Monetary Policy, Investment and Rational Inattention*

Zijian Wang Renbin Zhang Weimin Zhou

Current draft: October 29, 2024

Abstract

This paper examines the relationship between monetary policy, firm investment decisions, and rational inattention. By analyzing firms' 10-K and 10-Q reports, we measure attention allocation and demonstrate that firms paying greater attention to inflation experience a more significant impact of monetary policy on their investment decisions. Additionally, we demonstrate that industries with higher average attention to inflation adjust their prices more significantly in response to economic changes. We develop a two-period model showing that firms with greater attention to macroeconomic factors adjust prices more quickly to monetary policy shocks, ultimately reducing the magnitude of their investment adjustments. Our findings highlight the critical roles of information frictions and attention heterogeneity in understanding monetary policy transmission.

Keywords: Monetary Policy, Firm Investment, Rational Inattention
JEL Codes: D83, E44, E52

*We would also like to thank numerous seminar participants for their comments in different stages of the paper. Zijian Wang is affiliated at Jinan University (email:zijianwang305@gmail.com). Renbin Zhang is affiliated at Shandong University (email:zhang.renbin.ken@gmail.com). Weimin Zhou is affiliated at Sichuan University (email:zhouweimin.econ@gmail.com).

1 Introduction

The relationship between monetary policy and firms' investment decisions has been extensively studied from both theoretical and empirical perspectives. The general consensus is that negative monetary shocks reduce firms' investments through various channels. However, despite the growing recognition of information frictions in firms, the role of attention heterogeneity in shaping their investment response to monetary policy has not been thoroughly investigated. The answer to this question is theoretically ambiguous. On the one hand, firms that pay more attention to macroeconomic conditions might adjust their investment more quickly to contractionary monetary policy shocks. On the other hand, more attentive firms might also adjust their price more quickly, leading to a lower price and reduced equilibrium investment cost, and ultimately less response of investment. This could result in a smaller investment response, consistent with the well-established finding that more flexible prices diminish the impact of monetary policy shocks. Against this backdrop, our study explores the intricate relationship between rational inattention, monetary policy shocks, and investment behavior, using empirical evidence from firms' 10-Q reports.

Conventional wisdom holds that contractionary monetary policy shocks generally lead to a reduction in firms' investment expenditures. We confirm these findings in our empirical results. Moreover, beyond the prevailing narrative of monetary policy's average effect, we aim to highlight how firms' attention to inflation influences their investment responses. This is based on a textual analysis of their 10-Q quarterly reports. Our empirical approach applies Natural Language Processing (NLP) techniques to quantify firms' attention to inflation within their quarterly disclosures, following Song and Stern (2020) and Flynn and Sastry (2023). We construct a novel measure of inflation attention by analyzing textual data from these reports, enabling us to assess how much firms focus on inflation trends in their decision-making processes. Our findings reveal that firms with higher attention to inflation show a smaller negative response to contractionary monetary policy shocks in their investment. This suggests that firms' inflation awareness plays a key role in shaping their investment response to monetary policy shocks. Using industry-level price adjustment data, we show that industries with higher average attention levels exhibit larger price-level adjustments. We argue that the reduced investment responsiveness associated with higher attention levels arises because lower equilibrium prices reduce investment costs, reducing the impact of monetary policy shocks. We present a theoretical model with rational inattentive firms and investment behaviors to explain such empirical findings.

In our empirical investigation, we meticulously examine the impact of two key contractionary monetary policy shocks, constructed using proxy-SVAR methodology following Bauer and Swanson (2023) and Gertler and Karadi (2015). Using quarterly Compustat data, we merge firm-level balance sheet information to construct a comprehensive dataset. To gauge firms' attention to inflation, To gauge firms' attention to inflation, we use a dictionary-based frequency count to track mentions of inflation-related keywords. Our primary empirical framework estimates the influence of inflation attention levels on firms' investment responses to contractionary monetary policy shocks, controlling for firm-specific factors, macroeconomic variables, and industry-fixed effects. On average, we observe a 0.592% reduction in investment following a 25 basis points (bps) monetary tightening. Notably, firms with attention levels above both the yearly and industrial medians experience only a 0.287% reduction in investment, indicating a response half as large as the average effect.

To interpret these empirical findings, we develop a simple model of rational inattentive firms, which make pricing and investment decisions under attention constraints. Firms allocate attention to monitor monetary policy shocks and then adjust prices and investment levels. Firms with higher attention make more responsive price adjustments.Since capital prices are closely tied to equilibrium prices, larger price reductions following interest rate cuts lower the cost of capital investment. This reduction in capital costs partly offsets the adverse effects of contractionary monetary policy shocks on attentive firms. That is, more flexible prices help reduce the overall impact of these shocks.

This mechanism underscores the strategic allocation of attention resources by firms in their pricing decisions. To validate our theoretical framework, we conduct additional empirical analysis examining how average industry attention levels affect price responses to monetary policy shocks. Our findings suggest that industries with greater attention to inflation allocate more resources to monitoring price dynamics, improving their ability to anticipate and adapt to economic changes.

In light of these findings, our study deepens the understanding of firms' investment decisions in response to monetary policy shocks, with a focus on the role of rational inattention. Our research offers valuable insights for policymakers and market participants by showing how rational inattention shapes firms' investment behavior, helping them navigate the complexities of the macroeconomic environment.

Related Literature Our paper contributes to several strands of literature. First, we examine the role of information in shaping firms' behavior. Building on seminal works on rational inattention by Sims (2003), Mackowiak and Wiederholt (2009), and Paciello (2012), we show how rational inattention influences the transmission of monetary policy shocks to firms' pricing decisions. Our study offers a novel perspective by analyzing how firms' investment behavior is shaped by their level of attentiveness. Specifically, we find that more attentive firms take a more cautious approach to reducing investment when faced with contractionary monetary policy.

Second, our study contributes to the growing literature on the heterogeneous effects of monetary policy across firms. Building on prior research by Gertler and Gilchrist (1994), Ottonello and Winberry (2020), Kashyap et al. (1994), and Kashyap and Stein (1994), we explore how firms' responses to monetary policy adjustments vary based on their attentiveness, controlling for firm size, age, etc. In contrast to conventional analyses, we highlight the role of firms' attention to inflation in shaping their responsiveness to monetary policy changes. Our study employs a unique empirical approach, encompassing distinct specifications, identification methodologies, firm samples, and time periods, thus enriching our understanding of the nuanced dynamics underlying monetary policy transmission mechanisms.

Lastly, we contribute to the literature on textual analysis for measuring firms' attention allocation. Based on methodologies proposed by Song and Stern (2020) and Flynn and Sastry (2023), we analyze firms' 10-K and 10-Q financial reports to gauge their focus on inflation-related information. By focusing on inflation-specific attention rather than general economic conditions, we uncover valuable insights into how monetary policy influences firms' investment decisions, beyond its impact on their capital market performance.

Roadmap: Our paper is organized as follows. Section 2 presents descriptive empirical evidence highlighting the variation in firm-level responses to monetary policy based on their attention to inflation. In Section 3, we develop a framework integrating rational inattention with investment behavior to interpret our findings. Section 4 delves into the heterogeneity of industrial price responsiveness, aligning with our theoretical predictions. Finally, Section 5 concludes our study, summarizing key insights and outlining avenues for future research.

2 Empirical Evidence

This section presents new empirical evidence on how firm investment responses to monetary policy shocks vary with their attention to inflation. We find that firms paying more attention to inflation experience a smaller reduction in investment in response to contractionary monetary policy shocks. We begin by describing the data sources and the construction of our variables, with a focus on the text-based measures, sample selection, and summary statistics. Next, we formalize these findings through a detailed empirical analysis.

2.1 Data

We construct the firm-level panel dataset by extracting inflation attention measures from 10-K and 10-Q filings, combined with balance sheet variables from the quarterly Compustat dataset.

Textual Measures of Inflation Attention From 10-K and 10-Q Filings. We construct quarterly textual measures of firm-level attention by matching keywords to publicly traded companies' annual Form 10-K and quarterly Form 10-Q filings. These filings are required and made available by the U.S. Securities and Exchange Commission (SEC).[1] We apply the methodology of Bodnaruk et al. (2015) to download and parse all electronic filings, and exclude stopwords in line with standard practice.[2]

To measure firm attention, we use dictionary-based frequency counts to identify when firms discuss inflation-related words or phrases, which contain words and phrases that commonly are associated with inflation We use three different keyword lists to measure firms' attention to inflation, as shown in Table A.1. First, we use the single keyword "inflation" as our narrowest measure of firms' direct tracking of inflation. Second, we adopt the dictionary developed by Konchitchki and Xie (2023), which uses Latent Dirichlet Allocation (LDA) methods. This dictionary is chosen primarily to capture the inflation risk firms face, which is a key factor in their incentive to monitor inflation. Third, we combine the dictionaries of Konchitchki and Xie (2023) and Song and Stern (2020) to include additional keywords and terms, creating our broadest measure. A drawback of this keyword list is the inclusion of abbreviations like "CPI" or "PMI", which may refer to firms or organizations in financial filings. We perform a robustness check to truncate our sample so as to avoid such mismatching. Later, these three measures of inflation attention will be denoted as d^k, where $k = 1, 2, 3$.

We focus on measuring firms' attention to inflation rather than monetary policy because firms' financial reports contain surprisingly few mentions of the phrase "monetary policy". In our dataset of 96,847 observations, only 1,017 files contain "monetary policy". In contrast,

[1] Approximately one third of firms do not publish fourth quarter 10-Q filings but use 10-K filing as a substitute. So we merge both 10-K and 10-Q filings to construct our quarterly textual measure database.

[2] We download comprehensive text documents of all 10-Q and 10-K filings from the SEC. Notably, our dataset does not include amended filings. Each raw text file obtained from the Electronic Data Gathering, Analysis, and Retrieval system (EDGAR) undergoes a series of processing steps and the detailed parsing strategy described in Appendix B of Bodnaruk et al. (2015). The codes for downloading and parsing are available at`https://sraf.nd.edu/textual-analysis/code/`. We use the stopword library provided at `https://sraf.nd.edu/textual-analysis/stopwords/`, specifically the "StopWords_Generic.txt" file.

64,848 reports mention "inflation" and other price-level-related phrases. Moreover, inflation is commonly used as a proxy for attention to monetary policy (Coibion et al., 2018; Yang, 2022). Therefore, we use the keywords associated with the topic of inflation to measure firms' attention to the general monetary condition.[3]

We apply our three dictionaries to each 10-Q and 10-K report, then measure the continuous attention intensity, c^k_{jt}, which represents the fraction of total words that are keywords in the corresponding filings for firm j in period t, excluding stopwords:

$$c^k_{j,t} = \frac{\text{Total matched keywords}^k_{j,t}}{\text{Total words}_{j,t}} \times 100,$$

where $k = 1, 2, 3$ again denote the three measures of inflation attention. To capture the heterogeneous exposure of firm-level inflation attention and avoid abnormally high values in the continuous measure, we construct a dummy variable for higher inflation attention, $d^k_{j,t}$. For each firm j at date t, their attentive status is 1 if their continuous measure $c^k_{j,t}$ is larger than that 2-digit NAICS industry median level:

$$d^k_{j,t} = \mathbb{I}\big(c^k_{j,t} > median_s(c^k_{j,t})\big)$$

where s represents industry.

Accounting Variables. We extract firm-level balance sheet and income statement data from quarterly Compustat, a database of publicly listed U.S. firms available through Wharton Research Data Services (WRDS). Compustat meets several critical criteria for our research. It provides quarterly data, allowing us to analyze monetary policy changes at a high frequency. Additionally, it offers a long panel of data, enabling us to capture within-firm variations over time, and contains comprehensive balance sheet information, facilitating

[3] This result is consistent with Coibion et al. (2018). Using New Zealand survey data, they show that firms are barely aware of the monetary policy inflation target, despite New Zealand being the first country to adopt the inflation-targeting monetary policy. As a result, they use firms' inflation backcasting, nowcasting, and forecasting errors as a measure of firms' attention to monetary policy.

the construction of our key variables. To our knowledge, Compustat is the only dataset that fulfills these specific requirements. However, Compustat does not include privately held firms, which may face distinct financial constraints, potentially limiting our analysis.

Following Ottonello and Winberry (2020), we define firm-level *investment* $(\Delta \log(k_{j,t+1}))$ as the change in capital stock $\log(k_{j,t+1})$ from the end of quarter t to the end of quarter $t+1$. We construct leverage as the ratio of total debt (DLTT + DLC) to total assets, and firm size as the logarithm of assets (AT). We calculate firms' age as the number of consecutive years a company's stock price is observed in Compustat, following Hadlock and Pierce (2010). We use the North American Industry Classification System (NAICS) for sectoral classification.

Following standard practices in the literature, we exclude firms in finance and insurance (NAICS 52), utilities (NAICS 22), and miscellaneous industries (NAICS 99). The sample period of all variables spans from 1994Q1 to 2020Q1. Finally, nominal variables are deflated using the CPI, while nominal capital stock is deflated using the PPI. Summary statistics of firm-level variables are provided in Table A.2. Additional details about these variables and the sample selection process are included in Appendix A.

2.2 Heterogeneous Response by Attention

We investigate whether a firm's inflation attention influences the responsiveness of its investment to monetary policy shocks. To test this, we estimate the following specification:

$$\Delta \log k_{jt+1} = \gamma \epsilon_t^m + \beta \epsilon_t^m \times d_{jt} + \delta d_{jt} + \alpha_s + \Gamma_1' X_{jt} + \Gamma_2' Y_t + e_{jt} \tag{2.1}$$

where d_{jt} is firm j's inflation attention measure at time t, ϵ_t^m is the monetary policy shocks, X_{jt} is a set of firm-level controls, including size, age, and leverage. Y_t is a set of macroeconomic variables including four lags of GDP growth, inflation rate, and unemployment rate. We include industry fixed effects at the 4-digit NAICS level α_j to capture variation across firms, which is our primary focus. This approach follows Song and Stern

(2020) who argues that most variation in attention occurs across firms rather than within firms. We follow follow Gertler and Karadi (2015) and Bauer and Swanson (2023) by using the monetary policy shocks implied by the Proxy-SVAR Details of this approach are provided in Appendix A. $\Delta \log k_{jt+1}$ denotes the firm-level investment, where k_{jt+1} is the book value of firm j's physical capital stock at the end of period t, following Ottonello and Winberry (2020). Throughout, we cluster standard errors two ways to account for correlation within industry and within quarters.

Table 1: Heterogeneous Response of Firm Investment to Monetary Policy

	(1)	(2)	(3)	(4)
ϵ_t	-0.592***	-0.660***	-0.653***	-0.632***
	(0.102)	(0.109)	(0.110)	(0.117)
$\epsilon_t \times d^1_{jt}$		0.373***		
		(0.110)		
$\epsilon_t \times d^2_{jt}$			0.309***	
			(0.102)	
$\epsilon_t \times d^3_{jt}$				0.220*
				(0.131)
Observations	96730	96730	96730	96730
R^2	0.004	0.043	0.043	0.060
Firm Controls	Yes	Yes	Yes	Yes
Aggregate Controls	Yes	Yes	Yes	Yes
Industry FEs	Yes	Yes	Yes	Yes

NOTE: This table reports the coefficient estimates of γ and β in Equation (2.1). Column (1) report the average effect of monetary policy shocks to firm investment and column (2) - (4) report both the average and differential effects. The sample period spans from 1994Q1 to 2020Q1. Standard errors are clustered at the sector-quarter level and reported in parentheses. The stars denote the p-values: * $p < 0.10$; ** $p < 0.05$; *** $p < 0.01$.

Table 1 reports the results from estimating the specification (2.1), the first row reports the average effect of a 25 bps monetary policy shocks (γ) and the second to fourth rows report the differential effect of monetary shocks (β) conditional on firms' inflation attention measure d^1_{jt}, d^2_{jt}, d^3_{jt}, as described before. Column (1) reports the average impact of monetary shocks without the interaction terms, while the interacted estimates in columns (2) to (4) reveal significant heterogeneity.

The estimated coefficient γ is significantly negative, indicating that firm investment decreases in response to a 25 bps monetary policy shock, consistent with the literature.[4] The differential coefficient β is significantly positive, indicating that firms' relatively higher inflation attention reduces the sensitivity of their investment response to monetary policy. For example, column (2) shows that a 25 bps monetary policy shock leads to an average 0.660% drop in investment. However, firms that pay more attention to inflation than the sample median experience a 0.373% smaller decline in investment. This strong attenuating effect is robust across alternative attention measures, as shown in columns (3) and (4).

Dynamics. To ensure that the weaker investment response in firms with relatively higher inflation attention, documented in Table 1, remains economically significant over longer horizons. We employ the following Jordà (2005)-style local projection to estimate the dynamics of these differential impulse responses of investment to monetary shocks:

$$\Delta \log k_{jt+h} = \beta_h \epsilon_t^m \times d_{jt} + \alpha_{sth} + \Gamma_h' X_t + e_{jth} \tag{2.2}$$

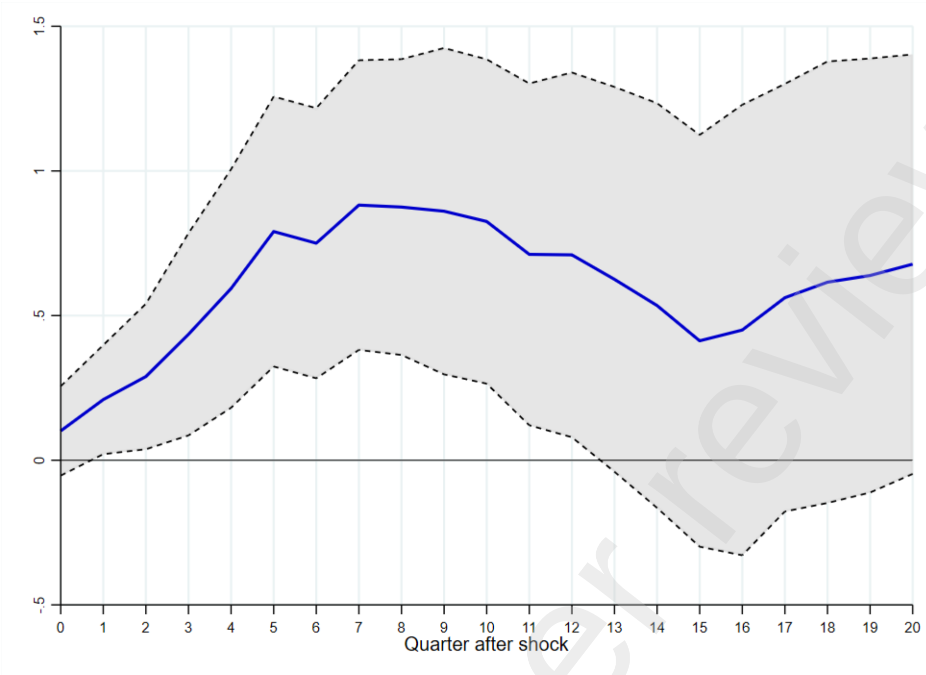
where the dependent variable $\Delta \log k_{jt+h} \equiv \log k_{jt+h} - \log k_{jt}$ represents the cumulative changes in the physical capital stock from quarter t to quarter $t+h$ with h denoting the projection horizons. Coefficient β_h captures how the cumulative response of investment over horizon h to a 25 bps monetary tightening depends on the firm's relative attention d_{jt} in quarter t.

In this specification, because the main coefficient of interest is the interaction term β_h, we include industry-by-time fixed effects α_{sth} to control for time-varying unobserved macroeconomic conditions affecting all firms within a given industry. These fixed effects also ensure that the results are not influenced by long-run industry-specific trends.

Figure 1 shows the impulse response functions to a 25 bps monetary policy shock. The cumulative differences are positive for all horizons, corroborating that the investment of more

[4] The magnitude of this average impact is consistent with the estimates from Anderson and Cesa-Bianchi (2024).

Figure 1: Dynamics of Differential Response to Monetary Shocks



NOTE: This figure plots the dynamic effects of differential impulse responses to 25 bps monetary policy shock. Coefficient β_h estimated from Equation (2.2). The solid lines show the point estimates of the impulse responses. The shaded area are 90% confidence intervals.

attentive firms responds less to monetary policy shocks. The peak of cumulative differences by inflation attention occurs after 7 quarters, while these persistent differences are imprecisely estimated with large standard errors after 13 quarters. This result once again indicates that the investments of firms with more inflation attention are significantly less responsive to the shock for up to 5 years.

2.3 Robustness Check

In Appendix B, we conduct various robustness checks. Overall, our main results are robust to different specifications, data sources, and alternative monetary policy shocks.

First, to account for firms' attention to economic conditions, we construct alternative measures by incorporating Song and Stern (2020)'s major keyword (economic conditions) into our baseline measures, denoted as $d^4_{jt}, d^5_{jt}, d^6_{jt}$. We re-estimate the model in Equation

(2.1), and the results remain robust, as shown in Table B.3.

Second, Table B.4 reports the contemporaneous differential impact of monetary policy on firm-level investment using Gertler and Karadi (2015)'s monetary shocks. The differential impact remains significant, reinforcing our main finding that the investment of firms with higher inflation attention declines less in response to monetary policy shocks.

Note that we cannot include time fixed effects in Equation (2.1), as they would absorb the time-series variation needed to identify the coefficient of interest γ. To verify that including time fixed effects does not alter our results, we next use sector-by-quarter fixed effects α_{st} to remove the average effect and focus on estimating the interaction between monetary policy and inflation attention. The differential results driven by firms' inflation attention remain positively significant, as shown in Table B.5.

Lastly, we re-estimate the dynamic local projection using Gertler and Karadi (2015)'s monetary shocks and our alternative inflation attention measures (d_{jt}^2 and d_{jt}^3). The results in Figures B.1, B.2, and B.3 confirm the robustness of the differential investment adjustments in response to monetary shocks.

3 Simple Model with Firm Investment

In this section, we build a simple two-period model to illustrate the mechanisms through which attention can affect firms' investment response to monetary policy shocks, as outlined in Section 2. This model is built on the seminal work by Mackowiak and Wiederholt (2009), while incorporating firms' investment behaviors, which is a novel addition to the rational inattention literature.[5] In this simplified model, time is divided into two periods. The economy comprises a representative household, a continuum of firms, and a monetary policy authority. While households and the central bank possess complete information about the

[5] To the best of our knowledge, we are the first to combine optimal pricing and investment behavior under a rational inattention framework. Most previous work highlights pricing behavior under rational inattention, such as Mackowiak and Wiederholt (2009), Afrouzi (2019), and Paciello (2012). Few papers study investment behavior, though Zorn (2020) examines firms' investment in a new classical model without optimal pricing.

economy, firms operate under conditions of rational inattention, incurring a cost proportional to the amount of information they acquire (measured using Shannon mutual information, as proposed by Sims (2003)).

3.1 Household

The representative household consists of a consumer and a large number of workers who take nominal prices of goods and wages as given and form demand for products from different firms. Household's preference in period t is given by

$$U(C_t, L_t) = \log(C_t) - \phi_L L_t \tag{3.1}$$

where C_t denotes final consumption good and L_t represents the labour. The final consumption good C_t is a composite index of all firms' products in period t, modeled using the Dixit-Stiglitz aggregator with the elasticity of substitution $\epsilon > 1$

$$C_t = \left[\int_0^1 (C_{i,t})^{\frac{\epsilon-1}{\epsilon}} di\right]^{\frac{\epsilon}{\epsilon-1}} \quad t \in \{1,2\}, \quad i \in [0,1] \tag{3.2}$$

In addition to the labour income, households have access to a one-period bond in period 1, B_1, with the nominal interest rate $R_{1,2}$ and receive firms' profits, Π_1. The representative household's budget constraints in the two periods are given by

$$\int_0^1 P_{i1}C_{i1}di + B_1 \leq W_1 L_1 + \Pi_1, \tag{3.3}$$

$$\int_0^1 P_{i2}C_{i2}di \leq W_2 L_2 + R_{1,2}B_1 + \Pi_2, \tag{3.4}$$

respectively.

The household's optimal behavior implies the demand function for each variety i as

$$C_{i,t} = \left(\frac{P_{i,t}}{P_t}\right)^{-\epsilon} C_t, \tag{3.5}$$

and the first-order condition with respect to the one-period bond implies the Euler equation

$$P_1 C_1 = \frac{1}{\beta} \frac{P_2 C_2}{R_{1,2}}. \tag{3.6}$$

This Euler equation establishes a connection between the interest rate monetary policy rule and the money supply monetary policy rule, a relationship that will be further elucidated in the subsequent subsection. In addition, the household's optimal labour decisions leads to

$$W_t = \phi_L P_t C_t, \quad t \in \{1, 2\} \tag{3.7}$$

which implies a infinite elasticity of labour supply at given wage.

3.2 Monetary Policy

Following the standard literature on information economics (e.g., Woodford (2001), Mankiw and Reis (2002), Mackowiak and Wiederholt (2009), Afrouzi (2019)), we assume that the monetary policy authority specifies an exogenous stochastic process for nominal aggregate demand in the first period, $M_1 = P_1 C_1$, as

$$m_1 = \log M_1 - \log \bar{M} \tag{3.8}$$

$$m_1 \sim N(0, \sigma_m^2). \tag{3.9}$$

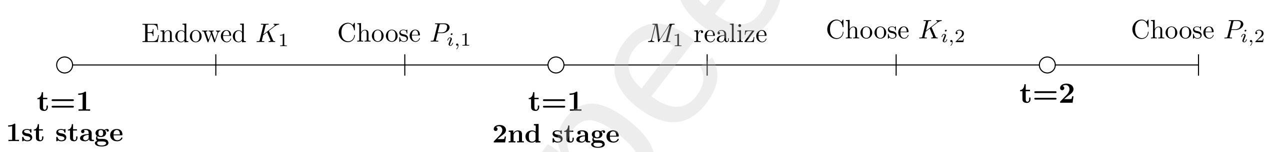
where $\bar{M}$ is the non-stochastic steady state level of aggregate demand and m_1 is normally distributed with variance σ_m^2.

3.3 Firms

We now examine the price setters' problem, which is a key part of the model. There is a unit mass of monopolistic competitive firms indexed by $i \in [0, 1]$. Firms are owned by the household and operate with capital and labor as inputs.

The timing is as follows: Period 1 is divided into two stages. During the first stage, firms, initially endowed with homogeneous capital K_1, make pricing decisions $P_{i,1}$ while operating under conditions of rational inattention. In the second stage, monetary shocks materialize, after which firms determine the capital to be used in period 2, denoted as $K_{i,2}$. In period 2, no aggregate shocks occur, and firms set prices $P_{i,2}$ without making further investments. Figure 2 illustrates the timeline of firms' decision making process.

Figure 2: Timeline of Firm i's decision making



Firms utilize a Cobb-Douglas production technology with labor and capital as inputs

$$Y_{i,t} = L_{i,t} K_{i,t}^{\alpha} \tag{3.10}$$

where $K_{i,t}$ and $L_{i,t}$ denote, respectively, capital holdings and labor input used by firm i in period t for production $Y_{i,t}$.[6]

The model rests on two fundamental assumptions: First, the price of capital equals the price of the final consumption good in period 1, $P_{i,1}$, making Tobin's Q equal to 1. This is a standard assumption in the literature on firm-specific capital, as explored in studies such as Yun (1996), Tanaka et al. (2019), Sveen and Weinke (2005), and Woodford (2005). Second, the model assumes that capital is fully depreciated by period 2. While this assumption

[6] In Appendix Appendix C.3, we show that a standard constant returns to scale production functions still deliver the essential results.

is not crucial to our main proposition, it aligns with the broader understanding that in a finite-period model, capital will inevitably depreciate fully over time.

3.3.1 First Period

Given our timeline, prices are fully flexible in each period, which implies that the price-setting problem is essentially a static optimization problem. In the first stage of period 1, firms face information frictions. They do not observe aggregate demand precisely and must acquire a signal about the aggregate demand level. Thus, firm i's price-setting problem, under rational inattention, is reduced to:

$$\max_{P_{i,1},s_{i,t}} E_i[P_{i,1}Y_{i,1} - W_1 L_{i,1}] - \lambda\kappa \tag{3.11}$$

$$\text{s.t. } Y_{i,1} = \left(\frac{P_{i,1}}{P_1}\right)^{-\epsilon} Y_1 \tag{3.12}$$

$$Y_{i,1} = L_{i,1}K_{i,1}^{\alpha} \tag{3.13}$$

$$\kappa = I(M_1; s_{i,1}). \tag{3.14}$$

Here, E_i is the expectation operator conditional on firm i's information in period 1, κ represents the information flow concerning the monetary policy shock, and λ is the marginal cost of acquiring information. The term $I(M_1; s_{i,1}) = h(M_1) - h(M_1|s_{i,1})$ denotes the Shannon mutual information, which measures the reduction in uncertainty about the monetary policy shock conditional on the signal $s_{i,1}$. [7] The information represented by I can be thought of as a firm's attention to the unknown aggregate state. Firms' choice of signal is assumed to have the following form

$$s_{i,1} = m_1 + \eta_i, \quad \eta \sim (0, \sigma_\eta^2)$$

[7]The Shannon mutual information is calculated as $I(M_1; s_{i,1}) = \frac{1}{2}\log_2\left(\frac{\sigma^2_{M_1}}{\hat{\sigma}^2_{M_1|s}}\right)$.

where η_i is idiosyncratic Gaussian white noise process that is independent of m_1. The rationale behind this assumption is that firms lack precise observation of the true state of monetary policy m_1. However, they have the option to incur a cost to obtain a signal regarding the shock. The accuracy of this signal depends on the extent of the marginal cost the firm is willing to incur.

The profit-maximizing price under perfect information of firm i is given by

$$P_{i,1}^{\diamond} = \frac{\epsilon}{\epsilon - 1} \frac{W_1}{K_1^{\alpha}} = \frac{\epsilon}{\epsilon - 1} \frac{\phi_L M_1}{K_1^{\alpha}} \tag{3.15}$$

which responds to stochastic aggregate demand M_1, given other predetermined variables.

Following Mackowiak and Wiederholt (2009) and Maćkowiak and Wiederholt (2015), we solve the problem by transforming the profit maximization problem into a profit loss minimization problem. This is done under a log-quadratic approximation around the non-stochastic steady state, caused by price deviations from the profit-maximizing price level.[8] [9]

$$\min_{\kappa} E\left[\left(p_{i,1}^{\diamond} - p_{i,1}^{*}\right)^2\right] + \lambda\kappa \tag{3.16}$$

subject to the constraint on information flow $I(m_1; s_{i,1})$:

$$I(m_1; s_{i,1}) = \frac{1}{2}\log_2\left(\frac{\sigma_{m_1}^2}{\hat{\sigma}_{\eta}^2}\right) \leq \kappa, \tag{3.17}$$

where lowercase letters denote the log deviation of the variable from its steady state value. The optimal price setting rule with imperfect information is the expectation of the profit-maximizing price conditional on the chosen signal by firm i

$$p_{i,1}^{*} = E[p_{i,1}^{\diamond} | s_{i,1}], \tag{3.18}$$

[8]See Appendix Appendix C.2 for detailed derivation.

[9]The marginal cost λ is normalized so that we do not have a constant multiplier in front of the squared profit loss term under second-order approximation.

where $p^{\diamond}$ denotes the profit-maximizing price. From Equation (3.15), we can obtain

$$p^{\diamond}_{i,1} = m_1 \tag{3.19}$$

which represents a direct mapping of the nominal aggregate demand, i.e. monetary neutrality.[10] The analytical solution of firms' attention choice and price response to monetary shock is straightforward given this profit-maximizing price. Firm i's control variable is simplified to choosing κ only, and receiving the relevant signal afterward. Firm i's price will be determined according to Equation (3.18).

Taking the first-order condition with respect to κ yields the optimal attention level chosen by firm i:

$$\kappa^* = -\frac{1}{2}\log_2 \frac{\lambda}{2\ln(2)\sigma_m^2} \tag{3.20}$$

and given this attention level, firm's price will be set according to

$$p^*_{i,1} = \big(1 - \frac{\lambda}{2\ln(2)\sigma_m^2}\big)s_{i,1} = (1 - 2^{-2\kappa})s_{i,1} \tag{3.21}$$

Integrating across all firms i from the price (3.21) yields the aggregate price level under rational inattention:

$$p_1 = \underbrace{(1 - 2^{-2\kappa})}_{\equiv G} m_1 \tag{3.22}$$

Lemma 1. *The equilibrium price response to a monetary shock, G, has the following properties:*

- *G decreases with the marginal cost of information flow, i.e., $\frac{\partial G}{\partial \lambda} < 0$.*

[10] It is worth mentioning that this neat pricing equation stems from our increasing returns to scale production function, which abstracts from any real rigidity or strategic complementarity in firms' pricing decisions. Assuming a CRS or DRS production function does not alter our main conclusion, but it complicates the solution process with a fixed point problem.

- *G increases with the attention devoted, i.e.,* $\frac{\partial G}{\partial \kappa} > 0$.

- *G increases with the volatility of the monetary policy shock, i.e.,* $\frac{\partial G}{\partial \sigma_m} > 0$.

Proof. Take the partial derivative of G with respect to κ, λ and σ_m will deliver the relevant results. ■

As will become clear later, the lemma helps explain the empirical observation that heterogeneity in attention affects how firms respond to monetary policy shocks. In addition, we provide supporting empirical evidence for this result in the next section.

In the second stage of period 1, monetary shocks materialize. By this point, prices have been chosen by firms under rational inattention, and firms must make investment decisions for period 2. Since aggregate uncertainty has resolved at this stage, firm i's problem is

$$\max_{K_{i,2}} Q_{1,2}(P_{i,2}Y_{i,2} - W_2 L_{i,2}) - P_1(K_{i,2} - K_1). \tag{3.23}$$

where $Q_{1,2} = R_{1,2}^{-1}$. Since the prices for the first period are already determined, firms will only choose investment in the second stage, implying that the first-order condition for investment is

$$P_1 = Q_{1,2} W_2 \frac{MPK_{i,2}}{MPL_{i,2}}. \tag{3.24}$$

On the left-hand side, P_1 is the price of the investment good in period 1 and represents the marginal cost of investing one more unit of capital for period 2. On the right-hand side, $Q_{1,2} W_2 \frac{MPK_{i,2}}{MPL_{i,2}}$ represents the discounted nominal marginal savings in firm i's labor cost associated with using one additional unit of capital in the next period, which can be viewed as the marginal gain from investing one more unit of capital. By substituting the Euler equation (3.6) and labor decision (3.7) into the firm's FOC for investment (3.24), we obtain the optimal capital choice for firm i in period 2 as

$$K_{i,2} = \frac{\alpha\beta W_2 L_{i,2} M_1}{M_2 P_1} = \frac{\alpha\beta\phi_L P_2 C_2 L_{i,2} M_1}{P_1 P_2 C_2} = \frac{\alpha\beta\phi_L L_{i,2} M_1}{P_1}$$

Firms' investments are the same across all firms because the investment decisions are determined once aggregate shocks are materialized and capital decisions are simply affected by aggregate price level. In addition, their investments are independent of period 2 endogenous variables, apart from the labor demand $L_{i,2}$.

3.3.2 Second Period

In period 2, we assume the absence of any monetary policy shocks, thus eliminating uncertainty. Firms merely set prices without engaging in further capital investment. Since we do not introduce any idiosyncratic firm heterogeneity beyond the signals each firm receives, the capital choices for period 2 will be identical across firms, as derived in Section 3.3.1. With capital predetermined and subject to the standard demand and production functions, firms choose their prices for period 2, implying the optimal price for firm i is as follows:

$$P_{i,2} = P_2 = \mu\frac{W_2}{K_2^\alpha} = \mu\frac{\phi_L P_2 C_2}{K_2^\alpha}, \tag{3.25}$$

which is identical across all firms.

With this homogeneous optimal pricing equation, we can determine the aggregate consumption level as

$$C_2 = \frac{K_2^\alpha}{\mu\phi_L}. \tag{3.26}$$

which depends on the predetermined capital level.

Capital in period 2, K_2, is assumed to depreciate fully after being used in production, and with no further investment, the market clearing condition is simply $Y_2 = C_2$. Thus, labor input for production in period 2, L_2 is

$$L_2 = \frac{Y_2}{K_2^\alpha} = \frac{C_2}{K_2^\alpha} = \frac{1}{\mu\phi_L}. \tag{3.27}$$

which remains homogeneous across all firms and is independent of aggregate conditions. At this point, all endogenous variables in period 2 are determined, and we can compute the change in capital (investment) accordingly.

3.3.3 Investment Response to Monetary Policy Shock

With all endogenous variables determined, to analyze firms' investment response to a monetary policy shock, we substitute (3.27) into (3.3.1) and compute the capital change between the two periods as investment:

$$I_{i,1} = K_{i,2} - K_{i,1} = \frac{\alpha\beta\phi_L M_1}{\mu P_1} - K_{i,1}. \tag{3.28}$$

Clearly, the firm's investment response to monetary policy is affected by the equilibrium price in period 1. The intuition is that if the equilibrium price increases significantly in the first period, the marginal cost of investment will rise. To satisfy the first-order condition in Equation (3.24), firms can only adjust their capital, since the other components of the marginal cost remain unaffected by the equilibrium price P_1, as indicated in Section 3.3.1. Consequently, as the equilibrium price increases, investment will decrease, and with expansionary monetary policy in the first period, investment will increase (average effect). In addition, the more P_1 decreases with M_1, the smaller the decrease in investment with M_1 (differential effect). Thus, both the average and differential effects are illustrated in this equation.

We now redirect our focus to the initial period and examine the factors that influence the equilibrium price response to a monetary policy shock. As illustrated in Equation (3.22), under rational inattention, the equilibrium price level responds only partially to a monetary policy shock. Denoted as m_1, this response increases with the firm's level of attention to the shock. Consequently, increased attention to inflation prompts firms to react swiftly by adjusting prices. However, this results in a comparatively weaker investment response to monetary policy shocks.

Proposition 1. *Firms' investment response to monetary policy shocks weakens as their attention to these shocks increases.*

Proof. From Equation (3.22), we know

$$p_1 = Gm_1$$

Substituting the above equation into Equation (3.28), we obtain the capital in period 2 in log-deviation form as

$$k_{i,2} = m_1 - p_1 = (1 - G)m_1 = (1 - 2^{-2\kappa})m_1.$$

In the case of a contractionary monetary policy shock (i.e., m_1 decreases), investment will decrease accordingly, i.e., $\frac{\partial k_{i,1}}{\partial m_1} > 0$. However, given that the equilibrium price response increases with attention, $\frac{\partial G}{\partial \kappa} > 0$, we have

$$\frac{\partial}{\partial \kappa}\left(\frac{\partial k_{i,1}}{\partial m_1}\right) < 0,$$

indicating that the investment response to monetary policy shocks decreases as the attention level κ increases. ■

This proposition supports the primary empirical findings discussed in Section 2, which show that firms with greater attention to monetary matters adjust their investment decisions more gradually in response to monetary policy shocks. The rationale behind this observation is that higher attention levels lead to more pronounced price adjustments and more pronounced capital cost adjustments, reducing price rigidity, which reduces the effect of monetary policy shocks.

Once prices have been adjusted, firms then make their investment decisions. However, due to significant adjustments in consumption prices, capital prices face downward pressure in response to a contractionary monetary policy shock. Consequently, this dampens the pace of investment in some industries. Thus, we expect to observe an empirical pattern in which industries with heightened attention to inflation, a proxy for monetary policy attention, tend to exhibit slower investment adjustment in response to monetary policy shocks. The next section confirms this prediction.

4 Supporting Evidence for Price Adjustment

We propose a theoretical framework to illustrate the observed empirical dynamics, where firms with greater attention adjust prices faster. Though this mechanism is well-documented in the theoretical literature (Mankiw and Reis, 2002; Mackowiak and Wiederholt, 2009), in this section, we provide supporting evidence on whether more attentive industries, as predicted by models, adjust prices faster following monetary policy shocks.

Because firm-level price data is not available, we instead estimate how sectoral average inflation attention affects sectoral price adjustment via the monetary policy transmission mechanism:

$$\log P_{st+1} - \log P_{st} = \gamma \epsilon_t^m + \beta \epsilon_t^m \times d_{st} + \alpha_s + \Gamma' Z_t + e_{st} \tag{4.1}$$

where P_{st} represents the Producer Price Index (PPI) of industry s (6-digit NAICS) in quarter t, ϵ_t^m denotes the identified monetary shocks, and d_{st} is the sectoral average inflation attention. Z_t represents a set of macroeconomic controls, as described above, and α_s is the sectoral fixed effect.

Table 2 reports the regression results on the average and differential responses to mone-

Table 2: Heterogeneous Response of Sectoral Price Adjustment to Monetary Policy

	(1)	(2)	(3)	(4)	(5)	(6)
ϵ_t	-0.044***	-0.049***	-0.038**			
	(0.017)	(0.017)	(0.017)			
$\epsilon_t \times d^1_{st}$	-0.063***			-0.073***		
	(0.023)			(0.025)		
$\epsilon_t \times d^2_{st}$		-0.052**			-0.061***	
		(0.023)			(0.021)	
$\epsilon_t \times d^3_{st}$			-0.073***			-0.077***
			(0.023)			(0.027)
Observations	18937	18937	18937	18937	18937	18937
R^2	0.048	0.048	0.048	0.079	0.079	0.079
Aggregate Controls	Yes	Yes	Yes	No	No	No
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	No	No	No	Yes	Yes	Yes

NOTE: Columns (1)–(3) report both the average and differential effects of a 25 bps contractionary monetary policy shock from Equation (4.1), while Columns (4)–(6) report the differential effects only. The sample period spans from 1994Q1 to 2020Q1. Standard errors are clustered at the sector-quarter level and reported in parentheses. Stars denote the p-values: * $p < 0.10$; ** $p < 0.05$; *** $p < 0.01$.

tary policy shocks. Column (1) indicates that sectoral prices decrease by 4.4% in response to a 25 bps monetary policy shock, and prices in more attentive sectors decrease by an additional 6.3%. This result is robustly significant under alternative inflation attention measures, as shown in Columns (2)–(3). In addition, Columns (4)–(6) include industry-time fixed effects to estimate only the differential impact. The results indicate that this differential responsiveness, driven by sectoral average inflation attention, is still significantly negative.

In Appendix B, we also report the dynamic impulse responses using the local projection method. Figure B.4 illustrates the average and differential response to contractionary monetary policy shocks. Unlike Song and Stern (2020), who estimate the dynamic impacts within industries measured by 4-digit NAICS, our findings extend their analysis by employing a more granular 6-digit NAICS classification. This narrower industry definition allows for a more precise analysis, and we provide comprehensive estimates of both contemporaneous and dynamic effects, resulting in more significant and robust findings.

5 Conclusion

In this study, we explored the intricate relationship between monetary policy, firm investment decisions, and the role of rational inattention. Our findings indicate that firms' attention to inflation significantly moderates their investment responses to contractionary monetary policy shocks. Specifically, firms that exhibit higher levels of attention to inflation experience a smaller reduction in investment, highlighting the importance of information frictions in shaping economic behavior.

By employing a novel empirical approach that analyzes textual data from firms' 10-K and 10-Q reports, we quantified how much attention firms allocate to inflation-related information. This analysis reveals that firms with heightened inflation awareness are more adept at adjusting their pricing strategies, leading to lower equilibrium prices and reduced investment costs. Consequently, these firms are less affected by negative monetary shocks, suggesting that attention to macroeconomic conditions can serve as a buffer against the detrimental effects of contractionary policies.

Our research contributes to the broader literature on monetary policy transmission by emphasizing firm-level heterogeneity in responses based on information processing capabilities. It underscores the need for policymakers to consider the varying levels of attention among firms when designing and implementing monetary policies. Future research could further investigate the implications of rational inattention in different economic contexts and explore additional factors that influence firms' investment behavior in response to monetary policy changes.

References

Afrouzi, Hassan, "Strategic Inattention, Inflation Dynamics and the Non-Neutrality of Money," 2019.

Anderson, Gareth and Ambrogio Cesa-Bianchi, "Crossing the credit channel: credit spreads and firm heterogeneity," *American Economic Journal: Macroeconomics*, 2024, *16* (3), 417–446.

Bauer, Michael D and Eric T Swanson, "A reassessment of monetary policy surprises and high-frequency identification," *NBER Macroeconomics Annual*, 2023, *37* (1), 87–155.

Bodnaruk, Andriy, Tim Loughran, and Bill McDonald, "Using 10-K text to gauge financial constraints," *Journal of Financial and Quantitative Analysis*, 2015, *50* (4), 623–646.

Coibion, Olivier, Yuriy Gorodnichenko, and Saten Kumar, "How do firms form their expectations? new survey evidence," *American Economic Review*, 2018, *108* (9), 2671–2713.

Flynn, Joel P and Karthik Sastry, "Attention cycles," *Available at SSRN 3592107*, 2023.

Gertler, Mark and Peter Karadi, "Monetary policy surprises, credit costs, and economic activity," *American Economic Journal: Macroeconomics*, 2015, *7* (1), 44–76.

_ **and Simon Gilchrist**, "Monetary policy, business cycles, and the behavior of small manufacturing firms," *The Quarterly Journal of Economics*, 1994, *109* (2), 309–340.

Gilchrist, Simon and Egon Zakrajšek, "Credit spreads and business cycle fluctuations," *American economic review*, 2012, *102* (4), 1692–1720.

Gürkaynak, Refet S, Brian Sack, and Eric Swanson, "The sensitivity of long-term interest rates to economic news: Evidence and implications for macroeconomic models," *American economic review*, 2005, *95* (1), 425–436.

Hadlock, Charles J and Joshua R Pierce, "New evidence on measuring financial constraints: Moving beyond the KZ index," *The Review of Financial Studies*, 2010, *23* (5), 1909–1940.

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

Kashyap, Anil K and Jeremy C Stein, "Monetary policy and bank lending," in "Monetary policy," The University of Chicago Press, 1994, pp. 221–261.

_ , Owen A Lamont, and Jeremy C Stein, "Credit conditions and the cyclical behavior of inventories," *The Quarterly Journal of Economics*, 1994, *109* (3), 565–592.

Konchitchki, Yaniv and Jin Xie, "Undisclosed material inflation risk," *Journal of Monetary Economics*, 2023, *140*, S82–S100.

Mackowiak, Bartosz and Mirko Wiederholt, "Optimal sticky prices under rational inattention," *American Economic Review*, 2009, *99* (3), 769–803.

Maćkowiak, Bartosz and Mirko Wiederholt, "Business cycle dynamics under rational inattention," *The Review of Economic Studies*, 2015, *82* (4), 1502–1532.

Mankiw, N Gregory and Ricardo Reis, "Sticky information versus sticky prices: a proposal to replace the New Keynesian Phillips curve," *The Quarterly Journal of Economics*, 2002, *117* (4), 1295–1328.

Melosi, Leonardo, "Signalling effects of monetary policy," *The Review of Economic Studies*, 2017, *84* (2), 853–884.

Miranda-Agrippino, Silvia and Giovanni Ricco, "The transmission of monetary policy shocks," *American Economic Journal: Macroeconomics*, 2021, *13* (3), 74–107.

_ **and Hélene Rey**, "US monetary policy and the global financial cycle," *The Review of Economic Studies*, 2020, *87* (6), 2754–2776.

Nakamura, Emi and Jón Steinsson, "High-frequency identification of monetary non-neutrality: the information effect," *The Quarterly Journal of Economics*, 2018, *133* (3), 1283–1330.

_ **and** _ , "Identification in macroeconomics," *Journal of Economic Perspectives*, 2018, *32* (3), 59–86.

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

Paciello, Luigi, "Monetary policy and price responsiveness to aggregate shocks under rational inattention," *Journal of Money, Credit and Banking*, 2012, *44* (7), 1375–1399.

Ramey, Valerie A, "Macroeconomic shocks and their propagation," *Handbook of macroeconomics*, 2016, *2*, 71–162.

Sims, Christopher A, "Implications of rational inattention," *Journal of monetary Economics*, 2003, *50* (3), 665–690.

Song, Wenting and Samuel Stern, "Firm inattention and the efficacy of monetary policy: A text-based approach," *Available at SSRN 3900641*, 2020.

Sveen, Tommy and Lutz Weinke, "New perspectives on capital, sticky prices, and the Taylor principle," *Journal of Economic Theory*, 2005, *123* (1), 21–39.

Swanson, Eric T, "Measuring the effects of federal reserve forward guidance and asset purchases on financial markets," *Journal of Monetary Economics*, 2021, *118*, 32–53.

Tanaka, Mari, Nicholas Bloom, Joel M David, and Maiko Koga, "Firm performance and macro forecast accuracy," *Journal of Monetary Economics*, 2019.

Woodford, Michael, "Imperfect common knowledge and the effects of monetary policy," Technical Report, National Bureau of Economic Research 2001.

— , "Firm-specific capital and the New-Keynesian Phillips curve," 2005.

Yang, Choongryul, "Rational inattention, menu costs, and multi-product firms: Micro evidence and aggregate implications," *Journal of Monetary Economics*, 2022, *128*, 105–123.

Yun, Tack, "Nominal price rigidity, money supply endogeneity, and business cycles," *Journal of monetary Economics*, 1996, *37* (2), 345–370.

Zorn, Peter, "Investment under Rational Inattention: Evidence from US Sectoral Data," Technical Report, CESifo Working Paper 2020.

Appendix A Details on Data Construction

Identification of Monetary Policy Shocks. As the literature documents, measuring fluctuations in monetary policy is challenging, primarily because fluctuations in the Federal Funds Rate largely reflect the Federal Reserve's reactive adjustments to overall economic conditions.

To address this issue, the common practice in the literature is to use the change implied by a federal funds futures contract, calculated using a narrow time window (e.g., 30 minutes) around the Federal Reserve's Federal Open Market Committee (FOMC) announcements. Since futures contracts provide a measure of market participants' expectations about interest rates, these high-frequency surprises are regarded as a better proxy for exogenous monetary policy shocks (Gürkaynak et al., 2005; Swanson, 2021). However, recent literature raises questions about the exogeneity of this approach and the relevance of monetary surprises. Critics argue that monetary policy surprises may be correlated with macroeconomic and financial data that are publicly available before the FOMC announcement (Nakamura and Steinsson, 2018b; Miranda-Agrippino and Rey, 2020).

To address these concerns, we adopt the methodology developed by Bauer and Swanson (2023) and identify monetary policy shocks using a proxy SVAR approach, where orthogonal monetary surprises serve as instruments. To construct the monetary policy surprises, we expand the set of announcements to include speeches by the Fed chairman, and disentangle the surprises from macroeconomic and financial data preceding the announcement. This adjustment mitigates any attenuation bias or "price puzzles" in SVARs and local projections (Ramey, 2016), providing more precise estimates of monetary policy effects on macroeconomic variables. Thus, we use this new measure of monetary policy surprises, which is both more relevant and more exogenous than those used by previous researchers.

The identifying assumption of the interest rate surprises is that, given the short time horizon, the interest rate surprises cannot be affected by other non-monetary news. However, recent literature suggests that interest rate surprises may still contain news about the determinants of monetary policy, introducing confounding factors. When information frictions between the central bank and financial market participants are present, interest rate surprises may also capture differences in expectations about the state of the macroeconomy. Additionally, they may reflect discrepancies between the actual central bank reaction function and the expectations of market participants (Melosi, 2017; Nakamura and Steinsson, 2018a; Miranda-Agrippino and Ricco, 2021). To address the so-called federal information effect, we estimate the following specification:

$$mps_t = \alpha + \beta' X_{t-} + e_t \tag{A.1}$$

where t denotes FOMC announcement dates, and mps_t is the high-frequency interest rate surprise. X_{t-} represents a set of macroeconomic and financial market predictors prior to the FOMC announcement, including the nonfarm payrolls surprise, employment growth, changes in the S&P 500, changes in the slope of the yield curve, changes in commodity prices, and the implied skewness of the 10-year Treasury yield, following Bauer and Swanson (2023). Non-zero estimated coefficients $\hat{\alpha}$ and $\hat{\beta}$ in Equation A.1 imply the predictability of interest rate surprises based on the pre-FOMC predictors. Thus, we construct the orthogonal interest rate surprises as follows:

$$mps'_t = mps_t - \hat{\alpha} - \hat{\beta}' X_{t-} \tag{A.2}$$

We use the orthogonalized high-frequency interest rate surprise as an instrument and employ the SVAR framework to compute the implied structural monetary policy shocks. The SVAR includes the logs of industrial production and the consumer price index, the two-year government bond yield (all taken from the FRED database at the Federal Reserve Bank of St. Louis), and the excess bond premium from Gilchrist and Zakrajšek (2012). See Bauer and Swanson (2023) for more details. Moreover, we update the standard interest rate surprise series from Gertler and Karadi (2015) to 2020M4 and run the SVAR to obtain alternative monetary policy shocks, which we denote as GS shocks, for robustness checks.

Construction of the Textual Attention Measures. Table A.1 contains the list of keywords used in the frequency search. The keywords are selected based on the most frequent words or phrases used in articles that describe inflation. We gradually expand the set of keywords step-by-step.

Table A.1: Keywords for inflation attention

Variable	Keywords
inflation-1	inflation
inflation-2	inflation, inflationary, disinflation, disinflationary, hyperinflation, hyper-inflationary
inflation-3	inflation, inflationary, disinflation, disinflationary, hyperinflation, hyper-inflationary, price index, price level, consumer price index, cpi, pmi, ppi

Sample Selection. Our sample selection process follows standard practices in the literature to ensure the robustness and representativeness of our analysis. Specifically, we focus on firms headquartered in the United States, with an industrial (INDL) classification rather than financial services (FS), and report their financials in USD. This criterion helps maintain consistency and comparability across the sample.

To enhance the quality of our dataset, we exclude firms classified under finance and insurance (NAICS code 22), utilities (NAICS code 52), and other miscellaneous industries (NAICS code 99). Additionally, we also exclude firms with leverage ratios above 10 or below 0 to mitigate the influence of extreme outliers on our analysis.

The sample period spans from 1994Q1 to 2020Q1. We begin our analysis in 1994 to ensure a sufficient number of firms are filing 10-Q reports, ensuring comprehensive coverage of our sample. Furthermore, we end the sample period in the first quarter of 2020 to avoid distortions from the unprecedented impact of the COVID-19 pandemic on monetary policy transmission.

Subsequently, we merge this textual dataset derived from the 10-Q analysis with the Compustat dataset using the Central Index Key (CIK), a unique identifier assigned by the Securities and Exchange Commission (SEC).

Moreover, we limit the sample to firms observed for at least 20 quarters because the impulse response functions are estimated over a five-year forecast horizon. Finally, nominal variables are deflated by the CPI deflator, and nominal capital stock is deflated by the PPI deflator. The summary statistics of our constructed variables are presented in Appendix Table A.2.

Table A.2: Summary Statistics

	mean	sd	p50	p25	p75
att_{it}^1	0.006	0.016	0.000	0.000	0.005
att_{it}^2	0.008	0.019	0.000	0.000	0.008
att_{it}^3	0.013	0.034	0.000	0.000	0.013
$\Delta \log k_{it+1}$	1.965	17.155	-0.453	-2.456	2.336
Age	10.101	7.647	8.500	3.500	15.750
Size	5.539	3.050	5.933	3.617	7.730
Leverage	0.272	0.271	0.208	0.031	0.410
Market-Book Ratio	2.833	3.337	1.504	0.942	2.949
Liquidity Ratio	-0.767	7.812	0.204	0.035	0.430
Sales Growth	0.022	0.383	0.018	-0.064	0.108

NOTE: This table reports the summary statistics of key variables, with a sample period spanning from 1994Q1 to 2020Q1 and a total of 96,847 observations.

Appendix B Robustness Check

Table B.3: Robustness Check: Firm Investment and Alternative Attention Measures

	(1)	(2)	(3)
ϵ_t	-0.645**	-0.642**	-0.645**
	(0.273)	(0.273)	(0.275)
$\epsilon_t \times d^4_{jt}$	0.421**		
	(0.211)		
$\epsilon_t \times d^5_{jt}$		0.415**	
		(0.102)	
$\epsilon_t \times d^6_{jt}$			0.473**
			(0.225)
Observations	90309	90309	90309
R^2	0.011	0.011	0.011
Firm Controls	Yes	Yes	Yes
Aggregate Controls	Yes	Yes	Yes
Industry FEs	Yes	Yes	Yes

NOTE: Columns (1)–(3) report both the average and differential effects of a 25 bps monetary policy shock from Equation (2.1). d^4_{jt}, d^5_{jt}, and d^6_{jt} are constructed from d^1_{jt}, d^2_{jt}, and d^3_{jt} by including Song and Stern (2020)'s prevalent keyword to capture firm-level attention to economic conditions. The sample period spans from 1994Q1 to 2020Q1. Standard errors are clustered at the sector-quarter level and reported in parentheses. The stars denote the p-values: * $p < 0.10$; ** $p < 0.05$; *** $p < 0.01$.

Table B.4: Robustness Check: Firm Investment and Gertler and Karadi (2015)'s Shock

	(1)	(2)	(3)
ϵ_t	-0.457***	-0.436***	-0.426***
	(0.096)	(0.095)	(0.095)
$\epsilon_t \times d^1_{jt}$	0.250**		
	(0.126)		
$\epsilon_t \times d^2_{jt}$		0.305***	
		(0.111)	
$\epsilon_t \times d^3_{jt}$			0.296**
			(0.133)
Observations	96847	96847	96847
Firm Controls	Yes	Yes	Yes
Aggregate Controls	Yes	Yes	Yes
Industry FEs	Yes	Yes	Yes

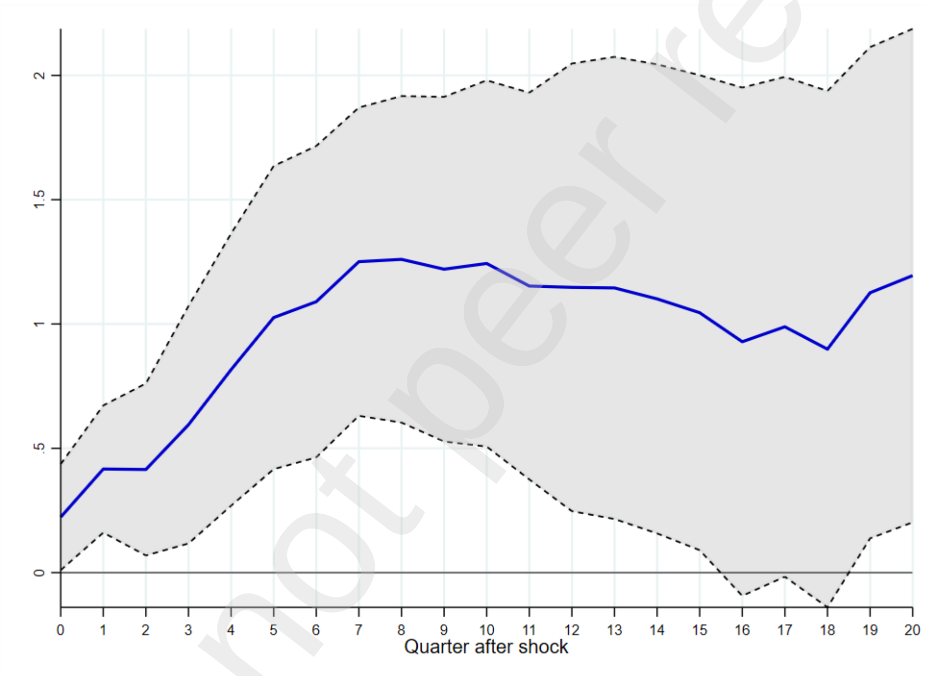
NOTE: Columns (1)–(3) report both the average and differential effects of a 25 bps monetary policy shock from Equation (2.1). In addition, we consider alternative monetary policy shocks constructed by Gertler and Karadi (2015). The sample period spans from 1994Q1 to 2020Q1. Standard errors are clustered at the sector-quarter level and reported in parentheses. The stars denote the p-values: * $p < 0.10$; ** $p < 0.05$; *** $p < 0.01$.

Table B.5: Robustness Check: Firm Investment and Sector-by-time Fixed Effects

	(1)	(2)	(3)
$\epsilon_t \times d^1_{jt}$	0.425***		
	(0.124)		
$\epsilon_t \times d^2_{jt}$		0.354***	
		(0.123)	
$\epsilon_t \times d^3_{jt}$			0.342***
			(0.123)
Observations	96730	96730	96730
R^2	0.06	0.06	0.06
Firm Controls	Yes	Yes	Yes
Industry-Time FEs	Yes	Yes	Yes

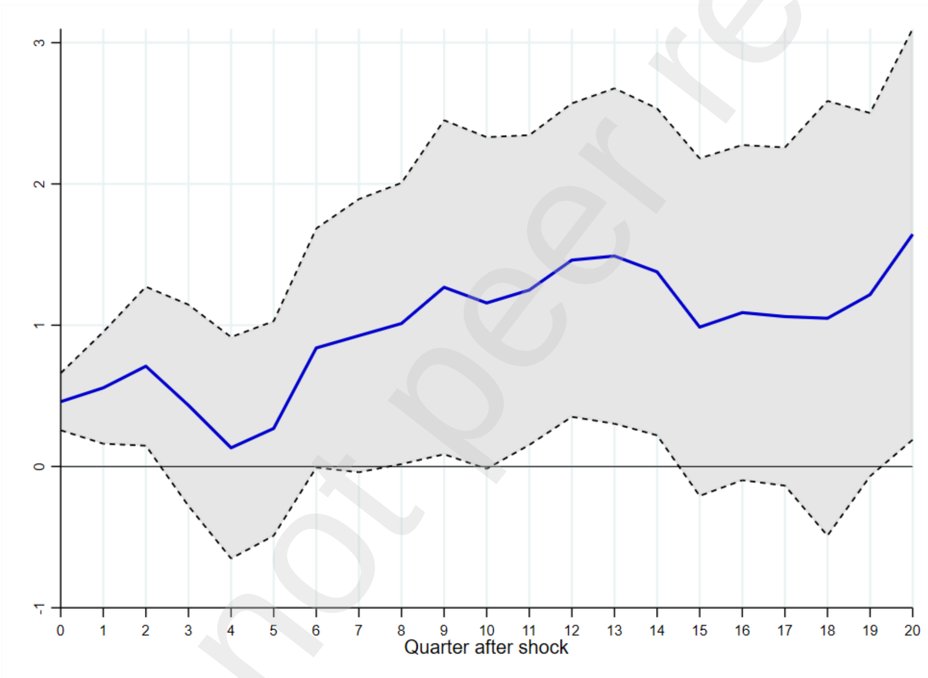
NOTE: Columns (1)–(3) report the differential effects of a 25 bps monetary policy shock by including industry-time fixed effects α_{st} in Equation (2.1). The sample period spans from 1994Q1 to 2020Q1. Standard errors are clustered at the sector-quarter level and reported in parentheses. The stars denote the p-values: * $p < 0.10$; ** $p < 0.05$; *** $p < 0.01$.

Figure B.1: Robustness Check: Dynamic Differential Response with Alternative Shock



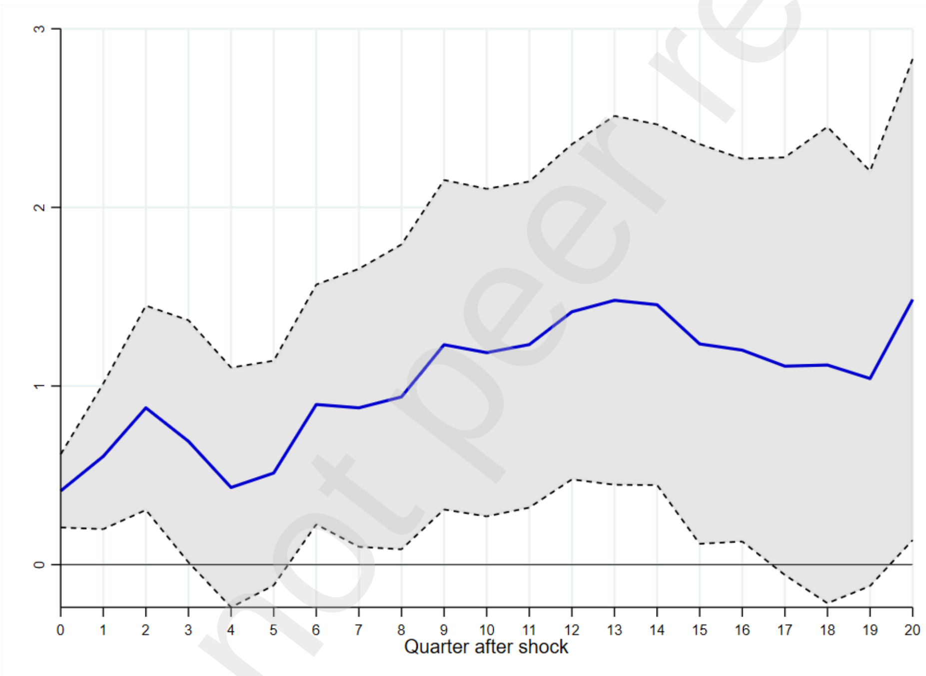
NOTE: This figure shows the dynamic effects of differential impulse responses to the 25 bps shock from Gertler and Karadi (2015). The coefficient β_h is estimated from Equation (2.2). The solid lines show the point estimates of the impulse responses. The shaded areas are 90% confidence intervals.

Figure B.2: Robustness Check: Dynamic Differential Response with d^2_{jt}



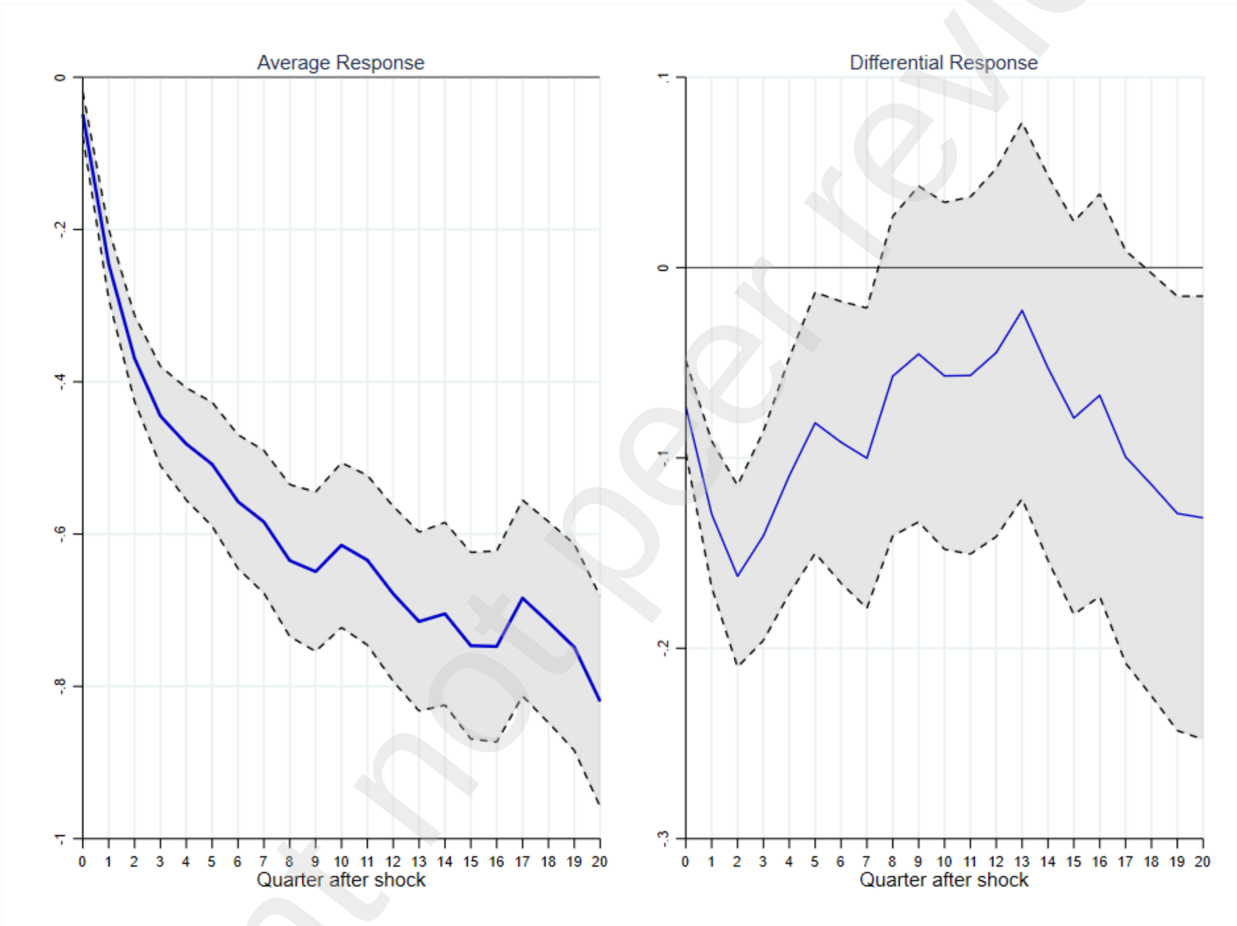
NOTE: This figure shows the dynamic effects of differential impulse responses to a 25 bps monetary policy shock. The coefficient β_h is estimated from Equation (2.2) using the attention measure d^2_{jt}. The solid lines show the point estimates of the impulse responses. The shaded areas are 90% confidence intervals.

Figure B.3: Robustness Check: Dynamic Differential Response with d^3_{jt}



NOTE: This figure shows the dynamic effects of differential impulse responses to a 25 bps monetary policy shock. The coefficient β_h is estimated from Equation (2.2) using the attention measure d^3_{jt}. The solid lines show the point estimates of the impulse responses. The shaded areas are 90% confidence intervals.

Figure B.4: Robustness Check: Dynamic Response of Sectoral Price Adjustment



NOTE: This figure shows the dynamic response of price adjustment to a 25 bps monetary policy shock based on the dynamic specification of Equation (4.1) over the subsequent 20 horizons. The left panel shows the average response (coefficient γ for each horizon), and the right panel shows the differential response of sector-level attention. The solid lines show the point estimates of the impulse responses. The shaded areas are 90% confidence intervals.

Appendix C Model Appendix

Appendix C.1 Objective function Approximation: profit loss

Firm i in period 1 maximizes its expected profit. However, due to flexible price setting under rational inattention, the price-setting problem is essentially static. Thus, firm i's objective function with endowed capital K_1 is

$$\Pi_{i,t} = P_{i,1} Y_{i,t} - W_t L_{i,t}$$

where

$$\begin{aligned} Y_{i,1} &= \left(\frac{P_{i,1}}{P_1}\right)^{-\epsilon} Y_1 \\ L_{i,1} &= \frac{Y_{i,1}}{A K_1^{\alpha}} \\ W_1 &= \phi_L M_1. \end{aligned}$$

After substituting all these conditions into the profit function, now we can rewrite the profit function in terms of $P_{i,1},\ M_1,\ P_1$

$$\begin{aligned} \Pi_{i,t} &= P_{i,1} Y_{i,t} - W_t L_{i,t} \\ &= \Pi(P_{i,1}, P_t, M_t) \\ &= \Pi(\bar{P} e^{P_{i,1}}, \bar{P} e^{p_t}, \bar{M} e^{M_t}) \end{aligned}$$

where a small letter denotes the log-deviation of the variable from its value at the non-stochastic solution.

Now we take the second-order Taylor approximation of the profit function as

$$\begin{aligned}\hat{\pi}_{i,t} &= \pi_1 p_{i,1} + \frac{\pi_{11}}{2} p_{i,1}^2 + \pi_{12} p_{i,1} p_t + \pi_{13} p_{i,1} m_t \\ &= \pi(p_{i,1}, p_t, m_t)\end{aligned}$$

where

$$\begin{aligned}\pi_{11} &= \lambda_j^{\sigma-1} \bar{P}^{\sigma-1} \bar{M} \left[(1-\sigma)^2 \bar{P}_j^{1-\sigma} - \sigma^2 \bar{P}_j^{\sigma} \bar{R}_j A^{-1}\right] \\ \pi_{12} &= (\sigma-1)\lambda_j^{\sigma-1} \bar{P}^{\sigma-1} \bar{M} \left[(1-\sigma) \bar{P}_j^{1-\sigma} + \sigma \bar{P}_j^{\sigma} \bar{R}_j A^{-1}\right] \\ \pi_{13} &= \lambda_j^{\sigma-1} \bar{P}^{\sigma-1} \bar{M} \left[(1-\sigma) \bar{P}_j^{1-\sigma} - \sigma \bar{P}_j^{\sigma} \beta^{-1} A^{-1}\right].\end{aligned}$$

Taking the first order condition with respect to the choice variable $p_{i,1}$ leading to

- Desired price given full information and LQ profit function

$$\text{FOC}(p_{i,1}): \quad p_{i,1}^* = -\frac{\pi_{12}}{\pi_{11}} p_t - \frac{\pi_{13}}{\pi_{11}} m_t$$

- Optimal price given information set $\mathbb{I}_{i,t}$ and LQ profit function

$$p_{i,1} = E[p_{i,t}^* | \mathcal{I}_{i,t}] = -E[\frac{\pi_{12}}{\pi_{11}} p_t + \frac{\pi_{13}}{\pi_{11}} m_t | s_{i,t}^M]$$

Appendix C.2 The Optimal Attention Allocation

The firm's problem involves two decisions: the optimal prices given input choices and signals, and the optimal signal to maximize profit. Below, we show the optimal decisions for price and attention allocation. For firms with endowed capital, the optimal pricing decision under perfect information is derived as follows

$$\begin{aligned}
\max_{P_{i,1}} \; P_{i,1}Y_{i,t} - W_t L_{i,t} - R_t K_1 &= P_{i,1}^{1-\nu} P_t^{\nu} C_t - W_t\left(\frac{P_{i,1}^{-\nu} P_t^{\nu} C_t}{K_1^{\alpha} A}\right) \\
\Rightarrow \quad P_{i,1} &= \frac{\nu}{(\nu-1)} \frac{W_t}{A} \\
\Rightarrow \quad \ln P_{i,1} &= \ln \frac{\nu}{\nu - 1} + \ln W_t - \ln A \\
&= \mathcal{C} + \ln M_t,
\end{aligned}$$

where $\mathcal{C} = \ln \frac{\nu}{\nu-1} - \ln A + \ln \phi_L$. Thus, the log-deviation of firm i's optimal price under perfect information is

$$p_{i,1}^{*} = \ln P_{i,1} - \ln P_i = m_t.$$

The optimal price with imperfect information is (by law of total variance)

$$p_{i,1} = E[p_{i,1}^{*} | s_{i,t}] = \frac{\sigma_M^2}{\sigma_M^2 + \tau_M^2}(m_t + \eta_{i,t}^{M}).$$

After second-order Taylor approximation, we follow Mackowiak and Wiederholt (2009) and define the profit loss function resulting from a suboptimal price set by the inattentive decision-maker as follows

$$
\begin{aligned}
&\frac{\pi_{11}}{2}E(p_{i,1}-p^*_{i,1})^2\\
=&\frac{\pi_{11}}{2}\left(\frac{\sigma_M^2}{\sigma_M^2+\tau_M^2}(m_t+\eta^M_{i,t})-m_t\right)^2\\
=&\frac{\pi_{11}}{2}\left(-\frac{\tau_M^2}{\sigma_M^2+\tau_M^2}m_t+\frac{\sigma_M^2}{\sigma_M^2+\tau_M^2}\eta^M_{i,t}\right)^2\\
=&\frac{\pi_{11}}{2}\left(\frac{(\tau_M^2)^2\sigma_M^2+(\sigma_M^2)^2\tau_M^2}{(\sigma_M^2+\tau_M^2)^2}\right)^2\\
=&\frac{\pi_{11}}{2}\left((\frac{1}{4})^\kappa\sigma_M^2\right).
\end{aligned}
$$

Then firm's problem becomes minimising the profit loss and information capacity cost by choosing κ

$$
\begin{aligned}
\min_{\kappa_k}\frac{\pi_{11}}{2}E(p_{i,1}-p^*_{i,1})^2+\bar{\lambda}\kappa\\
s.t.\frac{1}{2}\log_2\left(\frac{\sigma_M^2}{\tau_M^2}+1\right)=\kappa
\end{aligned}
$$

which is equivalent to

$$
\min_{\kappa}\frac{\pi_{11}}{2}\left((\frac{1}{4})^\kappa\sigma_M^2\right)+\bar{\lambda}\kappa.
$$

For ease of notation, we scale up λ to have the following form

$$
\min_{\kappa}(\frac{1}{4})^\kappa\sigma_M^2+\lambda\kappa
$$

where $\lambda=\frac{2\bar{\lambda}}{\pi_{11}}$. By taking FOC with respect to κ, we get

$$
\kappa^*=-\frac{1}{2}\log_2\frac{\lambda}{2\ln(2)\sigma_m^2}. \tag{C.1}
$$

The corresponding pricing decision with this optimal capacity is

$$p^*_{i,1} = \big(1 - \frac{\lambda}{2\ln(2)\sigma_m^2}\big)s_{i,1} = (1 - 2^{-2\kappa})s_{i,1}. \tag{C.2}$$

Appendix C.3 Constant Return to Scale Production Function

We considered an increasing return to scale production function in the main model for the ease of exposition,

$$Y_{i,t} = L_{i,t}K^{\alpha}_{i,t}. \tag{C.3}$$

We can prove that a standard constant return to scale production function as follows can deliver the similar analytical results which will not alter our main conclusion

$$Y_{i,t} = L^{1-\alpha}_{i,t}K^{\alpha}_{i,t}. \tag{C.4}$$

Firms with endowed capital need to choose the optimal price and commit to produce the differentiated goods using labour as the other input, the optimal pricing decision under perfect information can be derived as follows

$$\begin{aligned}
\max_{P_{i,1}} \; & P_{i,1}Y_{i,t} - W_tL_{i,t} = P^{1-\nu}_{i,1}P^{\nu}_tC_t - W_t\Big(\frac{P^{-\nu}_{i,1}P^{\nu}_tC_t}{K^{1-\alpha}_1A}\Big)^{\frac{1}{\alpha}} \\
\Rightarrow \quad & P^{1+\frac{(1-\alpha)\nu}{\alpha}}_{i,1} = \frac{\nu}{\alpha(\nu-1)}\frac{W_t}{A^{\frac{1}{\alpha}}}(P^{\nu}_tC_t)^{\frac{1-\alpha}{\alpha}}K^{\frac{\alpha-1}{\alpha}}_1 \\
\Rightarrow \quad & P^{\alpha+(1-\alpha)\nu}_{i,1} = \big[\frac{\nu}{\alpha(\nu-1)}\big]^{\alpha}\frac{W^{\alpha}_t}{A}(P^{\nu}_tC_t)^{1-\alpha}K^{\alpha-1}_1 \\
& P^{\alpha+(1-\alpha)\nu}_{i,1} = \big[\frac{\nu}{\alpha(\nu-1)}\big]^{\alpha}\frac{W^{\alpha}_t}{A}(P^{\nu-1}_tM_t)^{1-\alpha}K^{\alpha-1}_1 \\
& P^{\alpha+(1-\alpha)\nu}_{i,1} = \big[\frac{\nu}{\alpha(\nu-1)}\big]^{\alpha}\frac{W^{\alpha}_tM^{1-\alpha}_t}{A}(P^{\nu-1}_t)^{1-\alpha}K^{\alpha-1}_1
\end{aligned}$$

thus, we have the following price in log

$$\ln P_{i,1} \quad = C + \frac{\alpha}{\alpha+(1-\alpha)\nu}\ln M_t + \frac{1-\alpha}{\alpha+(1-\alpha)\nu}\ln M_t + \frac{(1-\alpha)(\nu-1)}{\alpha+(1-\alpha)\nu}\ln P_t$$

where $C = \frac{\alpha}{\alpha+(1-\alpha)\nu}\ln\frac{\nu}{\alpha(\nu-1)} + -\frac{1}{\alpha+(1-\alpha)\nu}\ln A$. Thus, the log-deviation of firm i's profit-maximization price is

$$\begin{aligned} p^*_{i,1} &= \ln P_{i,1} - \ln P_i \\ &= \frac{\alpha}{\alpha+(1-\alpha)\nu}m_t + \frac{1-\alpha}{\alpha+(1-\alpha)\nu}m_t + \frac{(1-\alpha)(\nu-1)}{\alpha+(1-\alpha)\nu}p_t \\ &= \frac{1}{\psi}m_t + \frac{\psi-1}{\psi}p_t \end{aligned}$$

where $\psi = \alpha + (1-\alpha)\nu$.

To solve this problem, we can guess the aggregate price response as $p_t = hm_t$ due to the absence of idiosyncratic shock, and substitute into the profit-maximization price $p^*_{i,1}$ to get

$$p^*_{i,1} = \frac{1+(\psi-1)h}{\psi}s_{i,t}$$

Using the profit loss objective function, we have

$$\frac{\pi_{11}}{2}E(p_{i,1}-p^*_{i,1})^2 = \frac{\pi_{11}}{2}\left(\xi^2(\frac{1}{4})^\kappa\sigma_M^2\right)$$

where $\xi = \frac{1+(\psi-1)h}{\psi}$. Firm i's problem is essentially similar to the one with increasing return to scale production function:

$$\min_\kappa \xi^2(\frac{1}{4})^\kappa\sigma_M^2 + \lambda\kappa$$

which implies the optimal capacity as

$$\kappa^* = -\frac{1}{2}\log_2 \frac{\lambda}{2\xi^2 \ln(2)\sigma_m^2} \tag{C.5}$$

Integrating over all individual firms yields the equilibrium price level under rational inattention:

$$p_1 = \big(1 - \frac{\lambda}{2\xi^2 \ln(2)\sigma_m^2}\big)m_1 \tag{C.6}$$

To solve the initial guess $p_1 = hm_1$, we just need to solve a fixed point problem

$$p_1 = \big(1 - \frac{\lambda}{2\xi^2 \ln(2)\sigma_m^2}\big)m_1 = \big(1 - \frac{\lambda}{2(\frac{1+(\psi-1)h}{\psi})^2 \ln(2)\sigma_m^2}\big)m_1 = hm_1,$$

which implies the equilibrium price response as a function of $\sigma_m,\ \psi,\ \lambda$

$$h = H(\sigma_m, \psi, \lambda)$$

It is not difficult to prove that $\frac{\partial h}{\partial \sigma_m} > 0$ and $\frac{\partial h}{\partial \lambda} < 0$, which are identical to the main theoretical results in 1. Hence, our proposition results are preserved under a standard constant return to scale production function.

Title:

Monetary Policy, Investment and Rational Inattention

Authors:

Zijian Wang, [1] Renbin Zhang, [2] Weimin Zhou[3]

Affiliations:

[1]Jinan University, 601 Huangpu Avenue West, Guangzhou, 510632, China

[2]Shandong University, 27 Shanda Nanlu, Jinan, 250100, China

[3]Sichuan University, 1 1st Ring Road, Chengdu, 610065, China

Corresponding author:

Zijian Wang

Jinan University, Huangpu Avenue West 601, Guangzhou, 510632, China

E-mail: zijianwang305@gmail.com

Tel: +8615001016636

Conflict of Interest:

The authors have nothing to disclose.