at a constant rate following

$$\partial_t \pi_t = -\beta_\pi (\pi_t - \pi) \tag{18}$$

for given π_0, where $\beta_\pi \geq 0$ captures the degree of mean reversion. The following proposition describes the impact of the shock on the path of the investment rate, $\{d\iota_t\}$, and the cumulative impulse response of the investment rate, which we define as $CIRF \equiv \int_0^\infty d\iota_t dt$ and which corresponds to the integral of the area under the impulse response function.

Proposition 3 (Investment Responses to Inflation in Partial Equilibrium). *Consider a positive shock to inflation at $t = 0$, $d\pi_0 > 0$, that follows the law of motion (18). Under sticky discount rates (i.e., $\theta_f^\delta < \infty$ for some f), the cumulative impulse response of the investment rate is strictly positive, $CIRF > 0$, and the investment rate response of group f is positive for $t < \bar{t}_f \equiv \frac{1}{\theta_f^\delta - \beta_\pi} \log \frac{(r+\theta_f^\delta)\theta_f^\delta}{(r+\beta_\pi)\beta_\pi}$. Under flexible discount rates ($\theta_f^\delta = \infty$), the investment rate response is zero for all t and, thereby, $CIRF = 0$.*

We illustrate Proposition 3 using the calibration of Table 6. We consider a permanent shock to inflation ($\beta_\pi = 0$). Figure 4 shows the responses of the aggregate real discount rate ($\delta_t^{real} = \delta_t - \pi_t$) and the aggregate investment rate (ι_t). In the textbook model with flexible discount rates, the nominal discount rate incorporates the nominal cost of capital one-to-one, leaving the real discount rate unchanged. Hence, changes in expected inflation have no direct effect on investment.

In contrast, under sticky discount rates, the nominal discount rate responds weakly to the nominal cost of capital and therefore to the expected inflation shock. As a result, the real discount rate falls, stimulating investment. While Figure 4 shows the effects of a permanent shock, Proposition 3 proves that the cumulative and impact responses of investment are always positive for the general case $\beta_\pi > 0$.

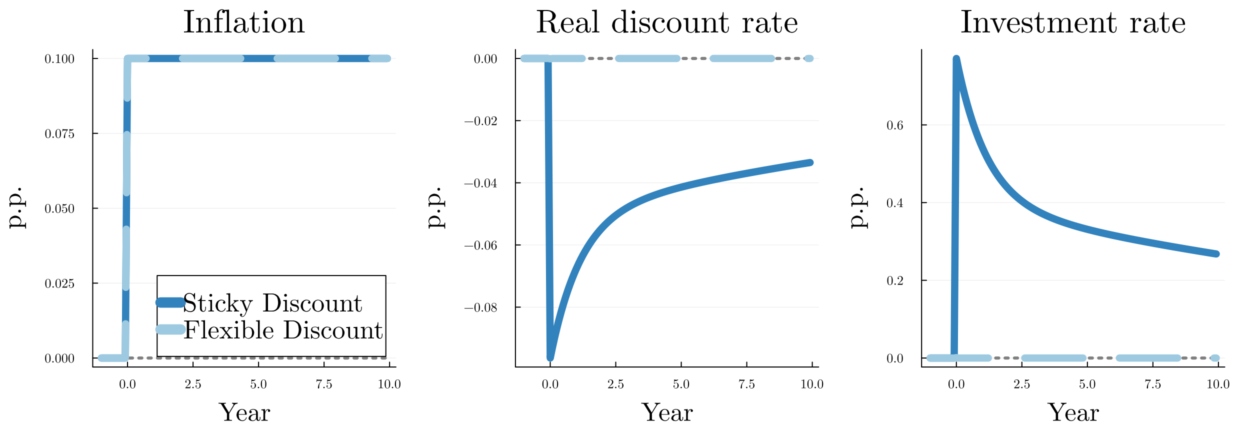

Figure 4: Partial Equilibrium Responses to an Inflation Shock

The figure plots aggregate impulse responses to an inflation shock for our benchmark calibration and for flexible discount rates ($\theta_f^\delta = \infty$ for all f). Inflation, the real discount rate, and the investment rate are annualized.

Mechanism 2: Weak Effects of Real Interest Rates. We consider an exogenous shock to the real interest rate, holding expected inflation and future cash flows constant:

$$\partial_t r_t = -\beta_r (r_t - r) \tag{19}$$

for given r_0, where $\beta_r \geq 0$ captures the degree of mean reversion.

Proposition 4 (Investment Response to Real Interest Rates in Partial Equilibrium). *Consider a positive shock to the real interest rate at $t = 0$, $dr_0 > 0$ following the law of motion (19). Under sticky discount rates (i.e., $\theta_f^\delta < \infty$ for some f), the cumulative impulse response of the investment rate is smaller in absolute terms than in the textbook model with flexible discount rates. The investment rate response of group f is smaller in absolute terms than in the textbook model for $t < \bar{t}_f \equiv \frac{1}{\theta_f^\delta - \beta_r} \log \frac{(r+\theta_f^\delta)\theta_f^\delta}{(r+\beta_r)\beta_r}$.*

We illustrate Proposition 4 in Figure 5. We model a one percentage point shock that decays with a quarterly autocorrelation of 0.75. An increase in the real interest rate has larger effects on investment if the real discount rate increases by more. In the textbook model, nominal discount rates move one-to-one with the nominal cost of capital. As a result, real discount rates move one-to-one with the real cost of capital after the real interest rate shock, lowering the investment rate substantially. In contrast, nominal discount rates move less under sticky discount rates, dampening the response of investment. Proposition 4 proves that both the impact and cumulative responses are smaller (in absolute terms) under sticky discount rates.

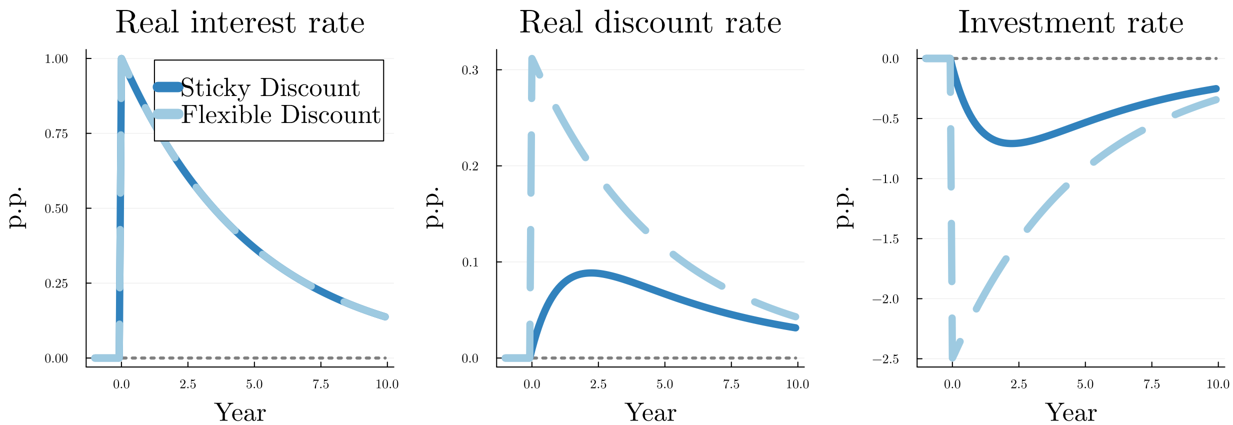

Figure 5: Partial Equilibrium Responses to a Real Interest Rate Shock

The figure plots aggregate impulse responses to a real interest rate shock for our benchmark calibration and for flexible discount rates ($\theta^{\delta}_{f} = \infty$ for all f). Inflation, the real discount rate, and the investment rate are annualized.

Sticky Discount Rates and Alternative Models. The model with sticky discount rates makes distinct predictions not just from the textbook, but also from alternative models where firms respond sluggishly to shocks, such as models with high adjustment costs.

One distinct prediction is that exogenous shocks to expected inflation (holding constant the real cost of capital and cash flows) directly raise investment in the model with sticky discount rates. A further distinct prediction is that exogenous shocks to future cash flows (holding expected inflation and real interest rates constant) have identical effects in the textbook model and the model with sticky discount rates.[20] In contrast, models with high adjustment costs also predict weak responses to cash flow shocks.

Hence, sticky discount rates do not induce more sluggish responses to all kinds of shocks, but instead can lead to stronger responses than the textbook (for expected inflation), identical responses (for cash flows), or weaker responses (for the real interest rate).

4.4 Empirical Moments in the Model

We show that the model is consistent with two empirical findings: (i) the slow incorporation of the cost of capital into discount rates and (ii) the association between expected inflation and the investment of sticky firms.

[20]This equivalence follows from observing that the equations determining discount rate setting, (15) and (16), do not depend on cash flows, $\{\omega_t\}$. Hence, cash flow shocks induce the same investment response, (10) and (11), regardless of θ^{δ}_{f}.

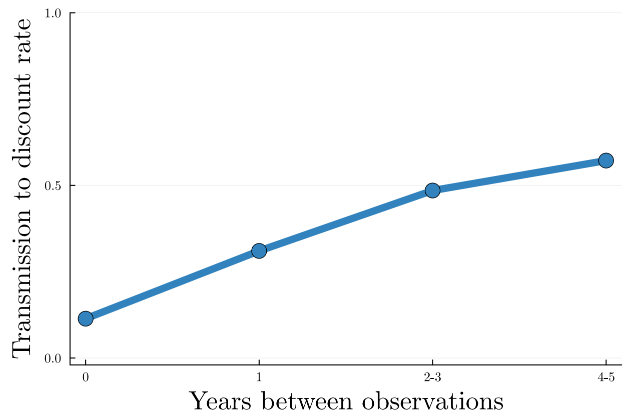

Figure 6: Horizon-Dependent Incorporation in the Model

The figure plots the average discount rate in the model calibrated as in Section 4.2 at various horizons after a permanent 1 percentage point increase in the nominal financial cost of capital. The bin at 0.5 is for horizons up to 0.5 years, the bin at 1 for horizons greater than 0.5 and up to 1.5 years, the bin at 2-3 for horizons greater than 1.5 and up to 3.5 years, and the bin at 4-5 for horizons greater than 3.5 and up to 5.5 years. The empirical analogue is in Figure A4.

Slow Incorporation. We simulate a permanent 1 percentage point shock to the nominal cost of capital in the model, driven by a permanent increase in expected inflation. The average discount rate in the model incorporates the increase in expected inflation weakly in the short run, but increasingly over time, as shown in Figure 6. The empirical analogue in Figure A4 shows a similar pattern over time.

Breakeven Inflation and Investment. We simulate a permanent 1 percentage point increase in inflation, keeping the real interest rate and expected cash flows constant. We then use the model to calculate the investment rates of sticky and flexible firms in the year after the shock. We find that the investment rate of sticky firms is 3 percentage points higher. The relevant empirical analogue is the coefficient of 3.3 (standard error: 1.6), reported in column 4 of Table 5. Although not targeted, the estimate in the model is therefore consistent with the empirical coefficient.

4.5 The Costs of Sticky Discount Rates to Firm Value

Sticky discount rates reduce the financial market value of firms, relative to a world where firms face no discount rate adjustment frictions. We quantify the loss in the value of an individual firm due to using sticky discount rates, relative to fully flexible discount rates, keeping prices and the behavior of all other firms constant. This loss equals the present value of all future distortions to the firm's capital stock. We show in Supplement A.5 that, to a second order, the percentage loss in firm value is

$$\frac{1}{2}\frac{1}{\phi r^2}\mathbb{E}_t \int_t^\infty e^{-r(s-t)}(\delta_{is} - coc_s)^2 ds. \tag{20}$$

A lower adjustment cost (ϕ) raises the loss by making capital more sensitive to discount rates, thereby generating larger distortions under sticky discount rates. The terms inside the integral capture that larger discount rate wedges are costly.

The expected magnitude of the wedges depends on the expected evolution of the financial cost of capital (coc_t). We adopt the common assumption that the financial cost of capital follows a Cox-Ingersoll-Ross (CIR) process:

$$dcoc_t = -\beta_{coc}(coc_t - \overline{coc}) + \sigma_{coc}\sqrt{coc_t}\, dZ_t, \tag{21}$$

where $\beta_{coc} \geq 0$ is a parameter governing the persistence, σ_{coc} determines the variance, and dZ_t is the increment of the standard Brownian motion. This square-root process ensures that the cost of capital cannot turn negative. We calibrate the process to match the observed behavior of the financial cost of capital in the U.S. between 1980 and 2024. We set $\beta_{coc} = 0.1$ and $\sigma_{coc} = 0.015$ at the annual frequency and assume an average cost of capital $\overline{coc}$ of 9%, in line with our calibration above.

We simulate a time series of the cost of capital for 10,000 years. Separately for sticky and flexible firms, we calculate the resulting series of discount rate wedges implied by firms' discount rate setting described in Proposition 2. Given the series of discount rate wedges, we calculate the ex post value loss in every year and take the average across years to get the ex ante expected value loss. We run 1,000 such simulations.

The median expected value loss for a flexible firm across the 1,000 simulations is close to 0%, reflecting that discount rate wedges of flexible firms are short-lived and do not meaningfully impact the capital stock. The median expected value loss for a sticky firm is 4.4%, relative to a firm without any discount rate wedges. This loss is sizeable, but not extreme, and smaller than the impact of common organizational frictions (e.g., Rajan et al. 2000). Hence, firms may find it tolerable to maintain sticky discount rates if it helps them overcome frictions that would reduce firm value by more than 5% (see also Appendix B).

5 General Equilibrium Model with Sticky Discount Rates

We embed the firm's problem with sticky discount rates from Section 4 in a New Keynesian general equilibrium model. We use a textbook New Keynesian model in the baseline because of its prevalence in business cycle analysis, but we show that the key mechanisms also operate in models with flexible prices and borrowing-constrained households.

5.1 New Keynesian Block

The preferences of the representative household, defined over consumption $\{C_t\}$ and labor $\{L_t\}$, are

$$\int_0^\infty e^{-\int_0^t \rho_s ds} \left[u(C_t) - v(L_t)\right] dt, \tag{22}$$

where $u(C) = \frac{C^{1-\sigma}}{1-\sigma}$ and $v(L) = \frac{L^{1+\nu}}{1+\nu}$. The patience of households is captured by the household discount rate ρ_s at time s. The parameter σ is the inverse of the elasticity of intertemporal substitution, and ν is the inverse of the Frisch elasticity of labor supply. The budget constraint is

$$C_t + \partial_t a_t = r_t a_t + \frac{W_t}{P_t} L_t, \tag{23}$$

where a_t is real asset holdings, r_t is the real rate of return, and W_t/P_t is the real wage. The household chooses $\{C_t, L_t, a_t\}$ to maximize (22) subject to (23). Household optimization implies the following consumption Euler equation,

$$\partial_t \hat{C}_t = \frac{1}{\sigma}(r_t - \rho_t), \tag{24}$$

and the labor supply condition,

$$\nu \hat{L}_t = -\sigma \hat{C}_t + \hat{W}_t - \hat{P}_t, \tag{25}$$

where hat variables denote log deviations from steady state values.

Retailers set prices subject to a Calvo (1983) friction. A continuum of retailers buys intermediate inputs from firms at price p_t. Each retailer converts the inputs into a differentiated variety with constant elasticity of substitution $\varepsilon > 1$. Retailers set prices, but the opportunity to adjust prices arrives only with Poisson arrival rate $\theta^p > 0$. This results in the New Keynesian Phillips curve

$$r\pi_t = \theta^p(r + \theta^p)\left[\sigma \hat{C}_t + \nu \hat{L}_t - \alpha(\hat{K}_t - \hat{L}_t) - \hat{A}_t\right] + \partial_t \pi_t. \tag{26}$$

Using the labor supply condition (25), the firm's cash flow ω_t per unit of capital can be expressed as

$$\hat{\omega}_t = \sigma \hat{C}_t + \nu \hat{L}_t - (\hat{K}_t - \hat{L}_t). \tag{27}$$

The central bank sets a sequence of nominal interest rates $\{i_t\}$, where $i_t = r_t + \pi_t$. In the long-run steady state, the real interest rate equals the household discount rate, $r = \rho$, so that $\lim_{t\to\infty} i_t = \rho + \pi_\infty$, where π_∞ is the long-run inflation target. We assume that the central bank reacts sufficiently strongly to non-fundamental shocks so that there is a unique bounded equilibrium. These assumptions imply that setting the sequence of nominal interest rates is equivalent to setting the sequence of real interest rates and the long-run inflation target.

The goods market clearing condition is

$$\frac{C}{Y}\hat{C}_t + \frac{\iota K}{Y}(\hat{\iota}_t + \hat{K}_t) = \hat{A}_t + \alpha \hat{K}_t + (1-\alpha)\hat{L}_t, \tag{28}$$

and the aggregate capital stock evolves according to

$$\partial_t \hat{K}_t = \iota_t - \xi. \tag{29}$$

Given monetary policies, $\{r_t, \pi_\infty\}$, and shock processes, $\{\rho_t, \hat{A}_t\}$, the equilibrium of this economy consists of $\{\hat{C}_t, \iota_t, \hat{K}_t, coc_t, L_t, \hat{W}_t - \hat{P}_t, \pi_t, \hat{q}_t, \hat{\omega}_t, \{\delta_{ft}, \delta^*_{ft}, \iota_{ft}\}_{f=1}^F\}$ such that (11)-(17) and (24)-(27) hold.

5.2 Calibration of the New Keynesian Block

Panel B of Table 6 summarizes the calibration of the New Keynesian block. We assign standard values to most of the parameters. We set the elasticity of intertemporal substitution to 0.5, $1/\sigma = 0.5$, and the Frisch elasticity of labor supply to 0.5, $1/\nu = 0.5$. The price flexibility parameter is set so that the quarterly frequency of price adjustment is 25% (Nakamura and Steinsson 2008), $\theta^p = -4\log(1-25\%) \approx 0.5$. The remaining parameters calibrate the firm's problem as discussed in Section 4. The steady state household discount rate, ρ, equals the steady state real interest rate, which we set to 9% annually.

6 General Equilibrium Implications of Sticky Discount Rates

The new mechanisms due to sticky discount rates have major impacts on how macroeconomic shocks propagate in general equilibrium models. We summarize three such impli-

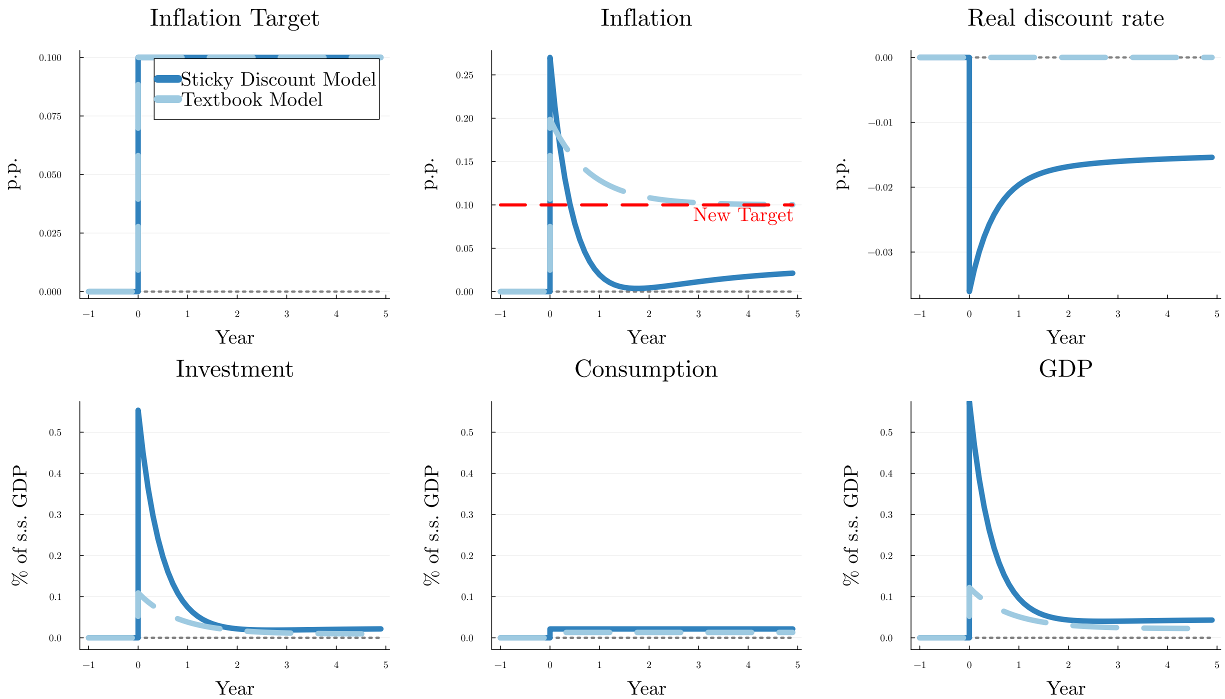

Figure 7: General Equilibrium Responses to an Inflation Target Shock

The figure plots aggregate impulse responses to a 0.1 percentage point increase in the inflation target, keeping real interest rates constant. The inflation target, inflation, the real discount rate, and the real variables are annualized.

cations in this section. Throughout, we compare the predictions of our model with sticky nominal discount rates (containing two groups of firms with heterogeneous stickiness as in Sections 4 and 5) to a textbook model where all firms have fully flexible discount rates that always equal the nominal cost of capital.

6.1 Monetary Policy Transmission

We study two distinct monetary policy instruments: changes in the long-run inflation target, π_∞, and changes in real interest rates, $\{r_t\}$.

The impulse responses to a 0.1 percentage point increase in the long-run inflation target, keeping real interest rates constant, are in Figure 7. Sticky discount rates amplify the investment response by a factor of four relative to the textbook model because greater expected inflation directly lowers the real discount rates of firms. The impulse responses are broadly consistent with time series evidence suggesting that a higher inflation target is associated with higher investment (Mumtaz and Theodoridis 2017) and output (De Michelis and Iacoviello 2016, Uribe 2022, Lukmanova and Rabitsch 2023).

The strong response of investment under sticky discount rates also occurs when prices are fully flexible and for varying degrees of price stickiness, as we show in Figures A5 and A6. Hence, sticky discount rates are a distinct source of monetary non-neutrality in all standard models.[21] The inflation target also increases consumption in models with hand-to-mouth households, as we show in Supplement B. In general, the key new mechanisms driven by sticky discount rates therefore also matter in models with borrowing-constrained households (e.g., Auclert et al. 2020).

In Figure 7, realized inflation in the first year after the shock increases by more under sticky discount rates than in the textbook because of the greater initial investment response. In the subsequent few years, inflation is slightly lower under sticky discount rates because the greater initial investment raises the capital stock and thus leads to relatively lower price increases.

Our findings do not imply that the central bank should adjust the inflation target at high frequency. Our main aim is to illustrate that the direct link from expected inflation to investment matters in general equilibrium. This mechanism operates following any shock to expected inflation, for example, consumption demand shocks as in Section 6.2. We discuss potential monetary policy implications in Section 6.3.

The impulse responses to a conventional monetary policy shock, keeping the long-run inflation target constant, are in Figure 8. We model a one percentage point shock to the real interest rate that decays with a quarterly autocorrelation of 0.75. Under sticky discount rates, the real discount rate adjusts to changes in the real cost of capital more slowly, so investment is substantially less responsive than in the textbook.

The literature shows that the investment sensitivity to the interest rate plays an important role in macroeconomics (e.g., House and Shapiro 2008, Khan and Thomas 2008, Reiter et al. 2013, Ottonello and Winberry 2020, Winberry 2021). Textbook models typically generate an investment sensitivity that is higher than that implied by empirical estimates (e.g., see Koby and Wolf 2020). In comparison, sticky discount rates generate a sensitivity closer to empirical estimates without relying on large adjustment costs.

6.2 Consumption-Investment Comovement

A long-standing challenge for textbook models is to generate the empirically observed positive procyclical comovement between consumption and investment in response to

[21] With fully flexible prices and flexible discount rates, the change in the inflation target is neutral for real outcomes. In the textbook New Keynesian model with flexible discount rates, the inflation target modestly changes investment, unlike in the partial equilibrium analysis in Section 4.3, because a higher target leads to higher prices in the future, incentivizing higher investment today. With inflation indexation in price setting, the changes in the inflation target would be fully neutral even in the New Keynesian textbook.

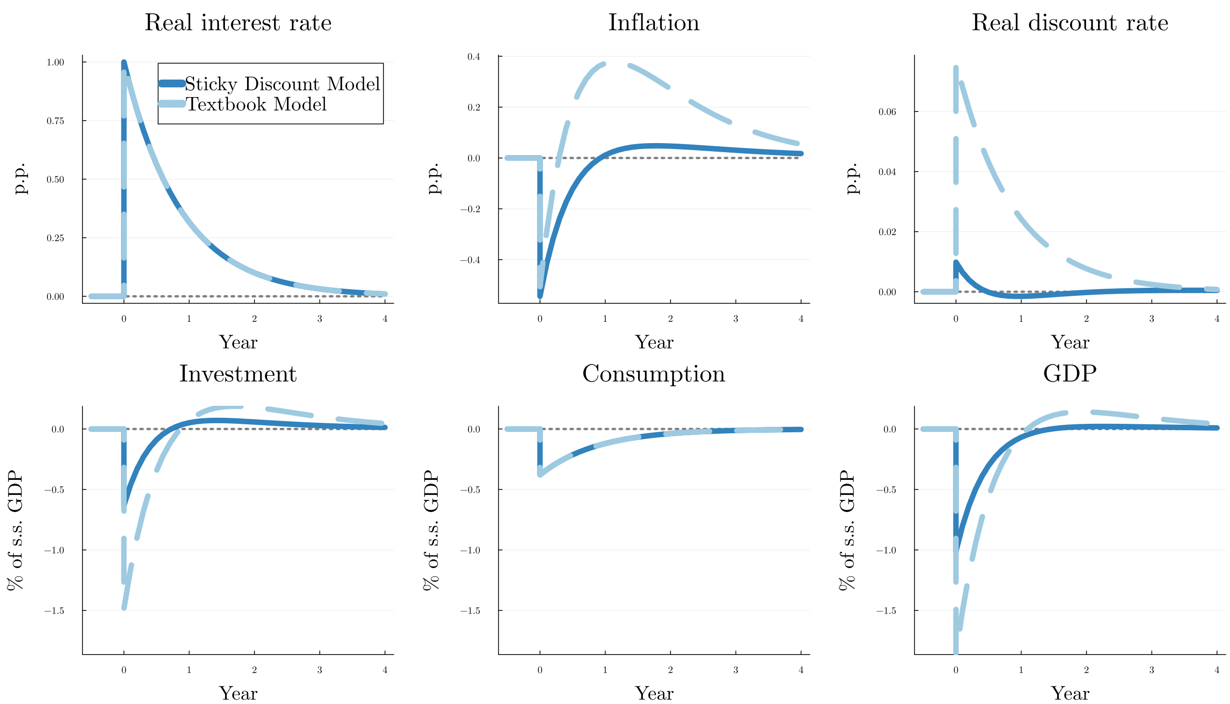

Figure 8: General Equilibrium Responses to a Real Interest Rate Shock

The figure plots aggregate impulse responses to a percentage point increase in the real interest rate, keeping the long-run inflation target constant. The real interest rate, inflation, the real discount rate, and the real variables are annualized.

demand shocks (Barro and King 1984). For instance, in the textbook New Keynesian model where the central bank targets inflation (e.g., using a Taylor rule), household demand shocks raise consumption but crowd out investment. In contrast, we show that the model with sticky discount rates naturally generates consumption-investment comovement after a demand shock.

We model a decrease in household patience as a unit increase in the household discount rate that decays with an autocorrelation of 0.6 at annual frequency. We now assume that monetary policy follows a standard Taylor (1993) rule, $i_t = \rho + \phi_\pi \pi_t$. This implies that real interest rates are given by $r_t = \rho + (\phi_\pi - 1)\pi_t$. We set $\phi_\pi = 1.5$, a standard parameterization in the literature (e.g., Galí 2015).

The impulse responses are in Figure 9. In the textbook model with fully flexible discount rates, lower household patience raises consumption and inflation, which in turn leads to a higher real interest rate. The higher interest rate has a strong negative impact on investment, a classic crowding-out effect. In contrast, inflation directly lowers firms' real discount rate in the model with sticky discount rates. Moreover, the real interest rate does not perfectly pass through to the real discount rate, dampening the initial crowd-out

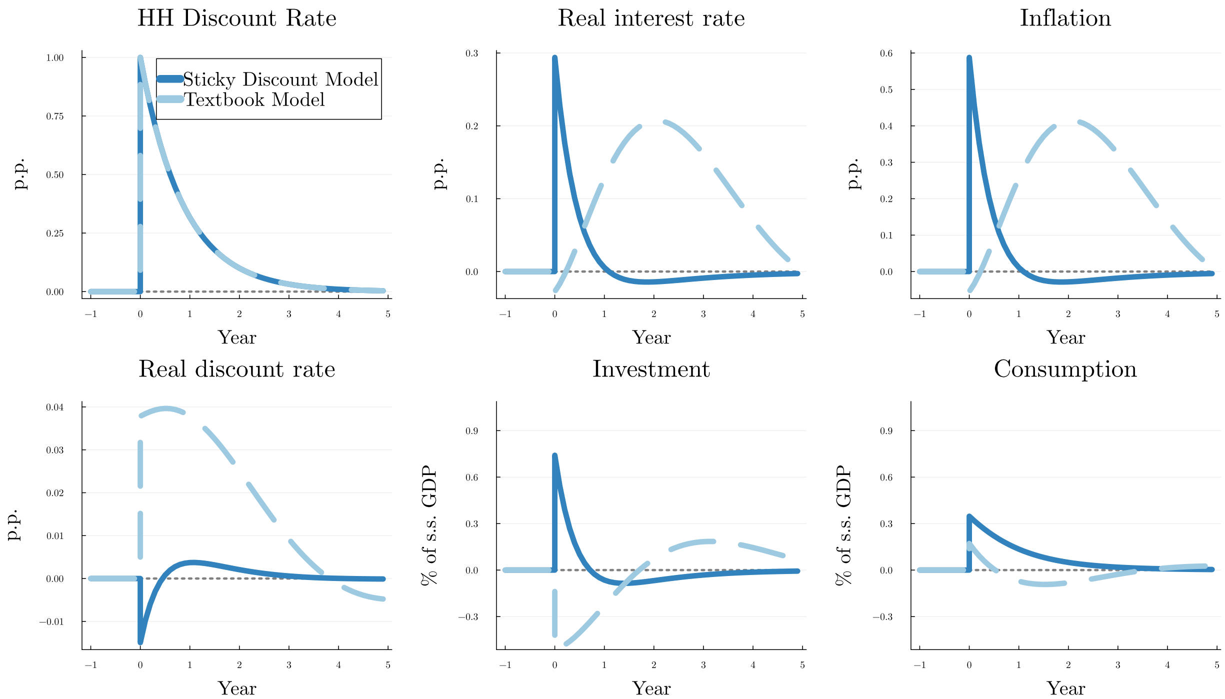

Figure 9: General Equilibrium Responses to a Household Demand Shock

The figure plots aggregate impulse responses to a unit decrease in household patience (an increase in the household discount rate). The household discount rate, the real interest rate, inflation, the real discount rate, and the real variables are annualized.

mechanism. As a result, investment increases with consumption following the patience shock. The two key mechanisms described in the analysis of the firm's problem in Section 4.3 therefore have a strong effect on general equilibrium dynamics.

We also find procyclical investment-consumption comovement in models with varying degrees of price stickiness, as shown in Figure A7, and models with hand-to-mouth households, as explained in Supplement B.

6.3 Ramsey Optimal Monetary Policy Problem

A large literature analyzes optimal monetary policy problems in New Keynesian models. In this final subsection, we describe a first step toward including sticky discount rates in such a problem. The textbook finding is "divine coincidence," implying that the central bank maximizes welfare by targeting zero long-run inflation. Existing extensions of the textbook model that feature the failure of divine coincidence typically still imply that the long-run inflation target should not react to temporary shocks (Woodford 2003).

The solution to the optimal monetary policy problem with sticky discount rates qualitatively differs from that with flexible discount rates. In particular, we show formally in

Appendix H and Supplement A.8 that it is not generically optimal for the central bank to maintain a zero long-run inflation target. The central bank actively changes the inflation target in response to temporary shocks. This finding stands in stark contrast to standard New Keynesian models where a zero long-run inflation target is optimal.

Taken together, our analysis suggests that optimal policy trade-offs change in models with sticky discount rates. In particular, changing long-run inflation expectations (through the inflation target) becomes a useful policy tool. Similarly to other optimal policy analyses in the New Keynesian model, the finding should be interpreted with caution because changes in the inflation target may lead to structural changes in firm behavior.discount rates are sticky due to state-dependent frictions.

7 Conclusion

The main contribution of this paper is to highlight a new mechanism linking expected inflation to real investment. The mechanism is driven by the fact that firms' nominal discount rates (i.e., their nominal marginal products of capital) are sticky with respect to expected inflation.

We present empirical evidence consistent with this mechanism. Firms' discount rates do not incorporate changes in expected inflation in the short run, but firms' price and cash flow forecasts strongly respond to expected inflation. As a result, we find that the investment rates of firms with stickier discount rates increase by more when expected inflation is high, compared to the investment rates of firms with less sticky discount rates.

Using a general equilibrium model, we show that the new mechanism fundamentally changes how investment behaves over the business cycle. Sticky discount rates constitute a distinct source of monetary non-neutrality, even in neoclassical models without any other nominal rigidities. Moreover, shocks to inflation expectations are much more powerful in stimulating investment than in the textbook. In comparison, conventional monetary shocks to real rates are less effective under sticky discount rates, in line with empirical estimates of the investment sensitivity to real interest rates.

With sticky discount rates, household demand shocks lead to procyclical investment-consumption comovement, addressing a long-standing challenge in the literature. In general, any shock that raises expected inflation crowds in the investment of firms with sticky discount rates. This finding stands in contrast to textbook models but is in line with time series data and our cross-sectional evidence.

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