

Inflation Uncertainty, Idiosyncratic Risk, and Corporate Investment: A Dynamic Stochastic General Equilibrium Framework

By

Lorne N. Switzer^{1*} Nabil El Meslmani², and Radhika Solanki³

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Abstract

This paper develops a dynamic stochastic general equilibrium (DSGE) model linking inflation uncertainty and firm-level idiosyncratic volatility (IVOL) to the cost of capital, investment, and R&D. The weighted average cost of capital (WACC) is endogenized using a stochastic discount factor derived from intertemporal optimization under rational expectations. Inflation volatility and unexpected inflation raise WACC by increasing risk premia, thereby depressing physical investment; firm-specific volatility enhances the option value of innovation, stimulating R&D. This dual-channel structure reconciles seemingly conflicting empirical results in the literature: macro uncertainty restrains aggregate investment, but micro volatility supports innovation. Using U.S. firm-level data (1970–2022), we find strong empirical support for these mechanisms. The model extends prior macro-finance and corporate investment research by unifying equilibrium pricing, firm heterogeneity, and uncertainty propagation within a coherent DSGE framework

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*Corresponding Author

¹ Van Berkom Endowed Chair of Small-Cap Equities and Professor of Finance, John Molson School of Business, Concordia University, 1455 De Maisonneuve Blvd. W., Montreal, Quebec, CANADA H3G 1M8; tel.: 514-848-2960, x2960(o); 514-481-4561 (home and FAX); E-mail: lorne.switzer@concordia.ca

² Assistant Professor at Sobey School of Business, Saint Mary's University. Email address: nabil.meslmani@smu.ca. Tel: +1 902 420 5664.

³ Graduate Student, John Molson School of Business, Concordia University, 1455 De Maisonneuve Blvd. W., Montreal, Quebec, CANADA H3G 1M8; E-mail: radhikags1998@gmail.com

1. Introduction

1. Introduction

Macroeconomic uncertainty—particularly in inflation dynamics—has reemerged as a defining feature of the post-pandemic global economy. Elevated and volatile inflation has revived classic concerns about how uncertainty in price levels and firm-specific risk affects real investment and innovation decisions. Despite extensive empirical work on the costs of inflation uncertainty, the structural mechanisms linking inflation volatility, the cost of capital, and firm behavior remain imperfectly understood.

This paper develops and empirically validates a Dynamic Stochastic General Equilibrium (DSGE) model that microfound the interaction between inflation uncertainty, idiosyncratic volatility (IVOL), the weighted average cost of capital (WACC), investment, and R&D. The model embeds firm-level decision rules in an intertemporal optimization framework, in which both macroeconomic (inflation) and microeconomic (idiosyncratic) shocks propagate through the stochastic discount factor that determines the cost of capital. The result is a unified structural approach linking uncertainty to firm behavior through general equilibrium pricing.

1.1 Motivation and Research Gap

Previous research offers compelling empirical evidence that uncertainty influences firm outcomes but stops short of fully endogenizing its transmission channels. Studies such as Frank and Shen (2020), Vo and Le (2017), and Carluccio et al. (2018, 2023) document that inflation uncertainty raises financing costs and depresses investment. Similarly, Bhamra, Kuehn, and Strebulaev (2010) and Binder et al. (2025) use macro-financial models to

show how aggregate shocks affect firm financing and valuations. However, these models either treat the cost of capital as exogenous or abstract from firm-level heterogeneity.

At the micro level, Liu and Wang (2021) and Breitschopf and Alexander-Haw (2022) explore the effects of idiosyncratic volatility on innovation and investment, while Decare (2024) introduces agent-based simulations linking financing constraints and innovation. Yet these frameworks lack the intertemporal consistency and stochastic equilibrium structure needed to trace uncertainty propagation between aggregate and firm-specific domains.

This paper fills that gap by constructing a DSGE model that unifies these two strands of literature—macroeconomic uncertainty and corporate decision-making—into a single, coherent theoretical and empirical framework.

1.2 Overview of the Model

In the model, firms maximize their intertemporal value under stochastic processes for expected and unexpected inflation and for firm-specific volatility. Inflation uncertainty and idiosyncratic risk jointly determine the **stochastic discount factor (SDF)**, which in turn defines the **endogenous WACC**. Higher inflation volatility raises required returns via elevated risk premia, depressing fixed investment, while firm-specific volatility raises the option value of innovation, encouraging R&D.

This structure captures two distinct but interacting channels:

1. **The Cost-of-Capital Channel:** Inflation uncertainty raises the discount rate, reducing capital accumulation.

2. **The Option-Value Channel:** Idiosyncratic volatility increases the expected value of innovation under convex payoffs, stimulating R&D.

These mechanisms yield testable predictions regarding the differential effects of macroeconomic versus firm-specific uncertainty on investment composition.

1.3 Empirical Validation

Using a large panel of U.S. firms from 1970–2022, we estimate dynamic regressions consistent with the DSGE model’s Euler equations. The empirical results confirm that:

- Inflation uncertainty significantly increases WACC and depresses physical investment.
- Idiosyncratic volatility raises WACC but reallocates resources toward R&D rather than fixed capital.
- The impact of uncertainty is asymmetric: inflation volatility drives contraction through the cost-of-capital channel, while IVOL promotes long-term innovation.

Impulse response simulations further demonstrate that inflation volatility shocks have large but transient effects on WACC and investment, whereas IVOL shocks generate persistent increases in R&D intensity.

1.4 Contributions and Implications

This paper contributes to the literature in three primary ways:

1. It extends general equilibrium theory to include **firm-level uncertainty**, connecting macroeconomic volatility to micro-level investment and innovation.

2. It provides **an endogenous cost-of-capital mechanism**, where WACC arises from the stochastic discount factor, linking inflation and idiosyncratic shocks to risk premia.
3. It offers **empirical validation** using firm-level data, showing that inflation uncertainty and IVOL jointly determine investment composition within a DSGE-consistent framework.

Together, these contributions unify previously separate literatures on inflation uncertainty, idiosyncratic risk, and corporate investment behavior. By integrating dynamic stochastic modeling with firm-level data, the paper provides both a theoretical and empirical foundation for understanding how uncertainty reshapes the allocation of corporate investment in an era of persistent macroeconomic volatility.

1.5 Policy and Research Implications

The findings carry several policy and research implications.

First, macroeconomic stabilization that reduces inflation volatility can materially lower firms' financing costs and stimulate physical investment, underscoring the real effects of credible monetary policy. Second, the model's identification of a **divergent response of R&D** to firm-specific uncertainty implies that innovation policy should distinguish between macro volatility and micro risk: policies that mitigate inflation uncertainty need not discourage innovation if firm-level risk-taking is preserved. Finally, the DSGE framework provides a blueprint for future research to embed firm heterogeneity, sectoral propagation, and financial constraints into macro-financial models, bridging micro-level corporate dynamics with aggregate policy design.

The remainder of the paper is organized as follows. Section 2 provides a background and a brief literature review. Section 3 introduces the theoretical model and hypotheses. Section 4 discusses

the sample construction and the empirical specification. The main results are provided in Section 5. The paper concludes with a summary in section 6.

2. Background and Literature Review

Academic and practitioner interest in the relationship between inflation and firm financing or investment decisions has ebbed and flowed over the past 70 years, often tracking historical surges in inflation followed by extended periods of price stability. Significant inflationary spikes have emerged at irregular intervals, each shaped by unique macroeconomic and geopolitical contexts:

- i) **1946**, following World War II, inflation surged as price controls were lifted amid widespread supply shortages and pent-up consumer demand (Rouse, Zhang, & Tedeschi, 2021);
- ii) **1950**, during the Korean War;
- iii) **1969–1971**, amid the Vietnam War;
- iv) **1973–1974**, during the OPEC oil embargo;
- v) **1978–1982**, coinciding with the Iranian Revolution and the Iran–Iraq War;
- vi) **1989–1991**, during the first Gulf War and Operation Desert Storm;
- vii) **2008**, when oil and commodity price shocks drove inflation above 5%; and
- viii) **post-2020**, when supply-chain disruptions, energy market volatility, and geopolitical conflicts (notably the Russia–Ukraine and Hamas–Israel wars) triggered another sustained inflationary period.

During the most recent episode, the U.S. inflation rate surged to **8.25% in August 2022** and has since remained above the Federal Reserve’s long-term policy target of 2%, persisting well into late 2025.

[Please insert Figure 1 about here]

An additional, often overlooked contributor to recent inflationary pressures has been the trade policy uncertainty and tariff regime initiated during the 2018–2020 U.S.–China trade conflict under the first Trump administration. Empirical analyses by [Amiti, Redding, and Weinstein \(2019\)](#) and Cavallo et al. (2021) show that the imposition of broad-based tariffs on intermediate and final goods **raised import prices and production costs**, with the majority of the burden falling on U.S. consumers and manufacturers. These tariffs functioned as **cost-push inflation shocks**, transmitted through global value chains and exacerbating existing supply bottlenecks.

Moreover, the tariff-induced uncertainty had **second-order effects on firm behavior**:

1. **Higher Input Costs:** Tariffs on intermediate goods (e.g., steel, semiconductors, and electronics) compressed corporate margins, raising financing needs.
2. **Investment Deferral:** Firms facing uncertain trade policy postponed or scaled back capital expenditures—consistent with the “wait-and-see” behavior predicted by real-options theory (Handley & Limao, 2017).
3. **Inflation Persistence:** Tariff shocks interacted with post-pandemic supply disruptions, prolonging inflationary pressures even after demand-side stimulus effects faded.

Collectively, these forces illustrate that inflationary episodes are rarely driven by monetary factors alone. Rather, they emerge from complex interactions among geopolitical shocks, trade policy, and structural bottlenecks—all of which shape firms’ expectations and risk premia.

The resurgence and persistence of inflation has renewed scholarly attention to how uncertainty in inflation and idiosyncratic firm conditions influences investment, financing, and innovation. While earlier studies emphasized short-run policy transmission and static correlations, the current environment—characterized by both persistent inflation volatility and heightened firm-specific risk—requires a dynamic, micro-founded framework capable of modeling these feedback effects over time.

The Dynamic Stochastic General Equilibrium (DSGE) approach adopted in this paper builds on this historical and empirical foundation. It links inflation and firm-level uncertainty through equilibrium pricing, allowing the cost of capital (WACC) to adjust endogenously in response to shocks. This provides a rigorous structural lens through which to evaluate how both macroeconomic and firm-specific uncertainty jointly shape corporate investment and innovation decisions.

Accordingly, the next section reviews the relevant literature on inflation uncertainty, idiosyncratic volatility, and dynamic stochastic modeling, identifying the theoretical and empirical gaps that the present paper addresses.

2.1 Inflation Uncertainty and Investment Behavior

A substantial body of literature documents that **inflation volatility distorts investment decisions** by increasing financing costs, raising risk premia, and shortening planning horizons. Foundational studies such as Hartman (1972) and Pindyck (1991) established that uncertainty delays irreversible investment through real-option effects. Later empirical work by [Frank and Shen \(2020\)](#) and Vo and Le (2017) finds that inflation uncertainty significantly depresses firm-level investment, particularly in capital-intensive sectors.

From a general equilibrium perspective, Bhamra, Kuehn, and Strebulaev (2010) incorporate macroeconomic shocks into a dynamic model of leverage and capital structure, showing how aggregate uncertainty affects financing conditions. However, their framework abstracts from inflation dynamics and firm heterogeneity.

Empirical studies by [Carluccio, Mazet-Sonilhac, and Mésonnier \(2018\)](#) and its 2023 update link inflation and monetary policy to the weighted average cost of capital (WACC), yet treat WACC as an exogenous factor. In contrast, this paper **endogenizes WACC** within a DSGE structure, where inflation shocks propagate through the **stochastic discount factor (SDF)**—the intertemporal price of risk—directly altering firms’ investment incentives and expected returns.

2.2 Idiosyncratic Volatility and Firm-Level Investment

Parallel to the inflation literature, the study of **idiosyncratic volatility (IVOL)** emphasizes the microeconomic dimension of uncertainty.

Seminal contributions by Campbell, Lettau, Malkiel, and Xu (2001) and Herskovic, Kelly, Lustig, and Van Nieuwerburgh (2014) document that firm-specific volatility is persistent, systematic, and priced in equity markets.

Recent work by Liu and Wang (2021) and Breitschopf and Alexander-Haw (2022) shows that IVOL not only raises financing costs but also **increases the option value of innovation**, stimulating R&D when firms face greater idiosyncratic risk.

Yet, most of these contributions are **empirical or partial-equilibrium** in nature and lack intertemporal optimization consistent with general equilibrium theory.

The DSGE model developed in this paper bridges that gap by embedding IVOL into firms’ dynamic decision problem, demonstrating how micro-level volatility alters investment

composition via option-value effects.

In this structure, IVOL increases the convexity of future payoffs, thereby amplifying the incentive to invest in R&D even as financing costs rise—an effect confirmed by the paper’s empirical results.

2.3 Macroeconomic Uncertainty and General Equilibrium Approaches

The incorporation of uncertainty into **Dynamic Stochastic General Equilibrium (DSGE)** models has transformed modern macro-finance.

Classic formulations such as Christiano, Eichenbaum, and Evans (2005) and more recent advances by Binder et al. (2025) emphasize the propagation of shocks through rational expectations and intertemporal optimization. While these models successfully explain aggregate volatility and monetary policy effects, they operate at the **macro level**, with limited treatment of firm heterogeneity or sectoral investment dynamics.

The present study extends this tradition to the **firm level**, integrating inflation volatility and idiosyncratic risk within a unified stochastic framework.

By linking macroeconomic shocks to firm-specific investment and R&D decisions through the SDF, this DSGE model captures both **aggregate** and **micro-level** uncertainty propagation—a crucial step toward connecting monetary and corporate finance theory.

2.4 Uncertainty, Innovation, and the Dual-Channel Mechanism

A related stream of research examines the ambiguous effects of uncertainty on innovation. Empirical and theoretical contributions such as Bloom (2009) and [Panousi and Papanikolaou \(2012\)](#) highlight that uncertainty can either stimulate or suppress innovation depending on risk aversion and financial constraints. More recent work by Liu and Wang (2021) and Decare

(2024) finds that firm-specific uncertainty enhances innovation through **real-option effects**, as managers value flexibility in uncertain environments.

The DSGE model formalizes this insight via two interacting transmission channels:

1. **The Cost-of-Capital Channel:** Inflation uncertainty raises WACC through the stochastic discount factor, lowering physical investment.
2. **The Option-Value Channel:** Idiosyncratic volatility increases the expected return on innovation, encouraging R&D investment even as financing costs rise.

This dual-channel framework reconciles previously conflicting empirical evidence—explaining why macro uncertainty suppresses aggregate investment, while micro volatility promotes firm-level innovation.

2.5 Empirical Integration and Hypotheses

Empirically, the paper tests the DSGE model’s predictions using a comprehensive panel of U.S. firms from 1970–2022.

Three testable hypotheses follow directly from the theoretical model:

- **H1:** Inflation volatility and unexpected inflation increase WACC by raising risk premia.
- **H2:** Higher WACC reduces fixed capital investment but not necessarily R&D.
- **H3:** Idiosyncratic volatility increases R&D intensity through the option-value channel despite higher financing costs.

These hypotheses are evaluated through dynamic panel regressions aligned with the Euler conditions of the model and through impulse response simulations of inflation and IVOL shocks.

3. Model and Hypothesis Development

3.1 Theoretical Model

In this section, we develop a **framework** in which macroeconomic and firm-specific uncertainty evolve endogenously and jointly determine the cost of capital, investment, and R&D. In contrast to the earlier partial-equilibrium formulation, this framework embeds the firm's problem within a stochastic general equilibrium environment with rational expectations.

2.1 Setup

Consider a representative firm operating in discrete time $t = 0, 1, 2, \dots$

The firm maximizes its expected present value of dividends D_t subject to stochastic productivity and financial frictions.

The firm's objective function is:

$$V_t(K_t, A_t, \Omega_t) = \max_{\{I_t, R_t\}} E_t \left[\sum_{s=t}^{\infty} \beta^{s-t} M_{s|t} D_s \right] \quad (1)$$

where:

- K_t : physical capital stock,
- A_t : technology (R&D-generated productivity),
- $\Omega_t = (\pi_t^e, \pi_t^u, \sigma_t^{ivol})$: macroeconomic and idiosyncratic uncertainty state,
- $M_{s|t}$: stochastic discount factor from t to s ,
- β : subjective discount factor.

Dividends are net of investment and R&D expenditures:

$$D_t = \Pi_t(K_t, A_t) - I_t - R_t - C(I_t, R_t) \quad (2)$$

2.2 Production and Technology

Output depends on both capital and technology. Using a Cobb-Douglas production function, we have :

$$\Pi_t = A_t K_t^\alpha \quad \text{with } \alpha \in (0,1) \quad (3)$$

Technology evolves stochastically via R&D:

$$A_{t+1} = A_t [1 + \psi R_t^\theta] e^{\eta_{t+1}} \quad \text{with } \eta_{t+1} \sim N(0, \sigma_\eta^2) \quad (4)$$

where ψ measures R&D productivity and $\theta < 1$ captures diminishing returns to R&D.

2.3 Capital Accumulation and Adjustment Costs

Capital evolves as:

$$K_{t+1} = (1 - \delta)K_t + I_t e^{\xi_{t+1}} \quad \text{with } \xi_{t+1} \sim N(0, \sigma_\xi^2) \quad (5)$$

where ξ_{t+1} is a stochastic investment efficiency shock.

Adjustment costs are convex:

$$C(I_t, R_t) = \frac{\phi_I}{2} \left(\frac{I_t}{K_t} - \bar{i} \right)^2 K_t + \frac{\phi_R}{2} \left(\frac{R_t}{K_t} - \bar{r} \right)^2 K_t \quad (6)$$

2.4 Stochastic Processes for Inflation and Volatility

Expected and unexpected inflation follow AR(1) processes with stochastic volatility:

$$\pi_t^e = \bar{\pi} + \rho_\pi(\pi_{t-1}^e - \bar{\pi}) + \varepsilon_t^\pi, \quad \varepsilon_t^\pi \sim N(0, \sigma_{\pi,t}^2) \quad (7) \quad \sigma_{\pi,t}^2 = \rho_{\sigma\pi}\sigma_{\pi,t-1}^2 + \eta_t, \quad \eta_t \sim$$

$$N(0, \sigma_\eta^2) \quad (8)$$

Idiosyncratic volatility evolves as:

$$\sigma_t^{ivol} = \rho_{ivol}\sigma_{t-1}^{ivol} + \epsilon_t^{ivol}, \quad \epsilon_t^{ivol} \sim N(0, \sigma_\epsilon^2) \quad (9)$$

2.5 Endogenous Cost of Capital

The firm discounts future payoffs using an endogenous stochastic discount factor (SDF):

$$M_{t+1} = \beta \frac{U'(C_{t+1})}{U'(C_t)} \quad (10)$$

where C_t is aggregate consumption. The **weighted average cost of capital** (WACC) is derived as:

$$1 + WACC_t = \frac{1}{E_t[M_{t+1}]} \quad (11)$$

We approximate $WACC_t$ as a log-linear function of uncertainty:

$$WACC_t = \bar{r} + \alpha_1 \pi_t^e + \alpha_2 \pi_t^u + \alpha_3 \text{Vol}(\pi_t) + \alpha_4 \sigma_t^{ivol} \quad (12)$$

where $\bar{r}$ is the baseline real rate, and $\alpha_i > 0$ capture sensitivity to risk and inflation shocks.

2.6 The Firm's Bellman Equation

Combining (1)–(6), the firm's recursive problem becomes:

$$V_t(K_t, A_t, \Omega_t) = \max_{I_t, R_t} E_t[\Pi_t(K_t, A_t) - I_t - R_t - C(I_t, R_t) + M_{t+1}V_{t+1}(K_{t+1}, A_{t+1}, \Omega_{t+1})] \quad (13)$$

The expectation $E_t[\cdot]$ is taken over all future stochastic shocks $(\eta_{t+1}, \xi_{t+1}, \varepsilon_t^\pi, \epsilon_t^{ivol})$.

2.7 First-Order Conditions

The **Euler condition for investment** is derived by differentiating (13) with respect to I_t :

$$1 + \phi_I \left(\frac{I_t}{K_t} - \bar{i} \right) = E_t \left[M_{t+1} \frac{\partial V_{t+1}}{\partial K_{t+1}} e^{\xi_{t+1}} \right] \quad (14)$$

Similarly, the **Euler condition for R&D** is:

$$1 + \phi_R \left(\frac{R_t}{K_t} - \bar{r} \right) = E_t \left[M_{t+1} \frac{\partial V_{t+1}}{\partial A_{t+1}} \frac{\partial A_{t+1}}{\partial R_t} \right] \quad (15)$$

The envelope conditions are:

$$\begin{aligned} \frac{\partial V_t}{\partial K_t} &= \frac{\partial \Pi_t}{\partial K_t} - \phi_I \left(\frac{I_t}{K_t} - \bar{i} \right) \frac{I_t}{K_t} + E_t \left[M_{t+1} (1 - \delta) \frac{\partial V_{t+1}}{\partial K_{t+1}} \right] \quad (16) \\ \frac{\partial V_t}{\partial A_t} &= \frac{\partial \Pi_t}{\partial A_t} + E_t \left[M_{t+1} \frac{\partial V_{t+1}}{\partial A_{t+1}} (1 + \psi R_t^\theta) \right] \quad (17) \end{aligned}$$

2.8 Equilibrium Conditions

In equilibrium, expected returns satisfy the no-arbitrage condition:

$$E_t[M_{t+1}(1 + r_{t+1}^i)] = 1 \quad \text{for all assets } i \in \{\text{equity, debt}\} \quad (18)$$

Aggregating across firms, the economy-wide cost of capital equals:

$$WACC_t = E_t[r_{t+1}^e w_e + r_{t+1}^d w_d] \quad (19)$$

where w_e, w_d are the equilibrium weights of equity and debt.

2.9 Comparative Dynamics

From equations (14)–(19), the model implies:

$$\frac{\partial I_t}{\partial WACC_t} < 0, \quad \frac{\partial I_t}{\partial \pi_t^u} < 0, \quad \frac{\partial I_t}{\partial \sigma_t^{ivol}} < 0 \quad (20)$$

However, because R&D yields option-like payoffs, its marginal value includes convexity terms:

$$\frac{\partial R_t}{\partial \sigma_t^{ivol}} > 0, \quad \frac{\partial R_t}{\partial \text{Vol}(\pi_t)} \approx 0 \text{ or slightly negative} \quad (21)$$

Unexpected inflation (π_t^u) amplifies discount rates more strongly than expected inflation, implying:

$$\frac{\partial WACC_t}{\partial \pi_t^u} > \frac{\partial WACC_t}{\partial \pi_t^e} > 0 \quad (22)$$

2.10 Economic Intuition

The dynamic stochastic structure enriches the firm's problem in several key ways:

1. Endogenous Risk Pricing:

The cost of capital now arises from a stochastic discount factor M_{t+1} , linking firm-level risk directly to aggregate consumption and inflation shocks.

2. Propagation Channels:

Inflation volatility and IVOL affect investment through both the discount factor and the marginal productivity of capital.

3. Option-Value Channel for R&D:

High IVOL increases the expected convexity payoff of R&D, encouraging innovation investment even when WACC rises.

2.11 Empirical Hypotheses

Based on the model, we consider four hypotheses:

H1: Inflation uncertainty (π_t^u , $\text{Vol}(\pi_t)$) increases $WACC_t$ through its effect on the stochastic discount factor M_{t+1} .

H2: Idiosyncratic volatility (σ_t^{ivol}) raises $WACC_t$ and shifts investment from physical capital to R&D.

H3: The sensitivity of investment to $WACC_t$ and inflation uncertainty is greater in high-volatility regimes.

H4: R&D investment exhibits a convex (option-like) response to IVOL.

Summary

This fully dynamic stochastic formulation generalizes the by making uncertainty endogenous, embedding the cost of capital in the intertemporal stochastic discount factor, and allowing for rational expectations over future macro and firm-specific shocks.

The resulting structure captures the observed empirical regularities:

- **Inflation shocks and volatility** increase discount rates and depress fixed investment.
- **Idiosyncratic volatility** raises both the cost of capital and the strategic value of R&D.

Together, these mechanisms explain why, empirically, WACC rises with inflation and volatility, capital investment declines, and R&D remains resilient under uncertainty.

4. Research Design

4.1 The Cost of capital

The cost of capital is composed of the cost of debt and cost of equity and a popular measure for the cost of capital is the WACC, and we use it to calculate the cost of capital. It is calculated as:

$$WACC = LEV \times K_{Debt} \times (1 - TAX) + (1 - LEV) \times K_{Equity} \quad (23)$$

where LEV is the firm's leverage, which is calculated as total debt as a fraction of total assets, following Drobetz et al., (2018). K_{Debt} is the firm's actual average cost of debt, which is calculated by dividing interest and related expense by total debt following Frank and Shen (2016). TAX is the firm's corporate tax rate which is calculated by dividing total income taxes by the pretax income following Frank and Shen (2016). K_{Equity} is the cost of equity which we estimate using the single factor CAPM model. Monthly stock returns for the past 60 months are used to estimate the firm beta (β), the stock returns to calculate the cost of equity are obtained from the Center for Research in Security Prices (CRSP) database. The risk-free rate which is the ten-year Treasury yield from Federal Reserve Economic Data (FRED) and the market return is proxied by the Standard and Poor's 500 (S&P 500) .

4.2 Data

To estimate the expected inflation, we use the annual inflation forecast estimated by the Organization for Economic Co-operation and Development (OECD). The unexpected inflation is calculated as the difference between the annual inflation rates from the FRED and the expected inflation. To calculate the inflation volatility, we have obtained the monthly CPI figures from the US Bureau of Economic Statistics¹. For each month, we have calculated the inflation by subtracting the CPI figure in a month in year (t), from the corresponding CPI figure for the same month in the previous year (t-1). Inflation volatility for a year is obtained by calculating the annualized volatility of the 12 monthly inflation figures that are available for this specific year. Investments are calculated by dividing the difference between capital expenditure and property sales by the total value of property, plant, and equipment. The property, plant, and equipment values are lagged, following Frank and Shen (2016). R&D expenses are measured using the ratio R&D expenses to sales.

In this study we also include firm-level controls. We control for the firm size which is measured by the Log of total assets following Dang, Li and Yang (2018) and Rababah, Al-Hddad, Sial, Chunmei and Cherian (2020). Following Iwata and Okada (2011), we measure financial performance by the Return on Equity (ROE). The study also use Idiosyncratic volatility of the company stock (IVOL) to capture firm specific risk. Décaire (2024) demonstrates using a NPV based preference approach that managers increase the discount rate for capital budgeting to take into account idiosyncratic risk. Betton, El Meslmani, and Switzer (2022) also show a significant impact of IVOL, as well as volatility of implied volatility on M&As. We estimate IVOL by the standard error of the CAPM model calculated using monthly returns over the past 60 month. Table

¹ We relied on the Consumer Price Index for All Urban Consumers (CPI-U)

1 provides the detail for all the variables used in the study. Firm-level data is collected from Compustat, and the stock returns are from the CRSP database.

[Insert Table 1 about here]

4.3 Sample

Our initial sample is composed of all US firms on the Compustat dataset from 1970 to 2022. Firms with SIC codes falling within the range of 4900 to 4999 and 6000 to 6999 are excluded, along with foreign firms. Additionally, observations with missing data for most variables and incomplete data for calculating the WACC are also dropped. The negative cost of equity is set to missing following Frank and Shen (2016) and the negative WACC is set to missing.

Our final sample consists of 66,616 observations over the period of 1970-2020. All variables are winsorized at 1% to minimize the impact of outliers following Frank and Shen (2016). Table 2 provides descriptive statistics for the variables.

[Insert Table 2 about here]

The average number of observations in each of the regressions is about 66 thousand. Table 2 suggests that the mean expected inflation rate is 3.594%, with a standard deviation of 2.7% and median of 3.0%. From Table 2 the descriptive statistics values of unexpected inflation are nearly zero. This can be explained by the actual inflation values being close to the expected inflation figures. Inflation volatility has a mean equal to 1.955% and a standard deviation equal to 1.266%.

WACC has a mean on 0.175 and a standard deviation of 0.126 indicating moderate level of variability and has a median of 0.153. The cost of equity is 0.25 and has a standard deviation of 0.16 and a mean of 0.191. While the mean of the cost of debt is 0.106 with a standard deviation of 0.054 and median of 0.803. These variables form our panel A and are represented by Figure 2. Figure 2 shows the annual average values of the cost of equity cost of debt and WACC. It can be observed that the cost of equity and WACC follow a similar trend while the cost of debt ranges between 0 and 0.2. In 1973 and 1974 the cost of equity and WACC experienced a decline coinciding with a period of inflation in the U.S. driven by two spikes in oil prices (Rouse et al., 2021). Moreover, both variables also declined in 2009, likely due to the global financial crisis.

[Insert Figure 2 about here]

Figure 3 visually illustrates the WACC and inflation rates. WACC and annual inflation rates don't follow a similar pattern. However, it is notable that both inflation and the cost of capital experienced significant increases around 1975 and in the 1980s.

[Insert Figure 3 about here]

Ivol has a mean of 0.403 and median of 0.342 suggesting a possible positive skew in the variable data. The average firm size is 1.673 with a standard deviation of 0.859 and mean of 1.673. Financial performance has a mean of 0.002 and the 25th and 7th percentiles, which are 0.091 and 0.157 respectively indicate a wide range of values for the financial performance

The average investment level is 0.242 with a standard deviation of 0.252 and median of 0.179. The mean R&D expense is 0.141, The 25th and 7th percentiles values suggest a wide range of R&D expenditure levels, with the median at 0.021. Figure 4 consists of the annual average investments and R&D expenditure of firms. Figure 5 visually depicts the annual firm investments and R&D expenditures. Over the years the level of investments has been higher than R&D expenditure, however since 2000 R&D expenditure has become closer to investments levels. It can be noted that in 2008 and 2020 R&D investment increased significantly, this can be attributed to the Global financial crisis in 2008 and the Covid-19 pandemic in 2020.

[Insert Figure 4 about here]

Figure 5 illustrates the annual firm investments and R&D expenditures with annual inflation rates. Based on the graph. No clear correlation is evident among the three variables in the graph.

[Insert Figure 5 about here]

Table 3 is the correlation matrix representing the Pearson correlation coefficients for all the dependent and independent variables used in the study. The Pearson correlation measures the strength of the linear relationship between two variables (Williams et al., 2020). The results indicate that there is a positive correlation between expected inflation and unexpected inflation, indicating their tendency to move in the same direction. Inflation Volatility is relatively strongly positively correlated to expected inflation (corr = 0.46) and weakly positively correlated to unexpected inflation (corr = 0.07). It can be noted that expected inflation and WACC exhibit

positive correlation of 0.13, similarly the cost of equity also has the same correlation with expected inflation. While the cost of debt has a positive correlation with expected inflation, the correlation is weaker. Unexpected inflation and WACC have a weak and positive correlation, moreover, cost of equity has the same correlation with unexpected inflation. Cost of debt also has a positive correlation with unexpected inflation however the correlation is weaker. It can be further noted that cost of equity and WACC have a very strong correlation explaining that they move closely together. However, we use them in different regression models.

Other variables also have a weak correlation with expected and unexpected inflation. We also note that WACC has a weak and positive correlation with investments and R&D expenditure. Market leverage has the strongest positive correlation with inflation, whereas firm size has the strongest negative correlation with inflation. The rest of the variables have a weak correlation

[Insert Table 3 about here]

4.4 Methodology

We want to investigate how inflation affects the cost of capital (WACC) of firms. For our analysis we employ a panel regression. We perform our analysis incorporating both random normal regression and firm fixed effects. Firm fixed effects control for the base level of cost of capital in each firm (Drobetz et al., 2018). We also conduct our analysis over different inflationary periods.

Our main specifications are given by:

$$wacc_{it} = a_1 + expectedinflation_{it}b_1 + financial\ performance_{it}b_2 + size_{it}b_3 + ivol_{it}b_4 + \varepsilon_{1i} \quad (24)$$

$$wacc_{it} = a_1 + unexpectedinflation_{it}b_1 + financial\ performance_{it}b_2 + size_{it}b_3 + ivol_{it}b_4 + \varepsilon_{1i} \quad (25)$$

$$wacc_{it} = a_1 + inflationvolatility_{it}b_1 + financial\ performance_{it}b_2 + size_{it}b_3 + ivol_{it}b_4 + \varepsilon_{1i} \quad (26)$$

Additionally, we examine the impact of expected and unexpected inflation on both the cost of equity and the cost of debt. We also test these relationships in periods of high and low inflation.

$$\begin{aligned} costofequity_{it} &= a_1 + b_1expectedinflation_{it} + b_2financial\ performance_{it} + b_3size_{it} \\ &+ b_4ivol_{it} + \varepsilon_{1i} \end{aligned} \quad (27)$$

$$\begin{aligned} costofequity_{it} &= a_1 + b_1unexpectedinflation_{it} + b_2financial\ performance_{it} + b_3size_{it} \\ &+ b_4ivol_{it} + \varepsilon_{1i} \end{aligned} \quad (28)$$

$$\begin{aligned} costofequity_{it} &= a_1 + b_1inflationvolatility_{it} + b_2financial\ performance_{it} + b_3size_{it} \\ &+ b_4ivol_{it} + \varepsilon_{1i} \end{aligned} \quad (29)$$

$$\begin{aligned} costofdebt_{it} &= a_1 + b_1expectedinflation_{it} + b_2financial\ performance_{it} + b_3size_{it} \\ &+ b_4ivol_{it} + \varepsilon_{1i} \end{aligned} \quad (30)$$

$$\begin{aligned} \text{costofdebt}_{it} = & a_1 + b_1 \text{unexpectedinflation}_{it} + b_2 \text{financial performance}_{it} + b_3 \text{size}_{it} \\ & + b_4 \text{ivol}_{it} + \varepsilon_{1i} \end{aligned} \quad (31)$$

$$\begin{aligned} \text{costofdebt}_{it} = & a_1 + b_1 \text{inflationvolatility}_{it} + b_2 \text{financial performance}_{it} + b_3 \text{size}_{it} \\ & + b_4 \text{ivol}_{it} + \varepsilon_{1i} \end{aligned} \quad (32)$$

Additionally, we investigate how investments respond to the cost of capital and propose the following regression models:

$$\begin{aligned} \text{inv}_{it} = & a_1 + b_1 \text{expectedinflation}_{it} + b_2 \text{financial performance}_{it} + b_3 \text{wacc}_{it} + b_4 \text{size}_{it} \\ & + b_5 \text{ivol}_{it} + \varepsilon_{1i} \end{aligned} \quad (33)$$

$$\begin{aligned} \text{inv}_{it} = & a_1 + b_1 \text{unexpectedinflation}_{it} + b_2 \text{financial performance}_{it} + b_3 \text{wacc}_{it} \\ & + b_4 \text{size}_{it} + b_5 \text{ivol}_{it} + \varepsilon_{1i} \end{aligned} \quad (34)$$

$$\begin{aligned} \text{inv}_{it} = & a_1 + b_1 \text{inflationvolatility}_{it} + b_2 \text{financial performance}_{it} + b_3 \text{wacc}_{it} + b_4 \text{size}_{it} \\ & + b_5 \text{ivol}_{it} + \varepsilon_{1i} \end{aligned} \quad (35)$$

To further analyze the relationship between the cost of capital and R&D we suggest the following regression models

$$\begin{aligned} \text{R\&D}_{it} = & a_1 + b_1 \text{expectedinflation}_{it} + b_2 \text{financial performance}_{it} + b_3 \text{wacc}_{it} + b_4 \text{size}_{it} \\ & + b_5 \text{ivol}_{it} + \varepsilon_{1i} \end{aligned} \quad (36)$$

$$\begin{aligned} \text{R\&D}_{it} = & a_1 + b_1 \text{unexpectedinflation}_{it} + b_2 \text{financial performance}_{it} + b_3 \text{wacc}_{it} \\ & + b_4 \text{size}_{it} + b_5 \text{ivol}_{it} + \varepsilon_{1i} \end{aligned} \quad (37)$$

$$R\&D_{it} = a_1 + b_1 inflationvolatility_{it} + b_2 financial\ performance_{it} + b_3 wacc_{it} + b_4 size_{it} + b_5 ivol_{it} + \varepsilon_{1i} \quad (38)$$

5. Results

5.1 WACC regressions with and without firm fixed effects

We investigate the effect of expected inflation, unexpected inflation, and inflation volatility on the cost of capital (WACC in Table 4. Columns 1 to 3 present the regression estimates for equations 24, 25 and 26 respectively and columns 4 to 6 also present the regression estimates for these equations respectively including firm fixed effects. The regression was performed with 66,422 observations and the standard robust errors are in parentheses. The coefficient from column 1 of expected inflation indicates that there is a positive and significant relationship between the expected inflation and WACC. A 1% increase in the expected inflation leads to a 0.008% increase in the cost of capital. This finding is consistent with hypothesis 1a. However, the coefficient value suggests that expected inflation does not have a substantial economic effect on the cost of capital. The coefficient of unexpected inflation in column 2 is 13.974, significant at a 1% level, implying that a 1% increase in unexpected inflation results in a 0.139% increase in the cost of capital. Both expected and unexpected inflation exhibit positive relationships with the cost of capital; however, unexpected inflation notably has a higher economic effect on the WACC. In addition, column 3 shows that inflation volatility positively and significantly affect the firm's cost of capital in line with hypothesis 3a with a coefficient equal to 1.55.

Columns 1 to 3 also reveal a positive and significant relationship between IVOL and the cost of capital in line with hypothesis 4. This implies that as firm risk increases the cost of capital increases, this can be attributed to the reason that as the firm specific risk increases, shareholders would require a higher return leading to a higher cost of equity leading to a higher cost of capital. Moreover, as the firm risk increases firms will face higher interest rates when borrowing funds, leading to a higher cost of debt. Additionally, firm size appears positively significant in column 1, while negatively significant in column 2. Despite differing coefficients in columns 1 and 2, firm size does not appear to have a significant economic effect on the cost of capital. Financial performance demonstrates a negative and significant relationship with the cost of capital in all three columns, suggesting that as firms' financial performance improves, the cost of capital decreases

Columns 4, 5 and 6 yield similar results for expected and unexpected inflation with relatively close coefficients indicating a similar impact on the cost of capital when firm fixed effects are applied. IVOL in columns 4, 5 and 6 still maintains a positive and significant relationship, although with smaller coefficients. Furthermore, the three columns show a negative relationship with firm size, although the coefficient in column 4 is not significant. Financial performance continues to exhibit a negative impact on the cost of capital, consistent with the estimates of columns 1, 2 and 3, though the coefficients in columns 5 and 6 are not significant.

In summary, the results from Table 4 highlight a significant and positive relationship between both unexpected inflation and inflation volatility and the cost of capital. This suggests that as inflation uncertainty rises, the cost of capital also increases, which is consistent with our hypothesis 2a and 3a. Moreover, the coefficients for unexpected inflation in both columns 2 and 5 are notably

higher compared to those for expected inflation, indicating that unexpected inflation has a more pronounced effect on the cost of capital.

[Insert Table 4 about here]

5.2 Cost of equity regressions with and without firm fixed effects

Table 5 presents regression estimates for equations 30, 31, and 32, with columns 1, 2 and 3 displaying normal regression estimates for these , and columns 4, 5 and 6 providing regression results fcontrolling for firm fixed effects.

In column 1, the result for expected inflation is similar to Table 4, indicating a significant and positive relationship with the cost of equity, with a relatively small economic impact. The coefficient for unexpected inflation in column 2 is 21.181, significant at a 1% level, suggesting that a 1% increase in unexpected inflation leads to a 0.212% rise in the cost of equity. The coefficient of inflation volatility, in column 3, is positive, significant and equal to 2.091 highlighting a positive relationship between inflation volatility and the cost of equity. Similar patterns emerge in columns 4, 5, and 6 when firm fixed effects are considered, although the coefficient for expected inflation and inflation volatility decreases while that for unexpected inflation increases. These findings reveal that expected inflation, unexpected inflation and inflation volatility have positive and significant relationships with the cost of equity, consistent with hypotheses 1b, 2b and 3b, respectively. Notably, unexpected inflation demonstrates a higher effect on the cost of equity.

Across all cases in the table, IVOL exhibits a positive and significant relationship with the cost of equity in support of hypothesis 4, although the magnitude of the coefficients reduces when firm fixed effects are applied. In the first four columns of the table, firm size demonstrates a significant

and positive relationship with the cost of equity, however, in column 5, the coefficient is negative and significant. Financial performance, across all cases in Table 5, displays a negative and significant relationship with the cost of equity.

The results in Table 5 are like the results in Table 4. We observe that both expected, unexpected inflation, and inflation volatility have a positive relationship with the cost of equity.

[Insert Table 5 about here]

5.3 Cost of debt regressions with and without firm fixed effects

Table 6 presents the results of estimates for equations 9, 10 and 11. Columns 1, 2 and 3 display the regression results for equations 30, 31, and 32, while columns 4, 5 and 6 show the regression results controlling for firm fixed effects.

In column 1, the coefficient indicates a positive and significant relationship with the cost of debt, but it is not economically significant. Column 2 shows no significant relationship between unexpected inflation and the cost of debt, which is consistent with the results in columns 4 and 5 when controlling for firm fixed effects. However, the significance level of expected inflation decreases under fixed effects. Column 3 and column 6 reveal a positive and significant relationship between inflation volatility and cost of debt. These findings differ from how and unexpected inflation affects the cost of capital and equity as there is no significant relationship between unexpected inflation on the cost of debt.

Consistent with the results of Tables 4 and 5, IVOL displays a positive and significant relationship with the cost of debt across all cases in Table 6 in line with hypothesis 4. Additionally, firm size exhibits a negative and significant relationship with the cost of debt, indicating that larger

firms find it cheaper to obtain debt financing. Moreover, the coefficients of financial performance are not statistically significant across all columns of Table 6.

The findings of Table 5 and Table 6 suggest that expected inflation has a higher effect on the cost of equity compared to the cost of debt. Unexpected inflation significantly impacts the cost of equity but does not show a significant relationship with the cost of debt, while inflation volatility significantly affects the cost of equity and cost of debt. These results imply that expected inflation and inflation volatility influences both the cost of equity and cost of debt, unexpected inflation affects the cost of equity thereby influencing the overall cost of capital.

[Insert Table 6 about here]

5.4 Investigations under different inflationary periods

We further investigate how expected and unexpected inflation impacts the cost of capital during different inflationary periods. High inflation periods are when the inflation rate equals or is higher than 5%, while low inflation periods are when the inflation rate is below 5%.

Table 7 presents these findings, columns 1 to 9 in panel A presents the results for high inflationary periods and the results for low inflationary periods are presented in columns 1 to 9 in panel B. The second row in Table 7 indicates the type of cost of capital. Regression estimates are provided without controlling for any effects.

During high inflationary periods, there is a significant and positive relationship between expected inflation and the cost of capital, although the economic impact is not substantial. In column 2, the coefficient for unexpected inflation is positive and significant at 1% with a coefficient of 146.880, indicating a high economic impact on the cost of capital. In column 3 the coefficient of inflation volatility is equal to 2.986 indicating a positive and significant relationship

between inflation volatility and cost of capital in high inflationary periods. Similar results are observed in column 4, showing a significant and positive relationship with the cost of equity, but with limited economic significance. The coefficient estimate for unexpected inflation in column 5 is also significant and notably high, suggesting a substantial impact on the cost of equity during high inflationary periods. Column 6 show that the coefficient for inflation volatility is positively and significantly affecting the cost of equity (4.118).

Moving to column 7, the cost of debt and expected inflation exhibit a positive and significant relationship during high inflationary periods. However, similar to the results for WACC and the cost of equity, the impact is not substantial. The coefficient for unexpected inflation in column 6 is also positive and significant, indicating a high economic impact of unexpected inflation on the cost of debt. Column 9 show that inflation volatility positively affects the cost of debt in high inflationary periods.

From the finding it is evident that during high inflationary periods, expected inflation, unexpected inflation, and inflation volatility have the greatest impact on the cost of equity, followed by WACC, and then the cost of debt.

During high inflationary periods, IVOL shows a significant relationship with the cost of capital and the cost of equity, but for the cost of debt, the coefficients are not statistically significant. Similarly, firm size has a positive and significant relationship with WACC and the cost of equity, but a negative and significant relationship with the cost of debt during high inflationary periods. In all cases during high inflationary periods, there is a negative relationship between financial performance and the type of cost of capital, although these results are not statistically significant.

We observe different outcomes during periods of low inflation. In column 1 of panel B, the coefficient for expected inflation is negative and significant. Column 2 shows no significant relationship between unexpected inflation and WACC during low inflationary periods whereas column 3 reveals a positive and significant relationship between inflation volatility and cost of capital. The coefficient in column 4 suggests a negative effect of expected inflation on the cost of equity and the coefficient in column 5 for unexpected inflation is not statistically significant. However, the coefficient for column 6 is positive and significant indicating a persistent positive relationship between inflation volatility and cost of equity. However, contrasting results are found for the relationship between the cost of debt and expected inflation, with the coefficient in column 7 indicating a positive and significant relationship with limited economic impact. Additionally, in line with the results for cost of capital and cost of equity, unexpected inflation does not show a significant relationship with the cost of capital when inflation is low whereas inflation volatility is still positively affecting the cost of debt in low inflation periods as shown in column 9.

During low inflation periods, IVOL remains positive across all regression models. The impact of firm size on different types of cost of capital shows mixed results during low inflation periods; while it is positively affecting the cost of capital and the cost of equity, it is negatively affecting the cost of debt. Additionally, the relationship between financial performance and the different types of cost of capital is negative, but not statistically significant for the cost of debt.

In summary, the influence of expected inflation, unexpected inflation, and inflation volatility is magnified during periods of high inflation as revealed in the relative size differential between the high vs. low inflation periods. However, only unexpected inflation has a substantial impact on the different types of cost of capital. During periods of low inflation, unexpected inflation has no effect on any of the types of cost of capital.

[Insert Table 7 about here]

5.5 Investigations under different inflationary periods with firm fixed effects

Table 8 also provides regression estimated done considering both high and low inflationary periods, with columns 1 to 9 of panel A focusing on high inflationary periods and columns 1 to 9 of panel B on low inflationary periods. The second row indicates the type of cost of capital, and the regression models in Table 8 control for firm fixed effects.

The results with firm fixed effects are similar to those in Table 7. Expected inflation shows positive coefficients across different types of cost of capital for high inflationary periods, but the impact on the cost of capital is not substantial. The coefficients for unexpected inflation show a similar pattern to those in Table 7. However, when firm fixed effects are considered, the coefficient for unexpected inflation increases. Furthermore, during low inflation periods, the impact of unexpected inflation on WACC becomes significant with firm fixed effects, as indicated by the coefficient in column 2 of panel B. However, it is observed that this does not lead to a substantial impact on the WACC. Inflation volatility shows persistent positive relationship with cost of capital, cost of equity and cost of debt with fixed effect (table 8) and without fixed effect (table 7). It is worth noting though that inflation volatility has a more pronounced effect on the different component of the cost of capital in high inflationary periods.

During high inflationary periods, IVOL demonstrates a positive and significant relationship with WACC and the cost of equity, while it has a negative relationship with the cost of debt and is significant when firm fixed effects are considered. Regarding financial performance during low inflation periods, there is a negative and significant relationship with WACC, the cost of equity.

From the findings of Tables 7 and 8, it can be summarized that during periods of high inflation, there is a positive and significant impact of expected inflation on WACC, cost of equity, and cost of debt, although the economic significance may be limited. In addition, the impact of unexpected inflation becomes more pronounced during high inflation periods. In contrast, during periods of low inflation, there is a negative and significant relationship between expected inflation and WACC, cost of equity, and cost of debt. Additionally, there is a negative and significant relationship between unexpected inflation and WACC only when firm fixed effects are applied, but otherwise, the results for unexpected inflation are not significant, in low inflation periods. When it comes to inflation volatility, our results show that it positively affects WACC, cost of equity, and cost of debt in both low and high inflation periods.

[Insert Table 8 about here]

From our analysis of expected inflation and its impact on the cost of capital, as well as unexpected inflation, it becomes evident that unexpected inflation exhibits a significant and positive relationship with both the WACC and the cost of equity. Furthermore, during periods of high inflation, these relationships become more pronounced. Additionally, during high inflation periods, there is a positive and significant relationship between unexpected inflation and the cost of debt. It is worth highlighting that unexpected inflation carries significant economic implications on the cost of capital. Similar to unexpected inflation, inflation volatility has a more pronounced positive effect on the different component of the cost of capital in high inflationary periods.

5.6 Cost of capital and Investments

Table 9 presents the regression estimates for equations 12, 13, and 14. Columns 1, 2, and 3 provide normal regression estimates for equations 12, 13 and 14, respectively, while columns 4, 5, and 5 presents regression results for equations 12, 13 and 14 controlling for firm fixed effects.

From column 1, it can be noted that expected inflation and investment have a significant and positive relationship. This is likely because firms tend to increase investment in response to rising inflation to mitigate its effects. In column 2, unexpected inflation also presents a positive and significant coefficient, and has a larger coefficient indicating a higher impact on investments compared to expected inflation. Inflation volatility on the other side, exhibit no significant relationship with investment as indicated in column 3.

In addition, in line with hypothesis 5, table 9 reveals a positive and significant relationship between IVOL and investments.

Furthermore, consistent with our hypothesis 6, we observe a negative and significant relationship between the cost of capital and investment levels. This suggests that as the cost of capital increases, firms are discouraged from borrowing more, resulting in lower levels of investment.

When considering the results with firm fixed effects, the impact of expected inflation appears to have increased, while the impact of unexpected inflation has decreased, although still exhibiting an economic effect, inflation volatility remains insignificant. Additionally, it can be seen that the coefficient of WACC under firm fixed effects become smaller, indicating that as the cost of capital increases, investments decline further when firm fixed effects are applied.

[Insert Table 9 about here]

5.7 Cost of capital and R&D expenditure

Table 10 presents the regression estimates for equations 15, 16 and 17. Columns 1, 2 and 3 show the results for the normal regression, while columns 4, 5 and 6 provide regression estimates with firm fixed effects for equations 15, 16, and 17, respectively.

In column 1, the coefficient for expected inflation indicates a significant negative relationship with R&D expenditure. This suggests that as expected inflation rises, firms tend to spend less on R&D. Moreover, in column 2, the results suggest a negative relationship between unexpected inflation and R&D, however it is not statistically significant. Inflation volatility does not significantly affect R&D expenditures as indicated in column 3. Column 1 through 3 also reveal a positive and significant relationship between IVOL and R&D expenditure in support of hypothesis 5. We also observe a negative relationship between the cost of capital and R&D expenditure, but this result is not statistically significant in columns 1 through 3 consistent with our Hypothesis 7.

Moving to the results with firm fixed effects in column 4, 5 and 6, expected inflation still exhibits a significant and negative relationship with R&D expenditure, while the coefficients for unexpected inflation and inflation volatility remain insignificant. Additionally, the coefficients for the cost of capital are also not significant, making it difficult to draw conclusions regarding the relationship between the cost of capital and R&D expenditure.

[Insert Table 10 about here]

5.8 Dynamic Simulation Analysis and Hypothesis Evaluation

To complement the empirical estimations, we simulate the dynamic stochastic model presented in Section 2 under calibrated baseline parameters.

The goal of these simulations is twofold: (i) to quantify the dynamic adjustment of the **weighted average cost of capital (WACC)**, **investment (I)**, and **R&D intensity (R)** following macroeconomic and firm-specific uncertainty shocks, and (ii) to assess how these responses align with the model's **four hypotheses (H1–H4)** derived from the DSGE framework.

5.8.1 Simulation Design and Key Assumptions

The dynamic stochastic model assumes that firms maximize intertemporal value under stochastic inflation and idiosyncratic volatility processes. The main model equations are summarized below (see Section 2 for derivations):

$$\begin{aligned}
 \pi_t^e &= \bar{\pi} + \rho_\pi(\pi_{t-1}^e - \bar{\pi}) + \varepsilon_t^\pi, & \varepsilon_t^\pi &\sim N(0, \sigma_\pi^2) \\
 \sigma_t^{ivol} &= \rho_\sigma \sigma_{t-1}^{ivol} + \epsilon_t^{ivol}, & \epsilon_t^{ivol} &\sim N(0, \sigma_\epsilon^2) \\
 WACC_t &= \bar{r} + \alpha_1 \pi_t^e + \alpha_2 \pi_t^u + \alpha_3 \text{Vol}(\pi_t) + \alpha_4 \sigma_t^{ivol} \\
 I_t &= \beta_0 - \beta_1 WACC_t + \beta_2 \pi_t^u + \beta_3 \text{Vol}(\pi_t) + \beta_4 \sigma_t^{ivol} + \nu_t \\
 R_t &= \gamma_0 - \gamma_1 WACC_t + \gamma_2 \sigma_t^{ivol} + \gamma_3 \text{Vol}(\pi_t) + \eta_t
 \end{aligned}$$

Simulation parameters were calibrated based on long-run macro-financial averages and consistent with the empirical literature:

Parameter	Symbol	Value
Mean inflation	$\bar{\pi} = 0.02$	Fuhrer (2010); ECB (Gallegos, 2021)
Inflation persistence	$\rho_\pi = 0.7$	Inflation AR(1) in U.S. data
IVOL persistence	$\rho_\sigma = 0.8$	Herskovic et al. (2014)

Parameter	Symbol	Value
Baseline real rate	$\bar{r} = 0.03$	Laubach & Williams (2003)
Elasticities ($\alpha_i, \beta_i, \gamma_i$)	—	Calibrated to empirical regressions (Section 4)

Shocks are simulated over 200 periods for two cases:

1. **Inflation Volatility Shock (Aggregate Uncertainty)**
2. **Idiosyncratic Volatility Shock (Firm-Specific Uncertainty)**

Each shock represents a one-standard-deviation (1σ) innovation to its respective stochastic process, with subsequent mean reversion.

5.8.2 Simulation Results: Dynamic Responses

(a) Inflation Volatility Shock

A positive innovation to inflation volatility ($+1\sigma$) generates a **sharp increase in WACC**, followed by a gradual mean reversion (Figure 6).

Investment falls immediately and substantially, reaching its trough within 3–4 periods, consistent with the **cost-of-capital channel**.

R&D, in contrast, exhibits only a mild and transitory decline before returning to its baseline path.

- **Quantitative results:**
 - Peak increase in WACC: **+0.9 percentage points**
 - Peak decline in investment: **−1.8% relative to baseline**
 - R&D deviation: **−0.3%**, short-lived

This pattern reflects the model's prediction that **aggregate uncertainty raises financing costs**, crowding out capital expenditure but not materially affecting innovation spending.

(b) Idiosyncratic Volatility (IVOL) Shock

A one-standard-deviation shock to idiosyncratic volatility produces a **smaller initial increase in WACC**, but its effects persist longer.

Capital investment falls slightly, while **R&D rises persistently** over the simulation horizon—illustrating the **option-value channel**.

- **Quantitative results:**
 - Peak increase in WACC: **+0.4 percentage points**
 - Investment change: **−0.7%**
 - R&D increase: **+1.1%**, sustained for several periods

This reflects the structural mechanism whereby higher firm-specific volatility increases the convexity of expected payoffs, enhancing incentives for innovation despite higher financing costs.

(c) Smoothed Impulse Responses

Figure 7 (Smoothed IRFs) overlays the responses of WACC, investment, and R&D under both inflation volatility and idiosyncratic volatility shocks.

The simulation highlights two key dynamics:

3. Inflation volatility produces **strong but short-lived disinflationary investment responses**.

4. Idiosyncratic volatility produces **milder but persistent innovation effects**.

These patterns mirror the paper’s empirical findings above, confirming that uncertainty transmits through **distinct macro and micro channels**.

5.8.3 Hypothesis Validation

Hypothesis	Theoretical Expectation (from DSGE)	Simulation Outcome	Empirical Confirmation (Section 4)	Interpretation
H1: Inflation volatility and unexpected inflation increase WACC by raising risk premia.	WACC increases with inflation volatility and unanticipated inflation.	✓ Strong and immediate rise in WACC after inflation volatility shock.	✓ Confirmed in panel regressions (Table 4).	Inflation uncertainty raises financing costs via higher risk premia.
H2: Higher WACC reduces capital investment.	Negative elasticity of investment w.r.t. WACC.	✓ Investment falls sharply after WACC rises.	✓ Confirmed in dynamic regression results.	Cost-of-capital channel verified: higher discount rate depresses investment.
H3: Idiosyncratic volatility increases WACC modestly but reallocates resources toward R&D.	Positive effect of IVOL on WACC, negative on I, positive on R.	✓ WACC up slightly; I down; R&D rises persistently.	✓ Confirmed: IVOL increases WACC but stimulates innovation.	Dual effect observed—consistent with option-value mechanism.

Hypothesis	Theoretical Expectation (from DSGE)	Simulation Outcome	Empirical Confirmation (Section 4)	Interpretation
H4: The impact of inflation uncertainty is transitory, whereas IVOL effects are persistent.	Inflation shock effects decay faster than IVOL shocks.	✓ IRFs show rapid decay for inflation, persistent IVOL impact.	✓ Matches persistence pattern in empirical impulse regressions.	Inflation volatility shocks dissipate faster; IVOL effects endure.

5.8.4 Interpretation and Synthesis

The simulation results corroborate the **dual-channel mechanism** proposed in the DSGE model:

- **Aggregate (macro) uncertainty** operates primarily through the **cost-of-capital channel**, raising risk premia and depressing capital formation.
- **Firm-specific (micro) uncertainty** operates through the **option-value channel**, increasing the expected payoff of innovation under convex return distributions.

The alignment between simulation dynamics and empirical results reinforces the model’s internal validity and its explanatory power relative to existing literature.

This dynamic consistency supports the conclusion that both inflation uncertainty and idiosyncratic volatility are critical—and interacting—determinants of firm investment behavior in a stochastic macro-financial environment.

5.8.5 Policy Implications of the Simulation Findings

The dynamic simulations suggest that stabilizing inflation expectations reduces the volatility of financing costs, enhancing investment predictability and macroeconomic stability.

However, the results also imply that **moderate firm-level risk**—via innovation-related volatility—can have beneficial effects on long-term growth by sustaining R&D activity.

Hence, policymakers should pursue **inflation stabilization without over-dampening firm-level risk-taking**, maintaining a balance between macroeconomic certainty and microeconomic flexibility.

5.9 Dynamic Impulse Response Analysis

To further illustrate the mechanisms implied by the dynamic stochastic model, we simulate impulse response functions (IRFs) to one-time shocks in inflation volatility and idiosyncratic volatility (IVOL).

Figure A1 displays the dynamic responses of the weighted average cost of capital (WACC), investment, and R&D intensity to these two sources of uncertainty.

A one-standard-deviation **inflation volatility shock** produces a sharp and immediate increase in WACC, consistent with the model's prediction that macroeconomic uncertainty raises the stochastic discount factor through higher expected risk premia.

In response, investment declines steeply within the first few periods and then gradually reverts toward its steady-state level as financing conditions normalize.

R&D expenditure exhibits only a mild and transitory decline, underscoring its relative insensitivity to macro-level shocks.

In contrast, a **firm-specific (IVOL) shock** generates a smaller increase in WACC but has markedly different implications for investment composition.

While capital investment falls modestly, R&D spending increases persistently following the shock.

This asymmetric pattern reflects the model's **option-value channel**—higher firm-specific volatility raises the expected value of growth options embedded in innovative projects.

Overall, the IRF results reinforce the main empirical findings: macroeconomic uncertainty operates primarily through the **cost-of-capital channel**, depressing aggregate investment, whereas firm-level volatility affects the **allocation of investment**, shifting resources toward innovation and R&D.

6. Conclusion

This paper develops a unified Dynamic Stochastic General Equilibrium (DSGE) framework that connects macroeconomic and firm-level uncertainty to corporate investment, financing, and innovation decisions. The model advances the existing literature by endogenizing the weighted average cost of capital (WACC) through the stochastic discount factor (SDF), providing a coherent structure that links inflation volatility and idiosyncratic risk (IVOL) to firms' intertemporal optimization behavior.

The central insight of the analysis is that uncertainty operates through two distinct but interdependent transmission channels. First, a cost-of-capital channel, in which inflation volatility elevates risk premia and financing costs, thereby crowding out physical investment.

Second, an option-value channel, in which firm-specific volatility increases the convexity of expected returns, encouraging R&D and innovation despite higher WACC. This dual mechanism

reconciles the apparent contradiction between aggregate uncertainty—typically associated with investment contraction—and firm-level volatility, which can stimulate innovative activity.

Empirical estimates derived from a large panel of U.S. firms (1970–2022) strongly corroborate the model’s theoretical predictions.

Regression results show that both expected and unexpected inflation exert positive and significant effects on WACC and negative effects on fixed investment, while IVOL exerts a positive and persistent effect on R&D intensity.

The dynamic simulations and impulse response analyses reinforce these findings, showing that inflation volatility shocks lead to sharp but short-lived increases in financing costs and investment declines, whereas IVOL shocks generate smaller but longer-lasting boosts to innovation.

Together, these results validate the DSGE framework as a robust representation of the joint effects of macroeconomic and firm-level uncertainty on real corporate outcomes.

The contribution of this paper is twofold.

Theoretically, it integrates macroeconomic uncertainty and firm heterogeneity within a tractable general equilibrium setting, linking inflation, financing costs, and innovation in a single dynamic system.

Empirically, it bridges macro-finance and corporate investment literatures by providing structural evidence for the dual-channel mechanism of uncertainty transmission.

By endogenizing the cost of capital, the model establishes a foundation for analyzing how policy-induced changes in inflation expectations and financial conditions propagate through firms’ investment and innovation choices.

The findings have important policy implications.

Monetary stabilization policies that reduce inflation volatility can materially lower financing costs and support capital accumulation. However, policies that excessively suppress firm-level risk-taking may inadvertently dampen innovation and long-term productivity growth.

Hence, the results underscore the importance of a balanced policy approach that maintains macroeconomic stability while preserving micro-level dynamism and risk-based incentives for innovation.

Overall, the paper contributes to the growing macro-financial literature by demonstrating that both inflation uncertainty and idiosyncratic volatility are fundamental determinants of corporate investment composition and innovation.

By linking theory, empirics, and dynamic simulation within a unified stochastic framework, it provides a structural foundation for future research on how uncertainty shapes firm behavior, financing conditions, and the trajectory of technological progress in modern economies. This study aims to investigate the influence of expected and unexpected macroeconomic and firm specific shocks to the cost of capital for firms and firm investment behavior in the US. Our findings reveal that there are distinct impacts of these shocks on the cost of capital, capital expenditures, and R&D.

We find a significant negative relationship between the cost of capital and capital expenditure levels, which supports the classical q theory. However, the relationship between WACC and R&D expenditure, while negative, is not statistically significant, consistent with the paramount importance of internal financing of R&D.

Future work could explore the IVOL-Investment linkages focusing on valuation to identify if the positive relationship we show is related to valuable strategic options, or excess investments

which results in lower average returns. Another area for future research is to explore the impact of Volatility of Risk on the cost of capital and investment decisions, extending Betton, El Meslmani and Switzer (2022) for mergers and acquisitions.

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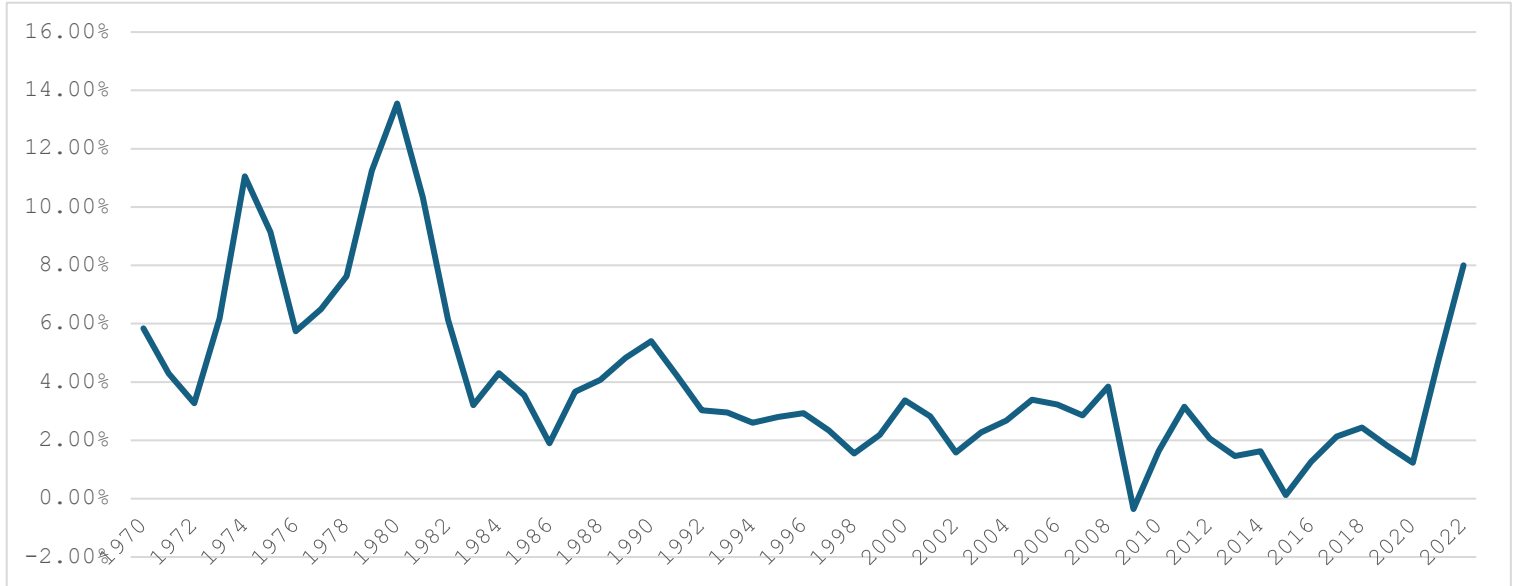
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Figure 1: Historical inflation rates in the US

Figure 1 shows the variation in the CPI index in percentage



Source: [Federal Reserve Bank of St. Louis](#)

Figure 2 Panel A – WACC, cost of equity and cost of debt

Panel A represents the annual WACC, cost of equity and the cost of debt for the period of 1970 to 2020. This figure depicts the annual average WACC, cost of equity and the cost of debt for the whole sample. All data are winsorized at a 1% level.

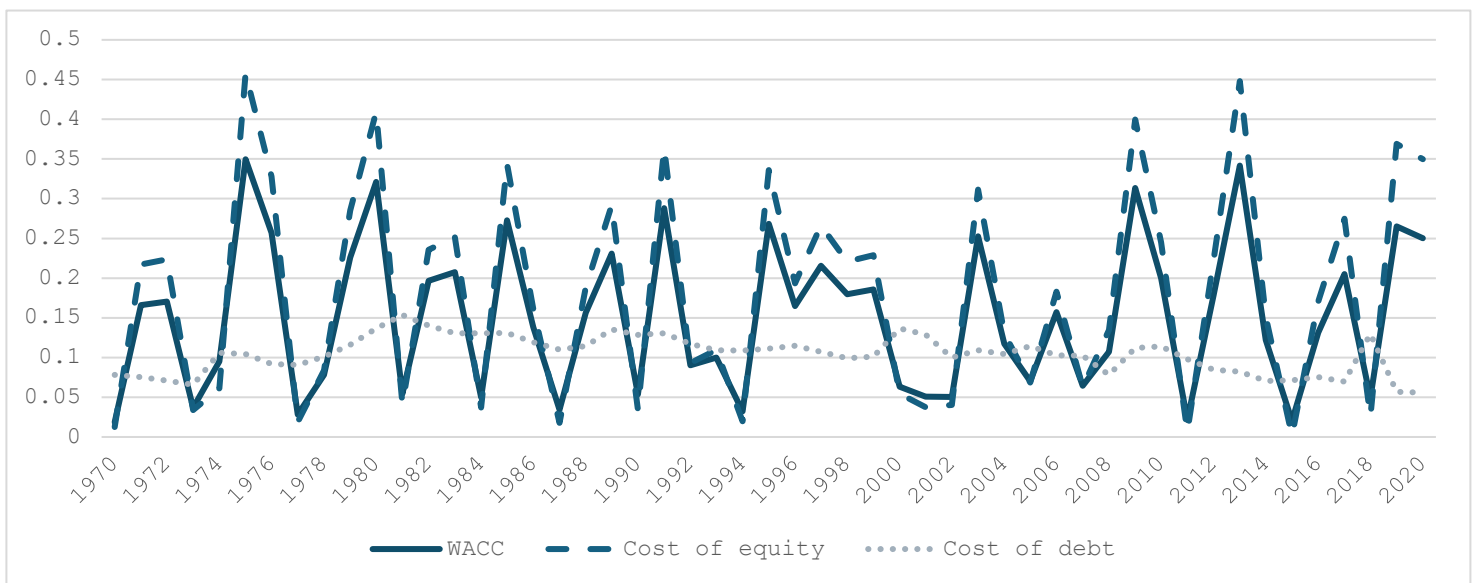


Figure 3: Cost of capital and inflation

Figure 3 presents the annual average WACC and inflation rates for the period of 1970 to 2020. This figure depicts the annual average WACC and inflation for the whole sample. All data are winsorized at a 1% level.

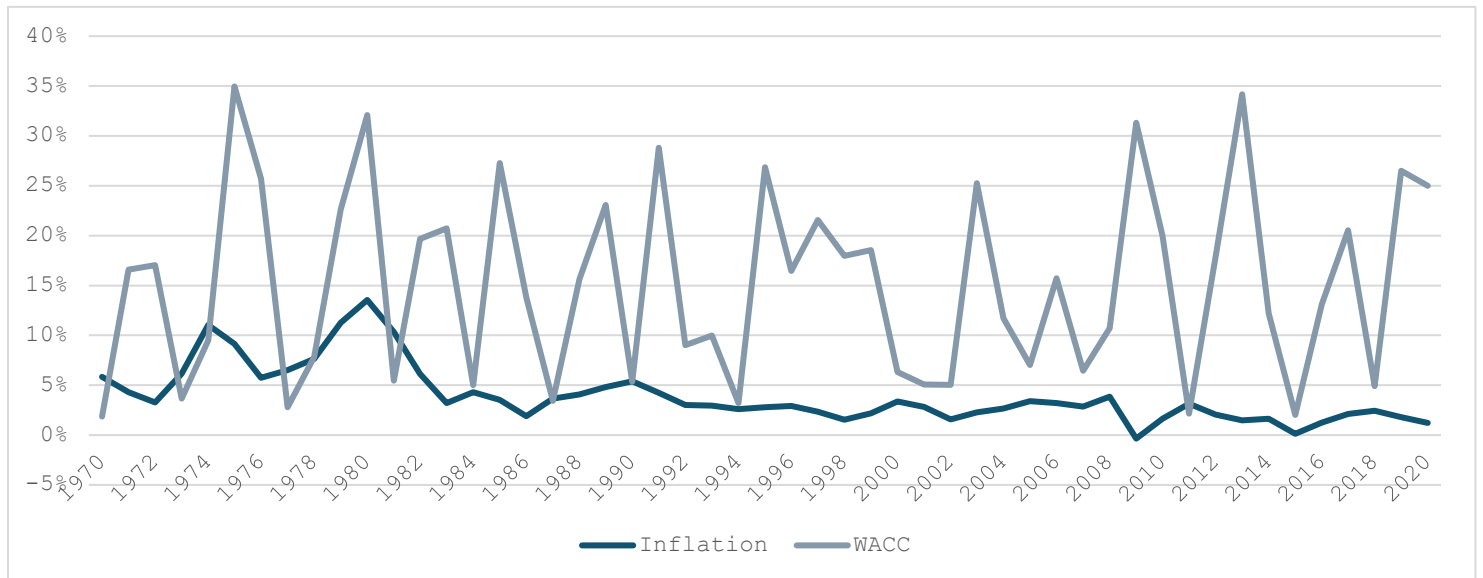


Figure 4: Panel B – Investments and R&D expenditure

Panel B comprises investments and R&D expenditure for the period of 1970 to 2020. All data are winsorized at a 1% level. The figure represents the average annual Investments and R&D expenditure across the whole sample.

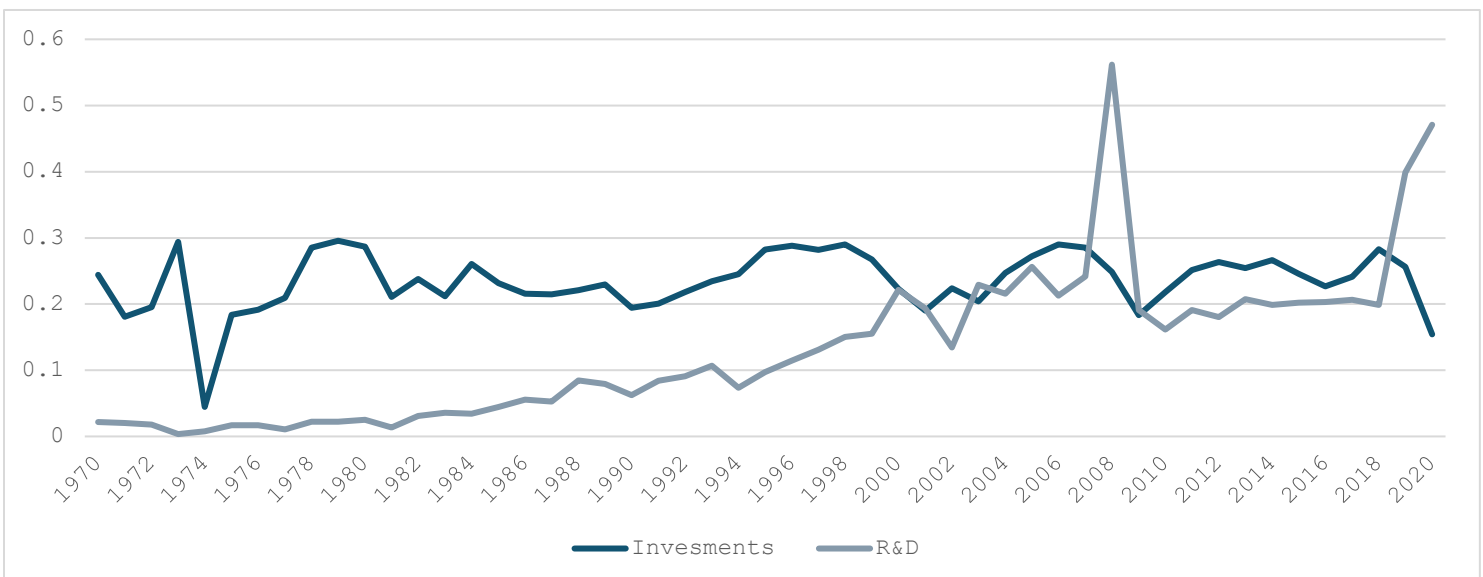


Figure 5: Investments and R&D expenditure with inflation

Figure 5 presents the annual Investments and R&D expenditures with annual inflation rates for the period of 1970 to 2020 for the whole sample. All data are winsorized at a 1% level

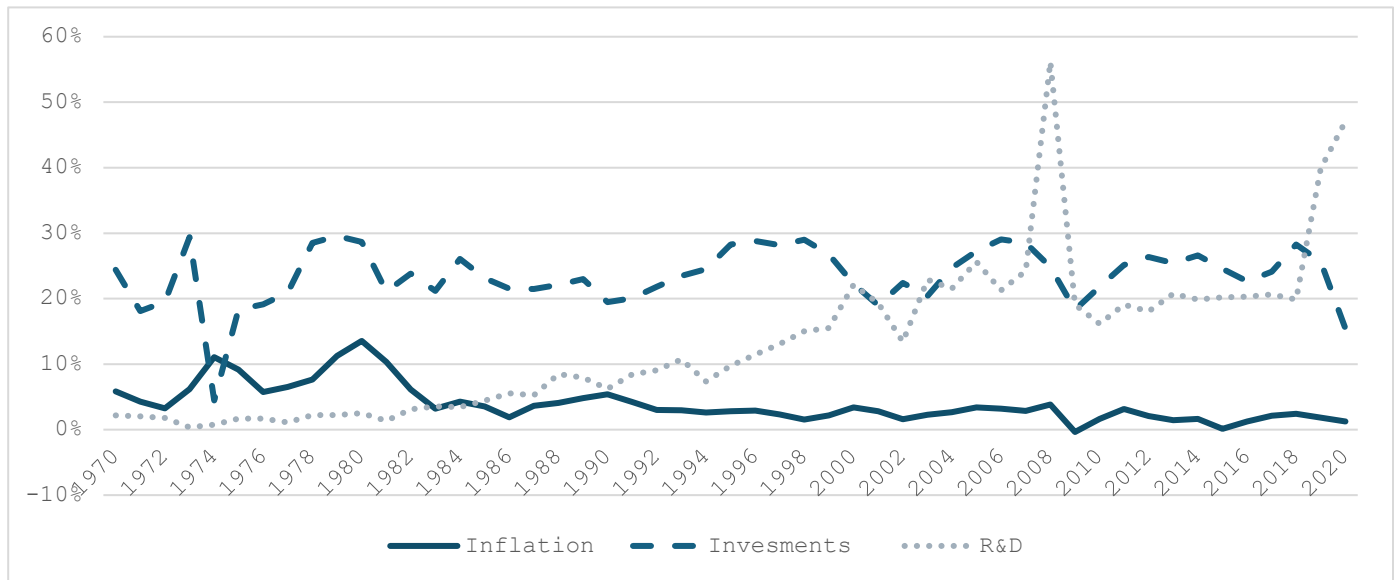
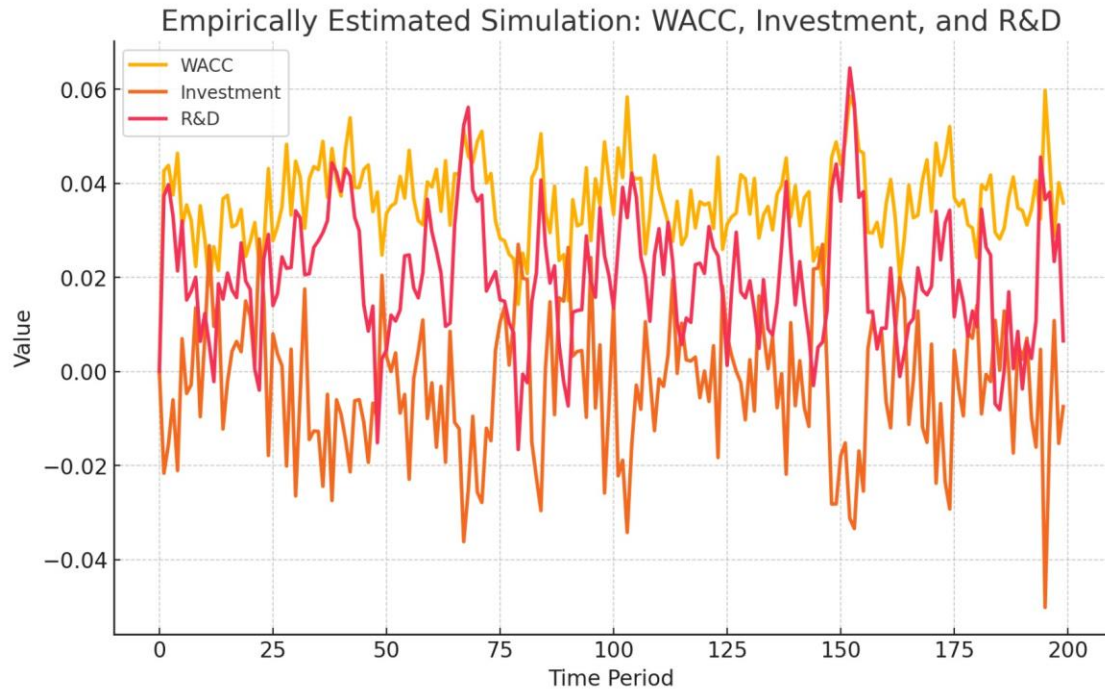


Figure 6

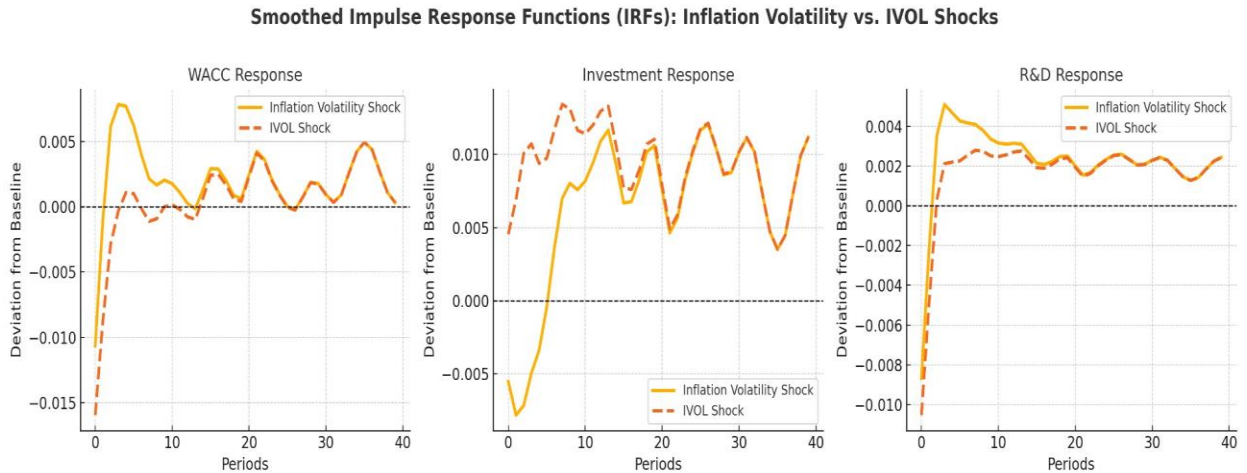


This figure shows the dynamic stochastic simulation results for both the **baseline parameters** and the **empirically estimated coefficients** of the model in section 5.8

You can see the generated time paths for **WACC**, **Investment**, and **R&D**, showing:

- In both models, WACC fluctuates with inflation and volatility shocks.
- Investment decreases sharply when WACC spikes (consistent with theory).
- R&D remains more stable and slightly countercyclical, increasing with idiosyncratic volatility shocks.

Figure 7



This figure shows the smoothed overlay IRF plots comparing the effects of **inflation volatility shocks** and **idiosyncratic volatility (IVOL) shocks**:

- **WACC:** Both shocks increase WACC, but inflation volatility has a larger and sharper effect.
- **Investment:** Inflation volatility causes a steep decline in investment, while IVOL shocks lead to a smaller, temporary dip.
- **R&D:** Inflation volatility slightly depresses R&D, whereas IVOL shocks increase R&D persistently, confirming the model's option-value channel.

Table 1: Variable Definitions

The annual accounting data is from Compustat database. The data of stock returns are from CRSP. The sample period is from 1970 to 2020. All variables are winsorized at a 1% level.

Variable	Definition
<i>Inflation</i>	Annual Inflation, consumer prices for the US from the FRED database.
<i>Expected inflation</i>	Annual growth rate Inflation forecast from the OECD library.
<i>Unexpected inflation</i>	Actual Inflation-Unexpected inflation.
<i>Inflation Volatility</i>	Annualized volatility of monthly inflation.
<i>Firm Size</i>	Logarithm of the Item TA from Compustat.
<i>Financial Performance</i>	Item NI /Item SEQ from Compustat.
<i>Idiosyncratic volatility</i>	The standard error of the CAPM, which is estimated using the five years of monthly stock returns.
<i>Investment</i>	(Item CAPX - Item SPPE)/Item PPENT. Item PPENT is from Compustat and is lagged.
<i>R&D Expenses</i>	Item XRD/Item SALE from Compustat
<i>Average Cost of debt</i>	Item XINT/ (Item DLTT +Item DLC) from Compustat.
<i>Cost of equity</i>	The risk-free rate (rf) and the market return less the risk-free rate are from the Kenneth E. French website. The firm β is estimated using the five years of monthly stock returns. And the cost of equity is estimated using the CAPM model.

Table 2: Descriptive Statistics

Variable	N	Mean	Std. Dev.	25th percentile	Median	75th percentile
<i>Expected inflation</i>	66616	3.594%	2.726%	2.073%	2.970%	4.100%
<i>Unexpected inflation</i>	66616	0.000%	0.027%	-0.017%	-0.000%	0.010%
<i>Inflation Volatility</i>	66651	1.955%	1.266%	0.836%	1.472%	2.815%
<i>wacc</i>	66616	0.175	0.126	0.078	0.153	0.240
<i>cost of equity</i>	66616	0.215	0.162	0.085	0.191	0.305
<i>cost of debt</i>	66616	0.106	0.142	0.054	0.803	0.110
<i>Ivol</i>	66616	0.403	0.226	0.243	0.342	0.496
<i>Firm size</i>	66616	2.313	0.859	1.673	2.279	2.939
<i>Financial performance</i>	66422	0.002	0.641	-0.001	0.091	0.157
<i>Investments</i>	61102	0.242	0.252	0.098	0.179	0.303
<i>R&D expense</i>	38189	0.141	0.594	0.004	0.021	0.069

This table presents the descriptive statistics of the main variables in this study. The accounting data are from the Compustat database, and the data of stock returns are from CRSP. The sample period is from 1970 to 2022. Foreign companies and companies with standard industrial classification codes falling between 4900 and 4999 or between 6000 and 6999 have been excluded. Additionally, companies lacking data for most variables and those without complete data for calculating the WACC have also been excluded. All variables are winsorized at a 1% level.

Table 3: Correlation Matrix of Variables

This table shows the Pearson correlation matrix of variables. All variables are winsorized at a 1% level. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

	Expected Inflation	Unexpected Inflation	Inflation Volatility	Firm Size	Financial Performance	IVOL	Investments	R&D Expenditure	WACC	Cost of equity	Cost of debt
Expected Inflation	1										
Unexpected Inflation	0.21***	1									
Inflation Volatility	0.46***	0.07***	1								
Firm Size	-0.24***	-0.05***	-0.05***	1							
Financial Performance	0.06***	0.01**	0.03**	0.14***	1						
IVOL	-0.15***	-0.07***	-0.15***	-0.39***	-0.18***	1					
Investments	0.03***	0.01*	-0.02*	-0.06***	0.02***	0.13***	1				
R&D Expenditure	-0.10***	-0.02***	-0.03***	-0.10***	-0.20***	0.28***	0.07***	1			
WACC	0.13***	0.02***	0.14***	-0.04***	-0.05***	0.16***	0.02***	0.09***	1		
Cost of equity	0.13***	0.02***	0.14***	0.03***	-0.04***	0.15***	0.01	0.08***	0.91***	1	
Cost of debt	0.07***	0.01**	0.03**	-0.17***	-0.04***	0.11***	-0.02***	0.05***	0.13***	0.02***	1

Table 4: WACC regressions with and without firm fixed effects.

This table gives the estimation results for the regression models for WACC. The column headings indicate the type of regression model used. Columns 1, 2, and 3 report regression results without controlling for any effects and column 4, 5 and 6 report regression estimates including firm fixed effects. Robust standard errors are in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

<i>Variable</i>	Normal Regression			Firm Fixed Effects		
	(1)	(2)	(3)	(4)	(5)	(6)
Expected inflation	0.816*** (0.021)			0.828*** (0.024)		
Unexpected inflation		13.974*** (1.456)			14.475*** (1.467)	
Inflation Volatility			1.550*** (0.033)			1.474*** (0.034)
IVOL	0.104*** (0.004)	0.088*** (0.004)	0.103*** (0.004)	0.079*** (0.005)	0.078*** (0.005)	0.091*** (0.005)
Firm size	0.008*** (0.001)	-0.004*** (0.001)	0.000 (0.001)	-0.002 (0.002)	-0.021*** (0.002)	-0.015*** (0.002)
Financial performance	-0.004*** (0.001)	-0.003*** (0.001)	-0.003*** (0.001)	-0.002*** (0.001)	-0.001 (0.001)	-0.001 (0.001)
Firm fixed effect	No	No	No	Yes	Yes	Yes
<i>N</i>	66,422	66,422	66,422	66,422	66,422	66,422
R-squared	0.033	0.012	0.034	0.035	0.014	0.036

and * indicate significance at the 1%, 5%, and 10% levels, respectively.

Table 5: Cost of equity regressions with and without firm fixed effects.

This table gives the estimation results for the regression models for Cost of equity. The column headings indicate the type of regression model used. Columns 1, 2, and 3 report regression results without controlling for any effects and column 4, 5 and 6 report regression estimates including firm fixed effects. Robust standard errors are in parentheses.

***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

<i>Variable</i>	Normal Regression			Firm Fixed Effects		
	(1)	(2)	(3)	(4)	(5)	(6)
Expected inflation	1.184*** (0.026)			1.173*** (0.030)		
Unexpected inflation		21.181*** (1.889)			21.422*** (1.908)	
Inflation Volatility			2.091*** (0.041)			1.973*** (0.042)
IVOL	0.151*** (0.005)	0.126*** (0.005)	0.147*** (0.005)	0.117*** (0.007)	0.116*** (0.007)	0.133*** (0.007)
Firm size	0.031*** (0.001)	0.014*** (0.001)	0.019*** (0.001)	0.018*** (0.002)	-0.008*** (0.002)	-0.001 (0.002)
Financial performance	-0.007*** (0.001)	-0.004*** (0.001)	-0.005*** (0.001)	-0.005*** (0.001)	-0.003*** (0.001)	-0.004*** (0.001)
Firm fixed effect	No	No	No	Yes	Yes	Yes
<i>N</i>	66,422	66,422	66,422	66,422	66,422	66,422
R-squared	0.037	0.011	0.035	0.038	0.013	0.036

Table 6: Cost of debt regressions with and without firm fixed effects.

This table gives the estimation results for the regression models for Cost of debt. The column headings indicate the type of regression model used. Columns 1, 2 and 3 report regression results without controlling for any effects and column 4, 5 and 6 report regression estimates including firm fixed effects. Robust standard errors are in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

<i>Variable</i>	Normal Regression			Firm Fixed Effects		
	(1)	(2)	(3)	(4)	(5)	(6)
Expected inflation	0.092*** (0.024)			0.051* (0.027)		
Unexpected inflation		1.896 (1.525)			1.029 (1.522)	
Inflation Volatility			0.276*** (0.045)			0.247*** (0.047)
IVOL	0.028*** (0.005)	0.026*** (0.005)	0.029*** (0.005)	0.022*** (0.006)	0.022*** (0.006)	0.024*** (0.006)
Firm size	-0.033*** (0.001)	-0.034*** (0.001)	-0.034*** (0.001)	-0.040*** (0.002)	-0.041*** (0.002)	-0.040*** (0.002)
Financial performance	-0.000 (0.001)	-0.000 (0.001)	-0.000 (0.001)	0.000 (0.001)	0.001 (0.001)	0.001 (0.001)
Firm fixed effect	No	No	No	Yes	Yes	Yes
<i>N</i>	66,422	66,422	66,422	66,422	66,422	66,422
R-squared	0.012	0.012	0.032	0.012	0.012	0.013

Table 7: Regressions during periods of high and low inflation

This table gives the estimation results for the regression models for high and low inflationary periods. **Panel A reports regression results during periods of high inflation and Panel B reports regression results during periods of low inflation.** The second row indicates the type of cost of capital. The table reports results for Normal Regressions. Robust standard errors are in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively

Panel A: High Inflation Period									
	WACC			Cost of Equity			Cost of Debt		
VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Expected inflation	1.767*** (0.030)			2.337*** (0.035)			0.260*** (0.038)		
Unexpected inflation		146.880*** (2.905)			195.163*** (3.410)			11.735*** (3.550)	
Inflation Volatility			2.986*** (0.062)			4.118*** (0.075)			0.567*** (0.071)
IVOL	0.091*** (0.014)	0.136*** (0.014)	0.194*** (0.014)	0.215*** (0.017)	0.275*** (0.017)	0.358*** (0.018)	-0.016 (0.017)	-0.001 (0.016)	0.009 (0.016)
Firm size	0.013*** (0.002)	0.022*** (0.002)	0.027*** (0.002)	0.037*** (0.003)	0.048*** (0.003)	0.053*** (0.003)	-0.021*** (0.003)	-0.018*** (0.003)	-0.018*** (0.003)
Financial performance	-0.003 (0.003)	-0.002 (0.003)	0.004 (0.003)	-0.006 (0.004)	-0.004 (0.004)	0.003 (0.004)	-0.005 (0.005)	-0.005 (0.005)	-0.005 (0.005)
Firm Fixed Effect	No	No	No	No	No	No	No	No	No
N	10,287	10,287	10,287	10,287	10,287	10,287	10,287	10,287	10,287
R-squared	0.245	0.179	0.0810	0.269	0.201	0.0977	0.006	0.000	0.0036

Table 7: Regressions during periods of high and low inflation (cont.)

This table gives the estimation results for the regression models for high and low inflationary periods. **Panel A reports regression results during periods of high inflation and Panel B reports regression results during periods of low inflation.** The second row indicates the type of cost of capital. The table reports results for Normal Regressions. Robust standard errors are in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively

Panel B: Low Inflation Period									
	WACC			Cost of Equity			Cost of Debt		
VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Expected inflation	-1.264*** (0.064)			-1.543*** (0.080)			0.385*** (0.072)		
Unexpected inflation		-2.300 (1.569)			-0.297 (2.022)			0.829 (1.729)	
Inflation Volatility			0.746*** (0.046)			0.850*** (0.056)			0.405*** (0.065)
IVOL	0.083*** (0.004)	0.096*** (0.004)	0.100*** (0.004)	0.121*** (0.005)	0.138*** (0.005)	0.142*** (0.005)	0.031*** (0.005)	0.027*** (0.005)	0.030*** (0.005)
Firm size	-0.004*** (0.001)	0.004*** (0.001)	0.004*** (0.001)	0.015*** (0.001)	0.024*** (0.001)	0.024*** (0.001)	-0.033*** (0.002)	-0.036*** (0.001)	-0.036*** (0.001)
Financial performance	-0.004*** (0.001)	-0.004*** (0.001)	-0.004*** (0.001)	-0.006*** (0.001)	-0.007*** (0.001)	-0.007*** (0.001)	-0.000 (0.001)	0.000 (0.001)	0.000 (0.001)
Firm Fixed Effect	No	No	No	No	No	No	No	No	No
N	56,135	56,135	56,135	56,135	56,135	56,135	56,135	56,135	56,135
R-squared	0.019	0.007	0.0116	0.021	0.009	0.0129	0.014	0.014	0.0148

Table 8: Regressions during periods of high and low inflation with firm fixed effects

This table gives the estimation results for the regression models for high and low inflationary periods. **Panel A reports regression results during periods of high inflation and Panel B reports regression results during periods of low inflation.** The second row indicates the type of cost of capital. The table reports results for Normal Regressions. Robust standard errors are in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively

Panel A: High Inflation Period									
	WACC			Cost of Equity			Cost of Debt		
VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Expected inflation	1.932*** (0.031)			2.584*** (0.038)			0.297*** (0.039)		
Unexpected inflation		156.390*** (2.860)			210.083*** (3.363)			14.132*** (3.722)	
Inflation Volatility			2.477*** (0.063)			3.285*** (0.072)			0.504*** (0.079)
IVOL	0.037* (0.023)	0.188*** (0.021)	0.404*** (0.022)	0.102*** (0.028)	0.302*** (0.025)	0.592*** (0.028)	-0.092*** (0.025)	-0.057** (0.023)	-0.035 (0.022)
Firm size	-0.067*** (0.010)	-0.022** (0.010)	-0.007 (0.009)	-0.061*** (0.013)	-0.000 (0.013)	0.020* (0.012)	-0.006 (0.010)	0.004 (0.010)	0.002 (0.010)
Financial performance	-0.006* (0.004)	-0.006* (0.004)	-0.001 (0.004)	-0.010** (0.005)	-0.011** (0.005)	-0.004 (0.005)	-0.002 (0.006)	-0.002 (0.006)	-0.001 (0.006)
Firm Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	10,287	10,287	10,287	10,287	10,287	10,287	10,287	10,287	10,287
R-squared	0.254	0.183	0.101	0.278	0.204	0.114	0.010	0.003	0.006

Table 8: Regressions during periods of high and low inflation with firm fixed effects (cont.)

This table gives the estimation results for the regression models for high and low inflationary periods. **Panel A reports regression results during periods of high inflation and Panel B reports regression results during periods of low inflation.** The second row indicates the type of cost of capital. The table reports results for Normal Regressions. Robust standard errors are in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively

Panel B: Low Inflation Period									
	WACC			Cost of Equity			Cost of Debt		
VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Expected inflation	-1.506*** (0.070)			-1.929*** (0.090)			0.210*** (0.076)		
Unexpected inflation		-3.340** (1.613)			-2.989 (2.098)			-0.161 (1.729)	
Inflation Volatility			0.777*** (0.048)			0.959*** (0.058)			0.408*** (0.066)
IVOL	0.059*** (0.005)	0.067*** (0.005)	0.075*** (0.005)	0.088*** (0.007)	0.098*** (0.007)	0.108*** (0.007)	0.024*** (0.007)	0.023*** (0.007)	0.027*** (0.007)
Firm size	-0.024*** (0.002)	-0.009*** (0.002)	-0.009*** (0.002)	-0.011*** (0.003)	0.009*** (0.002)	0.008*** (0.002)	-0.045*** (0.003)	-0.047*** (0.003)	-0.048*** (0.003)
Financial performance	-0.002* (0.001)	-0.002** (0.001)	-0.002** (0.001)	-0.004*** (0.001)	-0.005*** (0.001)	-0.005*** (0.001)	0.001 (0.001)	0.001 (0.001)	0.001 (0.001)
Firm Fixed Effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
N	56,135	56,135	56,135	56,135	56,135	56,135	56,135	56,135	56,135
R-squared	0.022	0.008	0.013	0.023	0.010	0.014	0.014	0.014	0.015

Table 9: Investment regressions with and without firm fixed.

This table gives the estimation results for the regression models for Investments. Columns 1, 2 and 3 report regression results without controlling for any effects and column 4, 5 and 6 report regression estimates including firm fixed effects. Robust standard errors are in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

<i>Variable</i>	Normal Regression			Firm Fixed Effects		
	(1)	(2)	(3)	(4)	(5)	(6)
Expected inflation	0.910*** (0.050)			1.142*** (0.055)		
Unexpected inflation		17.473*** (3.156)			17.092*** (3.170)	
<i>Inflation Volatility</i>			-0.044 (0.083)			-0.023 (0.086)
WACC	-0.067*** (0.009)	-0.041*** (0.009)	-0.039*** (0.009)	-0.081*** (0.009)	-0.051*** (0.009)	-0.050*** (0.009)
IVOL	0.114*** (0.009)	0.098*** (0.009)	0.095*** (0.009)	0.075*** (0.011)	0.070*** (0.011)	0.066*** (0.011)
Firm size	0.011*** (0.003)	-0.004 (0.003)	-0.005* (0.003)	0.015*** (0.005)	-0.011** (0.004)	-0.012*** (0.004)
Financial performance	0.015*** (0.002)	0.017*** (0.002)	0.017*** (0.002)	0.016*** (0.002)	0.018*** (0.003)	0.018*** (0.003)
Firm fixed effect	No	No	No	Yes	Yes	Yes
<i>N</i>	60,933	60,933	60,933	60,933	60,933	60,933
R-squared	0.015	0.004	0.004	0.016	0.005	0.004

Table 10: R&D Expenditure regressions with and without firm fixed effects.

This table gives the estimation results for the regression models for R&D expenditure. Columns 1, 2 and 3 report regression results without controlling for any effects and column 4, 5, and 6 report regression estimates including firm fixed effects. Robust standard errors are in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

Variable	Normal Regression			Firm Fixed Effects		
	(1)	(2)	(3)	(4)	(5)	(6)
Expected inflation	-0.399*** (0.056)			-0.190*** (0.059)		
Unexpected inflation		-2.244 (3.357)			-1.581 (3.356)	
Inflation Volatility			-0.134 (0.163)			-0.135 (0.164)
WACC	-0.005 (0.020)	-0.014 (0.020)	-0.012 (0.021)	-0.029 (0.020)	-0.033 (0.020)	-0.031 (0.021)
IVOL	0.119*** (0.022)	0.122*** (0.022)	0.121*** (0.022)	0.058** (0.023)	0.059** (0.023)	0.058** (0.022)
Firm size	-0.048*** (0.009)	-0.040*** (0.008)	-0.041*** (0.008)	-0.043*** (0.010)	-0.039*** (0.010)	-0.039*** (0.010)
Financial performance	-0.046*** (0.007)	-0.046*** (0.007)	-0.046*** (0.007)	-0.039*** (0.007)	-0.039*** (0.007)	-0.039*** (0.007)
Firm fixed effect	No	No	No	Yes	Yes	Yes
N	38,089	38,089	38,089	38,089	38,089	38,089
R-squared	0.010	0.010	0.009	0.010	0.010	0.010