The Macro Impact of the Debt-Inflation Channel on Investment*

Job Market Paper

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Abstract

This paper evaluates the macro impact of the debt-inflation (Fisher) channel of investment, whereby unexpected inflation erodes the real value of nominal debt and thus stimulates firm-level investment. Consistent with theory, I document new micro evidence that more indebted firms increase investment relative to others following unexpected increase in inflation. To quantify the macro effect of this channel, I develop a general equilibrium model with heterogeneous firms, financial frictions and nominal debt contracts. Calibrated to match key U.S. firm-level moments, the model implies that a 1% unexpected inflation raises aggregate investment by 0.8%. By applying the observed post-COVID inflation surprises, this firm-side debt-inflation is quantitatively important enough to explain about 70% of investment surge. This finding highlights a significant transmission mechanism for investment debt-inflation channel, in contrast to previous studies that found a more modest role for the channel on household consumption.

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1 Introduction

The post-COVID era has been marked by a surge in inflation globally, with rates in the U.S. reaching 40-year highs. This dramatic macroeconomic development has reignited intense academic and policy interest in the real effects of inflation. Among the various transmission mechanisms, the debt-inflation channel, or the Fisher channel—whereby unexpected inflation redistributes wealth from nominal creditors to nominal debtors by revaluing outstanding nominal contracts—stands out as a potentially important force even in low and well-anchored inflation environment. If borrowers have high marginal propensity to consume or invest, this wealth transfer via debt-inflation channel can generate significant real effects on aggregate activities. While the consequences of this channel for household balance sheets and consumption are well-documented (e.g., Doepke and Schneider (2006)), its role on the firm investment has received far less attention. Because non-financial corporations issue a substantial share of nominal debt, the lack of a firm-side perspective limits our comprehensive understanding of the debt-inflation channel.

This paper closes the gap by combining firm-level evidence with a general equilibrium heterogeneous firm model to quantify the macro impact of the debt-inflation channel of investment. In the first part of this paper, guided by a simple conceptual framework, I document the heterogeneous responses using firm-level evidence, which is consistent with the debt-inflation channel on investment. Following an unexpected inflation surprise, more-indebted firms increase investment relative to less-indebted peers. To assess aggregate consequences, I develop a heterogeneous-firm general equilibrium model with nominal debt and financing frictions in the second part of this paper. The calibrated model reproduces the empirical heterogeneity as well as various firm-level moments in the data. At the macro level, in response to a 1% inflation surprise, aggregate investment rises by about 0.83% and output by 0.15%, which are quantitatively sizable effects. During the post-COVID period with inflation surprise, debt-inflation channel alone can explain about 70% of changes in aggregate investment increases. The macro impact of the debt-inflation on investment stands in stark contrast to its typically modest effect on household consumption documented in the existing literature Auclert (2019).

I start by presenting a stylized two-period model as a conceptual framework building on DeAngelo et al. (2011) and Strebulaev et al. (2012), to motivate and guide my empirical specification and the heterogeneity analysis. I analytically demonstrate the debt-inflation mechanism: by devaluing outstanding nominal debt, unexpected inflation relaxes nearly binding financial constraints and in turn raises firm's investment. Two assumptions are central to drive the result. First, firms carry pre-existing nominal debt—both the nominal rate and the face value of today's repayment were contracted last period; this is the sole source of nominal rigidity. Second, non-negative dividend and borrowing constraints require firms to maintain sufficient internal funds and positive net worth. When the constraint is slack, firms invest up to the unconstrained optimum; when it binds, debt devaluation following unexpected inflation relaxes the constraint and scales up investment. With different endowments of nominal debt, the model shows that more indebted firms are more likely to increase investment in response to an inflation surprise.

I then turn to the data to validate and quantify this mechanism empirically. Using Compustat balance sheet information on debt, I document a key fact: following an increase in unexpected inflation, firms with high indebtedness significantly raise investment relative to those with low indebtedness. I control for firm fixed effects and sector-by-time fixed effects to absorb permanent heterogeneity across firms and differential sector exposure to aggregate changes. Quantitatively, a one-percentage-point increase in inflation is associated with a 35-basis-point relative increase in the investment rate for a firm with one standard deviation higher indebtedness. This finding is robust across various measures of indebtedness and inflation as well as other regression specifications. Using local projection method at longer horizons, the cumulative response peaks around the eighth quarter and then gradually decays. Consistent with the theory, these empirical findings provide the basis for the subsequent general-equilibrium analysis.

While the empirical analysis establishes the existence of the firm-side debt-inflation, it estimates relative responses and cannot identify the full aggregate effect. This is because dynamic adjustments in general equilibrium prices, particularly the real interest rate, are absorbed by the time fixed effects. To recover this "missing intercept" and quantify the channel's aggregate implications, I develop an infinite-horizon heterogeneous firm general equilibrium model with fixed nominal debt contracts and financial frictions. Beyond the two-period illustration used to clarify mechanisms, introducing heterogeneity in productivity and balance sheets allows the model to match the empirical motivation that investment responds differentially by indebtedness and to trace the full cross-sectional dispersion of responses. This design uncovers rich micro heterogeneity that a representative-agent setup would mask and lets me connect panel evidence to aggregate dynamics in a disciplined way. I calibrate the model to match key moments of firms' investment and indebted position in the Compustat data. I then solve the model's transitional dynamics following an inflation surprise using sequence-space Jacobian methods (Auclert et al. (2021)), which efficiently traces the aggregate response to unexpected inflation.

Quantitatively, large inflation surprises operating through the firm-side debt-inflation can materially shape investment dynamics. In a partial equilibrium setting without endogenous price adjustments, a 1% inflation surprise causes aggregate investment to jump by a substantial 4.5% on impact. This substantial effect demonstrates that the firm-side debt-inflation powerfully relaxes constraints and promotes investment. Once general-equilibrium feedbacks are introduced, especially the rise in the real rate induced by higher investment, the aggregate response attenuates: a 1% inflation surprise increases aggregate investment by 0.83% and output by 0.15%. Relatively highly indebted firms are better off and tend to invest more with the relaxing financial constraint, which pushes up the real rate and in turn hurts other firms. The real interest rate channel works in an opposite direction and depress the investment. Nevertheless, the overall effect on aggregate investment remains positive and significant, highlighting that the debt revaluation mechanism is quantitatively important and distinct from the traditional real interest rate channel. This finding stands in sharp contrast to studies on household consumption, which typically find only minor effects from the debt-inflation.

I simulate a panel of firms from my calibrated model along the transitional path, and it reproduces the key stylized facts from the empirical analysis. The simulated data confirm that more indebted firms invest significantly more than their less indebted peers following an inflation surprise, and the model reproduces the persistent, hump-shaped response observed in the data. These heterogeneous responses confirm that the debt-inflation operates differentially across firms, enabling analysis of cross-sectional firm dynamics and the identification of the missing-intercept component absent in reduced-form regressions.

Finally, applying the model to actual inflation data reveals that inflation shocks alone can drive non-negligible responses by relaxing financial constraints via debt-inflation, even without other macroeconomic shocks or disruptions. Two episodes are particularly illustrative. During the Great Recession, the large deflationary surprise tightened financial constraints, resulting in a 4% lagged decline in aggregate investment. Compared to actual private non-residential fixed investment, debt-inflation-channel-induced investment dynamics explain approximately 25% of the observed decline. Conversely, during the post-COVID inflation surge, the model predicts a 5% increase in investment relative to its steady-state value. Benchmarking to 2020Q3, the debt-inflation alone can account for up to 70% of the peak increase in investment during this period. These results underscore the firm-side channel's critical importance for capital accumulation, suggesting its macroeconomic significance is substantially more than its counterpart on the household consumption side.

Related Literature This paper mainly contributes to three strands of literature. The first is the literature on the debt-inflation (Fisher) channel, where unexpected inflation redistributes wealth by revaluing nominal contracts, originates with Fisher (1933). This channel gained modern prominence in macroeconomics through Doepke and Schneider (2006), who document its redistributive effects on household balance sheets. Subsequent studies, including Mian et al. (2013), Auclert (2019), Schnorpfeil et al. (2023) and Fagereng et al. (2023), explore implications for consumption and wealth inequality, largely from the household side. Firm-side analysis remain limited. Gomes et al. (2016) examine distorted investment and production decisions in a representative firm setting following unanticipated inflation. Fabiani and Fabio Massimo (2023) suggests positive relationship between stock return and firm's leverage. Brunnermeier et al. (2025) demonstrates how high inflation reduces the real value of corporate debt empirically using German hyperinflation data. None of these papers emphasizes the importance of heterogeneity, as well as its interaction with nominally rigid debt contracts and binding dividend constraints. I argue—empirically and quantitatively—that heterogeneity is central: I document the micro effect that investment's semi-elasticity to unexpected inflation is higher for more indebted and financially constrained firms, and I develop a heterogeneous-firm general-equilibrium model with nominal debt and financing frictions to quantify the macro impact and to separate debt-devaluation effects. This paper also demonstrates the firm-side debt-inflation is quantitatively meaningful, in sharp contrast to the modest effects on the household side.

Second, this paper adds to the macro-finance literature on investment dynamics under financial frictions. Foundational work shows how balance-sheet frictions amplify shocks (the "financial accelerator") and shape investment dynamics (Bernanke et al. (1999)). Building on this, recent firm-level evidence documents that investment responses to identified monetary shocks vary systematically across firms—by default risk, leverage, and balance-sheet liquidity—and embeds these facts in heterogeneous-firm models (Ottonello and Winberry (2020); Jeenas (2023); Durante et al. (2022); Chen (2023)). My paper introduces a novel interaction into this framework. Rather than frictions merely amplifying fundamental productivity or financial shocks, I show how unexpected inflation directly generates a type of wealth redistribution by devaluing debts, thereby endogenously relaxing frictions that bind firms. This distinguishes our work from Ottonello and Winberry (2020), who study the amplification of monetary policy shocks. By focusing on debt levels (measured as the logarithm of nominal debt) and unexpected inflation, I provide new insights into how financial frictions shape investment responses and a mechanism that is adjacent to (but different from) the conventional interest-rate or credit-spread channels emphasized in the monetary policy literature.

Third, this paper contributes to the literature on real effects with nominal rigidities beyond standard sticky-price and sticky-wage frameworks. While New Keynesian models emphasize frictions in goods and labor markets, a complementary strand highlights non–state-contingent nominal contracts—especially nominal debt—as sources of real effects (e.g., Sheedy (2014); Garriga et al. (2017); Alpanda and Zubairy (2017, 2019)). In contrast, Ippolito et al. (2018) study floating-rate loans, which shows the opposite direction of rigid debt. My contribution is by introducing nominal debt rigidity on the firm side, even with flexible prices, fixed nominal debt contracts interact with financing frictions so that unexpected inflation revalues liabilities and shifts investment, a mechanism orthogonal to and coexisting with standard sticky-price channels. Related ongoing work by Wang and Bai (2025) examines nominal wage contracts as another kind of "liability" for firms, reinforcing the idea that both debt and wage contracts can transmit inflation to real activity through nominally rigid obligations.

Roadmap The paper proceeds as follows. Section 2 develops a tractable two-period framework that formalizes the debt-inflation and generates testable predictions. Section 3 takes these predictions to Compustat data, documenting robust heterogeneous investment responses to inflation surprises. Section 4 develops the quantitative heterogeneous-firm model. Section 5 calibrates the model, presents the quantitative results including the aggregate dynamics in response to an inflation shock, and applies the model to two major historical episodes. Section 6 concludes the paper.

2 A Conceptual Framework

This section develops a simple two-period model to formalize the debt-inflation channel and derive testable predictions for the empirical analysis. The model shows how unexpected inflation redistributes wealth from creditors to debtors through the revaluation of nominal debt contracts, and how this redistribution translates into heterogeneous investment responses when firms face financial constraints.

2.1 Model Description

Environment Consider a model with two periods $t = 1, 2$, without uncertainty. It simplifies a strand of standard corporate finance model following Hennessy and Whited (2007) and DeAngelo et al. (2011), but there are some specific features added to demonstrate the debt-inflation of inflation. A representative firm produces output using capital with technology $y_t = k_t^{\alpha}$, where I assume productivity is normalized to be 1 without any innovations. All prices are exogenously given, including final good prices in two periods, P_1, P_2, and real interest rate r. The firm begins period 1 with an endowment k_1 and nominal debt burden B_1, which bears predetermined nominal interest rate R_1. In practice, nominal bond B_t is the net value of total bond subtracted by cash holdings, so it can be negative if the firm wants to save rather than borrow. In period 1, knowing full capital depreciation in the next period, the firm chooses its investment level, which determines its capital, k_2 , and issues new one-period nominal debt, B_2, at a pre-agreed nominal interest rate R_2.

Following Gomes et al. (2016), define $b_t = \frac{B_t}{P_{t-1}}$ the real value of debt normalized by the previous period's price level, and let $\Pi_t = 1 + \pi_t = \frac{P_t}{P_{t-1}}$ be the gross inflation rate. Then real debt value under current price level $\frac{B_t}{P_t}$ can be reformulated to be $\frac{b_t}{\Pi_t}$. Nominal interest rate follows Fisher equation. Given expected inflation is zero (let $P_2 = P_1$), nominal interest rate R_t is equal to real rate r. The firm chooses the investment k_2 and nominal risk-free corporate debt b_2 to maximize the discounted total value of real dividends $d_1 = k_1^\alpha - (k_2 - (1-\delta)k_1) - (1+r)\frac{b_1}{\Pi_1} + b_2$ and $d_2 = k_2^\alpha + (1-\delta)k_1 - (1+r)\frac{b_2}{\Pi_2}$. It is worth noting that though there is no uncertainty for the second period inflation, the first period inflation is undetermined and subject to change. The firm's objective is to maximize the discounted sum of real dividends, d_1 and d_2.

Financial Friction The model incorporates two crucial financial frictions, which links the firm's net worth to its investment capacity. First, I impose a non-negative dividend constraint

$$d_t \geq 0$$

This assumption, common in the macro-finance literature, implies that firms cannot issue equity to finance investment and must rely on internal funds (cash flow) or external debt. Usually equity issuance is expensive in terms of both direct and indirect costs and secondly, firms do not issue equity frequently in reality. This constraint is central to our mechanism, as it creates a direct link between a firm's net worth and its investment capacity. Second, to prevent default and ensure the firm can service its debt obligations, I impose a collateral-based borrowing constraint:

$$(1+r)b_2 \leq \phi k_2^\alpha$$

where ϕ is a parameter governing the tightness of credit markets. This constraint states that nominal repayment on debt cannot exceed a fraction ϕ of the firm's future value. Nominal debt rigidity are embedded in the two frictions here, as it allows unexpected inflation to revalue contracts, unlike indexed debt which neutralizes the Fisher effect.

Overall, the above maximization problem for a firm standing at the beginning of the period 1 can be formally stated as

$$
\begin{aligned}
&\max_{k_2,b_2}\{d_1+\frac{d_2}{1+r}\}\\
\text{s.t.}\quad & d_1=k_1^\alpha-k_2-(1+r)\frac{b_1}{\Pi_1}+b_2\geq 0\\
&\phi k_2^\alpha-(1+r)b_2\geq 0
\end{aligned}
$$

Where the second dividend constraint is omitted as the borrowing constraint has a better restriction. Fefine the net worth in the first period

$$nw_1\equiv k_1^\alpha-(1+r)\frac{b_1}{\Pi_1}$$

The two constraints can be combined into a single feasibility requirement:

$$nw_1\geq k_2-\phi\frac{k_2^\alpha}{1+r}$$

2.2 Optimality

The model generates heterogeneous investment responses to inflation surprises based on firms' financial positions.[1]

Unconstrained firms with high net worth ($nw_1>k_2^u-\phi\frac{(k_2^u)^\alpha}{1+r}$) invest at the first-best level $k_2^u=(\frac{\alpha}{1+r})^{\frac{1}{1-\alpha}}$, independent of inflation surprises. For a given level of initial capital k_1, they have sufficiently low initial debt have high net worth and invest at first-best level, where the marginal product of capital equals its user cost. For these firms, an unexpected inflation surprise $\Pi_1>\mathbb{E}_0\Pi_1$ reduces the real debt burden and increases dividend payout d_1, but leaves investment unchanged, because they are already at the unconstrained optimum.

Constrained firms with lower net worth face binding constraints, and their optimal investment $k_2^\star$ solves the boundary condition:

$$k_2^\star-\phi\frac{(k_2^\star)^\alpha}{1+r}=nw_1$$

For these firms, the debt-inflation operates through net worth: unexpected inflation reduces the real debt burden, raising net worth nw_1, which in turn relaxes the binding constraint and allows higher investment. Constrained firms with high initial debt b_1 have low net worth nw_1, making the non-negative dividend constraint binding. These firms are forced

[1]The detailed derivation of optimality conditions and the proof that $\phi<\alpha$ ensures non-neutrality of capital structure are provided in Appendix B.

to invest below the first-best level $k_2^\star < k_2^u$ because they must divert cash flow to meet the dividend constraint. When unexpected inflation occurs, the real value of debt payment $\frac{(1+r)b_1}{\Pi_1}$ falls, directly increasing net worth and relaxing the binding constraint. These firms can now increase investment $k_2^\star$, moving closer to the unconstrained optimum. Consequently, constrained firms with higher initial debt b_1 exhibit stronger investment responses to inflation surprises. This is a testable prediction that forms the basis of my empirical strategy. By the implicit function theorem, the total effect is:

$$\frac{\partial k_2^\star}{\partial \Pi_1} = \underbrace{\frac{\partial k_2^\star}{\partial nw_1}}_{\text{Marginal Propensity to Invest}} \cdot \underbrace{\frac{\partial nw_1}{\partial \Pi_1}}_{\text{Debt Revaluation}} > 0$$

where the marginal propensity to invest out of net worth is $\frac{1}{1-\frac{\phi\alpha(k_2^\star)^{\alpha-1}}{1+r}}$ and debt revaluation is $\frac{(1+r)}{(1+\pi_1)^2}$. Both partial derivatives are strictly positive for constrained firms. The magnitude of this effect depends on two factors: the size of the inflation surprise and the tightness of the financial constraint faced by the firm. The marginal propensity to invest reflect the investment sensitivity to financial conditions, helping understand how much investment respond to an incremental dollar of net worth. It is larger when the borrowing constraint binds more tightly (Lagrangian multiplier is larger, or when $\frac{\phi\alpha(k_2^\star)^{\alpha-1}}{1+r}$ is closer to 1), meaning firms are closer to their borrowing limit and small net worth changes have amplified effects on investment capacity. The second term captures the debt devaluation effect: how much real debt burden falls per percentage point of unexpected inflation. This effect is mechanically larger when initial nominal rates r are higher (more debt service to devalue) and when baseline inflation π_1 is lower (denominator effect). Appendix B provides complete derivations and proves both partial derivatives are strictly positive.

2.3 Model-based Guidance and Testable Predictions

The two-period model provides clear guidance for empirical testing. Define the investment rate as $i_1 = \frac{k_2}{k_1}$. Focusing constrained firms, differentiating the optimality condition with respect to inflation yields:

$$\Delta i_1^\star = \Delta\left(\frac{k_2^\star}{k_1}\right) = \underbrace{\frac{1}{k_1}\frac{1}{1-\frac{\phi\alpha(k_2^\star)^{\alpha-1}}{1+r}}\frac{(1+r)}{(1+\pi_1)^2}}_{\text{elasticity } \beta} \times b_1 \Delta \Pi_1 \tag{1}$$

The right-hand side of equation (1) takes the form of an interaction term between unexpected inflation $\Delta\pi_1$ and initial debt b_1, which directly motivates the empirical specification in Section 4. This interaction structure is not arbitrary—it emerges naturally from the model's economic mechanism: inflation's effect on investment operates through the revaluation of existing debt, so firms with more debt experience larger balance sheet shocks.

Equation (1) generates several insights about how firm heterogeneity shapes investment responses to inflation surprises. These include predictions about monotonicity in indebtedness (higher b_1 leads to larger responses), constraint interactions (effects concentrate where constraints bind), sorting by productivity (high-MPK firms respond more strongly), and state dependence (aggregate effects depend on the firm distribution). While these predictions are theoretically rich and guide the model's quantitative calibration, my primary empirical focus is on the core prediction that directly tests the existence of the debt-inflation:

The debt-inflation channel hypothesis predicts for constrained firms, the coefficient on the interaction term between initial debt and unexpected inflation should be strictly positive, i.e. $\beta > 0$. This prediction follows directly from the debt devaluation mechanism: unexpected inflation reduces the real value of nominal debt obligations, increasing net worth and relaxing financial constraints, which in turn allows higher investment. Testing $\beta > 0$ is the most direct and robust way to validate the existence of debt-inflation channel. Guided by equation (1), my baseline empirical specification regresses the investment rate on the interaction between unexpected inflation and firms' indebtedness proxy. This specification directly tests whether $\beta > 0$ in the cross-section, exploiting variation in firms' exposure to the same aggregate inflation shock. The coefficient on the interaction term provides an empirical estimate of β, averaged across constrained firms in the sample. When estimating dynamic effects, I can estimate local projections to obtain a path $\{\beta_h\}_{h\geq 0}$.

2.4 Discussion

Before proceeding to empirics, two clarifications help distinguish this channel from related mechanisms in the literature.. First, the debt-inflation channel operating through debt revaluation is conceptually distinct from the real interest rate channel emphasized by Auclert (2019). While unexpected inflation lowers the ex-post real rate, the two channels differ fundamentally: the real rate channel affects intertemporal substitution uniformly across agents via expected future rates, whereas the debt-inflation generates cross-sectional redistribution through the revaluation of existing debt stocks on impact. My framework isolates this by holding r constant; in the two-period model, $(1 + r)$ enters only through discounting and future borrowing constraints, not through the revaluation term $(1 + r)b_1/\Pi_1$. While both channels coexist in general equilibrium, I argue the debt-inflation is a first-order effect on impact for constrained firms.

Second, the key nominal rigidity here is distinct from standard New Keynesian frictions. Rather than price or wage stickiness, the mechanism relies on predetermined nominal debt contracts: the nominal rate R_t is set based on expected inflation $\mathbb{E}_{t-1}\Pi_t$ via the Fisher equation, but realized inflation deviations create a wedge in the real value of debt. This rigidity is pervasive in practice, corporate bonds, bank loans, and trade credit are overwhelmingly denominated in nominal terms. Yet it has received less attention than goods or labor market frictions. I take this institutional feature as given rather than microfounding it, though costly contract renegotiation or incomplete indexation markets could rationalize the prevalence of nominal debt.

In summary, the conceptual framework delivers three key insights. First, unexpected inflation acts as a wealth transfer to firms with nominal debt. Second, this transfer translates into higher investment only for financially constrained firms, generating heterogeneous responses based on initial debt positions. Third, the channel's strength depends on the interaction between debt levels and the tightness of financial constraints, yielding a testable prediction: $\beta > 0$. These insights guide both the empirical analysis and the quantitative general equilibrium model developed in subsequent sections.

3 Empirical Analysis

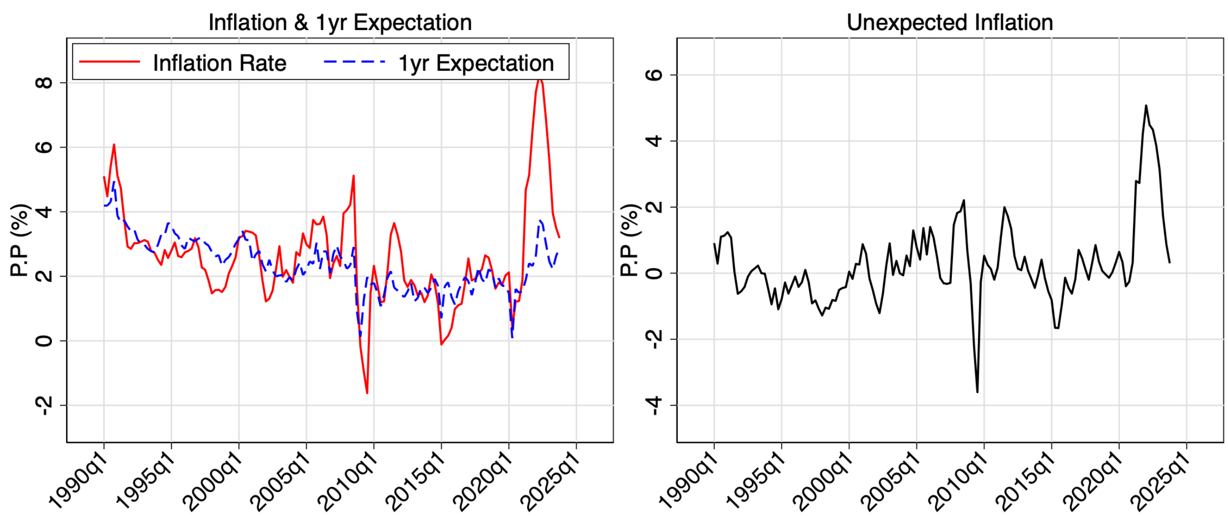
In this section, I empirically investigate the heterogeneous response of firm investment rates to unexpected inflation. Our central hypothesis is that the sensitivity of investment to inflation varies systematically with a firm's level of nominal indebtedness.

3.1 Data Descriptions

Inflation Data I obtain monthly Consumer Price Index (CPI) data from Bureau of Labor Statistics (BLS) and one-year-ahead inflation expectations from Federal Reserve Bank of Cleveland. Our sample period runs from 1990:Q1 to 2023:Q4, encompassing periods of both macroeconomic stability and significant turmoil, such as the Great Recession and the post-COVID inflation surge. I aggregate the monthly data to a quarterly frequency by averaging. The main measure of an unexpected inflation is then constructed as the difference between the realized quarterly CPI inflation and the 1-year-ahead inflation expectation as

$$\varepsilon_t^{\pi} = \pi_t - E_{t-1}\pi_t \tag{2}$$

Figure 1: Quarterly Inflation Series (1990Q1-2023Q4)



Notes: The red dashed line represents realized CPI inflation at the quarterly frequency (in percentage points). The blue dashed line shows one-year-ahead expected inflation, aggregated from monthly series. The black solid line depicts unexpected inflation, defined as $\varepsilon_t^{\pi} \equiv \pi_t^{\text{realized}} - \mathbb{E}_{t-1}[\pi_t]$. Positive values indicate that realized inflation exceeded expectations from one year prior. This unexpected inflation series is used throughout the empirical analysis. Two episodes stand out: the 2008-09 deflationary shock (reaching -0.9pp) during the financial crisis, and the 2021-22 inflation surprises (peaking at +1.4pp) during the post-COVID recovery. These large deviations provide key identifying variation for the debt-inflation, though results are robust to excluding these periods (see Appendix A).

I prefer CPI-based shocks to alternatives like oil price shocks because CPI inflation more directly reflects the aggregate price level relevant for the real value of nominal debt, whereas the pass-through from commodity prices to the general price level can be slow and incomplete.

Figure 1 present the time series for our inflation measures. As shown in Figure 1, inflation expectations are relatively well-anchored for most of the sample period, particularly between 2010 and 2019. The most significant deviations occurred during the 2008 financial crisis, which triggered a sharp deflationary shock, and the post-COVID period, which saw a rapid inflation spike. Contrary to approaches that exclude such "abnormal" periods, I retain them in our sample. These episodes provide additional variation that enhances the statistical power of our empirical design for quantifying the debt-inflation.

Firm-Level Data I draw firm-level data from the quarterly Compustat database for publicly traded firms in the North America. This dataset contains the necessary balance sheet and income statement variables to construct our measures of investment and indebtedness. While Compustat firms are typically larger than the average private firm, they account for a substantial portion of total U.S. private investment, making them a representative, albeit selected, sample. A potential concern is that these large public firms may be less financially constrained. Farre-Mensa and Ljungqvist (2016) suggests that public firms which could be identified as "constrained firms" are not truly constrained because they can borrow more and maintain certain debt level. Only low investment grade companies are likely to be constrained. However, considering public firms' size, stability, business diversification and relationship with external funding partnerships, the likelihood of senior debt default or bankruptcy is considerably low. This also motivates my model's focus on risk-free debt rather than incorporating endogenous default to focus on our main point of debt devaluation channel. Moreover, due to the concerns of future dividends, these public firms are less likely to issue equities, as contrary to small private firms. I also draw industrial level capital depreciation data from Bureau of Economic Analysis (BEA) to help back imputing investment series.

My main dependent variable is the firm's investment rate $i_{j,t}$ for firm j at time t, defined as real investment divided by the real capital stock. Following Ottonello and Winberry (2020), I construct real capital series using the perpetual inventory method and then calculate the investment rate at firm level. My primary measure of a firm's financial position is its level of indebtedness, measured as the logarithm of total corporate debt (the sum of long-term and short-term debt). To ensure the variable captures firm-specific variation and is comparable across firms and time, I residualize it by removing firm and time fixed effects. This transformation has a clear interpretation: the resulting variable (standardized debt level in logarithm) can be seen as the percentage deviation of a firm's debt from its own historical average, purged of aggregate time trends. I prefer this measure over the more conventional leverage ratio for several reasons. First, debt-inflation directly works on the level of nominal debt, which can be directly revalued by unexpected inflation, whereas leverage mixes the debt and asset simultaneously. The log-deviation interpretation aligns well with the state variable in our theoretical model. Second, leverage ratios in the data exhibit strong and persistent firm fixed effects (Lemmon et al. (2008)), representing stable traits rather than time varying exposure. Third, zero (Strebulaev and Yang (2013)) or one leverage ratios are not rare in Compustat; this accounting fact of negative equity value naturally creates outlier leverage ratios (Jan and Ou (2012)). For robustness concerns, I also present results using the net debt (total debt minus cash equivalents) and leverage ratio (total debt to total assets).

Table 1: Descriptive Statistics for Firm Investment and Indebtedness

Statistic	$\Delta \log k_{j,t}$	$i_{j,t}$	$b_{j,t-1}$
Mean	0.362	3.936	3.984
Median	-0.443	2.723	4.149
S.D.	8.729	10.263	2.993
95th Percentile	11.182	14.997	8.520
Observations	268757	268757	268757

Notes: $k_{j,t}$ is the real capital computed using perpetual inventory method from balance sheet information and industry average depreciation data from BEA following Ottonello and Winberry (2020). $\Delta \log k_{j,t} \equiv \log k_{j,t} - \log k_{j,t-1}$ is the net real capital change. $i_{j,t}$ is calculated as the real investment divided by capital stock in last period. Both series are in the unit of percentage points. $b_{j,t-1}$ is the logarithm of total debt $dlcq + dlttq$ from Compustat.

I winsorize all relevant variables at the 0.05% level in both tails to ensure the results will not be driven by outliers. Table 1 provides summary statistics for key variables used in the main results. On average, net real capital grows at 0.4% while investment rate is about 4%. The difference between the two are attributed to the capital deprecation. I prefer to use log debt measure as the proxy for indebtedness position in the main regression analysis. It has a standard deviation of approximately 3 log points and it is easier to interpret regression results economically when comparing two firms with 1 standard deviation higher in indebtedness. In Appendix A, I also show the sample using the leverage ratio, whose the sample size is larger than the sample with the log debt measure because firms with negative or zero debt are dropped due to the logarithm transformation.

3.2 Empirical Strategy

The goal of this empirical exercise is to identify and quantify the debt-inflation channel by linking firm's investment to the interaction between unexpected inflation and its indebtedness position. In the era of high inflation, creditors generally lose in real value but debtors win. Firms with higher nominal indebted positions should have less real financial burden relative to their less indebted peers so the overall cash flow or the net worth should be improved more. The core hypothesis is that for firms with significant nominal debt, an unexpected inflation acts as a positive wealth shock, relaxing financial constraints and stimulating investment.

To test this, I estimate the following regression specification similar to the derived relationship in equation (1):

$$i_{j,t} = \alpha_j + \alpha_{s,t} + \beta(x_{j,t-1} \times \varepsilon_t^\pi) + \gamma x_{j,t-1} + \mathbf{\Gamma}'_A(x_{j,t-1} \times \mathbf{A}_t) + \mathbf{\Gamma}'_Z \mathbf{Z}_{j,t-1} + e_{j,t} \tag{3}$$

where $i_{j,t}$ is the firm level real investment rate. Firm fixed effects α_j absorb time-invariant heterogeneity. Sector-by-time fixed effects $\alpha_{s,t}$ absorb all aggregate shocks common to firms within an industry-quarter, including the direct effect of unexpected inflation ε_t^π, other business cycle dynamics, sector-specific demand shifts and so on. $x_{j,t-1}$ is the proxy for firm j's indebtedness at the end of period $t-1$, and ϵ_t^π is the unexpected inflation at time t. In the main context, it is the standardized logarithm of total debt $b_{j,t-1}$. By demeaning the financial variable, the result is supposed not to be driven by the permanent heterogeneity in responsiveness across firms Ottonello and Winberry (2020). Instead, the estimate is driven by how a given firm responds to unexpected inflation when it has higher or lower indebtedness than usual. This standardized variable is also motivated by the model in the next section where firms are ex ante homogeneous. In order to isolate the debt-inflation channel effect from other differential impacts from business cycle dynamics, I control for the interaction between financial proxy $x_{j,t-1}$ and $\mathbf{A}_t$ which consists of GDP growth and federal funds rate. By adding these interaction terms, this empirical design only estimates the impacts of eroding debt by unexpected inflation on investment, rather than growth or monetary policy effects. $Z_{j,t-1}$ is a vector of standard firm-level controls widely used in the literature including total asset, sales growth rate, current asset ratio and Tobin's Q measure.

This specification exploits a difference-in-differences logic in continuous treatment. It effectively compares the investment response of two firms in the same sector and quarter but with different indebtedness exposure. Consider two firms, both in manufacturing in 2021Q4 facing the same 1 percentage point inflation surprise. If one firm has 1 std higher log debt than another, the model predicts this firm invests β percentage points more. The sector-time FE ensures this differential response is not driven by industry-specific shocks correlated with inflation. Crucially, this strategy cannot identify the *level* effect of inflation on aggregate investment—that is absorbed by $\alpha_{s,t}$. The regression estimates relative responses (the slope), not the intercept, which is the well-known the "Missing Intercept" problem. Recovering the aggregate effect requires the general equilibrium model in Section 4.

The key estimate of interest is β: showing that given an unexpected inflation, how investment rate responds to the debt level or how sensitive investment is with respect to the financial position. The debt-inflation channel predicts that β should be positive: a positive unexpected inflation ($\pi_t > 0$) should have a more positive (or less negative) effect on investment for firms with higher relative indebtedness than usual ($x_{j,t-1}$). The coefficient γ captures the direct effect of indebtedness on investment. Consistent with standard corporate finance and investment literature, I expect γ to be negative and significant, as a higher debt burden generally depresses investment. It is crucial to emphasize that the debt-inflation does not necessarily imply that debt promotes investment overall; rather, it suggests that inflation have differential impacts and could mitigate the overall negative effect of debt on investment. In other words, a higher indebted firm could have higher investment rate with unexpected inflation compared to low indebted peers. Due to the limited coverage of firms in Compustat, the regression estimate should be regarded as a lower bound of the true investment responsiveness, because publicly traded firms are often larger but less financially constrained than small private firms.

To trace the dynamic effects of the channel, I also employ the local projection method of Jordà (2005). I estimate the following equation for horizons h=0,1,...,12 quarters:

$$\Delta \log k_{j,t+h} = \alpha_j + \alpha_{s,t} + \beta_h(x_{j,t-1} \times \varepsilon_t^\pi) + \gamma_h b_{j,t-1} + \mathbf{\Gamma'}_{Ah}(x_{j,t-1} \times \mathbf{A}_t) + \mathbf{\Gamma'}_{Zh}\mathbf{Z}_{j,t-1} + e_{j,t,h} \quad (4)$$

where $\Delta \log k_{j,t+h} = \log k_{j,t+h} - \log k_{j,t-1}$, represents the cumulative growth in the capital stock over $h \geq 0$ periods. This measure is net of depreciation and thus provides a more conservative estimate of the investment response.

3.3 Main Empirical Results

Table 2 presents our main regression results, using standardized log of debt as the measure of indebtedness. All specifications include interactions of indebtedness with GDP growth and the federal funds rate and standard errors are clustered at both time and firm level unless otherwise stated. Column (1) shows shows a baseline specification with firm and sector-by-quarter fixed effects using unexpected inflation and column (2) is the preferred specification with firm level controls. Column (3) and (4) supplement the corresponding results using realized inflation. Shocks and other macro variables are absorbed by time fixed effects; therefore, I do not report their estimates in this table.

All four columns show that firms with higher indebtedness position are more responsive to the inflation. From column (1), the coefficient on the variable of interest, the interaction between unexpected inflation and indebtedness, is 0.116 and is statistically significant at the 1% level. Column (2) is my preferred specification with firm-level controls with point estimate 0.124. This implies that for a one-percentage-point increase in unexpected inflation, a firm with one standard deviation higher indebtedness (2.99 log points, from Table 1) increases its investment rate by an additional 0.35 percentage points (0.124×2.99). This economically meaningful effect shows that highly indebted firms substantially raise investment relative to their less-indebted peers when inflation surprises occur. This effect is equivalent to about 9% of the sample mean investment rate (3.94%), underscoring the channel's macroeconomic relevance. This substantial differential response provides strong support for the debt-inflation.

The coefficient on indebtedness itself is -0.547, highly significant and consistent with the theory that more indebted firms face tighter constraints in normal times. The negative interaction with GDP growth suggests that during economic expansions, more indebted firms benefit relatively less, highlighting that the inflation channel operates distinctly from an aggregate demand channel. Similarly, the negative coefficient on the FFR interaction confirms that tighter monetary policy disproportionately harms more indebted firms, consistent with the financial accelerator mechanism. Columns (3)-(4) using realized inflation show smaller but still significant coefficients (0.089-0.091), as expected since realized inflation conflates anticipated and unanticipated components.

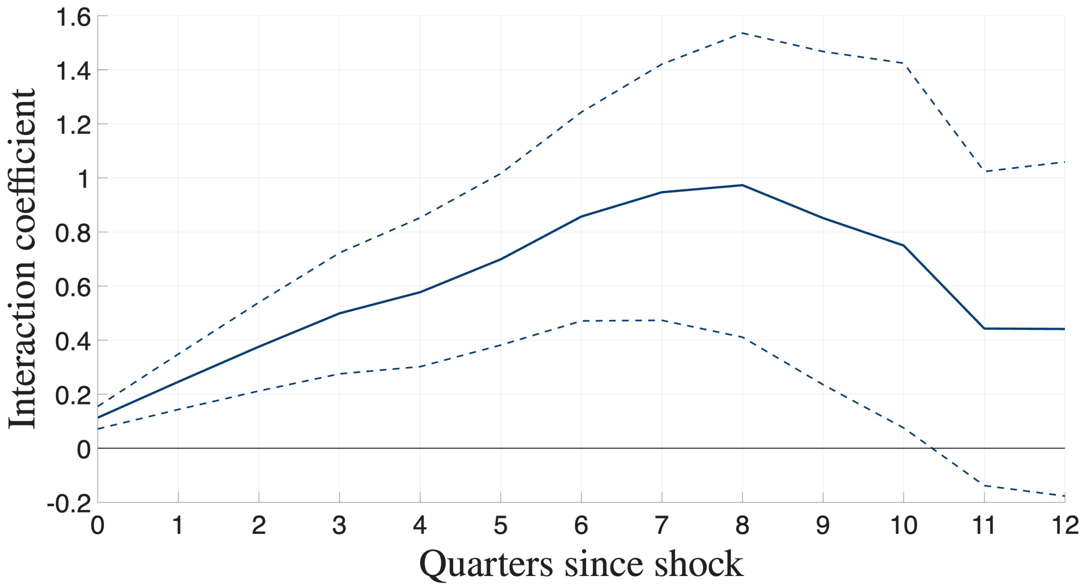
Table 2: Main Results

Investment Rate	(1)	(2)	(3)	(4)
Unexp. Inflation × Indebtedness	0.116***	0.124***		
	(0.029)	(0.029)		
Inflation × Indebtedness			0.089***	0.091***
			(0.023)	(0.023)
Indebtedness	-0.547***	-0.414***	-0.681***	-0.549***
	(0.075)	(0.082)	(0.078)	(0.085)
GDP Growth × Indebtedness	-0.044**	-0.045**	-0.046**	-0.047**
	(0.018)	(0.018)	(0.018)	(0.018)
FFR × Indebtedness	-0.054***	-0.060***	-0.078***	-0.085***
	(0.020)	(0.020)	(0.022)	(0.022)
Observations	268757	268757	268757	268757
R^2	0.118	0.125	0.118	0.124
Firm Control	No	Yes	No	Yes
Time Sector FE	Yes	Yes	Yes	Yes
Two-way Clustering	Yes	Yes	Yes	Yes

Notes: Standard errors in parentheses. $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$. Firm controls as indicated; all specifications include time-by-sector fixed effects; standard errors clustered by time and firm. Results are estimated from regression specification 3. First two columns employ unexpected inflation series ε_t^π constructed above, while third and fourth column show results directly using CPI inflation. $\mathbf{Z_{j,t}}$ is a vector of control variables at firm level and interaction of demeaned financial position with GDP growth and federal funds rate. Estimates of unexpected inflation or inflation series are absorbed by time fixed effects.

Figure 2 plots the dynamic impulse responses from the local projections (Equation 4). It shows the response using our primary Log Debt measure. The effect on capital accumulation

Figure 2: Dynamic Impacts after the Inflation Surprise



Notes: Plots the estimated coefficient β_h over h quarters following local projection regression (2). Dashed lines report 90% error bonds. Estimation of cumulative capital change is different from the investment rate from on impact regression.

is positive, statistically significant, and highly persistent. It peaks around the 8th quarter and decays slowly. The upward-sloping path of the cumulative capital stock implies that the rate of investment is positive and elevated for several quarters following the shock, consistent with a lasting impact from the debt revaluation.

3.4 Robustness Check

In Appendix A, I report a comprehensive set of robustness checks that validate the baseline empirical findings and further isolate the debt-inflation effects on firm investment responses to unexpected inflation. These exercises address potential concerns about sample composition, variable construction, and alternative transmission mechanisms, ensuring the results are not artifacts of specific assumptions or data peculiarities.

First, to distinguish the debt channel from confounding effects through other firm characteristics, I augment the baseline specification with interaction terms between unexpected inflation and a variety of controls, including sales (to capture potential sales inflation effects or the cash flow channel documented in Bhamra et al. (2023)), liquidity (Jeenas (2019)), firm size (scale dependencies) and age (life-cycle dependencies), and dividend payouts (for payout policy influences). Across these specifications, the core interaction estimate of interest remains positive, statistically significant, and quantitatively stable relative to the baseline. Notably, including interactions with sales or firm size does not attenuate the debt coefficient, underscoring that the estimated differential response arises specifically from debt devaluation, where inflation erodes real debt burden, rather than from nominal revenue boosts, scale economies, or other correlated channels that might disproportionately affect larger or faster-growing firms. Second, the results are insensitive to alternative measures of firm's indebtedness. Replacing the baseline gross debt measure with net debt, long-term debt, or leverage ratios yields consistently positive and significant interaction coefficients. Third, subsample analyses rule out undue influence from extreme periods. Restricting to post-1994 data, excluding both crises jointly, or dropping them separately preserves the positive debt-inflation interaction.

Taken together, these robustness checks affirm that the debt-devaluation channel is a robust, persistent feature of the data, driving differential investment responses to inflation surprises independently of alternative mechanisms, sample choices, or debt metrics. Detailed tables and figures, including graphical illustrations of interaction effects and subsample comparisons, are provided in the Appendix A. To back from the relative differential effects to the aggregate level effects, in what is to follow, I develop a model which nests the debt-inflation channel in a macroeconomic framework.

4 Quantitative Model of the debt-inflation

In this section, I extend the two-period model to a quantitative general equilibrium model with firm heterogeneity, fixed nominal debt and financial frictions.

4.1 Heterogeneous Firm

Wholesale Firms There is a continuum of firms on measure $(0, 1)$ indexed by i. Each firm produces using a decreasing returns to scale technology:

$$y_{i,t} = z_{i,t} k_{i,t}^{\alpha} n_{i,t}^{\nu}, \quad \alpha + \nu < 1 \tag{5}$$

where z is a firm-specific productivity, which follows an AR(1) process in logs

$$\log(z_{i,t+1}) = \rho \log(z_{i,t}) + \sigma \varepsilon_{i,t+1}, \quad \varepsilon_{j,t+1} \sim N(0, 1) \tag{6}$$

and $k_{i,t}, n_{i,t}$ are capital and labor used to produce wholesale goods. Firms make investment $i_{i,t}$ to accumulate capital

$$k_{i,t+1} = i_{i,t} + (1-\delta)k_{i,t} \tag{7}$$

subject to convex adjustment costs,

$$AC(i_{i,t}, k_{i,t}) = \frac{\gamma}{2}\frac{i_{i,t}^2}{k_{i,t}} = \frac{\gamma}{2}\frac{(k_{i,t+1} - (1-\delta)k_{i,t})^2}{k_{i,t}} \tag{8}$$

I retain the two core financial frictions from the two-period model. First, firms face a non-negative dividend constraint, which restricts them from issuing new equity and makes debt the sole source of external financing. Second, firms can issue one-period, risk-free nominal corporate bonds, $B_{i,t+1}$. The net debt position, $B_{i,t+1}$, can be negative, which I interpret as cash holdings or savings[2]. While traditional models often introduce frictions like tax shields to incentivize borrowing, I allow for saving to reflect the empirical fact that many firms hold cash for precautionary or strategic reasons. In each period, debtors and creditors agree commonly on a nominal interest rate R_{t+1} based on expected inflation and real interest rate for a nominal value $B_{i,t+1}$[3].

These wholesale firms sell their outputs in a competitive market at real relative price p_t. The real dividend for a continuing firm is given by:

$$d_{i,t} = p_t z_{i,t} k_{i,t}^{\alpha} n_{i,t}^{\nu} - w_t n_{i,t} - i_{i,t} - AC(i_{i,t}, k_{i,t}) - (1+R_t)\frac{b_t}{\Pi_t} + b_{i,t+1} \tag{9}$$

where $b_{i,t} = \frac{B_{i,t}}{P_{t-1}}$ and $b_{i,t+1} = \frac{B_{i,t+1}}{P_t}$. To ensure debt is risk-free, the repayment must be collateralized by the firm's value in the worst possible future state. This implies a borrowing constraint:

$$(1+R_{t+1})b_{i,t+1} \le \Pi_{t+1}\phi(p_{t+1}\underline{z}_{i,t+1}k_{i,t+1}^{\alpha}n_{i,t+1}^{\nu} - w_{t+1}n_{t+1} + (1-\delta)k_{i,t+1}) \tag{10}$$

where $\underline{z}$ is the lowest value of realized productivity and ϕ is a parameter measuring credit market tightness, which I later set to 1 for simplicity.

Finally, to match annual entry and exit dynamics as Ill as maintain a stationary distribution without modeling endogenous default, I assume an exogenous exit probability π_d. Each firm draw a death probability at the beginning of the period. Exiting firms liquidate their

[2] I do not feature any other risk free asset such as government bond, but it can be easily added to accommodate savings. It can be thought of that firms are saving to meet the demand for household borrowing.

[3] Central bank does not directly set nominal interest based on Taylor rule. In this simplified model, it only supplies money to meet money demand and to clear money market.

assets to pay off their debt after production without making new investment and borrowing decisions. New firms enter debt-free with an initial capital endowment k_0.

The firm's problem is to choose investment and debt based on the state z, k, b to maximize its value V , which is a weighted average of its continuation value V_c and exiting value V_d:

$$\begin{aligned}
V_t(z,k,b) &= (1-\pi_d)\,V_t^c(z,k,b) + \pi_d\,V_t^d(z,k,b) \\
V_t^c(z,k,b) &= \max_{k',b'} \Big\{ d(z,k,b,k',b') + \mathbb{E}\big[\Lambda' V_t(z',k',b' \mid z)\big] \Big\} \\
s.t. \qquad d_t &= p_t z k^{\alpha} n^{\nu} - w_t n - i - AC(i,k) - (1+R_t)\frac{b}{\Pi_t} + b' \geq 0 \\
b' &\leq \frac{\Pi_{t+1}}{1+R_{t+1}} (p_{t+1}\underline{z}' k'^{\alpha} n'^{\nu} - w_{t+1} n' + (1-\delta)k')
\end{aligned} \tag{11}$$

where Λ is the stochastic discount factor, and the bellman equation is subject to the non-negative dividend and borrowing constraints.

Appendix C shows full derivation for the optimality conditions building for Lagrangian. Here I summarize that the firm's investment Euler condition that pins down contemporaneous investment can be written as

$$(1+\xi_t)\Big(1+\gamma\frac{i_t}{k_t}\Big) = \mathbb{E}_t\big[\Lambda_{t,t+1} V_{k'}(z',k',b')\big] + \psi_t\,\frac{\partial \mathcal{B}_t(k')}{\partial k'},$$

where $\xi_t \geq 0$ is the multiplier on the dividend non-negativity constraint and $\psi_t \geq 0$ is the multiplier on the collateral-based borrowing constraint. The debt Euler takes the form

$$1 = \mathbb{E}_t\Big[\Lambda_{t,t+1}\,\frac{1+R_{t+1}}{\Pi_{t+1}}(1+\xi_{t+1})\Big] + \psi_t.$$

These two relations make clear the channels at work: (i) a binding dividend multiplier ($\xi_t > 0$) amplifies the effective marginal cost of investment on the left hand side and thus dampens immediate investment responses; (ii) the borrowing multiplier ψ_t enters both conditions and captures how credit tightness constrains optimal choices. Appendix C proves that, under standard regularity assumptions and for firms initially constrained, a small unexpected increase in gross inflation Π_t reduces both ψ_t and ξ_t locally, which in turn raises contemporaneous investment.

Timing: At the beginning of the period, each firm's idiosyncratic productivity, $z_{i,t}$ realizes. Then, an i.i.d. "death shock" determines whether the firm will exit at the end of the period. Firms designated to continue will produce, invest, pay off old debt, and issue new bonds. Firms designated to exit will only produce and pay off their debt before leaving the market. To keep the total mass of firms constant at one, a measure π_d of new firms enters at the end of each period. These entrants start with initial capital k_0 and zero debt, assuming their initial funding comes from equity provided by households. The evolution of the cross-sectional distribution of firms, μ_t, is thus governed by:

$$\begin{aligned}\mu_{t+1}(z', k', b') = &\int (1-\pi_d)\, \mathbf{1}\{k' = k^*(z,k,b)\}\, \mathbf{1}\{b' = b^*(z,k,b)\}\, g(z' \mid z)\, \mathrm{d}\mu_t(z,k,b) \\ &+\; m_{\text{ent}}\, \mu_{\text{ent}}(z')\, \mathbf{1}\{k' = k_0\}\, \mathbf{1}\{b' = 0\}\,,\end{aligned} \tag{12}$$

4.2 Other Agents and Market Clearing

To close the model, I introduce three other standard agents.

Retailers and Final Goods Producer A continuum of monopolistically competitive retailers indexed by j buy wholesale goods and differentiate them using a linear technology $\tilde{y}_j = y$. A final goods producer then aggregates these differentiated varieties using a constant elasticity of substitution (CES) technology, $Y_t = \left(\int_0^1 \tilde{y}_{jt}^{\frac{\epsilon_p - 1}{\epsilon_p}}\, dj\right)^{\frac{\epsilon_p}{\epsilon_p - 1}}$ with standard price index $P_t = \left(\int_0^1 \tilde{P}_{jt}^{1-\epsilon_p} dj\right)^{\frac{1}{1-\epsilon_p}}$ where $\tilde{P}_j$ is the price for differentiated goods j. This setup yields a constant markup, such that the real price of wholesale goods is $p = \frac{\epsilon_p - 1}{\epsilon_p}$.[4]

Households A representative household maximizes expected lifetime utility from consumption and leisure:

$$U(\{C_t\}, \{N_t\}) = E_0 \sum_{t=0}^{\infty} \beta^t (\log C_t - \chi N_t) \tag{13}$$

subject to the budget constraint

$$P_t C_t + S_{t+1} = W_t N_t + (1 + R_t) S_t + D_t \tag{14}$$

where S_t represents the nominal saving in the form of corporate bonds, and D_t is the aggregate dividend received from firms. The household's optimization provides the economy's stochastic discount factor

$$\Lambda_{t,t+1} = \beta \frac{u'(C_{t+1})}{u'(C_t)} = \beta \frac{C_t}{C_{t+1}} \tag{15}$$

The linear disutility from labor implies a perfectly elastic labor supply, where the real wage w_t is pinned down by the marginal rate of substitution.

[4]In the model, I keep flexible prices to fully isolate the debt-inflation effect, which is the main focus of this paper. But by adding normal rigidities, this model can be extended to study monetary policy designs in the future.

Market Clearing The goods market clears when total production equals the sum of consumption, investment, and adjustment costs, accounting for entry and exit:

$$\int y_{jt} d\mu_t = Y_t = C_t + (1-\pi_d)\int (i_{jt} + AC_{jt}) d\mu_t + \mu_{ent} k_0 - \pi_d (1-\delta) K_t \tag{16}$$

Since corporate bonds is the only asset in the market, the asset market clears implicitly, as household savings must equal the aggregate net debt of the corporate sector:

$$\int b_{i,t} d\mu_t = \frac{S_t}{P_{t-1}} \tag{17}$$

Labor market clears following labor supply meets labor demand

$$\int n_{i,t} d\mu_t = N_t \tag{18}$$

Equilibrium The steady state equilibrium for the flexible price economy is given by a set of value functions $V_t(z_{i,t}, k_{i,t}, b_{i,t})$, decision rules $k_{i,t+1}, b_{i,t+1}, n_{i,t}$ for capital, debt and labor, a measure of firms $\mu_t(z_t, k_t, b_t)$, and a set of prices $w_t, r_t, p_t, \Lambda_{t,t+1}$ such that: (i) given prices, all firms optimize: V solves bellman equation with associated policy rules; (ii) household optimize; (iii) goods market, labor market and asset market all clear; and (iv) the distribution of firms μ is stationary.

5 Unexpected inflation and Quantitative Analysis

In this section, I quantify the effect of an unexpected inflation. Our flexible-price environment provides a clean laboratory for a thought experiment: I can introduce a fully exogenous unexpected inflation, driven by a one-time change in the money supply, and trace out its real effects through the debt-inflation alone.

5.1 Calibration

I calibrate the model at a quarterly frequency to match key features of the U.S. economy and firm-level data from Compustat. Following the standard approach in the quantitative macroeconomics literature, all parameters are set externally based on established values from prior studies and empirical estimates. This parsimonious calibration strategy allows me to evaluate the model's ability to match key moments in the data without overfitting through targeted parameter selection. I solve for the steady-state policy functions and firm distribution using value function iteration combined with a Howard's improvement algorithm, which accelerates convergence by iteratively fixing the policy function while updating values.

Several parameters are set based on standard values in the macroeconomic literature. The household discount factor β is set to 0.99, implying an annual real interest rate of approximately 4% in steady state. The quarterly depreciation rate δ is set to 0.025, corresponding to an annual depreciation rate of 10%, consistent with values commonly used in business cycle models and U.S. Bureau of Economic Analysis data.

For the firm's production technology, I follow the literature on heterogeneous firm dynamics. The capital share α is set to 0.25 and the labor share ν is set to 0.60, such that $\alpha + \nu = 0.85$. This calibration generally follows Ottonello and Winberry (2020) and ensures decreasing returns to scale at the firm level. The combined returns to scale parameter also helps the model generate aggregate employment shares consistent with the data, with roughly $\frac{\epsilon_p - 1}{\epsilon_p}\nu \approx 55\%$ of output accruing to labor, which is close to the current aggregate labor share around 59%.

The idiosyncratic productivity process is calibrated based on estimates from the firm dynamics literature. I set the persistence parameter ρ_z to 0.90 and the standard deviation of innovations σ_z to 0.10, respectively, squarely within the ranges estimated for U.S. manufacturing firms (Ottonello and Winberry (2020), Catherine et al. (2022)). These values generate realistic dispersion in firm size and growth rates. I discretize the productivity process z into 7 states using the Tauchen (1986) method by Terry and Knotek II (2011).

The parameters governing financial frictions are chosen based on empirical evidence and prior literature. The borrowing constraint parameter ϕ is set to 1.00, reflecting the typical collateral value of firm assets and implying that firms can borrow up to the full present value of their productive assets. This value is consistent with borrowing constraints in the corporate finance literature . The exogenous exit probability π_d is set to 0.02 per quarter, corresponding to an annual exit rate of approximately 8%, consistent with empirical evidence on firm turnover in the United States. The investment adjustment cost parameter γ is set to 1.00, within the range of 0.045 to 3 commonly used in the investment literature (Cooper and Haltiwanger (2006) and Winberry (2021)). This choice helps generate realistic investment dynamics while avoiding computational difficulties that arise with either very small or very large adjustment costs. The initial capital endowment for entrants k_0 is set to 0.20 to match the young and old firm size ratio from BDS.

Model Fit Despite relying entirely on externally calibrated parameters without any targeted moment matching, the model performs remarkably well in fitting key features of the firm-level data. Table 4 presents the comparison between data and model-generated

Table 3: Calibrated Parameters for the full model

Description	Parameter	Value	Source/Target
Household			
Discount factor	β	0.99	Fixed
Labor Disutility	χ	1.07	60% Employment Rate
Firm			
TFP Persistence	ρ_z	0.9	Ottonello and Winberry (2020)
SD of Innovations to TFP	σ_z	0.1	Catherine et al. (2022)
Depreciation Rate	δ	0.025	10% Annual Depreciation (BEA)
Coefficient on Capital	α	0.25	Return to Scale = 85%
Coefficient on Labor	ν	0.6	SS Labor Share $\approx$ 54%
Borrowing Limit	ϕ	1	Gross Leverage
Exogenous Death Rate	π_d	0.02	8% Annual Exit
Investment Adjustment Cost	γ	1	0.05-2
Initial Capital for Entrants	k_0	0.2	Employment Size Ratio[a]
Elasticity of Substitution	ϵ_p	10	Ottonello and Winberry (2020)

[a] Source: U.S. Census Bureau – CES, Business Dynamics Statistics (2022), the ratio is employment of firms $<$ 1 year old divided by firms $>$ 10 years old, ≈ 0.0216.

moments. The model successfully captures the mean gross leverage ratio, generating a value of 0.286 compared to 0.316 in the data. It also closely approximates the mean investment rate, producing 4.40 percentage points versus 3.94 in the data, and captures a substantial portion of the cross-sectional standard deviation of investment rates (8.27 in the model versus 10.26 in the data).

The model also generates realistic persistence in firm financial structure, with a leverage autocorrelation of 0.989 that is close to the empirical value of 0.938. Additionally, the model produces a realistic fraction of firms with positive net debt (63.2% in the model versus 70.8% in the data) and matches the annual exit rate exactly at 8%. The ratio of employment in young firms (age $<$ 1 year) to mature firms (age $>$ 10 years) is 0.02 in the model, very close to the data value of 0.022.

The model's performance across these diverse moments, achieved without parameter tuning to target specific statistics, provides confidence that the underlying economic mechanisms are well-captured. This external validation is particularly important for the credibility of the quantitative exercises that follow. It suggests the core mechanism (debt devaluation relaxing constraints) is correctly specified and that counterfactual predictions, such as how transitory inflation erodes real debt burdens differentially across leveraged firms, are credible, reflecting genuine economic forces embedded in the model's structure rather than artifacts of overfitting.

Table 4: Model Fit

Moment	Description	Data	Model
$\mathbb{E}[\frac{b}{k}]$	Mean Gross Leverage	0.316	0.286
$\mathbb{E}[i]$	Mean Investment Rate (p.p.)	3.936	4.398
$Corr(lev_t, lev_{t-1})$	Leverage Auto-correlation	0.938	0.989
$\sigma(\frac{i}{k})$	SD Investment Rate (p.p.)	10.263	8.27
$Frac(b > 0)$	Share of Positive Net Debt	0.708	0.632
$\mathbb{E}[\text{Exit}]$	Annual Exit Rate	0.08	0.08
$\frac{N_{age<1yr}}{N_{age>10yr}}$	Employment Size Ratio	0.022	0.2

5.2 Quantitative Results

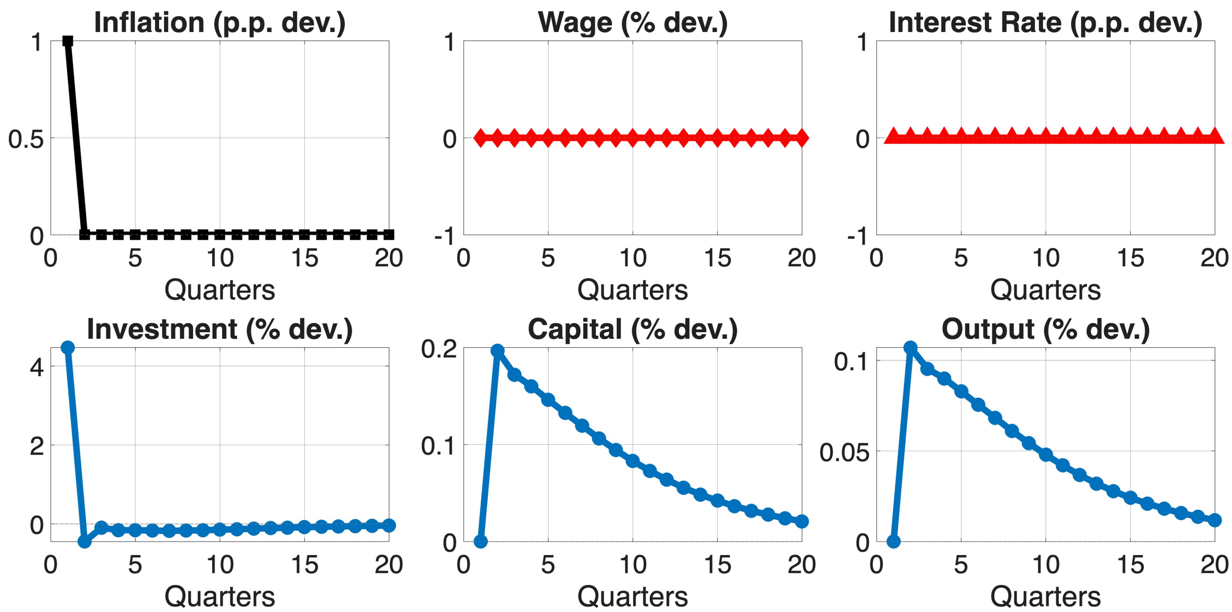
The calibrated model is initialized at its steady state and then hit by a transitory, unexpected 1% inflation shock.[5] I solve for the full transition path using the sequence-space Jacobian method (detailed in Appendix D) and report both partial equilibrium and general equilibrium impulse responses for aggregate variables in Figure 3 and 4.

Figure 3 reports partial-equilibrium impulse responses to an inflation shock, holding wages and the real rate fixed so that the responses isolate the Fisher (debt-inflation) channel. In the bottom-left panel, investment jumps on impact—about 4.5% above its steady-state level. On impact, the increase in the price level reduces the real burden of outstanding nominal debt, effectively transferring resources toward indebted firms. This balance-sheet revaluation relaxes financial constraints for those firms and triggers positive investment response. As the shock vanishes, those constraints re-tighten; investment therefore overshoots and adjusts downward before gradually returning to steady state. Capital, being a predetermined stock, peaks with a one-period lag: it rises in the second period and is then gradually eroded as investment falls below replacement. Output co-moves with factor inputs; because labor is chosen statically as a function of capital, output broadly tracks the capital path, though diminishing returns imply a smaller proportional response than for capital. Taken in isolation, the inflation-only experiment produces sizable movements. In the data, however, such large deviations are typically attenuated by general equilibrium feedbacks. Most notably the endogenous responses of real rates should push against the partial equilibrium dynamics.

Figure 4 shows that the debt-inflation still produces a quantitatively meaningful short-run increase in investment in general equilibrium. In the baseline calibration, aggregate investment jumps by about 0.83% relative to steady state on impact. This response is

[5] In this section I do not model the structural source of the shock; the shock could reflect exchange-rate moves, changes in the central-bank inflation target, or commodity-price shocks.

Figure 3: Partial Equilibrium Impulse Response Function following 1% Unexpected Inflation

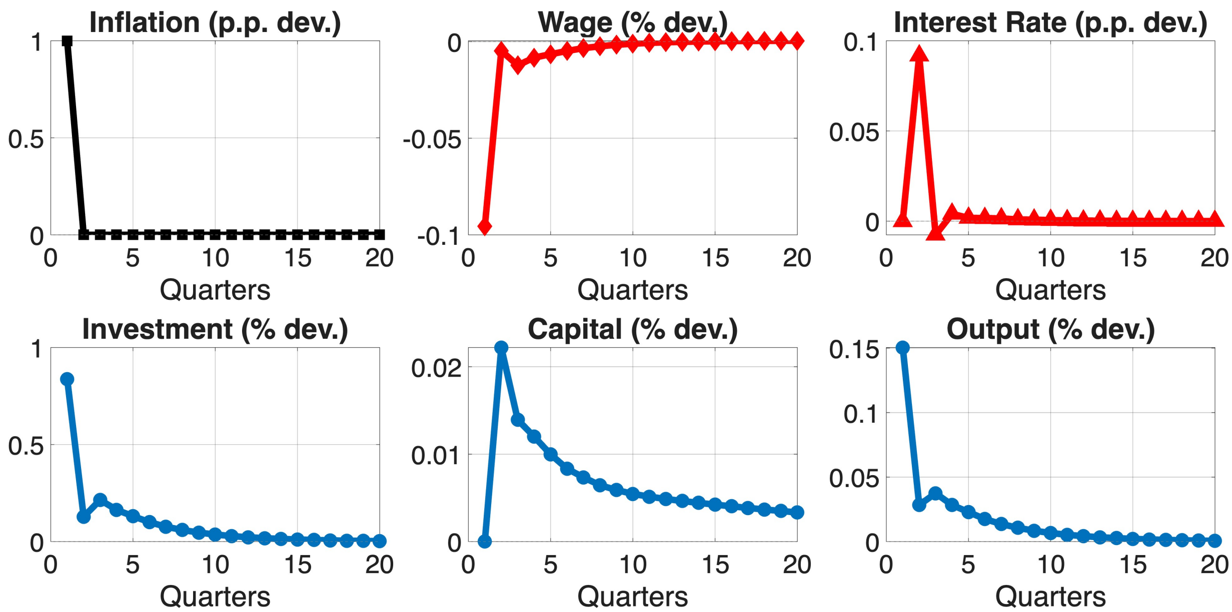


Notes: This figure plots partial equilibrium impulse responses to a one percent transitory unexpected inflation solved from calibrated model, with wages and real rates unchanged. Panels show percentage deviation from steady state; horizons in quarters.

economically significant, especially compared to household-side estimates near zero. The aggregate capital stock also rises, reaching a peak above steady state even with fact that adjustment costs are accounted for.

The top panels of Figure 4 display the core price dynamics. Inflation in these experiments is transitory (it vanishes in the second period), but the economy displays longer-lived adjustments in real wages and the real interest rate. A notable general-equilibrium outcome is that the real wage falls on impact despite higher investment-driven labor demand which would in turn push up wages. In our specification, higher investment crowds out contemporaneous consumption; with log utility this requires a decline in real wages to satisfy the household Euler condition. The right-hand top panel shows the real-rate response (constructed according to the indexing convention described in Section 2). In the first period of shock, the ex post real rate should fall on impact, but realized variable does not change contemporaneous and future decisions. It is the immediate balance-sheet revaluation (not contemporaneous real rate effects) that drives the investment jump; subsequently, the real interest rate rises endogenously as aggregate investment demand increases, raising the user cost of capital for all firms and crowding out investment for less-constrained firms, damping and eventually reversing part of the initial surge. The bottom panels of Figure 4 report same key real aggregates: investment, capital, and output as in figure 3. Investment peaks quickly

Figure 4: Impulse Response Function following 1% Unexpected Inflation



Notes: This figure plots general equilibrium impulse responses to a one percent transitory unexpected inflation solved from calibrated model. Panels show percentage deviation from steady state; horizons in quarters. Top middle panel shows real wages fall on impact due to consumption crowding-out, then gradually recover. Top right panel shows real interest rate rises endogeneously as investment demand increases, dampening the initial surge.

and then decays, capital adjusts more slowly because of depreciation and adjustment costs, and output responds primarily through labor in the short run (capital is predetermined and slowly evolved).

These aggregate responses reflect the interaction of an initial redistribution and subsequent general-equilibrium feedbacks. The immediate investment impulse is driven mainly by policy-function shifts for constrained, indebted firms following debt devaluation. Persistence and any overshooting arise from distributional dynamics: as constrained firms invest aggressively on impact, they accumulate capital and debt, moving toward the unconstrained region in subsequent periods. This endogenous 'graduation' from constraints naturally causes the investment boom to decay even without mean reversion in inflation. Aggregate prices and quantities adjust accordingly and push aggregates back to their steady state level.

5.3 Heterogeneous Responses

In order to better assess how well the calibrated model can reproduce the empirical estimates, I simulate a panel of firms' decisions in response to the observed series of unexpected inflation (Section 3). From the simulated panel I then estimate the empirical specification in equation 3, mirroring the empirical procedure as closely as possible.

It is worth emphasizing some features and choices when doing simulation. The model has only three state variables $\{z, k, b\}$, so it cannot mechanically generate every control that enters the empirical regression (for example, an interaction between GDP growth and past indebtedness). By contrast, firm-level idiosyncratic productivity paths are directly observable in the simulation and can be included as controls; this gives the simulated regression somewhat more information than the empirical one. The model is single-sector, so all specifications use firm and time two-way fixed effects only. In the simulated panel the firm's initial debt position is the state variable b (not a lagged, observed series); when comparing directly to the empirical specification I therefore report results both with b used contemporaneously and with the one-period lag to match the empirical construction.

Table 5 summarizes the main comparison. Column (1) reproduces the empirical benchmark from the Compustat sample. Columns (2) and (3) report estimates from the model-implied panel under alternative specification choices. Qualitatively, the simulated regressions match the empirical signs: firms with higher indebtedness increase investment more following an unexpected inflation surprise. Quantitatively, however, the simulated coefficients are smaller—roughly a factor of three to five smaller than the empirical estimates.

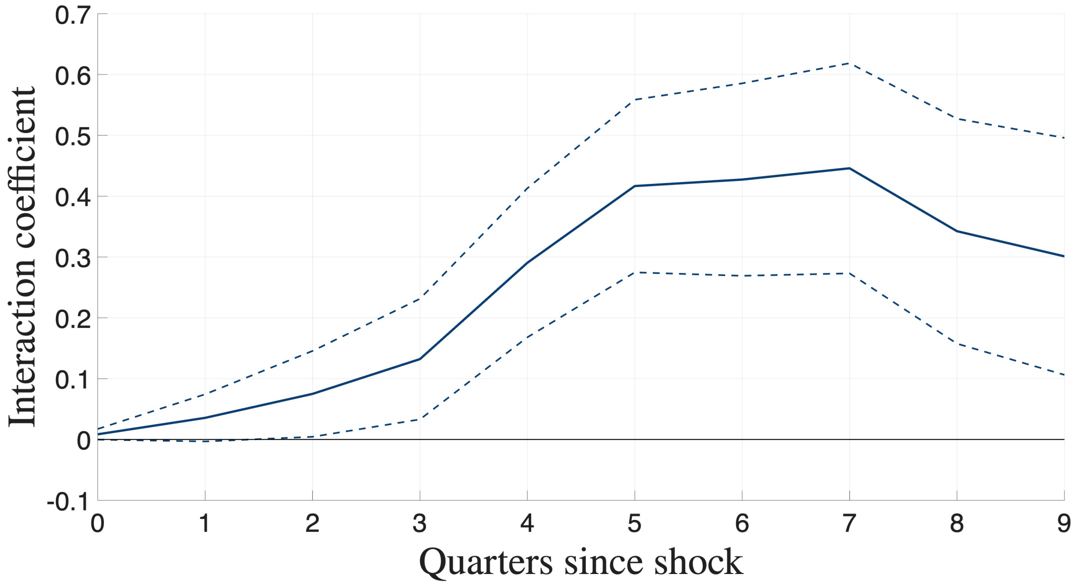
Table 5: Empirical and Model Implied Heterogeneous Responses

Investment Rate	Empirical Estimate		Model Implied Results	
	(1)	(2)	(3)	(4)
Unexp. Infl. × Indebt.	0.116***	0.124***	0.048*	0.024***
	(0.029)	(0.029)	(0.026)	(0.005)
Firm Control	No	Yes	No	Yes
Observations	268757	268757	192801	192801
R^2	0.118	0.125	0.272	0.968

Notes: Standard errors in parentheses. $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$. Firm controls include interaction between real rate and financial position, productivity, size, sales growth and liquidity measures; all specifications include firm and time two way fixed effects. Results are estimated from regression specification 3. Simulated data ranges from 1995Q1 to 2023Q4 using real unexpected inflation series and model implied real rate series. Estimates of unexpected inflation or inflation series are absorbed by time fixed effects.

Several reasons may help to understand the quantitative differences. First, the simulated panel takes advantage of linear approximation which could cause some accuracy problems. Second, measurement could matter: the empirical indebtedness proxy is constructed from

Figure 5: Simulated Dynamic Impacts after the Inflation Surprise



Notes: Plots the estimated coefficient β_h over h quarters following local projection regression (2), using model simulated data. Dashed lines report 90% error bonds.

accounting data subject to reporting lags, definitional choices, while the model uses the structural state b without measurement error. Third, the simulated panel contains fewer omitted variables... including those omitted variables in the empirical regression may help to amplify the reduced-form coefficient. While this quantitative gap is notable, the model successfully replicates the qualitative sign. This suggests the core economic mechanism is captured correctly, even if real-world factors not present in the model amplify the effect observed in the data.

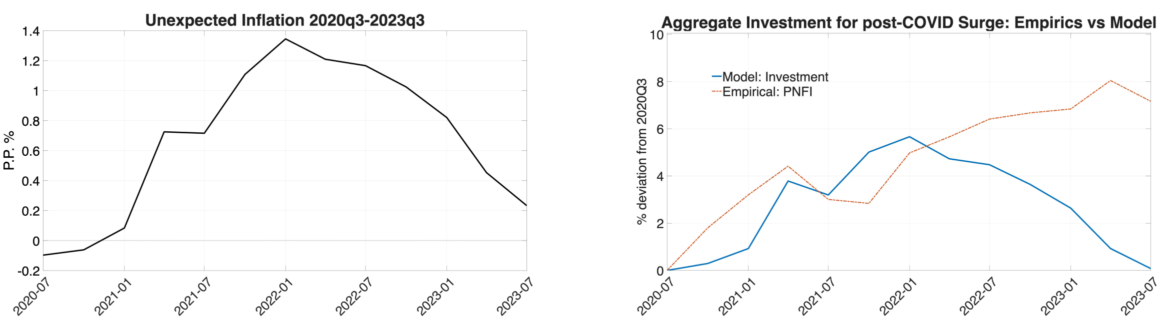
To study dynamic effects, I re-estimate the local-projection specification in equation 4 on the simulated panel and plot the cumulative responses in Figure 5. The simulated impulse-response profile matches the qualitative hump shape found in the data (Figure 2), but the magnitudes are substantially smaller. The 90% confidence bands are wide in the early horizons, and many point estimates are not statistically different from zero at conventional levels. This pattern is consistent with the cross-sectional concentration of the effect: when only a small subset of firms (the highly indebted and constrained) drives the aggregate response, sampling variability and measurement choices materially affect the estimated dynamic impulse.

In summary, the simulation exercise reproduces the empirical results and supports the paper's qualitative mechanism: the debt-inflation reallocates resources toward indebted firms and yields a short-run investment increase.

5.4 Empirical Relevance: Two Episodes

In order to assess the empirical relevance of the firm-side debt-inflation, I feed the historical unexpected-inflation series described in Section 3 into the model. Specifically, I conduct counterfactual exercises by constructing aggregate investment responses as the linear combination of the impulse responses with the observed shock sequence, derived via the sequence-space Jacobian method around the steady state. This isolates the partial equilibrium contribution of debt revaluation to aggregate investment, abstracting from concurrent monetary policy reactions, supply-chain disruptions, and other contemporaneous shocks that affected the economy during these episodes. Two episodes, the post-COVID inflation surge and the Great Recession, are particularly interesting and informative.

Figure 6: The Post-COVID Inflation Surge



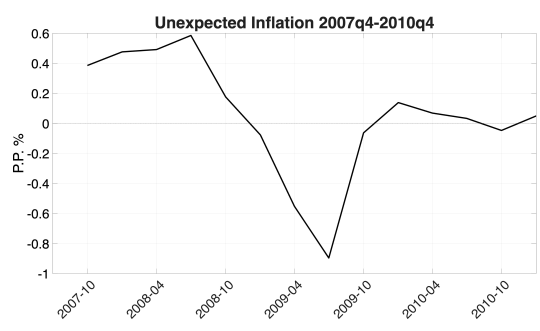
(a) Unexpected Inflation (b) Post-COVID Investment

The Post-COVID Investment Surge Figure 6 examines the post-COVID period, which featured a sequence of large positive inflation surprises unprecedented in recent decades. Panel (a) plots the unexpected inflation series from 2020Q3 to 2023Q3, showing a sustained period of positive surprises that peaked at approximately 1.4 percentage points in early 2022. Panel (b) compares the model-implied investment path (blue line) with the actual private non-residential fixed investment (PNFI) from FRED (orange dashed line), both normalized to 2020Q3 = 0. The model generates a substantial investment boom driven exclusively by the debt-inflation. The model-implied investment peaks at 5.66% above the 2020Q3 baseline in 2022Q1, capturing the qualitative upswing in investment activity during this period. The actual PNFI data shows a peak increase of 8.04% in 2023Q1, suggesting that the debt-inflation alone can account for up to 70% of the observed post-COVID investment surge at its peak.

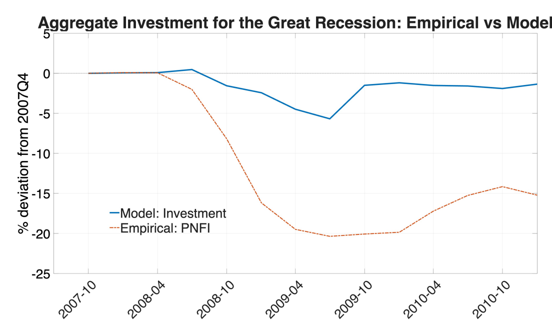
Several factors help reconcile the modest gap between the model and data. First, the model slightly underpredicts the magnitude of the realized increase, which is partly attributable to the model's linearization around steady state—the Sequence Space Jacobian method captures first-order effects but abstracts from second-order amplification mechanisms that may be quantitatively important during large shocks. Second, the post-COVID period involved substantial real-side changes not modeled here, such as the relaxation of pandemic-related constraints, sector-specific demand shifts, and fiscal stimulus programs. They are all likely to have amplified the transmission from balance-sheet relief to investment. Third, the model abstracts from the dynamic complementarities between debt relief and other investment determinants—for instance, firms experiencing debt-inflation-channel windfalls may also have expanded capacity to hire workers, invest in intangibles, generating positive feedback loops not captured in the baseline framework.

Nevertheless, the model's ability to explain up to 70% of the peak investment surge using inflation surprises alone is notable, particularly when compared to the modest household-side Fisher effects documented in prior literature (Doepke and Schneider (2006), Auclert (2019)). This peak-share metric should be interpreted as an upper bound for two reasons. First, contemporaneous monetary policy tightening—the Federal Reserve raised rates aggressively from 2022 onward—likely dampened the debt-inflation effect through higher user costs of capital and tighter future borrowing constraints. Second, general equilibrium forces such as rising real wages and real interest rates, which are present in the model, already attenuate the partial equilibrium Fisher effect. The timing of the model's peak (2022Q1) also leads the data's peak (2023Q1) by one year, which may reflect the model's assumption of immediate balance-sheet adjustment. In reality, firms may have taken time to recognize the debt devaluation, adjust their capital expenses, and navigate persistent supply-chain bottlenecks that delayed investment execution.

Figure 7: The Great Recession



(a) Unexpected Inflation



(b) The Great Recession Investment

The Great Recession Figure 7 examines the deflationary episode during the Great Recession, where the debt-inflation operates in reverse—falling prices increase the real debt burden, tightening financial constraints and depressing investment. Panel (a) shows the unexpected inflation series from 2007Q4 to 2010Q4, with a dramatic deflationary shock reaching -0.88 percentage points in 2009Q1. Panel (b) presents the model-implied investment path alongside actual PNFI data, both normalized to 2007Q4 = 0.

The model predicts a 5.68% decline in aggregate investment at the trough (2009Q2), driven mechanically by the deflationary debt-inflation elevating real debt burdens for constrained firms. The empirical PNFI data shows a far more severe collapse, declining by 20.36%. Consequently, the debt-inflation explains approximately 28% of the observed investment decline at the peak share.

The model's explanatory power is thus weaker in this deflationary downturn than in the post-COVID inflationary expansion, revealing an important asymmetry. This asymmetry is natural and informative: in expansions driven by positive inflation surprises, the debt-inflation operates as a direct, first-order wealth transfer that immediately relaxes binding constraints, with few countervailing forces (beyond general equilibrium price adjustments). In severe recessions, by contrast, the deflationary debt-inflation is one of many contractionary forces, and it may be dominated by credit supply disruptions, uncertainty, and demand shortfalls that are outside the model's scope.

Both episodes reveal revealing timing discrepancies: model rebounds lead data by 2–3 quarters. These stem from the baseline's parsimony, for instance, one-period nominal debt enables instantaneous revaluation, unlike multi-maturity structures that smooth effects. Extending the model to incorporate a realistic debt maturity structure would smooth the debt-inflation's impact over time, generating more gradual investment responses. The model's convex adjustment costs generate symmetric responses to positive and negative shocks of equal magnitude, while the data suggest asymmetric adjustment. Investment irreversibilities are absent from the baseline model, would create asymmetry. This would naturally generate the observed pattern of sharp declines and gradual recoveries. Finally, the Sequence Space Jacobian method's reliance on first-order linearization abstracts from the nonlinearities and second-order effects that may be quantitatively important during large shocks. For instance, borrowing constraints may bind more severely and for more firms during deep recessions than the linearized model predicts, amplifying the deflationary debt-inflation's contractionary effects.

5.5 Discussion

The debt-inflation emerges as a quantitatively robust mechanism for reallocating investment toward indebted firms following inflation surprises, with particularly strong effects during periods of sustained positive surprises like the post-COVID episode. The channel's explanatory power is more modest during severe downturns characterized by multiple concurrent shocks, yet even in the Great Recession, it accounts for roughly one-quarter of the investment collapse—a non-trivial contribution.

Relative to the well-documented household-side Fisher effects, which Auclert (2019) finds to be modest and sometimes statistically indistinguishable from zero, these results point to a quantitatively meaningful firm-side debt-inflation for investment. This asymmetry between household consumption and firm investment responses likely reflects differences in both the size of debt holdings (nonfinancial corporate debt is 72% of GDP versus household credit-to-GDP is about 68%[6]) and the sensitivity of expenditure decisions to net worth shocks: investment is likely to be more elastic due to financial constraints, while consumption is smoothed through precautionary savings.

The model's performance also suggests that the firm-side debt-inflation interacts importantly with monetary policy and other macroeconomic forces. During the post-COVID episode, accommodate monetary tightening likely dampened the Fisher effect through higher user costs and tighter expected future constraints, yet investment still surged—consistent with the model's prediction that balance-sheet relief dominates for constrained firms. But more aggressive monetary policy could futher raise interest rate and mute debt-inflation effects with higher real rates. During the Great Recession, by contrast, monetary policy was constrained by the zero lower bound, and credit supply disruptions likely amplified the deflationary debt-inflation beyond what the model predicts. Future research incorporating active monetary policy rules, occasionally binding zero lower bounds, and time-varying credit conditions could shed light on these policy interactions and refine the model's predictions during crisis episodes.

6 Conclusion

This paper combines micro-level evidence with a calibrated heterogeneous-firm general-equilibrium model to study how unexpected inflation affects corporate investment via the revaluation of nominal debt (the debt-inflation). Empirically, consistent with a simple conceptual framework, I document a robust finding from U.S. firm-level data that firms with

[6]In a model without government, firms are net debtors while households are net savers.

different financial positions have differential investment responses to unexpected inflation. In particular, firms carrying larger nominal debt burdens tend to increase investment relatively more after a positive inflation surprise.

To identify mechanisms and quantify aggregate implications, I develop a tractable heterogeneous firm model with rigid nominal debt contracts and financing frictions. The model isolates the mechanism and quantifies its aggregate significance. Transitory inflation erodes the real value of outstanding nominal debt, relaxes financing constraints for a subset of indebted firms, and triggers an investment increase. In the baseline calibration, a 1% inflation surprise produces a non-negligible rise in aggregate investment by 0.83% and output 0.15%; simulated panels reproduce the cross-sectional heterogeneity observed in the data. When I map observed inflation surprises into the model, the debt-inflation explains a meaningful share (up to 70% peak-share) of the post-COVID investment surge, while it accounts for a smaller fraction of the Great Recession.

These findings elevate the firm-side debt-inflation as a quantitatively relevant mechanism for investment—complementary to the household-side Fisher effects found to be modest for consumption. They should, however, be read as upper-bound accounting for inflation-driven movements: policy tightening, price/wage adjustments, supply disruptions, and other shocks attenuate pass-through in the data. This study also opens several avenues for future research. The model simplifies the debt structure to one-period bonds; incorporating a richer term structure of corporate debt could reveal how maturity profiles mediate the strength and timing of the debt-inflation. Furthermore, embedding this mechanism in a framework with an endogenous monetary policy response would allow for a deeper analysis of optimal policy and the trade-offs between stabilizing prices and leveraging debt relief.

In conclusion, by shifting the focus from households to firms, the paper establishes the investment debt-inflation (Fisher) channel as a quantitatively important which is previously under-emphasized mechanism. Recognizing these firm-side effects is essential for a complete picture of how inflation shapes macroeconomic dynamics and for designing policies that account for heterogeneity in corporate financial positions.

References

Sami Alpanda and Sarah Zubairy. Addressing household indebtedness: Monetary, fiscal or macroprudential policy? *European Economic Review*, 92:47–73, 2017.

Sami Alpanda and Sarah Zubairy. Household debt overhang and transmission of monetary policy. *Journal of Money, Credit and Banking*, 51(5):1265–1307, 2019.

Adrien Auclert. Monetary policy and the redistribution channel. *American Economic Review*, 109(6):2333–67, 2019.

Adrien Auclert, Bence Bardóczy, Matthew Rognlie, and Ludwig Straub. Using the sequence-space jacobian to solve and estimate heterogeneous-agent models. *Econometrica*, 89(5): 2375–2408, 2021.

Ben S Bernanke, Mark Gertler, and Simon Gilchrist. The financial accelerator in a quantitative business cycle framework. *Handbook of macroeconomics*, 1:1341–1393, 1999.

Harjoat S Bhamra, Christian Dorion, Alexandre Jeanneret, and Michael Weber. High inflation: Low default risk and low equity valuations. *The Review of Financial Studies*, 36(3): 1192–1252, 2023.

Markus Brunnermeier, Sergio Correia, Stephan Luck, Emil Verner, and Tom Zimmermann. The debt-inflation channel of the german (hyper) inflation. *American Economic Review*, 115(7):2111–2150, 2025.

Sylvain Catherine, Thomas Chaney, Zongbo Huang, David Sraer, and David Thesmar. Quantifying reduced-form evidence on collateral constraints. *The Journal of Finance*, 77(4): 2143–2181, 2022.

Yuchen Chen. Monetary policy, debt structure, and credit reallocation. *Debt Structure, and Credit Reallocation (October 3, 2023)*, 2023.

Russell W Cooper and John C Haltiwanger. On the nature of capital adjustment costs. *The Review of Economic Studies*, 73(3):611–633, 2006.

Harry DeAngelo, Linda DeAngelo, and Toni M Whited. Capital structure dynamics and transitory debt. *Journal of financial economics*, 99(2):235–261, 2011.

Matthias Doepke and Martin Schneider. Inflation and the redistribution of nominal wealth. *Journal of Political Economy*, 114(6):1069–1097, 2006.

Elena Durante, Annalisa Ferrando, and Philip Vermeulen. Monetary policy, investment and firm heterogeneity. *European Economic Review*, 148:104251, 2022.

Andrea Fabiani and Piersanti Fabio Massimo. Inflation, capital structure and firm value. *Bank of Italy Temi di Discussione (Working Paper) No*, 1434, 2023.

Andreas Fagereng, Magnus AH Gulbrandsen, Martin B Holm, and Gisle J Natvik. How does monetary policy affect household indebtedness? 2023.

Joan Farre-Mensa and Alexander Ljungqvist. Do measures of financial constraints measure financial constraints? *The review of financial studies*, 29(2):271–308, 2016.

Irving Fisher. The debt-deflation theory of great depressions. *Econometrica: Journal of the Econometric Society*, pages 337–357, 1933.

Carlos Garriga, Finn E Kydland, and Roman Šustek. Mortgages and monetary policy. *The Review of Financial Studies*, 30(10):3337–3375, 2017.

Joao Gomes, Urban Jermann, and Lukas Schmid. Sticky leverage. *American Economic Review*, 106(12):3800–3828, 2016.

Christopher A Hennessy and Toni M Whited. How costly is external financing? evidence from a structural estimation. *The Journal of Finance*, 62(4):1705–1745, 2007.

Filippo Ippolito, Ali K Ozdagli, and Ander Perez-Orive. The transmission of monetary policy through bank lending: The floating rate channel. *Journal of Monetary Economics*, 95: 49–71, 2018.

Ching-Lih Jan and Jane A Ou. Negative-book-value firms and their valuation. *Accounting horizons*, 26(1):91–110, 2012.

Priit Jeenas. Firm balance sheet liquidity, monetary policy shocks, and investment dynamics. *Work*, 5, 2019.

Priit Jeenas. Firm balance sheet liquidity, monetary policy shocks, and investment dynamics. 2023.

Òscar Jordà. Estimation and inference of impulse responses by local projections. *American economic review*, 95(1):161–182, 2005.

Michael L Lemmon, Michael R Roberts, and Jaime F Zender. Back to the beginning: persistence and the cross-section of corporate capital structure. *The journal of finance*, 63 (4):1575–1608, 2008.

Atif Mian, Kamalesh Rao, and Amir Sufi. Household balance sheets, consumption, and the economic slump. *The Quarterly Journal of Economics*, 128(4):1687–1726, 2013.

Pablo Ottonello and Thomas Winberry. Financial heterogeneity and the investment channel of monetary policy. *Econometrica*, 88(6):2473–2502, 2020.

Philip Schnorpfeil, Michael Weber, and Andreas Hackethal. Households' response to the wealth effects of inflation. Technical report, National Bureau of Economic Research, 2023.

Kevin D Sheedy. Debt and incomplete financial markets: A case for nominal gdp targeting.

Brookings Papers on Economic Activity, 2014(1):301–373, 2014.

Ilya A Strebulaev and Baozhong Yang. The mystery of zero-leverage firms. *Journal of financial Economics*, 109(1):1–23, 2013.

Ilya A Strebulaev, Toni M Whited, et al. Dynamic models and structural estimation in corporate finance. *Foundations and Trends® in Finance*, 6(1–2):1–163, 2012.

George Tauchen. Finite state markov-chain approximations to univariate and vector autoregressions. *Economics letters*, 20(2):177–181, 1986.

Stephen J Terry and Edward S Knotek II. Markov-chain approximations of vector autoregressions: Application of general multivariate-normal integration techniques. *Economics Letters*, 110(1):4–6, 2011.

Yajie Wang and Yan Bai. Financing from workers: Can labor market power mitigate financial frictions? Federal Statistical Research Data Center (FSRDC) research project, unpublished, 2025.

Thomas Winberry. Lumpy investment, business cycles, and stimulus policy. *American Economic Review*, 111(1):364–396, 2021.

Eric R Young. Solving the incomplete markets model with aggregate uncertainty using the krusell–smith algorithm and non-stochastic simulations. *Journal of Economic Dynamics and Control*, 34(1):36–41, 2010.

Appendix

A Additional Empirical Results

This section of appendix provides various robustness checks.

A.1 Data Construction

This subsection describes the firm-level variables used in the empirical analysis in this paper.

Variables Descriptions.

Investment: defined as $i_{j,t}$ of firm j at the end of period t. To get investment rate, I firstly calculate the series of real capital. For each firm, I set the first value of kj, t to be the level of gross plant, property, and equipment (ppegtq) in the first period in which this variable is reported in Compustat. From this period onwards, I compute the evolution of $k_{j,t+1}$ using the changes of net plant, property, and equipment (ppentq), which is a measure net investment with significantly more observations than ppegtq (net of depreciation). If a firm has a missing observation of ppentq located between two periods with non-missing observations, I estimate its value using a linear interpolation with the values of ppentq right before and after the missing observation; if two or more consecutive observations are missing we do not do any imputation. We only consider investment spells with 20 quarters or more. Investment rate is calculated as the real investment expense divided by the last period capital stock.

Indebtedness: main proxy of indebtedness is defined as $b_{j,t}$, total debt (sum of dlcq and dlttq) and residualized to purge firm and time fixed effects. Alternative measures include net indebtedness, leverage and net leverage. Net indebtedness is defined as the total debt minus cash and short-term investments (cash equivalents, cheq) in Compustat. Leverage is defined as the ratio of total debt to total assets (atq). Net leverage is defined as the ratio of total debt minus net current assets (actq minus lctq) to total assets.

Real sales growth: measured as log-differences in sales (saleq) deflated using the BLS implicit price deflator. Size: measured as the log of total real assets, deflated using the BLS implicit price deflator. Liquidity: defined as the ratio of cash and short-term investments (cheq) to total assets. Cash flow: measured as EBIT divided by capital stock. Dividend payer: defined as a dummy variable taking a value of one in firm-quarter observations in which the firm paid dividends to preferred stock of the company (constructed using dvpq). Age: defined as the number of quarters appeared in the sample. Tobin's Q:

Sectoral dummies: I consider the following sectors: (i) agriculture, forestry, and fishing: sic ¡ 999; (ii) mining: sic ∈[1000; 1499]; (iii) construction: sic ∈ [1500; 1799]; (iv) manufacturing: sic ∈[2000; 3999]; (v) transportation, communications, electric, gas, and sanitary services: sic ∈[4000; 4999]; (vi) wholesale trade: sic ∈[5000; 5199]; (vii) retail trade sic ∈[5200; 5999]; (viii) services: sic ∈[7000; 8999].

Sample Selection Our empirical analysis excludes (in order of operation): 1. Firms in finance, insurance, and real estate sectors (sic ∈[6000; 6799]), utilities (sic ∈ [4900; 4999]), nonoperating establishments (sic = 9995), and industrial conglomerates (sic = 9997). 2. Firms not incorporated in the United States. 3. Firm-quarter observations that satisfy one of the following conditions, aimed at excluding extreme observations: i. Negative capital or assets ii. Acquisitions (constructed based on aqcy) larger than 5% of assets. iii. Investment rate is in the top and bottom 0.5% of the distribution. iv. Investment spell is shorter than 40 quarters. v. Net current assets as a share of total assets higher than 10 or below -10. vi. Leverage higher than 10 or negative. vii. Quarterly real sales growth above 1 or below -1. viii. Negative sales or liquidity.

After applying these sample selection operations, I winsorize observations of leverage and distance to default at the top and bottom 0.5% of the distribution.

Table 6 summarizes the firm-level control variables, which are standard in the corporate finance literature. Notably, the average firm in our sample holds a low proportion of short-term debt (7.1%). This empirical fact suggests that the effects I document would likely be even stronger with a model featuring long-term debt, as the debt-inflation has more poIr when debt maturity is longer. Our model simplifies this by assuming one-period debt, which likely provides a conservative estimate of the channel's true strength.

Table 6: Firm Control Variables

Ctrl Variables	Mean	Median	S.D.	IQR
Sales Growth	0.011	0.014	0.222	0.167
Size	5.530	5.573	2.400	3.425
Curr Asset Ratio	0.516	0.520	0.247	0.392
Age (sample)	12.438	11.000	8.009	11.500
Profit to Capital	-0.238	0.039	6.430	0.147
ST Debt Ratio	0.071	0.013	0.260	0.054
Div Paying	0.091	0.000	0.288	0.000

A.2 Sample Selection

I include two crisis periods in the main regression sample, which may in turn arouse suspicion that these periods can drive the main result. Table 7 presents the results with various samples. Column (3) excludes the two import recessions: the Great Recession and COVID recession and the point estimate does not change much in terms of magnitude and significance. The last column further excludes the whole post COVID period and the main estimate of interest declines but remain significant at 10% level. Overall, the main result is robust across various samples.

Table 7: Results for Various Samples

	(1)	(2)	(3)	(4)	(5)	(6)
Unexp Infl × Indebtedness	0.124***	0.108***	0.129***	0.127***	0.126***	0.076*
	(0.029)	(0.029)	(0.031)	(0.032)	(0.029)	(0.042)
Indebtedness	-0.414***	-0.423***	-0.354***	-0.413***	-0.372***	-0.269***
	(0.082)	(0.083)	(0.105)	(0.095)	(0.086)	(0.108)
Growth × Indebtedness	-0.045**	-0.037*	-0.057**	-0.043**	-0.055**	-0.074**
	(0.018)	(0.019)	(0.026)	(0.021)	(0.021)	(0.030)
FFR × Indebtedness	-0.060***	-0.058**	-0.064***	-0.061***	-0.072***	-0.060**
	(0.020)	(0.023)	(0.020)	(0.020)	(0.020)	(0.021)
Observations	268757	244950	251150	255870	264037	232390
R^2	0.125	0.129	0.127	0.126	0.126	0.136
Firm Control	Yes	Yes	Yes	Yes	Yes	Yes
Time Sector FE	Yes	Yes	Yes	Yes	Yes	Yes
Time Clustering	Yes	Yes	Yes	Yes	Yes	Yes

Notes: Standard errors in parentheses. $^*p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$. Firm controls as indicated; all specifications include time-by-sector fixed effects; standard errors clustered by time. Results are estimated from regression specification 3. Column (1) is the main result. Column(2) considers only post 1994 sample. Column (3) excludes the Great Recession and COVID recession. (4) and (5) excludes the two recessions respectively. (6) only considers the pre-COVID sample and excludes the Great Recession.

A.3 Interaction with Financial Variables

A key concern is whether the estimated interaction effect genuinely reflects debt devaluation or instead captures inflation's impact through other firm characteristics correlated with indebtedness. For instance, unexpected inflation might inflate nominal sales revenues, disproportionately benefiting firms with high operating leverage or market power. Alternatively, inflation could affect investment through cash flow channels, liquidity constraints, or life-cycle dynamics unrelated to balance sheets. To address these concerns, Table 8 augments the baseline specification with additional interaction terms between unexpected inflation and various firm-level controls: liquidity (cash holdings), firm size (log assets), age, and dividend payout ratios. I also explore alternative debt measures: net debt (gross debt minus cash) and long-term debt.

Across all specifications, the coefficient on the debt-inflation interaction term remains positive, statistically significant, and quantitatively stable—ranging from 0.065 to 0.127, compared to the baseline estimate of 0.124 in Table 2. This stability is economically meaningful: it indicates that the differential investment response between high- and low-debt firms persists even after controlling for inflation's potential effects through alternative channels. Column (1) using net debt yields a coefficient of 0.065, slightly smaller than the baseline, likely because netting out liquid assets partially offsets the debt burden that inflation erodes. Column (5) using long-term debt is particularly informative, generating the largest coefficient (0.127). Long-term debt has fixed nominal repayment schedules extending multiple years into the future, making it most exposed to inflation surprises—short-term debt, by contrast, refinances at prevailing rates and thus partly adjusts to new inflation expectations. The finding that long-term debt generates the strongest response aligns precisely with the model's emphasis on predetermined nominal contracts as the source of the Fisher effect.Columns (2)-(4) and (6) control for interactions with liquidity, size, age, and dividend policy while retaining the baseline debt measure. The debt interaction coefficient remains highly significant in all cases (0.082-0.119), demonstrating that the debt-inflation operates independently of these firm characteristics. Notably, the fact that controlling for size (Column 3, capturing scale effects) and age (Column 4, capturing life-cycle dynamics) does not attenuate the debt coefficient suggests the Fisher effect is not merely proxying for larger or more mature firms having different inflation sensitivities. Similarly, controlling for dividend payout (Column 6) confirms the result is not driven by payout policy differences across high- and low-debt firms. Together, these results establish that the debt-inflation interaction captures a distinct mechanism—the revaluation of nominal debt—rather than reflecting omitted firm attributes or alternative transmission channels.

A.4 Measure of Leverage

In the main context, I use logarithm of debt as the main proxy for the indebtedness. Due to the mechanism of debt-inflation, the level variable is naturally more advantageous than the ratio. But in the literature, leverage ratio is a commonly used proxy for financial position, therefore I also provide the sample statistics and regression results using leverage

Table 8: Results Controlling for Interaction with Different Financials

	NetDebt	Liquidity	Size	Age	LongDebt	Div
Unexp Infl × Indebtedness	0.065**	0.082***	0.109***	0.109***	0.127***	0.119***
	(0.028)	(0.030)	(0.032)	(0.027)	(0.033)	(0.029)
Observations	179450	254991	255045	255045	255045	255045
R^2	0.140	0.128	0.126	0.129	0.126	0.126

Notes: * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Standard errors in parentheses; two-way clustering by firm and time. Firm, sector-time FE and aggregate controls included. Net debt and long debt columns replace the debt in the main specification. All controls the interaction with GDP growth and federal funds rate.

ratio. Table 10 and figure 8 present the corresponding regression result and dynamic plot. On impact estimates are significant and precise but the following dynamic effects do not show similar persistency like in figure 2

Table 9: Firm Investment Summary

Statistic	$\Delta \log k_{jt+1}$	i_t	$\Delta \log(ppe)_{jt+1}$	$capx_t$	lev_{t-1}
Mean	0.490	4.107	0.490	9.088	0.269
Median	-0.441	2.743	-0.466	4.343	0.201
S.D.	8.983	10.643	14.480	542.663	0.371
95th percentile	12.031	15.986	16.568	22.453	0.751
Observations	316147	316147	315334	313402	316147

Notes: Because taking logarithm will naturally omit zero debt firms, the regression sample using leverage ratio is significantly larger than that using log debt. Other than observations, other sample statistics are similar to table 1

Table 10: Results using Leverage

Investment Rate	(1)	(2)	(3)	(4)
Unexpected inflation × Lev	0.055*	0.056*		
	(0.030)	(0.030)		
Inflation × Lev			0.052**	0.054**
			(0.024)	(0.024)
Leverage	-0.484***	-0.357***	-0.562***	-0.439***
	(0.074)	(0.072)	(0.086)	(0.086)
GDP Growth × Lev	-0.045***	-0.045***	-0.047***	-0.047***
	(0.015)	(0.015)	(0.016)	(0.015)
FFR × Lev	-0.045**	-0.036**	-0.058***	-0.050***
	(0.018)	(0.017)	(0.019)	(0.018)
Observations	316147	316147	316147	316147
R^2	0.110	0.117	0.110	0.117
Firm Control	No	Yes	No	Yes
Time Sector FE	Yes	Yes	Yes	Yes
Two-way Clustering	Yes	Yes	Yes	Yes

Notes: Standard errors in parentheses. $^*p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$. Firm controls as indicated; all specifications include time-by-sector fixed effects; standard errors clustered by time and firm. Results are estimated from regression specification 3. First two columns employ unexpected inflation series ε_t^π constructed above, while third and fourth column show results directly using CPI inflation. $\mathbf{Z_{j,t}}$ is a vector of control variables at firm level and interaction of demeaned financial position with GDP growth and federal funds rate. Estimates of unexpected inflation or inflation series are absorbed by time fixed effects. This table show robust results in addition to table 2

B Two-Period Model Capital Structure

Setup. Set $\delta = 1$ and $\Pi_2 = 1$. Period-1 net worth after repaying old nominal debt is

$$nw_1 \;=\; k_1^\alpha \;-\; \frac{1+i_1}{\Pi_1}\, b_1 \tag{19}$$

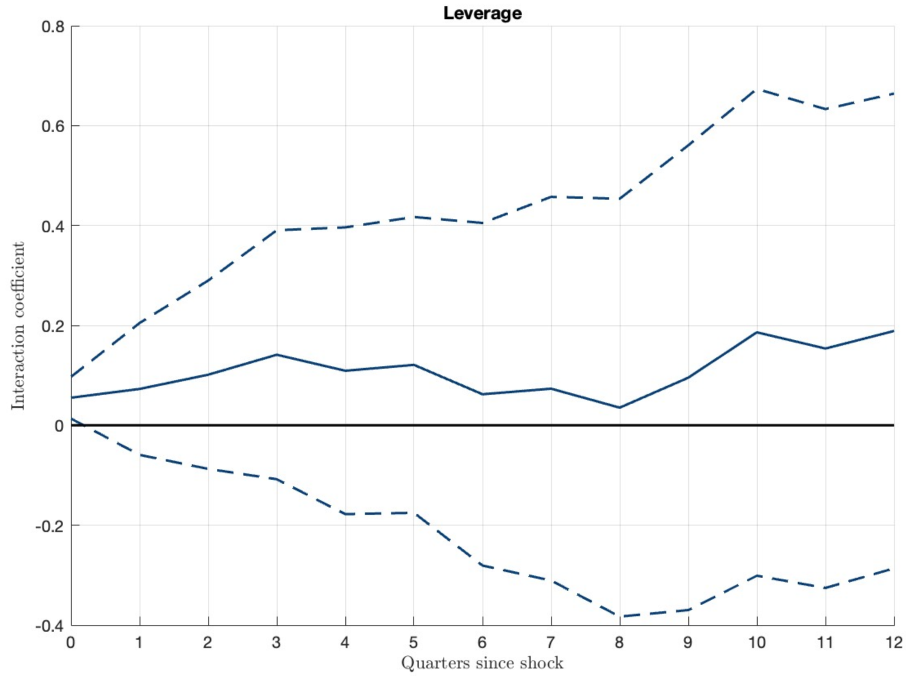
The nonnegative dividend constraint implies

$$d_1 \geq 0 \quad \Longleftrightarrow \quad k_2 - b_2 \;\leq\; nw_1 \tag{20}$$

The borrowing (collateral) constraint is

$$(1+r)b_2 \;\leq\; \phi\, k_2^\alpha \quad \Longleftrightarrow \quad b_2 \;\leq\; \frac{\phi}{1+r}\, k_2^\alpha \tag{21}$$

Figure 8: Dynamic Impacts after the Inflation Surprise



Notes: Plots the estimated coefficient β_h over h quarters following local projection regression (2) using leverage ratio as the proxy of indebtedness. Dashed lines report 90% error bonds. Estimation of cumulative capital change is different from the investment rate from on impact regression. We can regard the slop of the graph as the investment responses and in the 8th quarter, the positive investment responses vanish.

Combining (20)–(21) yields the single feasibility inequality

$$h(k_2) \;\equiv\; k_2 \;-\; \frac{\phi}{1+r}\, k_2^{\alpha} \;\leq\; nw_1 \tag{22}$$

Unconstrained benchmark. With $\delta = 1$, the unconstrained optimum k_2^u satisfies

$$1 \;=\; \frac{1}{1+r}\,\alpha\,(k_2^u)^{\alpha-1} \qquad \Longrightarrow \qquad k_2^u \;=\; (\frac{\alpha}{1+r})^{\frac{1}{1-\alpha}} \tag{23}$$

Evaluate the feasibility function at k_2^u:

$$h(k_2^u) = k_2^u - \frac{\phi}{1+r}(k_2^u)^{\alpha} = k_2^u\left[1 - \frac{\phi}{\alpha}\right], \quad \text{since } \frac{1}{1+r}(k_2^u)^{\alpha} = \frac{k_2^u}{\alpha}. \tag{24}$$

Implication. The sign of $h(k_2^u)$ depends only on $\alpha - \phi$:

- If $\alpha > \phi$, then $h(k_2^u) > 0$. To implement k_2^u the firm needs strictly positive net worth

$nw_1 \geq h(k_2^u) > 0$. Firms with lower (but feasible) $nw_1 \in [0, h(k_2^u))$ cannot reach k_2^u; their optimum is constrained on the boundary $k_2 - \frac{\phi}{1+r} k_2^\alpha = nw_1$. This creates a nonempty constrained region and a non-neutral Fisher effect on impact.

- If $\alpha \leq \phi$, then $h(k_2^u) \leq 0$. Because feasible firms satisfy $nw_1 \geq 0$, they automatically meet $nw_1 \geq h(k_2^u)$ and choose k_2^u (unconstrained); the constrained region vanishes on impact.

Choosing $\phi < \alpha$ ensures $h(k_2^u) > 0$ by (A6), so for realistic nw_1 some firms are constrained while others are not. In the two-period illustrations, I set $\phi = 0.6$ and (e.g.) $\alpha = 0.8$, which guarantees: (i) a nonempty constrained set $nw_1 \in [0, h(k_2^u))$; (ii) heterogeneous responses to inflation across indebtedness b_1; and (iii) a strictly positive on-impact slope $\partial k_2^*/\partial \pi_1$. This choice delivers the non-neutrality.

C Firm Optimality Conditions in Quantitative Model

This appendix provides a complete derivation of the firm's first-order conditions (FOC). I also present envelope relations, the full Kuhn–Tucker characterization, and a local comparative-static result that signs the effect of a small, unexpected inflation surprise on the borrowing multiplier ψ_t, the dividend multiplier ξ_t, and contemporaneous investment i_t.

C.1 Lagrangian

A continuing firm (index suppressed) solves

$$V_t^c(z,k,b) = \max_{k',\,b'} \Big\{ d_t + \mathbb{E}_t[\Lambda_{t,t+1} V_{t+1}(z',k',b')] \Big\},$$

subject to the dividend identity (real terms)

$$d_t = p_t z_t k_t^\alpha n_t^\nu - w_t n_t - i_t - AC(i_t,k_t) - (1+R_t)\frac{b_t}{\Pi_t} + b_{t+1}, \tag{25}$$

with $i_t = k' - (1-\delta)k$ and $AC(i,k) = \frac{\gamma}{2}\dfrac{i^2}{k}$.

The borrowing (collateral) limit is

$$b_{t+1} \le \mathcal{B}_t(k_{t+1}) \equiv \phi \cdot \frac{\Pi_{t+1}}{1+R_{t+1}} \Big(p_{t+1}\, z_{t+1}\, k_{t+1}^\alpha n_{t+1}^\nu - w_{t+1} n_{t+1} + (1-\delta) k_{t+1} \Big), \tag{26}$$

where $\phi > 0$ measures credit-market tightness (higher ϕ increases allowable borrowing).I set $\phi = 1$ as a normalization; here keep it explicitly.

Introduce multipliers: $\xi_t \ge 0$ on the dividend non-negativity constraint $d_t \ge 0$, and $\psi_t \ge 0$ on the borrowing constraint $\mathcal{B}_t(k') - b' \ge 0$. The continuation Lagrangian is

$$\mathcal{L}_t = d_t + \mathbb{E}_t[\Lambda_{t,t+1} V_{t+1}(z',k',b')] + \xi_t\, d_t + \psi_t \big(\mathcal{B}_t(k') - b'\big).$$

C.2 First-order conditions

Differentiate $\mathcal{L}_t$ w.r.t. choice variables b' and k'. Expectations are conditional on information at t.

FOC w.r.t. b'

$$\frac{\partial \mathcal{L}_t}{\partial b'} : \quad 1 + \mathbb{E}_t[\Lambda_{t,t+1} V_{b'}(z',k',b')] - \psi_t = 0.$$

Using envelope (below) $V_{b'}(z',k',b') = -\frac{1+R_{t+1}}{\Pi_{t+1}}(1+\xi_{t+1})$, we obtain

$$1 \;=\; \mathbb{E}_t\Big[\Lambda_{t,t+1}\,\frac{1+R_{t+1}}{\Pi_{t+1}}(1+\xi_{t+1})\Big] + \psi_t. \tag{27}$$

Complementarity:

$$\psi_t \geq 0, \qquad \mathcal{B}_t(k') - b' \geq 0, \qquad \psi_t(\mathcal{B}_t(k') - b') = 0.$$

FOC w.r.t. k'**.** Because $i_t = k' - (1-\delta)k$ and $\partial AC/\partial k' = \partial AC/\partial i \cdot \partial i/\partial k' = \gamma\, i_t/k_t$, differentiation yields

$$(1+\xi_t)\frac{\partial d_t}{\partial k'} + \mathbb{E}_t[\Lambda_{t,t+1}V_{k'}(z',k',b')] + \psi_t\frac{\partial \mathcal{B}_t(k')}{\partial k'} = 0.$$

Since $\partial d_t/\partial k' = -1 - \gamma\frac{i_t}{k_t}$, rearrange to

$$(1+\xi_t)\Big(1+\gamma\frac{i_t}{k_t}\Big) = \mathbb{E}_t[\Lambda_{t,t+1}V_{k'}(z',k',b')] + \psi_t\,\frac{\partial \mathcal{B}_t(k')}{\partial k'}. \tag{28}$$

Remarks: - The multiplicative factor $1+\xi_t$ multiplies the marginal current cost of investing; if $\xi_t = 0$ we recover the simplified condition often used in text. - The term $\psi_t\partial_{k'}\mathcal{B}_t$ captures how increasing k' relaxes future borrowing capacity (via collateral) and thus raises the marginal value of investment when $\psi_t > 0$.

Envelope conditions

By the envelope theorem,

$$V_b(z,k,b) \;=\; \frac{\partial d_t}{\partial b}\,(1+\xi_t) \;=\; -\frac{1+R_t}{\Pi_t}(1+\xi_t). \tag{29}$$

And formally[7],

$$\begin{aligned} V_k(z,k,b) = {} & (1+\xi_t)\Big(p_t z\alpha k^{\alpha-1}n^{\nu} - \partial_k AC(i,k)\Big) \\ & + \mathbb{E}_t\Big[\Lambda_{t,t+1}\Big(V_{k'}(z',k',b')\,\partial_k g_k(z,k,b) + V_{b'}(z',k',b')\,\partial_k g_b(z,k,b)\Big)\Big] \\ & + \mathbb{E}_t\Big[\Lambda_{t,t+1}\Big(\frac{\partial V_{t+1}}{\partial p_{t+1}}\partial_k p_{t+1} + \frac{\partial V_{t+1}}{\partial w_{t+1}}\partial_k w_{t+1} + \frac{\partial V_{t+1}}{\partial R_{t+1}}\partial_k R_{t+1} + \cdots\Big)\Big], \end{aligned} \tag{30}$$

The explicit expansion of $V_{k'}$

[7] real relative price p does not change in my flexible price model, but with nominal rigidities, it will.

Kuhn–Tucker conditions

$$\xi_t \geq 0, \quad d_t \geq 0, \quad \xi_t d_t = 0,$$

$$\psi_t \geq 0, \quad \mathcal{B}_t(k') - b' \geq 0, \quad \psi_t(\mathcal{B}_t(k') - b') = 0.$$

C.3 Sign of $\partial\psi/\partial\Pi$, $\partial\xi/\partial\Pi$, and $\partial i/\partial\Pi$

I now linearize the key FOC+KKT system to sign the responses of ψ_t, ξ_t, and i_t to a small, unexpected increase in gross inflation Π_t. Keep ϕ explicit: since $\mathcal{B}_t$ is proportional to ϕ (see (26)), ϕ scales $\partial_{k'}\mathcal{B}_t$ and thus the sensitivity of investment to ψ_t.

Key identities for linearization. Write the core (nonlinear) system as

$$F_1(\psi_t, \xi_{t+1}, \Pi_{t+1}, R_{t+1}, \ldots) \equiv 1 - \mathbb{E}_t\Big[\Lambda_{t,t+1}\frac{1+R_{t+1}}{\Pi_{t+1}}(1+\xi_{t+1})\Big] - \psi_t = 0, \tag{31}$$

$$F_2(\psi_t, \xi_t, k', b', i_t, \ldots) \equiv (1+\xi_t)(1+\gamma i_t/k_t) - \mathbb{E}_t[\Lambda_{t,t+1}V_{k'}] - \psi_t\partial_{k'}\mathcal{B}_t(k') = 0, \tag{32}$$

$$F_3(d_t, \xi_t) \equiv d_t \;=\; 0 \quad \text{(for firms with binding dividend constraint)}. \tag{33}$$

Here F_3 expresses the binding dividend condition $d_t = 0$ for firms with $\xi_t > 0$ pre-shock. For unconstrained firms use $d_t > 0, \xi_t = 0$.

Total differentiation. For a constrained-firm (pre-shock $\xi_t > 0$, $\psi_t \geq 0$) take total differentials of (31)–(33) around the pre-shock steady state and collect unknowns

$$x \equiv (\mathrm{d}\psi_t,\ \mathrm{d}\xi_t,\ \mathrm{d}\xi_{t+1},\ \mathrm{d}k_{t+1},\ \mathrm{d}b_{t+1},\ \mathrm{d}i_t, \ldots)^\top.$$

We can write the linear system as

$$A\,x \;=\; B\,\mathrm{d}\Pi_t, \tag{34}$$

where A is the Jacobian matrix of partial derivatives of $F \equiv (F_1, F_2, F_3, \ldots)$ w.r.t. the unknown vector x, and B collects direct partials of F with respect to Π_t. In particular the entry of B corresponding to F_3 (the dividend eq.) contains

$$\frac{\partial d_t}{\partial \Pi_t} = (1+R_t)\frac{b_t}{\Pi_t^2} > 0 \quad (\text{for } b_t > 0).$$

Sufficient sign conditions. Under standard assumptions—(i) the Jacobian A is nonsingular (so the implicit function theorem applies), (ii) the Jacobian has economically plausible sign pattern we obtain

$$x = A^{-1}B\,\mathrm{d}\Pi_t,$$

so the sign of each component of x is given by the sign of the corresponding element of $A^{-1}B$.

Intuition and sign results. The direct effect of $\mathrm{d}\Pi_t > 0$ is to raise contemporaneous real dividends (term $\partial d/\partial\Pi_t > 0$); to keep $d_t = 0$ for a constrained firm, other variables must adjust. Two adjustment channels dominate:

1. **Debt Euler / expectation channel:** a larger Π_t reduces the real burden of nominal debt $(1+R_t)b_t/\Pi_t$ and also reduces the expected real repayment factor $(1+R_{t+1})/\Pi_{t+1}$, lowering $\mathcal{E}_t$ in equation (31). Since $1 = \mathcal{E}_t + \psi_t$, a fall in $\mathcal{E}_t$ implies ψ_t must fall: $\mathrm{d}\psi_t < 0$.
2. **Dividend multiplier channel:** increased real dividends directly relax the binding dividend constraint, implying ξ_t must fall to restore the constraint. Thus $\mathrm{d}\xi_t < 0$.

Given $\mathrm{d}\psi_t < 0$ and $\mathrm{d}\xi_t < 0$, the RHS of the investment FOC (32) declines (because the term $\psi_t \partial_{k'}\mathcal{B}_t$ becomes smaller and $(1+\xi_t)$ decreases), implying the required discounted marginal payoff from investing falls; therefore the optimal i_t increases: $\mathrm{d}i_t > 0$.

Assume the Jacobian A defined by the FOC+KKT system is nonsingular and that $\partial_{k'}\mathcal{B}_t(k') > 0$. For firms with binding dividend constraint ($d_t = 0,\ \xi_t > 0$) and binding or near-binding borrowing constraint, a small unexpected positive change in gross inflation Π_t leads to

$$\frac{\partial\psi_t}{\partial\Pi_t} < 0, \qquad \frac{\partial\xi_t}{\partial\Pi_t} < 0, \qquad \frac{\partial i_t}{\partial\Pi_t} > 0.$$

D Solution Method

D.1 Steady-State Equilibrium Solution

In this section, I outline the numerical algorithm used to solve for the steady-state equilibrium of the model. I solve for the stationary firm distribution and the corresponding equilibrium prices and policy functions using value function iteration on a discretized state space.

The state space for an individual firm is given by its idiosyncratic productivity z, capital stock k, and real net debt position b. I discretize the state space as follows:

- **Productivity (z):** The AR(1) process for idiosyncratic productivity is discretized into $N_z = 7$ states using the Tauchen (1986) method, as adapted by Terry and Knotek II (2011).

- **Capital (k) and Debt (b):** I specify discrete grids for capital (120) and debt (100). The grids are designed to be sufficiently wide to ensure the bounds are non-binding and feature more points concentrated in regions where the value function exhibits more curvature, such as near the borrowing and dividend constraints.

The computational algorithm proceeds as follows:

1. **Initialization:** Guess a set of steady-state aggregate prices, specifically the real wage w and the real interest rate r. The household's stochastic discount factor is then given by $\Lambda = \beta$.

2. **Value Function Iteration (Inner Loop):** Given the steady-state real interest rate $\{r\}$, which is pinned down by the household's discount factor, guess a real wage $\{w\}$, solve the firm's dynamic programming problem to find the optimal policy functions for investment $k'(z, k, b)$ and borrowing $b'(z, k, b)$, and the associated value function $V(z, k, b)$.

   (a) Start with an initial guess for the value function, $V_0(z, k, b)$.

   (b) Iterate on the Bellman equation until convergence:

   $$V_{j+1}(z, k, b) = \max_{k', b'} \{d(z, k, b, k', b') + \beta \mathbb{E}[V_j(z', k', b')|z]\}$$

   subject to the non-negative dividend and borrowing constraints. This step yields the converged value function $V^*(z, k, b)$ and the policy functions $k^*(z, k, b)$ and

$b^*(z,k,b)$ for the given prices. The iteration stops when the sup-norm distance between successive value functions, $\|V_{j+1} - V_j\|_\infty$, is smaller than a specified tolerance level ϵ_V.

3. **Distribution Calculation:** With the converged policy functions, compute the stationary (ergodic) distribution of firms, $\mu(z,k,b)$, across the state space. This is done by iterating on the law of motion for the distribution using Young (2010) until it converges to a fixed point.

4. **Market Clearing (Outer Loop):**

   (a) Using the stationary distribution $\mu(z,k,b)$ and the policy functions, compute the aggregate quantities for capital (K), labor (N), investment (I), and net debt (B).

   (b) Check if the labor markets clear at the guessed prices $\{w\}$. Specifically, verify if the intra-temporal Euler equation holds.

   (c) If not, update the guessed prices $\{w\}$ in the direction of the excess demands and return to step 2.

5. **Convergence:** The algorithm has converged when the market-clearing conditions are satisfied within a specified tolerance ϵ_M. The final output includes the steady-state equilibrium prices $\{w^*, r^*\}$, aggregate quantities $\{C^*, I^*, K^*, N^*\}$, the firm value function $V^*(z,k,b)$, policy functions $\{k^*(z,k,b), b^*(z,k,b), n^*(z,k,b)\}$, and the stationary distribution $\mu^*(z,k,b)$.

D.2 Transitional Dynamics Solution

To analyze the economy's response to an unexpected inflation shock, I compute the model's transitional dynamics using the sequence-space Jacobian method developed by Auclert et al. (2021). This method is highly efficient for solving heterogeneous-agent models with aggregate shocks, as it avoids the need to repeatedly simulate the full distribution of firms over time. The approach linearizes the model's equilibrium conditions around the steady state and solves for the entire time path of aggregate variables and firm-level decisions simultaneously.

The computational procedure is as follows:

1. **Define the Sequence-Space Equilibrium:** First, the dynamic model is cast in sequence space. The unknowns are the infinite sequences of aggregate variables, prices, and the distribution of firms, $\{Y_t, C_t, I_t, K_t, w_t, r_t, \mu_t\}_{t=0}^{\infty}$, in response to a sequence of

aggregate shocks. The equilibrium is characterized by a system of equations representing market clearing, households' and firms' optimality conditions, and the law of motion for the firm distribution for all periods $t \geq 0$.

2. **Linearize the System:** The system of equations is linearized around the deterministic steady state. This involves computing the derivatives of the equilibrium conditions with respect to the sequence of endogenous and exogenous variables. A key advantage of the sequence-space Jacobian method is that it provides techniques to efficiently compute these derivatives (Jacobians) without iterating on the value function. The derivatives of the firm-level policy rules with respect to aggregate variables are crucial inputs.

3. **Construct the Sequence-Space Jacobian:** The core of the method is the construction of the Jacobian matrix, $\mathcal{J}_x$ and $\mathcal{J}_z$, which represents the stacked, linearized equilibrium conditions.

   When computing the Jacobians, I firstly solve the backward iteration given the specific price shock. Using two-sided numerical differentiation technique, I can effectively calculate the policy changes and the resulting $\mathcal{Y}$ in this process Then I forward iterate to get the distributional change.

   Secondly, I follow Auclert et al. (2021) to compute the expectation vectors and construct Fake News Matrix $\mathcal{F}$ by summarizing $\mathcal{Y}$ and the inner product of expectation vectors and distributional changes.

   Finally, I build up the Jacobian matrix with each entity $\mathcal{J}_{t,s} = \mathcal{J}_{t-1,s-1} + \mathcal{F}_{t,1}$.

4. **Solve for the Transition Path:** This economy can be effectively summarized by three equations:

$$\mathbf{H}(\mathbf{U}, \mathbf{Z}) = \begin{pmatrix} \frac{\mathbf{1}}{\mathbf{C_t}} - \beta(\mathbf{1} + \mathbf{r_{t+1}})\frac{\mathbf{1}}{\mathbf{C_{t+1}}} \\ \mathbf{w_t} - \chi \mathbf{C_t} \\ \mathbf{Y_t} - \mathbf{C_t} - \mathbf{I_t} - \mathbf{AC_t} - \bar{\mu}_{\mathbf{ent}}\mathbf{k_0} + \pi_{\mathbf{d}}(\mathbf{1} - \delta)\mathbf{K_t} \end{pmatrix} = 0$$

   Where:

$$\mathbf{U} = (\mathbf{w}, \mathbf{r}, \mathbf{C}) \qquad \mathbf{Z} = \mathbf{\Pi}$$

   and $\mathbf{X} = \{\mathbf{Y}, \mathbf{I}, \mathbf{AC}, \mathbf{K}\}$ are all functions $\mathbf{M}(\mathbf{U}, \mathbf{Z})$ from firm block.

   The system is solved by inverting the Jacobian matrix to find the economy's impulse response functions (IRFs):

$$d\mathbf{U} = -\mathbf{H}_u^{-1}\mathbf{H}_z \cdot d\mathbf{Z}$$
$$d\mathbf{X} = \mathbf{M}_u d\mathbf{U} + \mathbf{M}_z d\mathbf{Z} = \mathbf{G} d\mathbf{Z}$$

where $d\mathbf{U}$ is the vector of changes of endogenous variable (w, r, C) from their steady-state values over time. $d\mathbf{X}$ is the vector of percentage deviations of all other aggregate variables from their steady-state values, and $d\mathbf{Z}$ is the vector representing the sequence of exogenous shocks (in this case, the one-time, unexpected 1% inflation shock at $t = 0$). This single matrix inversion yields the complete, linear approximation of the transition path for all aggregate variables (Investment, Output, Capital, etc.) following the shock.

This approach cleanly isolates the effects of the debt-inflation. By feeding a one-time, transitory inflation surprise into the model, I can trace out its real effects on the economy while holding all other potential shocks constant. The resulting impulse response functions, as shown in Figures 4 and 5, illustrate the dynamic adjustment of the economy as the initial wealth redistribution from the debt-inflation propagates through general equilibrium feedbacks.