# The Fed Information Effect and the Profitability Channel of Monetary Policy: Evidence and Theory

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**Abstract**

We provide firm-level evidence that the Federal Reserve's economic outlook expressed during FOMC announcements has real effects. Using a high frequency measure of Fed information, we show that analyst forecast revisions to Fed information are larger for more cyclical firms. We construct a heterogeneous firm New Keynesian model incorporating this finding to analyze Fed information's effect on investment. Our model predicts greater sensitivity of firm profitability and investment to Fed information for more cyclical firms. We find evidence for both predictions. At the aggregate level, our model provides an explanation for inflation's slow decline in 2022-2023 despite aggressive rate hikes.



**Keywords**: Monetary Policy, Fed Information Effect, Heterogeneous Investment Response.

**JEL Classification**: E22, E52, G31.

# 1 Introduction

Federal Open Market Committee (FOMC) announcements are closely followed by market participants and corporate managers. In addition to an announcement of the target Federal Funds rate, these announcements contain information about the Federal Reserve's economic outlook.[1] While much work has examined how the Fed's economic outlook influences the public's forecast of economic conditions, a phenomenon referred to as the "Fed Information effect" (see, e.g., the literature following Romer and Romer 2000), less is known about whether Fed information has real effects.

In this paper, we provide evidence that firms alter their investment policies following a Fed information shock. We first show that, following a Fed information shock, analysts revise their earnings and sales forecasts of individual firms and that such revisions are larger in magnitude for more cyclical firms. We use this evidence to propose that Fed information impacts future firm productivity and construct a heterogeneous firm New Keynesian model that embeds this premise. Our model rationalizes the observed comovement of interest rates and the stock market following Fed information shocks. In addition, it predicts more cyclical firms to have higher profitability and investment rate sensitivities to Fed information shocks. We find evidence for both these predictions in the data.

To identify a Fed information shock, we use an existing high frequency measure constructed by Jarociński and Karadi (2020) (henceforth "JK"). JK separate a monetary policy shock into two components: a Fed information component which they refer to as a Central Bank Information shock (henceforth "CBI shock") and a conventional monetary shock (henceforth "MP shock"). The CBI (MP) shocks are identified from positive (negative) comovements of

[1] The Fed conveys its economic outlook following an FOMC meeting in various ways such as through the FOMC meeting statement and the Summary of Economic Projections (the "dot plots").

interest rates and the aggregate stock market. The logic of their identification scheme is that in the absence of positive news regarding future economic prospects, an interest rate increase would lead to a decline in the stock market—this is a positive MP shock. On the other hand, if the interest rate increase is accompanied by Fed announcements that are interpreted by the public to be positive economic news, then the level of the stock market can increase—this is a positive CBI shock. In appendix A, we provide new, direct evidence that the CBI shock is indeed correlated with revisions in the Fed's internal Tealbook forecasts of real GDP growth.

To study the effect of Fed information on firm investment, we first analyze revisions in forecasts of firm fundamentals by equity analysts following a CBI shock. Analysis of analyst forecast revisions is an important first step in testing if Fed information has real effects since expectations are expected to respond sooner to Fed information than the actual implementation of investment plans. Furthermore, analysts' forecasts are also observed at a higher frequency—monthly rather than the quarterly investment series. We study analysts' forecasts contained in the Institutional Broker's Estimate System (IBES) dataset focussing on sales and earnings per share (EPS) forecasts of individual firms, focussing on cross-sectional heterogeneity in forecast revisions following a CBI shock.

The idea guiding our empirical strategy to detect the Fed information effect on analysts' forecasts is as follows: if the public update their forecast of aggregate economic conditions following Fed announcements, we expect to see cross-sectional differences in analysts' revisions of firm-level variables following these announcements because firms differ in their sensitivity to aggregate economic conditions. Therefore, we sort firms based on the cyclicality of their business conditions and test for cross-sectional differences in revisions of analysts' forecasts following Fed announcements.[2] An important advantage of using firm-level data is that the

[2]We use a firm's Capital Asset Pricing Model (CAPM) beta, as our measure of firm cyclicality.

large heterogeneity in the sensitivity of firm fundamentals to aggregate economic conditions magnifies the Fed information effect in the cross-section. This makes it easier to detect its effects.

We analyze analyst revisions at the frequency of FOMC meetings. We find that more cyclical firms see a greater upward (downward) revision in analyst forecasts of sales and EPS following a positive (negative) CBI shock. The results are statistically significant and economically large. For example, a firm has 0.33 (0.19) units higher semi-elasticity of revisions in sales (EPS) projections to a CBI shock when its CAPM beta is one standard deviation higher than the typical firm in our sample. In establishing this and all other empirical results in our paper, we follow Bauer and Swanson (2022, 2023) and control for macroeconomic news released in the run up to Fed announcements.

Next, we propose a heterogeneous firm New Keynesian model to analyze the effect of Fed information on firms' investment policies. We model the Fed information effect by assuming that the central bank receives news about the future path of aggregate productivity and shares the news with firms and investors in FOMC announcements. One feature of our model, which is new relative to the existing literature, is that we account for ex-ante differences in the cyclicality of firm productivity. We verify that this feature of our model captures our finding that sales and EPS forecasts of more cyclical firms are more sensitive to Fed information.

Our model rationalizes a defining feature of Fed information—a positive comovement between interest rates and the stock market. To see how this arises in our model in equilibrium, consider a scenario in which the Fed shares news of an increase in future aggregate productivity. All else equal, the nominal interest rate increases, both because of an increase in inflation due to the impending economic boom and also because of an increase in the real interest rate resulting from higher growth expectations. The level of the aggregate stock market increases due to expectations of higher future dividends.

Our model makes two firm-level predictions. First, it predicts a CBI shock to have heterogeneous effects on firm profitability (defined as the return on assets). In particular, it affects more cyclical firms to a greater extent. To see the intuition for this prediction, consider a realization of a positive CBI shock. This is a scenario in which Fed information predicts an increase in future aggregate productivity. The increase in aggregate productivity implies a relatively larger increase in productivity for more cyclical firms. A greater increase in productivity for more cyclical firms, in turn, implies a greater increase in profitability for such firms. To test this prediction in the data, we analyze realized firm profitability over a three year period following a CBI shock. In line with our model's prediction, we find the profitability of more cyclical firms to be more sensitive to a CBI shock.

Second, our model predicts more cyclical firms to have a higher sensitivity of their investment rate to a CBI shock relative to less cyclical firms. To see the intuition for this prediction, once again, consider a realization of a positive CBI shock—a scenario associated with an increase in expected future aggregate dividends. For firms, the increase in aggregate productivity increases the present value of investing, with more cyclical firms experiencing a greater increase in the value of investing.

We test this prediction of our model by analyzing the sensitivity of firm investment rates to a CBI shock. In line with our model's predictions, we find cross-sectional differences in investment sensitivity to be statistically significant and economically large. For instance, we analyze capital accumulated by firms in the two years following a CBI shock and estimate the semi-elasticity of this accumulated capital to a CBI shock. We find this semi-elasticity to be 0.35 units higher for a firm whose CAPM beta is one standard deviation higher than the typical firm in our sample.

In general, changes in firms' investment can be due to either changes in the discount rate used by firms to value investment or due to changes in firm profitability (see, e.g., Kogan and Papanikolaou 2012, equation 17). While a large literature has emphasized that monetary policy can affect firm investment by changing the discount rate (see, e.g., Bernanke and Gertler 1995 and Christiano, Eichenbaum, and Evans 2005), to the best of our knowledge, our paper is the first to provide evidence that monetary policy can drive investment by impacting firm profitability. We refer to this channel as the *profitability channel* of monetary policy.

At the aggregate level, our model predicts a muted response of inflation to a Fed Funds rate increase when Fed announcements signal higher than average future productivity. Quantitatively, we find that every 1 basis point increase in news about peak future productivity requires an additional 3.7 basis points increase in the Fed Funds rate to achieve the same inflation outcome as in a scenario without news about higher than average future productivity. Our model therefore provides a quantitative framework to rationalise Fed Chair Powell's recent comment in his August 25, 2023 Jackson Hole speech that, "[a]dditional evidence of persistently above-trend growth could put further progress on inflation at risk and could warrant further tightening of monetary policy."

### Related Literature

Our paper contributes to three strands of literature. The first analyzes the effects of monetary policy on firm investment. The channels highlighted by this strand of literature operate through the discount rate channel, that is, monetary policy affects investment by influencing the discount rate used by the firm to value investment. Examples include the traditional interest rate channel in which policy rate changes are partially transmitted to real rates due to nominal rigidities (see, e.g., Christiano, Eichenbaum, and Evans (2005) for evidence) and the credit channel of monetary policy that analyzes how financial frictions interact with monetary policy (see Bernanke and Gertler (1995) for a review of the earlier literature and Ottonello and Winberry (2020) for recent work leveraging firm heterogeneity to shed light on this channel). In general, however, a change in a firm's investment policy can be either due to a change in its discount rate or due to a change in firm profitability. Our contribution to this literature is to show that monetary policy can affect investment through the profitability channel.

Second, we contribute to the strand of literature that analyzes the effect of central bank communications, such as FOMC statements. The existing literature has studied the effect of such communication on the public's expectations and also on asset prices. The literature analyzing the effect of central bank communication on public's expectations include Romer and Romer (2000), Campbell, Evans, Fisher, and Justiniano (2012), and Nakamura and Steinsson (2018) who show that Fed announcements change professional forecasters' expectations of inflation, unemployment, and real GDP forecasts, respectively. The literature that shows the effect of central bank communication on asset prices include Cieslak and Schrimpf (2019), Jarociński and Karadi (2020), and Bianchi, Ludvigson, and Ma (2022) who study the response of interest rates and the aggregate stock market to Fed announcements to analyze the information content of announcements. They find that Fed announcements contain a news component about future economic growth and also financial risk premia. Studies which focus on the effect of central bank communication on risk premium include Hansen, McMahon, and Tong (2019) who provide evidence from the U.K., Leombroni, Vedolin, Venter, and Whelan (2021) who show that the European Central Bank's communication affects long term sovereign yields in Europe, and Pflueger and Rinaldi (2022) who propose a theory to explain the large reaction of asset prices to central bank announcements. While existing papers focus on the effect of central bank communication on the public's expectations and on asset prices, we contribute to this literature by showing that Fed announcements affect corporate policies.

Bauer and Swanson (2022, 2023) question the evidence establishing the Fed information effect by showing that such evidence is not robust to controlling for news released prior to Fed announcements. More recent papers, however, find evidence of a Fed information effect after controlling for news released prior to Fed announcements. Golez and Matthies (2025) analyze S&P 500 dividend strips and Jarociński and Karadi (2025) study both FOMC and non-FOMC Fed announcements and find robust evidence of the Fed information effect. Our empirical evidence using analyst expectations, profitability, and investment are similarly robust to controlling for news released prior to Fed announcements. Similar to our cross-sectional evidence, Ai, Han, Pan, and Xu (2022) analyze firm level stock returns to monetary policy announcement surprises and also find evidence in line with the Fed information effect.

Third, we contribute to the growing literature on heterogeneous firm New Keynesian models which studies the effect of monetary policy shocks in the presence of heterogeneous firms (see, e.g., Ottonello and Winberry 2020). Unlike Ottonello and Winberry (2020), who study the transmission of monetary policy shocks in the presence of financial frictions, firms in our model do not face financial frictions. Instead, we emphasize heterogeneity in the cyclicality of firm productivity.

There is also a large literature that analyzes the effect of monetary policy announcements (not necessarily restricted to the central bank's private information) on asset prices. The empirical literature in this area focuses on asset price changes around announcements by the central bank or in the period immediately before the announcement (i.e., the "pre-FOMC announcement drift"). For a list of references, see the recent review article by Ai, Bansal, and Guo (2023). While most of this literature studies the response of the aggregate stock market to monetary policy surprises, a recent literature examines the cross-section of stock returns to better understand the channel through which monetary policy surprises affect stock returns. These include studies on how the response of stock returns in the cross-section depends on the type of monetary policy shock (see, e.g., Ozdagli and Velikov 2020) or firm characteristics such as the ability of firms to flexibly adjust prices in response to cost shocks (Gorodnichenko and Weber, 2016), financial constraints (see, e.g., Chava and Hsu 2020), a firm's liability structure (Gürkaynak, Karasoy-Can, and Lee, 2022), among others.

# 2 Fed information and analyst forecast revisions

In this section, we show that analysts revise their forecasts for individual firms following realizations of a Fed information (i.e., CBI) shock. Specifically, we show that the sensitivity of analyst revisions to the CBI shock is higher for more cyclical firms.

## 2.1 Data

**Monetary policy shocks.** FOMC announcements can simultaneously convey information about monetary policy as well as the Fed's assessment of future economic outlook. In order to focus on the Fed information effect, we use the Jarociński and Karadi (2020) (henceforth "JK") decomposition of monetary policy shocks. Specifically, JK decomposes a monetary policy shock into a central bank information shock (henceforth "CBI shock") and a conventional monetary policy shock (henceforth "MP shock"). They identify these two shocks through the comovement between the S&P 500 index and the 3-month Fed funds futures over a 30-minute window around FOMC announcements—CBI and MP shocks are associated with positive and negative comovements between the S&P 500 and interest rates, respectively.[3]

In Appendix A, we use the Tealbook (formerly, the Greenbook) to provide additional complementary evidence that the CBI shock is positively correlated with revisions in the Fed's internal forecast of real GDP. We also refer the reader to Jarociński and Karadi (2020) who provide evidence that a positive (negative) CBI shock forecasts an increase (decrease) in future GDP. We follow the literature and restrict our empirical analysis to scheduled FOMC meetings (see, e.g., Nakamura and Steinsson 2018 and Bauer and Swanson 2023).

**Analyst forecast data.** Our analysis for revisions in sales forecasts covers the period January 1996 – June 2019, and our analysis for revisions in EPS forecasts covers the period January 1990 – June 2019. We use the monthly summary files from the Institutional Broker's Estimate System (IBES) to measure analyst revisions following each scheduled FOMC announcement. The IBES dataset contains analysts' forecasts for individual firms with each firm being covered by multiple analysts (the average number of analysts covering a firm is six).

The timing in our analysis is as follows. We use the monthly IBES summary files. These files are released on the third Thursday of every month and contains a a snapshot of outstanding forecasts of individual analysts. Our analysis is at the FOMC meeting level. For the FOMC meeting in month $t$, we match it to the IBES monthly summary file for that month if the FOMC meeting occurs before the IBES file is released. Otherwise, we match it to the IBES summary file for the following month.[4] Figure 1 shows this timeline.

[3]JK implement this idea using a structural vector autoregression where the CBI and MP shocks are identified using sign restrictions.

[4]In our sample, the average number of days between an FOMC announcement and the subsequent IBES file used to estimate revisions is 15 days.

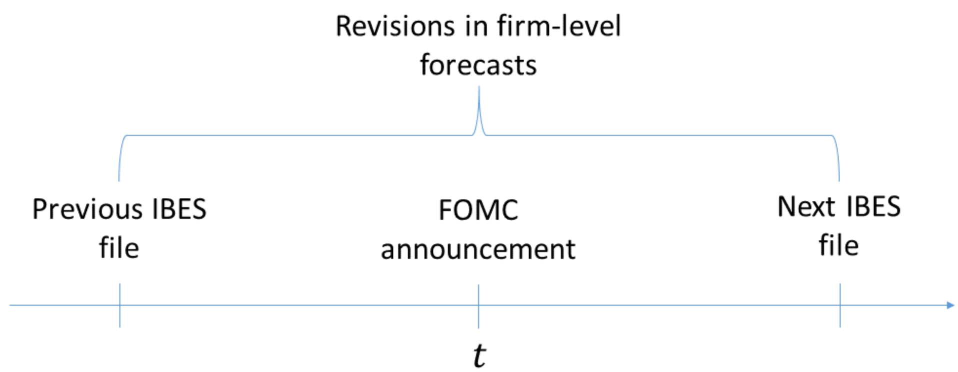



**Figure 1: Measuring revisions in expectations of firm-level outcomes following scheduled FOMC announcements.**

IBES files contain analysts' forecasts for a number of firm variables. We focus on the two most populated measures from IBES: sales and earnings per share (EPS). The measure of forecast revisions we use is:

$$\mathrm{UpRevX}_{i,t} = \frac{\mathrm{UpRevX}_{it} - \mathrm{DownRevX}_{it}}{\#\mathrm{X}_{it}}, \tag{1}$$

where $\#\mathrm{X}_{it}$ is the total number of sales or EPS forecasts received by IBES from all analysts in month $t$, $\mathrm{UpRevX}_{it}$ ($\mathrm{DownRevX}_{it}$) is the number of analysts who upward (downward) revise their forecasts for sales or EPS for firm $i$ in month $t$ relative to their previous forecast. We use the one-year ahead forecasts from IBES to be in line with the Fed information effect literature (see, e.g., Nakamura and Steinsson 2018).[5]

[5] We use the IBES forecast corresponding to a one-year ahead forecast horizon which corresponds to a "Forecast Period Indicator" FPI= 2. This horizon has the virtue of not containing any sub-period which has already been realized. As an example, consider the sales forecast made in May 2024 of a firm with fiscal year end in December. The FPI=2 forecast for sales is a forecast for the period January 2025 – December 2025. The FPI=1 forecast is a forecast for January 2024 – December 2024 and includes five months that have already been realized. Nakamura and Steinsson (2018) use quarterly data with a forecast horizon of three quarters.

**Other firm-level variables.** We use the CAPM beta of a firm as a measure of its cyclicality. We estimate the CAPM beta of each firm as the loading of the excess monthly return of this firm on the excess monthly return of the market over our entire sample period. We use the market-value weighted portfolio of all stocks listed in CRSP as our proxy for the market; we use the return on the 1-month Treasury bill as our measure of the risk-free rate.

We use quarterly financial data from Compustat to measure firm-level variables. We exclude financial firms (sic code from 6000 to 6999) and utility firms (sic code from 4900 to 4999). We merge stock price data from CRSP with Compustat data, and keep firms with a share code of 10 or 11 and an exchange code of 1, 2, or 3.

We include four firm-level control variables: the logarithm of total asset *qtq*, book leverage (current debt *dlcq* plus long-term debt *dlccq* divided by total asset), Tobin's Q (total asset minus book equity *ceqq* plus market equity $cshoq \times prccq$ divided by total asset), and cash flow (income before extraordinary items *ibd* plus depreciation and amortization *dbq* divided by lagged total asset).

We report all summary statistics, including those variables appearing in Section 5, in Table 1.

## 2.2 Revisions in forecasts of firm fundamentals

In this section, we provide evidence for the Fed information effect based on cross-firm differences in revisions of analyst projections for firms' sales and earnings per share (EPS) following FOMC announcements. Our approach leverages the substantial cross-sectional variation in firms' sensitivity to business cycle conditions. The logic is as follows: if an FOMC announcement reveals, say, positive news about future aggregate economic conditions, we would expect larger upward revisions in analysts' forecasts of sales and EPS for more cyclical

**Table 1: Summary Statistics.** This table reports summary statistics for variables used in our analysis. The sample period is 1990—2019.

| | $N$ | Mean | Median | Std Dev | | $N$ | Mean | Median | Std Dev |
|---|---|---|---|---|---|---|---|---|---|
| | | | | A. Firm level variables | | | | | |
| UpRevSales | 305,191 | -0.0112 | 0 | 0.4136 | Log assets | 331,364 | 5.0475 | 4.9717 | 2.2755 |
| UpRevEPS | 429,564 | -0.0253 | 0 | 0.3776 | Book leverage | 331,364 | 0.2368 | 0.1702 | 0.3020 |
| $\text{Profit}_{i,t\to t+3}$ | 312,524 | 0.0121 | 0.1102 | 0.4308 | Tobin's Q | 331,364 | 2.5589 | 1.6150 | 3.1342 |
| $\text{Profit}_{i,t+4\to t+7}$ | 304,780 | 0.0111 | 0.1077 | 0.4240 | Cash flow | 331,364 | -0.0134 | 0.0185 | 0.1269 |
| $\text{Profit}_{i,t+8\to t+11}$ | 281,431 | 0.0171 | 0.1086 | 0.4013 | CAPM $\beta$ | 9,338 | 1.2199 | 1.1350 | 0.8882 |
| $\Delta logk_{i,t-1\to t-1+8}$ | 331,364 | 0.1010 | 0.0223 | 0.5288 | | | | | |
| | | | | B. FOMC meeting level variables | | | | | |
| CBI | 236 | -0.0051 | -0.0020 | 0.0284 | $\Delta$ log S&P 500 | 236 | 0.0178 | 0.0316 | 0.0713 |
| MP | 236 | -0.0034 | -0.0012 | 0.0473 | $\Delta$ Slope | 236 | -0.01 | -0.635 | 0.4441 |
| Nonfarm Payrolls | 236 | -0.1635 | -0.06 | 0.9646 | $\Delta$ log Comm. Price | 236 | 0.0105 | 0.0134 | 0.0780 |
| Emp Growth | 236 | 1.1090 | 1.5991 | 1.5842 | Treasury Skewness | 236 | 0.1239 | 0.1471 | 0.2842 |
| | | | | C. Quarterly level variables | | | | | |
| CBI | 118 | -0.0101 | -0.0041 | 0.0427 | $\Delta$ log S&P 500 | 118 | 0.0355 | 0.0529 | 0.1303 |
| MP | 118 | -0.0069 | -0.0060 | 0.0588 | $\Delta$ Slope | 118 | -0.02 | -0.0827 | 0.8095 |
| Nonfarm Payrolls | 118 | -0.3269 | -0.27 | 1.4387 | $\Delta$ log Comm. Price | 118 | 0.0211 | 0.0305 | 0.1401 |
| Emp Growth | 118 | 2.2181 | 3.0294 | 3.2866 | Treasury Skewness | 118 | 0.2479 | 0.2539 | 0.5503 |

firms.

Formally, we investigate the following panel regression:

$$\text{UpRevX}_{i,t} = \delta_{CBI}\left(\beta_i \times CBI_t\right) + \delta_{MP}\left(\beta_i \times MP_t\right) + \boldsymbol{\gamma}'\boldsymbol{X}_{i,t^-} + \eta_i + \theta_{s,t} + \epsilon_{i,t}. \tag{2}$$

The dependant variable $\text{UpRevX}_{i,t}$ is the net upward revision in analysts' forecasts of either sales (UpRevSales) or EPS (UpRevEPS) for firm $i$ following an FOMC announcement at time $t$. We implement regression (2) at the frequency of FOMC meetings. This is the same frequency used in the literature that tests for the Fed information effect using survey expectations from the Blue Chip forecasts (see, e.g., Nakamura and Steinsson 2018).

The key coefficients of interest are the slope coefficients for the interaction terms between monetary shocks and firm cyclicality $\beta_i$ (which we measure using a firm's CAPM beta). In the presence of Fed information effects, we would expect upward (downward) revisions in analyst forecasts of more cyclical firms to be stronger following a FOMC announcement that conveys positive (negative) news regarding future economic prospects—that is, a positive coefficient $\delta_{CBI}$.

We include controls $\boldsymbol{X}_{i,t^-}$ for firm level variables that may influence revisions in analysts' forecasts at time $t$: log total asset, book leverage, Tobin's Q, and cash flow. These controls variables are available quarterly, so we use their values from the quarter before the monetary shock to ensure that they are predetermined at the time of the monetary shock. We add firm fixed effects $\eta_i$ to control for firm-level time-invariant factors that may influence analyst revisions. We also include sector $s$ by time $t$ fixed effects $\theta_{s,t}$ to control for common sector-level shocks that may affect analyst revisions.[6] Note that we do not additionally include firm cyclicality $\beta_i$ and the monetary shock $CBI_t$ and $MP_t$ in regression (2) as these variables would be absorbed by the firm fixed effect $\eta_i$ and the sector by FOMC meeting fixed effects $\theta_{s,t}$, respectively. All standard errors are clustered at the firm and FOMC meeting level.

Table 2 shows the results. Consistent with the Fed information effect, column (1) shows that the coefficient on the interaction term between CBI and CAPM beta, $\delta_{CBI}$, is positive and statistically significant at the 1% level. Since $\text{UpRevX}_{i,t}$ is the net fraction of upward revisions, the coefficient $\delta_{CBI}$ can be interpreted as a semi-elasticity of upward revisions with respect to the CBI shock. The point estimate for $\delta_{CBI}$ implies that a firm has $0.439 \times 0.8882 = 0.39$ units higher semi-elasticity of revisions in sales projections when its CAPM beta is one standard deviation higher than the typical firm in our sample.

Column (4) repeats the exercise for net upward revisions in analysts' forecasts of EPS following FOMC announcements. We reach the same conclusion regarding the presence of the Fed information effect—the point estimate for $\delta_{CBI}$ is positive and statistically significant.

[6] We follow Ottonello and Winberry (2020, footnote 3) in defining the sectors based on SIC codes: agriculture, forestry, and fishing; mining, construction; manufacturing; transportation communications, electricity, gas, and sanitation services; wholesale trade; retail trade; and services. Finance, insurance, real estate, and utilities are excluded.

**Table 2: Revisions in analyst forecasts of firm fundamentals following FOMC announcements.** This table reports results for regression (2). *, **, and *** indicate significance at the 10%, 5%, and 1% level, respectively. Standard errors are clustered at the firm and FOMC meeting level and are reported in parentheses.

| | UpRevSales | | | UpRevEPS | | |
|---|---|---|---|---|---|---|
| | | | Non-earnings sample | | | Non-earnings sample |
| | (1) | (2) | (3) | (4) | (5) | (6) |
| CBI × $\beta$ | 0.439*** | 0.376*** | 0.185** | 0.314*** | 0.215** | 0.125** |
| | (0.094) | (0.110) | (0.077) | (0.099) | (0.084) | (0.056) |
| MP × $\beta$ | 0.066 | 0.067 | 0.007 | 0.024 | 0.018 | -0.003 |
| | (0.046) | (0.052) | (0.033) | (0.042) | (0.042) | (0.026) |
| Observations | 305,191 | 305,191 | 174,410 | 429,564 | 429,564 | 263,908 |
| $R^2$ | 0.092 | 0.092 | 0.085 | 0.079 | 0.079 | 0.086 |
| Firm-level Controls | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Economic News × $\beta$ | | ✓ | ✓ | | ✓ | ✓ |
| Firm FE | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Sector × Time FE | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |

Finally, we see the coefficient on the interaction term between MP shocks and firm cyclicality, $\delta_{MP}$, is insignificant. That is, conventional monetary policy shocks (which do not carry Fed information) do not generate cross-sectional differences in revisions in analyst forecasts of firm fundamentals following FOMC announcements. Since we obtain this null result robustly across all the specifications in Table 2, we do not further discuss this result.

**Controlling for non-FOMC news.** A potential concern with the specification reported in columns (1) and (4) of Table 2 is that the analyst revisions we are focussing on may not be due to FOMC announcements, but rather due to some other news. There are two potential types of news that are relevant: macroeconomic news or firm specific news. We address both of these concerns next.

First, we control for macroeconomic news released in the run up to FOMC announcements. The need to control for macroeconomic news when assessing the presence of the Fed information effect has been emphasized recently by Bauer and Swanson (2023). In our context, the concern is that the heterogeneity in analyst revisions may not necessarily stem from the Fed information effect but rather from macroeconomic news released in the lead up to an FOMC announcement.

To mitigate this concern, we add six interactions terms $\beta_i \times \text{News}_{k,t}$ to the specification (2) where $\text{News}_{k,t}$ $(k = 1, ..., 6)$ are the six macroeconomic and financial variables from Bauer and Swanson (2022). This specification allows each source of news to impact firms differently depending on firms' cyclicality $\beta_i$. The six variables are: (1) the most recent nonfarm payroll surprise, (2) the log change in nonfarm payrolls over the past 12 months, (3) the log change in the S&P 500 from 13 weeks prior to the FOMC announcement to the day before the announcement, (4) the 13 week change in the slope of the yield curve, (5) the 13 week log change in the Bloombeg BCOM commododity price index, and (6) the Bauer and Chernov (2024) option-implied skewness of the 10-year Treasury yield the day before the FOMC announcement. Columns (2) and (5) of Table 2 show results. Consistent with Bauer and Swanson (2023), we see that accounting for news does attenuate the point estimate for $\delta_{CBI}$ after controlling for macroeconomic news. However, the point estimate for $\delta_{CBI}$ remains positive and statistically significant at the 1% level. This indicates the presence of the Fed information effect over and above macroeconomic news in the run up to FOMC announcements.

Second, we address the possibility that the revisions in IBES forecasts might be a response to firm specific news released in an earnings call that took place in between the two IBES releases we are using to measure analyst forecast revisions (see Figure 1). To address this concern, we drop such firm-FOMC meeting observations (this filter results in losing half of the observations) and rerun our analysis. In addition, we include the controls for macroeconomic news (i.e., the six variables in Bauer and Swanson (2023) mentioned above). Columns (3) and (6) show the results. We see that while the point estimates for $\delta_{CBI}$ are attenuated compared to those in columns (2) and (5), respectively, they remain positive and statistically significant at the 1% level.

Our results in this section show that the sensitivity of analyst forecast revisions to Fed information is higher for more cyclical firms and that this result is robust to controlling for both macroeconomic and firm specific news.

# 3 Model

In this section, we develop a heterogeneous firm New Keynesian model featuring heterogeneity in firm cyclicality to interpret our evidence from Section 2 and study its aggregate implications. The environment consists of three components: (1) an investment component that captures heterogeneity in firms' responses to monetary policy, (2) a New Keynesian component that generates a Phillips curve, and (3) a representative household which closes the model.

## 3.1 Investment component

Time $t$ is continuous and the horizon is infinite. There is no aggregate uncertainty—we study the transition path of the economy following an unexpected monetary shock.

The investment component of the environment consists of a unit mass of firms that we refer to as wholesalers. Each wholesaler $i \in [0, 1]$ accumulates capital $K_i(t)$ and hires labor $N_i(t)$ at a real wage rate of $w(t)$ to produce an undifferentiated wholesale good. The production function is

$$y_i(t) = e^{\beta_i z(t)} K_i(t)^\alpha N_i(t)^{1-\alpha}$$

where $z(t)$ denotes aggregate productivity and we refer to $\beta_i$ as the "productivity beta" of firm $i$. Retail firms from the New Keynesian block of the environment (described later in Section 3.2) purchase wholesale goods at a per unit price of $p_w(t)$ in real terms.

Wholesalers are heterogeneous in their productivity betas whose cross-sectional distribution is given by $\beta_i \sim \Gamma$ with $\int \beta d\Gamma(\beta) = 1$ so that the average beta is one across firms. Cross-sectional differences in productivity betas give rise to differences in firm cyclicality which, in turn, lead to differences in firm policies and firms' responses to monetary shocks.

Wholesalers accumulate capital according to the law of motion

$$dK_i(t) = [\iota_i(t) - \delta] K_i(t) dt \tag{3}$$

where $\iota_i(t) \equiv I_i(t)/K_i(t)$ is the investment rate and $\delta$ is the rate of capital depreciation. Investments in capital are subject to quadratic adjustment costs so that $\left[\iota_i(t) + \frac{\kappa}{2}\iota_i(t)^2\right] K_i(t)$ is the total cost associated with an investment rate of $\iota_i(t)$.

Wholesalers are subject to Poisson exit shocks that arrive at rate $\chi$. Capital fully depreciates upon arrival of the exit shock and the affected wholesaler exits. Exiting wholesalers are replaced by newly entering wholesalers so that the total mass of wholesalers remain constant. Newly entering wholesalers are endowed with an initial capital of $K_{init}$. The role of entry and exit shocks is to ensure a stationary firm size distribution.

**Wholesalers' problem.** We now drop the subscript $i$ in referencing wholesalers in order to avoid clutter. Wholesalers' labor demand is determined by solving the static labor choice problem

$$\Phi(z(t), p_w(t), w(t); \beta)K(t) \equiv \max_{N(t)} p_w(t)e^{\beta z(t)}K(t)^\alpha N(t)^{1-\alpha} - w(t)N(t).$$

The solution implies a labor demand of $N(t, K; \beta) = K(t)n\left(z(t), p_w(t), w(t); \beta\right)$ where

$$n(z(t), p_w(t), w(t); \beta) = \left[\frac{(1-\alpha)p_w(t)e^{\beta z(t)}}{w(t)}\right]^{1/\alpha} \tag{4}$$

is the labor demand to capital ratio and

$$\Phi(z(t), p_w(t), w(t); \beta) = \alpha\left[p_w(t)e^{\beta z(t)}\right]^{1/\alpha}\left(\frac{w(t)}{1-\alpha}\right)^{1-1/\alpha} \tag{5}$$

is firm profitability as measured by the return on assets (ROA).

Wholesalers choose their investment policy to maximize the present value of future dividends

$$V(t, K; \beta) = \max_{\{\iota(s): s\geq t\}} \mathbb{E}\left[\int_t^{\tau_{exit}} e^{-\int_t^s r(u)du}\left[\Phi(z(s), p_w(s), w(s); \beta) - \iota(s) - \frac{\kappa}{2}\iota(s)^2\right]K(s)ds\right] \tag{6}$$

subject to the law of motion (3). Here, the expectation is over the time of exit $\tau_{exit}$, and the paths for the real interest rate $r(t)$, the wholesale price $p_w(t)$, and wages $w(t)$ are all taken as given by the wholesaler. In Appendix B.1, we show that the value function scales according to $V(t, K; \beta) = Kv(t; \beta)$ where the value to capital ratio $v(t; \beta)$ satisfies

$$[r(t) + \chi]v(t; \beta) = \max_{\iota} \Phi(z(t), p_w(t), w(t); \beta) - \iota - \frac{\kappa}{2}\iota^2 + v_t(t; \beta) + (\iota - \delta)v(t; \beta). \tag{7}$$

The first order condition for optimal investment is

$$\iota(t; \beta) = \kappa^{-1}\left[v(t; \beta) - 1\right]. \tag{8}$$

**Cross-sectional distribution of capital.** Let $f(t, K; \beta)$ denote the cross-sectional distribution of capital for wholesalers with productivity beta $\beta$ at time $t$. This distribution evolves according to the Kolmogorov forward equation (KFE)

$$f_t(t, K; \beta) = -\frac{\partial}{\partial K} \left[ \left( \iota(t; \beta) - \delta \right) K f(t, K; \beta) \right] + \chi \left[ \delta(K; K_{init}) - f(t, K; \beta) \right] \tag{9}$$

where $\delta(\cdot; K_{init})$ denotes the Dirac delta function with point mass at $K_{init}$. The first term on the right hand side of the KFE accounts for changes in capital due to investment while the second term accounts for changes in capital as a result of entry and exit.

## 3.2 New Keynesian component

This component of the environment generates a New Keynesian Phillips curve that relates nominal variables to the real economy.

**Retailers and final good producer.** There is a unit mass of retailers indexed by $j \in [0, 1]$. Each retailer $j$ produces a differentiated intermediate good $y_j(t)$ using the undifferentiated wholesale good as the only input. That is, retailer $j$ produces according to $y_j(t) = \widetilde{y}_j(t)$ where $\widetilde{y}_j(t)$ is the quantity of wholesale inputs used by retailer $j$.

A representative final good producer acts competitively and combines intermediate goods into the final good according to

$$Y(t) = \left( \int_0^1 y_j(t)^{1-\epsilon^{-1}} \, dj \right)^{\frac{1}{1-\epsilon^{-1}}}$$

where $\epsilon > 1$ is the elasticity of substitution across intermediate goods. The final goods aggregator implies a demand of

$$y_j(t) = Y(t) \left( \frac{p_j(t)}{P(t)} \right)^{-\epsilon} \tag{10}$$

for intermediate good $j$ when good $j$ has a nominal price of $p_j(t)$, where

$$P(t) = \left( \int_0^1 p_j(t)^{1-\epsilon} \, dj \right)^{\frac{1}{1-\epsilon}}$$

is the price index.

**New Keynesian Phillips curve.** Retailers are monopolistically competitive and set retail prices subjective to quadratic adjustment costs (Rotemberg, 1982). Specifically, retailer $j$ chooses the path of $p_j(t)$ to solve

$$\max \int_0^\infty e^{-\int_0^t r(s)ds} \Pi_j(t) \, dt \tag{11}$$

subject to the demand curve (10), where $\Pi_j(t) = \frac{p_j(t)}{P(t)} y_j(t) - p_w(t) y_j(t) - \frac{1}{2}\theta \left( \frac{p_j'(t)}{p_j(t)} \right)^2 Y(t)$ is retailer $j$'s real dividends and $\theta > 0$ is the price adjustment cost parameter.

We focus on a symmetric equilibrium in which $p_j(t) = P(t)$ and $y_j(t) = Y(t)$ for all $j$ and $t$. Let $\pi(t) = p_j'(t)/p_j(t) = P'(t)/P(t)$ denote the rate of inflation. In Appendix B.2, we show that the solution to retailers' optimal price setting problem (11) implies the following New Keynesian Phillips curve:

$$\left[ r(t) - \frac{Y'(t)}{Y(t)} \right] \pi(t) = \pi'(t) + \frac{\epsilon}{\theta} \left[ p_w(t) - p_w^\star \right] \tag{12}$$

where $p_w^\star = (\epsilon - 1)/\epsilon$.

## 3.3 Representative household

The representative household supplies labor and owns all firms in equilibrium. The representative household chooses consumption $C$ and labor $N$ to maximize utility

$$\int_0^\infty e^{-\rho t} \left( \frac{C(t)^{1-\gamma}}{1-\gamma} - \varphi N(t) \right) dt,$$

where $\rho$ is the household's subjective discount rate, $1/\gamma$ is the intertemporal elasticity of substitution, and $\varphi > 0$ is the disutility of labor. The household's saving in bonds $B(t)$ is subject to the budget constraint

$$dB(t) = [r(t)B(t) - C(t) + w(t)N(t) + \Pi(t)]\, dt$$

where $\Pi(t)$ denotes the total dividends, in real terms, that the household receives.

In Appendix B.3, we show that the solution to the household's utility maximization problem is characterized by the first order condition for labor supply,

$$w(t)C(t)^{-\gamma} = \varphi, \tag{13}$$

and the consumption Euler equation,

$$\frac{C'(t)}{C(t)} = \frac{r(t) - \rho}{\gamma}. \tag{14}$$

## 3.4 Monetary authority

The monetary authority sets the nominal interest rate $i(t)$ according to a Taylor rule:

$$i(t) = \rho + \phi_\pi \pi(t) + \varepsilon^m(t) \tag{15}$$

where $\phi_m > 1$ and $\varepsilon^m(t)$ is a deterministic monetary policy shock (which we describe in Section 3.6). In addition, nominal and real interest rates are linked by the Fisher equation

$$i(t) = r(t) + \pi(t). \tag{16}$$

We discuss our modeling of Fed information and conventional monetary shocks in Section 3.6.

## 3.5 Equilibrium

Given paths for $z(t)$ and $\varepsilon^m(t)$, an equilibrium consists of paths for (1) prices $i(t)$, $r(t)$, $\pi(t)$, $w(t)$, and $p_w(t)$, (2) wholesalers' policies $\iota(t;\beta)$, and (3) household policies $C(t)$ and $N(t)$ such that: (i) wholesalers' policies solve problem (7) taking price paths as given, (ii) household policies satisfy the first-order condition for labor supply (13) and the consumption Euler equation (14) taking price paths as given, (iii) price paths satisfy the New Keynesian Phillips curve (12), the Taylor rule (15), and the Fisher equation (16), (iv) the labor market clears: $N(t) = \int\int n\left(z(t), p_w(t), w(t); \beta\right) K f(t, K; \beta)\, dK d\Gamma(\beta)$, (v) the final good market clears: $C(t) + I(t) + \frac{1}{2}\theta\pi(t)^2 Y(t) = Y(t)$, where aggregate investment and aggregate output equal $I(t) = \int\int \left(\iota(t;\beta) + \frac{\kappa}{2}\iota(t;\beta)^2\right) K f(t, K; \beta)\, dK d\Gamma(\beta)$ and $Y(t) = \int\int n\left(z(t), p_w(t), w(t); \beta\right)^{1-\alpha} K f(t, K; \beta)\, dK d\Gamma(\beta)$, respectively, and (vi) the bond market clears: $B(t) = 0$.

### 3.5.1 Steady state

In a steady state equilibrium, all shocks are switched off and all policies and aggregate variables are constant over time. As a result, the steady state inflation rate $\pi_{ss}$, nominal interest rate $i_{ss}$, real interest rate $r_{ss}$, and wholesale prices $p_{w,ss}$ are given by $\pi_{ss} = 0$, $i_{ss} = \rho$, $r_{ss} = \rho$, $p_{w,ss} = p_w^\star$, respectively. We characterize steady state wages $w_{ss}$ and investment rate $\iota_{ss}$ in Appendix C.1.

We additionally normalize steady state productivity to $z_{ss} \equiv 0$.[7] This normalization implies that all wholesalers have identical policies and value to capital ratios in steady state, regardless of their productivity betas. That is, labor demand (4), investment (8), and firm

[7]If $z_{ss} \neq 0$, $\beta_i$ would instead capture differences in firm productivity with a more productive firm having a larger $\beta_i$ (in the case where $z_{ss} > 0$).

value (7) are all independent of $\beta_i$ in steady state. Heterogeneity in productivity betas do, however, generate differences in wholesalers' policies and firm values in response to shocks.

### 3.6 Monetary shocks and stock market response

We consider two types of monetary shocks. The first shock is a shock $\varepsilon^m(t)$ to the Taylor rule (15). The second shock is one in which the monetary authority learns about the future path of aggregate productivity $z(t)$ and subsequently shares it with all agents in the economy. Agents then respond according to their optimal policies while the monetary authority follows the Taylor rule (with $\varepsilon^m(t) = 0$). We study the equilibrium effects of these two shocks on interest rates and the aggregate stock market. In Section 4.2, we show that the first shock generates a negative comovement between interest rates and aggregate stock returns while the second shock can generate a positive comovement. For this reason, we refer to the first shock as a pure monetary shock and the second shock as a central bank information shock.

**Pure monetary shocks.** A pure monetary shock ("MP shock") has form

$$\varepsilon^m(t) = \Delta_m e^{-\psi_m t}, \quad t \geq 0, \tag{17}$$

where $\Delta_m$ and $\psi_m$ parameterize the size of the initial shock at $t = 0$ and the speed of the subsequent reversal, respectively. The specification (17) is the typical functional form for MP shocks considered in the literature (see, e.g., Kaplan, Moll, and Violante 2018, Section IV).

Note that for the case of a MP shock, our heterogeneous firm setting reduces to that of a representative firm model in which firm heterogeneity is longer present. To see this, note that $z(t) = z_{ss} = 0$ for a MP shock so that wholesalers' profitability (5) and investment rate (8) no longer depend on $\beta$.

**CBI shocks.** To motivate CBI shocks, let us first consider a total factor productivity (TFP) shock $\varepsilon^{TFP}(t)$ which we model as follows. Suppose that productivity is initially at its steady state value $z_{ss}$. A TFP shock impacts productivity immediately according to $z(t) = z_{ss} + \varepsilon^{TFP}(t)$ where

$$\varepsilon^{TFP}(t) = \Delta_{TFP} e^{-\psi_{TFP} t}, \quad t \geq 0. \tag{18}$$

Here, $\Delta_{TFP}$ parameterizes the immediate impact of the TFP shock and $\psi_{TFP}$ captures the speed of the subsequent reversal.

We model a CBI shock $\varepsilon^{CBI}(t)$ as follows. The monetary authority learns the future path of productivity $z(t) = z_{ss} + \varepsilon^{CBI}(t)$ and shares it with all agents in the economy in a FOMC announcement. Subsequently, all agents act according to their optimal policies while the monetary authority follows the Taylor rule (15) (with $\varepsilon^m(t) = 0$).

We parameterize CBI shocks as follows:

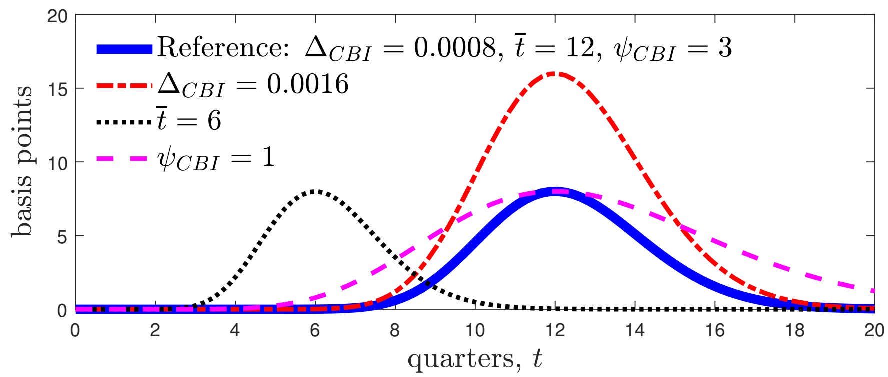
$$\varepsilon^{CBI}(t) = \Delta_{CBI} \times \left(t/\bar{t}\right)^{\psi_{CBI}\bar{t}} e^{-\psi_{CBI}(t-\bar{t})} \tag{19}$$

where $\Delta_{CBI}$, $\psi_{CBI} > 0$, and $\bar{t} > 0$ are parameters. The functional form (19) implies a hump-shaped deviation in productivity—$\varepsilon^z(t)$ always starts off at zero at $t = 0$ and increases to reach its peak value of $\Delta_{CBI}$ at $t = \bar{t}$ before subsequently decaying to zero with $\psi_{CBI}$ capturing the speed of the decay. The parameterization (19) therefore captures the idea that CBI shocks reveal information regarding the future prospects of the economy. In Figure 2, we illustrate the dependance of the CBI shock (19) on its parameters.

**Aggregate stock market.** We define the aggregate stock market as a claim on aggregate dividends $\Pi(t)$ which equals

$$\Pi(t) = \int_0^1 \left(\Phi_{it} - \iota_{it} - \frac{\kappa}{2}\iota_{it}^2\right) K_{it}\, di + \int_0^1 \Pi_j(t)\, dj$$

**Figure 2: Illustration of central bank information shocks.** This figure illustrates the central bank information (CBI) shock (19) for various parameter values. For reference, the solid line plots a CBI shock with parameter values $\Delta_{CBI} = 0.0008$, $\psi_{CBI} = 3$, and $\bar{t} = 12$. The other lines illustrate the effect of a change in the value of a single parameter (with all other parameters remaining unchanged from the reference values).




in real terms. The $\int_0^1 \left(\Phi_{it} - \iota_{it} - \frac{\kappa}{2}\iota_{it}^2\right) K_{it}\, di$ and $\int_0^1 \Pi_j(t)\, dj$ terms correspond to dividends from wholesalers and retailers, respectively; the final good producer pays out zero dividends in equilibrium. Note that equilibrium market clearing implies $\Pi(t) = C(t) - N(t)w(t)$.

The real value of aggregate stock market at time $t$, $S(t)$, equals the present value of future dividends

$$S(t) = \int_t^{\infty} e^{-\int_t^s r(u)du} \Pi(u)\, ds. \tag{20}$$

The corresponding nominal value is $S(t)/P(t)$. Assuming the economy is initially in steady state at $t = 0$, the return of the aggregate stock market upon impact of a shock at $t = 0$ is

$$r_{mkt} = \frac{S(t = 0^+) - S_{ss}}{S_{ss}} \tag{21}$$

where $S(t = 0^+)$ is the value of the stock market immediately after the arrival of the shock.

**CAPM beta.** We now define model-implied CAPM betas to connect our model to our empirical results (which use CAPM betas to measures firms' cyclicality).

Suppose the economy is initially in steady state at $t = 0$ so that wholesaler $i$'s value equals

$v_{ss}K_i(0)$ where $v_{ss}$ denotes the steady state value to capital ratio. The return of wholesaler $i$ upon impact of a shock at $t = 0$ is

$$r_i = \frac{v(t=0^+;\beta_i)K_i(0) - v_{ss}K_i(0)}{v_{ss}K_i(0)} = \frac{v(t=0^+;\beta_i) - v_{ss}}{v_{ss}} \tag{22}$$

where $v(t = 0^+; \beta_i)$ is the value to capital ratio immediately after the arrival of the shock.

The CAPM beta of wholesaler $i$ is the elasticity of the wholesaler's firm value with respect the value of the aggregate stock market:

$$\beta_{CAPM,i} \equiv \frac{r_i}{r_{mkt}} \tag{23}$$

where $r_{mkt}$ and $r_i$ are given by equations (21) and (22), respectively. Note that the CAPM beta (23) is defined with respect to a given shock. In our quantitative exercises in Section 4, we take the shock to be a TFP shock (18) when computing CAPM betas.

# 4 Quantitative Analysis

## 4.1 Calibration

We compute perfect foresight transition path following unexpected shocks with the economy starting from its steady state. We do so using the numerical procedure described in Appendix C.2. We take a unit of time to be a quarter and simulate the model using the parameter values in Table 3.

We choose household preferences as follows. We set the household's subjective discount rate to $\rho = 1.58/4\%$ so that the annualized real rate of interest is 1.58% in steady state. This value corresponds to the average of the Cleveland Fed's estimate of the one year real interest rate over the period 1982-2019 (see the series REAINTRATREARAT1YE from FRED). We

**Table 3: Parameters.** The model uses the parameters in this table. Each time period in the model corresponds to a quarter.

| Parameter | | Value | Parameter | | Value |
|---|---|---|---|---|---|
| Subjective discount rate | $\rho$ | 1.58/4% | Exit rate, wholesalers | $\chi$ | 5.5/4% |
| Intertemporal elas. of subs. | $1/\gamma$ | 1 | Initial capital endowment | $K_{init}$ | 1 |
| Disutility of labor | $\varphi$ | 2.395 | Capital coeff., wholesalers | $\alpha$ | 1/3 |
| Price adj. cost, retailers | $\theta$ | 100 | Capital adj. cost, wholesalers | $\kappa$ | 15 |
| Elas. of subs., final good | $\epsilon$ | 10 | Depreciation rate | $\delta$ | 6.86/4% |
| Taylor rule coeff. | $\phi_\pi$ | 1.25 | | | |

Cross-sectional distribution of productivity betas, $\Gamma$

| Bin | $\beta_i$ | Bin | $\beta_i$ |
|---|---|---|---|
| Bin #1 | 0.35 | Bin #6 | 1.01 |
| Bin #2 | 0.56 | Bin #7 | 1.12 |
| Bin #3 | 0.69 | Bin #8 | 1.26 |
| Bin #4 | 0.79 | Bin #9 | 1.46 |
| Bin #5 | 0.91 | Bin #10 | 1.84 |

Shocks

| | | | | | |
|---|---|---|---|---|---|
| MP shock, size | $\Delta_m$ | 0.0037 | CBI, size at peak | $\Delta_{CBI}$ | 0.0008 |
| MP shock, mean reversion | $\psi_m$ | 0.5 | CBI, time of peak | $\bar{t}$ | 12 |
| TFP shock, size | $\Delta_{TFP}$ | 0.01 | CBI, speed of decline | $\psi_{CBI}$ | 3 |
| TFP shock, mean reversion | $\psi_{TFP}$ | $-\log 0.9$ | | | |

set the intertemporal elasticity of substitution $1/\gamma$ to one which is the same value used in Kaplan, Moll, and Violante (2018), henceforth KMV, and Ottonello and Winberry (2020), henceforth OW. We set the disutility of labor $\varphi = 2.395$ in order to target steady state hours of $N_{ss} = 1/3$.

We set the elasticity of substitution across intermediate goods to $\epsilon = 10$ as in KMV and OW; this implies a steady state markup of 11%. We set retailers' price adjustment cost parameter to 100 which implies a slope of $\epsilon/\theta = 0.1$ in the New Keynesian Phillips curve (12); the latter is the slope value in KMV and OW. We set the coefficient on inflation to $\phi_\pi = 1.25$ in the Taylor rule (15) exactly as in KMV and OW.

We choose wholesalers' parameters as follows. We set the exit rate to $\chi = 5.5/4\%$ based on an average plant exit rate of 5.5% per anum documented in Lee and Mukoyama (2015, Table 2). We normalize the initial capital endowment to one, $K_{init} = 1$. We set the capital coefficient to $\alpha = 1/3$ in the production function which implies a steady state labor share of $(1 - \alpha)(\epsilon - 1)/\epsilon = 60\%$. We set capital adjustment costs to $\kappa = 15$ so that the impulse response of aggregate investment to a pure monetary shock is roughly twice that of the response in aggregate output (see the estimates in, e.g., Christiano, Eichenbaum, and Evans 2005, Fig. 1). We choose the capital depreciation rate to target a steady state capital growth rate $d \log k/dt = (\iota_{ss} - \delta)$ of 5% per anum based on the average cross-sectional capital growth rate in our sample (see Table 1—the average two year capital growth rate is 10.1%). This results in setting $\delta = 6.86/4\%$.

We calibrate the cross-sectional distribution of productivity betas $\Gamma$ to target the distribution of CAPM betas in the data. Specifically, we take $\Gamma$ to be a histogram of ten equally-sized bins in which the value of beta $\beta_i$ is the same within each bin. We then choose the ten bin values $\{\beta_i\}_{i=1,\dots,10}$ to minimize the sum squared error $\sum_{i=1}^{10} \left(\beta_{CAPM,i} - \beta_{CAPM,i}^{data}\right)^2$ between the model-implied CAPM betas $\beta_{CAPM,i}$ and their data counterparts $\beta_{CAPM,i}^{data}$ subject to the constraint that the cross-sectional average of betas equal one. In computing the model-implied CAPM beta (23), we take the shock to be a TFP shock (18) with initial size $\Delta_{TFP} = 0.01$ and rate of decay $\psi_{FTP} = -\log 0.9$ (the implied quarterly autocorrelation coefficient is 0.9, a typical value considered by the real business cycle; see, e.g., King, Plosser, and Rebelo 1988). We take the data counterparts $\beta_{CAPM,i}^{data}$ to be the median value of CAPM betas within each decile; these values equal 0.33, 0.57, 0.72, 0.84, 0.97, 1.09, 1.22, 1.38, 1.61, and 2.05 for deciles one through ten, respectively. The solution to the minimization problem gives productivity betas of 0.35, 0.56, 0.69, 0.79, 0.91, 1.01, 1.12, 1.26, 1.46, and 1.84 in deciles one through ten, respectively. The corresponding model-implied CAPM betas are 0.06, 0.30,

**Table 4: Model-implied moments.**

| Moment | Description | Value | Moment | Description | Value |
|---|---|---|---|---|---|
| | | A. Steady state moments | | | |
| $r_{ss}$ | Real rate, annualized | 1.58% | $N_{ss}$ | Hours | 1/3 |
| $\pi_{ss}$ | Inflation, annualized | 0% | $N_{ss}w_{ss}/Y_{ss}$ | Labor share of output | 60% |
| $i_{ss}$ | Nominal rate, annualied | 1.58% | $C_{ss}/Y_{ss}$ | Consumption to output | 75.2% |
| $1/p_w^\star - 1$ | Markup | 11% | $I_{ss}/Y_{ss}$ | Investment to output | 24.8% |
| $\iota_{ss} - \delta$ | Capital growth, annualized | 5% | $\Phi_{ss}$ | Profitability/ROA, annualized | 17.5% |
| | | B. Cross-sectional distribution of firm cyclicality | | | |
| $\beta_{CAPM,1}$ | Decile 1 | 0.06 | $\beta_{CAPM,6}$ | Decile 6 | 0.82 |
| $\beta_{CAPM,2}$ | Decile 2 | 0.30 | $\beta_{CAPM,7}$ | Decile 7 | 0.95 |
| $\beta_{CAPM,3}$ | Decile 3 | 0.45 | $\beta_{CAPM,8}$ | Decile 8 | 1.11 |
| $\beta_{CAPM,4}$ | Decile 4 | 0.57 | $\beta_{CAPM,9}$ | Decile 9 | 1.34 |
| $\beta_{CAPM,5}$ | Decile 5 | 0.70 | $\beta_{CAPM,10}$ | Decile 10 | 1.78 |

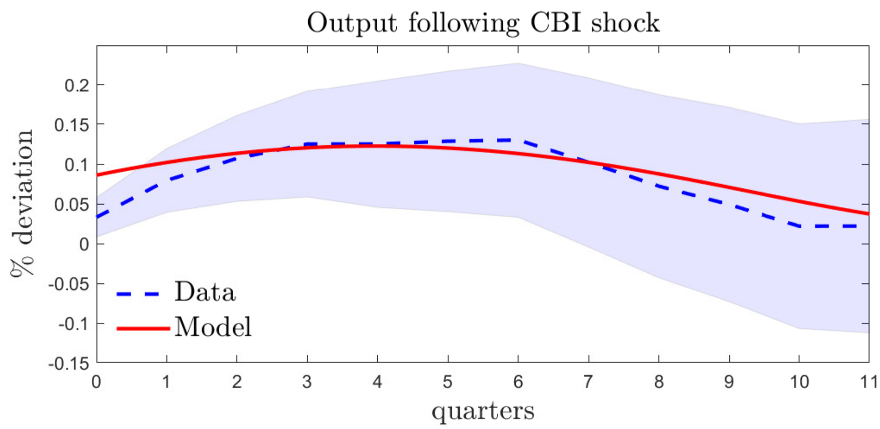
0.45, 0.57, 0.70, 0.82, 0.95, 1.11, 1.34, and 1.78 for deciles one through ten, respectively.

Table 4 summarizes the model-implied moments; Figure C.1 in Appendix C.1 displays the steady state capital distribution.

**Monetary shocks.** We investigate transition paths following MP and CBI shocks. For the MP shock (17), we set the speed of mean-reversion to $\psi_m = 0.5$ as in KMV and OW and choose the initial size of the shock to be $\Delta_m = 0.0037$ so that the nominal interest rate increases by 25 basis points upon impact of the shock.

For the CBI shock (19), we choose parameters so that (1) the nominal interest rate increases by 25 basis points upon impact of the shock, and (2) the model-implied output path following the CBI shock is in line with the data. Satisfying requirement (1) means setting the peak of the CBI shock to $\Delta_{CBI} = 0.0008$. For requirement (2), we first estimate the output path following a CBI shock by estimating cumulative GDP growth following a CBI shock, $\log GDP_{t+h} - \log GDP_{t-1} = a_h + b_h CBI_t + \epsilon_{t+h}$, over the period 1990Q1-2019Q2 for which

**Figure 3: Calibration of CBI shock.** The dashed line plots the point estimates of cumulative output growth following a 25 basis point CBI shock; the shaded region plots the plus and minus two standard error confidence bands. The solid line plots the model-implied counterpart for output growth.




CBI shocks are available. The resulting point estimates for the transition path following a 25 basis point CBI shock is $0.0025 \times \widehat{b}_h$ where $\widehat{b}_h$ is the slope coefficients estimate for quarter $h$. The dashed line in Figure 3 plots these point estimates while the shaded region plots the corresponding two standard error confidence band. We then choose the remaining parameters of the CBI shock (19), $\psi_{CBI}$ and $\bar{t}$, so that the model-implied output path following a CBI shock is in line with the data. This procedure results in setting $\bar{t} = 12$ and $\psi_{CBI} = 3$. The solid line in Figure 3 shows that the resulting model-implied path for output is indeed in line with the data.

#### 4.1.1 Validation

Next, we compare our model's cross-sectional implications for sales following monetary shocks to the findings from columns (1) to (3) of Table 2. Since these model-implied cross-sectional results are not targets in our calibration, they serve as validation for our modelling approach.

Figure 4 plots the cross-sectional difference in the cumulative growth of sales, $\log Sales(h; \beta_i) - \log Sales_{ss}$, $h = 8$ quarters following a monetary shock. Here, $Sales(t; \beta_i) =$

$p_w(t)y_i(t)$ denotes the sales of a firm in the $i$th beta decile while $Sales_{ss}$ refers to steady state sales (which does not depend on productivity betas). We see that our model-implied differences in sales responses aligns with our findings in columns (1) through (3) of Table 2. Specifically, there is no cross-sectional difference in the response a MP shock, whereas the response to a CBI shock increases with the firm's beta. In our model, a positive CBI shock signals an increase in future aggregate productivity $z(t)$. Consequently, firms with higher productivity betas $\beta_i$ experience larger gains in productivity and sales. In contrast, the absence of heterogeneity in the response of sales following a MP shock is because, as discussed in Section 3.6, our model reduces to a representative firm setting for MP shocks.

The model-implied results for cross-sectional differences in earnings per share (EPS) also align with the findings from columns (4) through (6) of Table 2—there is no cross-sectional difference in EPS following a MP shock and the cross-sectional difference in EPS is increasing in firms' beta for a CBI shock. We omit these model-implied differences for brevity.

## 4.2 Transition paths following MP and CBI shocks

The main finding of this section is that shocks to the future path of productivity $\varepsilon^{CBI}(t)$ are consistent with the effects of CBI shocks observed in the data—both in the time-series and in the cross-section.

### 4.2.1 Aggregate response

**MP shock.** Figure 5 shows the aggregate response following the calibrated contractionary MP shock. We see that the MP shock decreases economic activity and generates a negative comovement between interest rates and stock returns—the nominal rate increases by 25 basis points while the aggregate stock price decreases by 66 basis points upon impact of the shock.

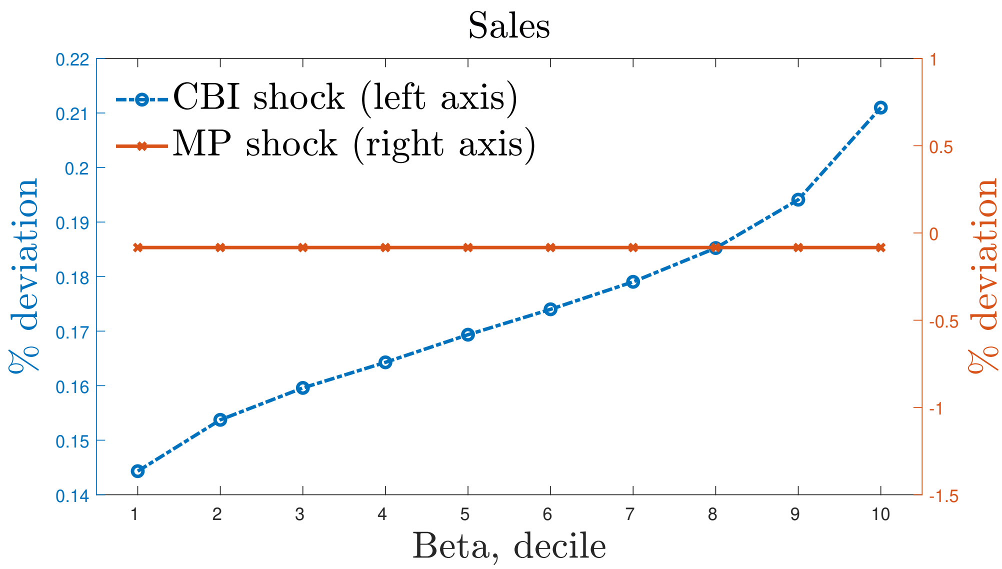



**Figure 4: Monetary shocks and the cross-sectional response in sales.** This figure plots the cumulative growth in sales $h = 8$ quarters following a shock. The lines with the crosses and circles show results for pure monetary and CBI shocks, respectively.

The reason for the decrease in economic activity is as follows. A contractionary MP shock increases nominal rates, and since prices are sticky, also increases the real rate. Higher real rates dampen investment by decreasing the present value of the cash flows generated by capital. Higher real rates also decrease household demand for consumption due to intertemporal smoothing. The resulting contraction in economic activity lowers inflation and is reflected in a drop in the value of the aggregate stock market.

**CBI shock.** Figure 6 shows the aggregate response following the calibrated CBI shock. We see that there is a positive comovement between the equilibrium nominal short interest rate and the level of the aggregate stock market—upon impact, the 25 basis point increase in the nominal rate is accompanied by a 3 basis point increase in the aggregate stock price.

The reason for the positive comovement between the stock price and the nominal short rate is as follows. A positive CBI shock $\epsilon^{CBI}(t)$ carries news about an upward revision in

**Figure 5: Aggregate responses to a contractionary MP shock.** This figure plots the aggregate impulse response to a pure monetary shock (17) with $\Delta_m = 0.0037$ and $\psi_m = 0.5$. The transition path is the perfect foresight path following an unexpected shock with the economy starting from its steady state.

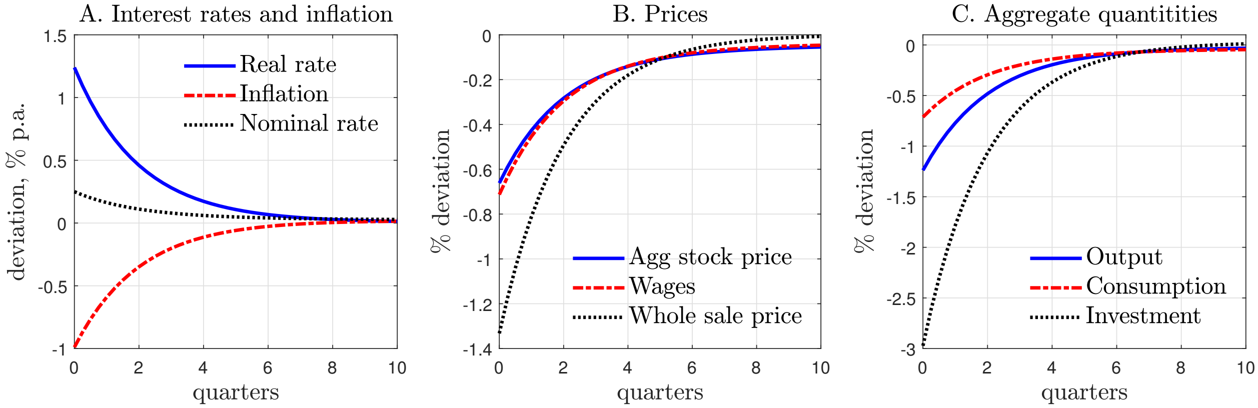
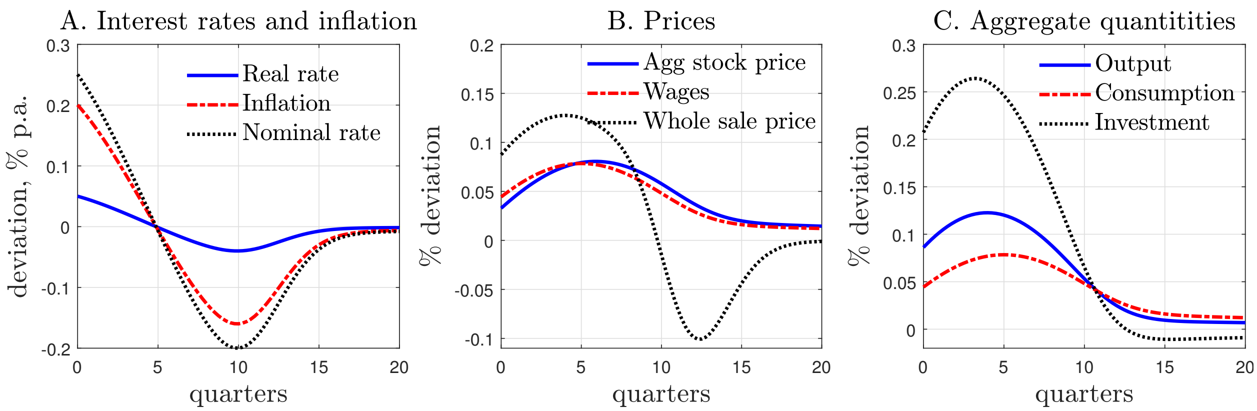



**Figure 6: Aggregate responses to an expansionary CBI shock.** This figure plots the aggregate impulse response to a CBI shock (19) with $\Delta_{CBI} = 0.0008$, $\psi_{CBI} = 3$, and $\bar{t} = 12$. The transition path is the perfect foresight path following an unexpected shock with the economy starting from its steady state.



future aggregate productivity. Therefore, following its realization, firms increase investment (see the dotted line in panel C of Figure 6) and gradually build up capital.[8] Output and consumption follow a similar pattern, with consumption peaking around $t = 5$ quarters after the shock (see the dash-dot line in panel C). A positive shock to expected consumption growth decreases household's demand for bonds, driving up the real short interest rate (see solid line in panel A). The nominal short rate also increases because of this increase in the real rate (see dotted line in panel A).

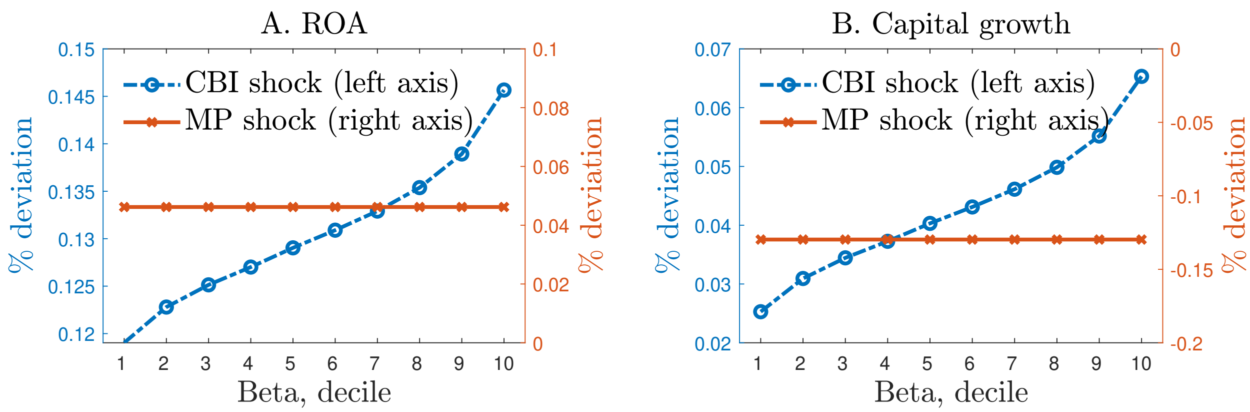
There are two opposing forces which influence the stock price following news about future productivity. First, an increase in future productivity $z(t)$ increases future dividends, which, all else equal, pushes up the stock price. Second, an increase in the real rate pushes down the stock price. In our calibration, the cash flow effect dominates, so that the stock price increases following a positive $\epsilon^{CBI}(t)$ shock.

## 4.3 The profitability channel and firm investment

In this section, we discuss two cross-sectional predictions of our model. First, our model predicts cross-sectional differences in future firm profitability in the period following a CBI shock and no such heterogeneity following a MP shock. Panel A of Figure 7 reports the results for average growth in profitability (5) $h = 8$ quarters following a shock: $\log \Phi(h; \beta_i) - \log \Phi_{ss}$ for each beta decile. The line with circles shows profitability growth following a positive CBI shock. We see that our model predicts more cyclical firms to have a greater increase in future profitability following this shock. The intuition for this prediction is as follows. The positive CBI shock arises in equilibrium because Fed information predicts an increase in future aggregate productivity. This expected increase in aggregate productivity implies

[8] Quickly building up capital is suboptimal since there is no immediate increase in productivity following a CBI shock.

**Figure 7: Cross-sectional response: $h = 8$ quarters.** Panels A and B plot ROA and cumulative growth in capital $h = 8$ quarters following a shock, respectively. The lines with the crosses and circles report results for pure monetary and CBI shocks, respectively.




a larger increase in productivity for more cyclical firms relative to less cyclical firms. The greater increase in productivity for more cyclical firms, in turn, implies a greater increase in profitability for such firms.

In contrast to the heterogenous cross-sectional response of future profitability to a CBI shock, the line with crosses in panel A of Figure 7 shows that our model predicts a homogeneous cross-sectional response of future firm profitability to a pure monetary (MP) shock. We analyze such cross-sectional differences in firm profitability in response to CBI and MP shocks in Section 5.1. We find support for our model's prediction in the data.

Second, our model predicts cross-sectional differences in firm investment following a CBI shock and no such heterogeneity in investment response following a MP shock. In particular, consider a firm whose beta is in the $i$th decile. Its cumulative growth rate in capital $h$ quarters after a shock at $t = 0$ equals $\log K_i(h) - \log K_i(0) = \int_0^h [\iota(t; \beta_i) - \delta]\, dt$ compared to $\int_0^h [\iota_{ss} - \delta]\, dt$ had no shock occurred at $t = 0$. The effect of the shock on capital accumulation is therefore $\int_0^h [\iota(t; \beta_i) - \iota_{ss}]\, dt$. Panel B of Figure 7 plots the effect of a CBI and a MP shock on capital accumulation for a horizon of $h = 8$ quarters. Similar to the prediction for profitability, we see that capital growth is higher for firms with higher betas following a CBI shock (see the line with the circles) while there is no cross-sectional difference following a MP shock (see the line with the crosses).

The heterogeneous investment response to a CBI shock is driven by differences in firm profitability. Specifically, following a positive CBI shock, more cyclical firms experience a greater increase in future profitability compared to less cyclical firms. Furthermore, as discussed in Section 4.2, a positive CBI shock is realized when the increase in future productivity is large enough to overwhelm the opposing effect of an increase in the real rate on the value of the aggregate stock market. For firms, this relatively large increase in aggregate productivity increases the present value of investing, with more cyclical firms experiencing a greater increase in the value of investing. Because the investment decisions are driven by changes in firm profitability, we call this the "profitability channel" of monetary policy. We analyze such cross-sectional differences in the capital growth of firms following CBI and MP shocks in Section 5.2. We find support for our model's prediction in the data.

# 5 Evidence for the profitability channel

In this section, we provide evidence for the cross-sectional predictions from Section 4.3. Section 5.1 and Section 5.2 show results for cross-sectional differences in firms' profitability and investment following monetary shocks, respectively. While the analyst revision analysis in Section 2.2 was at the FOMC meeting level, the analysis in this section is at a quarterly frequency.

## 5.1 Profitability channel

In Section 4.3, our model predicts a profitability channel in which positive Fed information forecasts larger increases in profitability for more cyclical firms. We now provide evidence for this prediction based on the following panel regression:

$$\text{Profit}_{i,t-4+4n\to t-1+4n} = \delta_{CBI,n}(\beta_i \times CBI_t) + \delta_{MP,n}(\beta_i \times MP_t) + \boldsymbol{\gamma}'\boldsymbol{X}_{i,t-1} + \eta_i + \theta_{s,t} + \epsilon_{i,t}. \quad (24)$$

The dependant variable $\text{Profit}_{i,t-4+4n\to t-1+4n}$ is the realized annual profitability in the $n$th year following quarter $t$ monetary shocks, where profitability is measured as a firm's return on assets. We include the same firm-level controls as regression (2). We also include firm and sector by year-quarter fixed effects. All standard errors are clustered at the firm and year-quarter level.

We use quarterly Compustat data to compute firms' future annual realized profitability, which is the sum of quarterly operating income before depreciation (*oibdpq*) in the first year (or second or third year, depending on the horizon) and divide it by the corresponding lagged total asset. Since the analysis is at a quarterly frequency, we follow the literature and construct quarterly monetary shocks by summing up the meeting level monetary shocks within each quarter. In computing this sum, we follow Nakamura and Steinsson (2018) and focus only on scheduled FOMC meetings.[9] Similarly, we construct quarterly economic news shocks by summing up the meeting level economic news shocks within each quarter.

Table 5 reports the results for the profitability regression (24). We see that the coefficient $\delta_{CBI,n}$ for the interaction term between firm cyclicality and CBI shocks is insignificant for the first year and becomes positive and statistically significant in the second at third year.

[9] The quarterly shocks we obtain is slightly different from the quarterly data provided by Jarociński and Karadi (2020). This is because Jarociński and Karadi (2020) also include unscheduled FOMC meetings when reporting their quarterly shock. Our results remain robust if we directly use their quarterly shocks.

**Table 5: Firm cyclicality and realized profitability following monetary shocks.** This table reports the results for regression (24) for $n \in \{1, 2, 3\}$ years. *, **, and *** indicate significance at the 10%, 5%, and 1% level, respectively. Standard errors are clustered at the firm and year-quarter level and are reported in parentheses.

| | $n = 1$ year | | $n = 2$ year | | $n = 3$ year | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| CBI $\times\ \beta$ | 0.021 | -0.009 | 0.094*** | 0.065* | 0.081** | 0.107** |
| | (0.032) | (0.031) | (0.033) | (0.036) | (0.036) | (0.041) |
| MP $\times\ \beta$ | 0.024 | -0.003 | -0.041** | -0.055*** | -0.003 | -0.004 |
| | (0.020) | (0.020) | (0.018) | (0.020) | (0.021) | (0.022) |
| Observations | 341,604 | 341,604 | 307,663 | 307,663 | 283,926 | 283,926 |
| $R^2$ | 0.775 | 0.775 | 0.703 | 0.703 | 0.699 | 0.699 |
| Firm-level Controls | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Economic News $\times\ \beta$ | | ✓ | | ✓ | | ✓ |
| Firm FE | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Sector $\times$ Time FE | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |

The coefficient $\delta_{MP,n}$ for the interaction term between firm cyclicality and MP shocks is less significant compared to the $\delta_{CBI,n}$. Specifically, $\delta_{MP,n}$ is insignificant for $n = 1$ and $n = 3$ years, while it is negative and significant at the 5% level for $n = 2$ years. Overall, we see that these results are broadly consistent with our model's predictions in Section 4.3. Our results are also consistent with the results from the contemporaneous paper by Golez et al. (2025) who use a different measure of Fed information shock (namely, one constructed from dividend strips) and find that the profitability of high CAPM beta firms is more sensitive to Fed information shocks than low CAPM beta firms.

## 5.2 Fed information effect and firm-level investment response

In this section, we provide evidence that (1) more cyclical firms have a higher investment sensitivity to the CBI shock, and (2) there is no heterogeneity in the investment response to

**Table 6: Firm cyclicality and the investment response to monetary shocks.** This table reports the results for regression (25) with $h = 8$ quarters. *, **, and *** indicate significance at the 10%, 5%, and 1% level, respectively. Standard errors are clustered at the firm and year-quarter level and are reported in parentheses.

| | (1) | (2) |
|---|---|---|
| CBI $\times$ $\beta$ | 0.543*** | 0.395*** |
| | (0.103) | (0.096) |
| MP $\times$ $\beta$ | 0.031 | -0.041 |
| | (0.063) | (0.053) |
| Observations | 331,364 | 331,364 |
| $R^2$ | 0.350 | 0.351 |
| Firm-level Controls | ✓ | ✓ |
| Economic News $\times$ $\beta$ | | ✓ |
| Firm FE | ✓ | ✓ |
| Sector $\times$ Time FE | ✓ | ✓ |

the MP shock between more and less cyclical firms. These results are consistent with our model's predictions from Section 4.2.

We investigate the following panel regression:

$$\Delta logk_{i,t-1\to t-1+h} = \delta_{CBI,h}\left(\beta_i \times CBI_t\right) + \delta_{MP,h}\left(\beta_i \times MP_t\right) + \boldsymbol{\gamma}'_h \boldsymbol{X}_{i,t-1} + \eta_i + \theta_{s,t} + \epsilon_{i,t}. \quad (25)$$

We measure firm $i$'s investment rate as the log change in firm $i$'s capital stock, $\Delta logk_{i,t-1\to t-1+h} \equiv \log k_{i,t-1+h} - \log k_{i,t-1}$, starting from the end of quarter $t-1$ to the end of quarter $t-1+h$. We follow Ottonello and Winberry (2020) and use quarterly Compustat data to construct capital stock based on the perpetual inventory method. We construct quarterly monetary shocks by summing up the meeting level monetary shocks within each quarter (as in Section 5.1). The remaining specification is the same as regression (24).

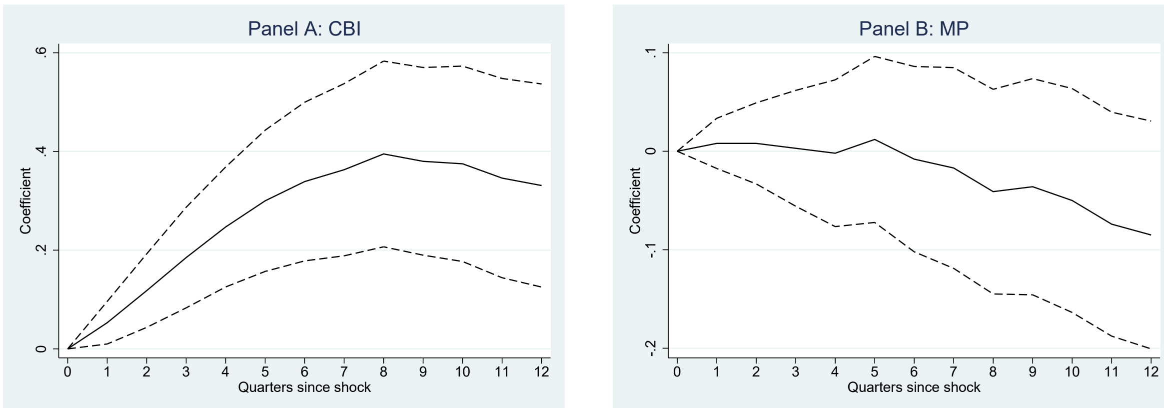
We first discuss our results for the investment response $h = 8$ quarters following FOMC announcements; our results for the full dynamic response of appears after this discussion. Table 6 reports the results for regression (25) for $h = 8$ quarters. Column (1) shows that the coefficient for the interaction between firm cyclicality and CBI shocks, $\delta_{CBI,8}$, is positive and statistically significant at the 1% level. This implies that more cyclical firms have higher investment rate sensitivity to CBI shocks compared to less cyclical firms. Column (2) shows results when we additionally include interactions between firm cyclicality and all six news variables from Bauer and Swanson (2022). We see that the coefficient $\delta_{CBI,8}$ remains positive and statistically significant at the 1% level. The point estimate from column (2) implies a firm has $0.395 \times 0.8882 = 0.35$ units higher semi-elasticity of investment to the CBI shock when it has a CAPM beta that is one standard deviation higher than the typical firm in our sample.

Table 6 additionally shows that the coefficient $\delta_{MP,8}$ for the interaction term between firm cyclicality and MP shocks is insignificant. That is, there is no cross-sectional difference in the investment rate response to an MP shock between less cyclical and more cyclical firms.

**Dynamic investment response.** While the results above are for $h = 8$ quarters, in Figure 8 we report estimates for the coefficients $\delta_{CBI,h}$ and $\delta_{MP,h}$ for regression (25) for $h = 1, 2, ..., 12$ quarters. These coefficients capture differences in cumulative capital growth across firms over the $h$ quarters following an FOMC announcement. We include all controls throughout this exercise, including the interaction terms involving all six news variables from Bauer and Swanson (2022).

The left panel in Figure 8 shows a large and persistent difference in the investment response to a CBI shock between more and less cyclical firms. The interaction coefficient $\delta_{CBI,h}$ increases from $h = 1$ to $h = 8$ quarters, and flattens out afterwards. In contrast, the

**Figure 8: Dynamic investment response to CBI and MP shocks.** The left and right panels plot estimates of $\delta_{CBI,h}$ and $\delta_{MP,h}$, respectively, for $h = 1, 2, \cdots, 12$ quarters. The solid line plots the point estimates while the dashed lines show 95% confidence intervals.



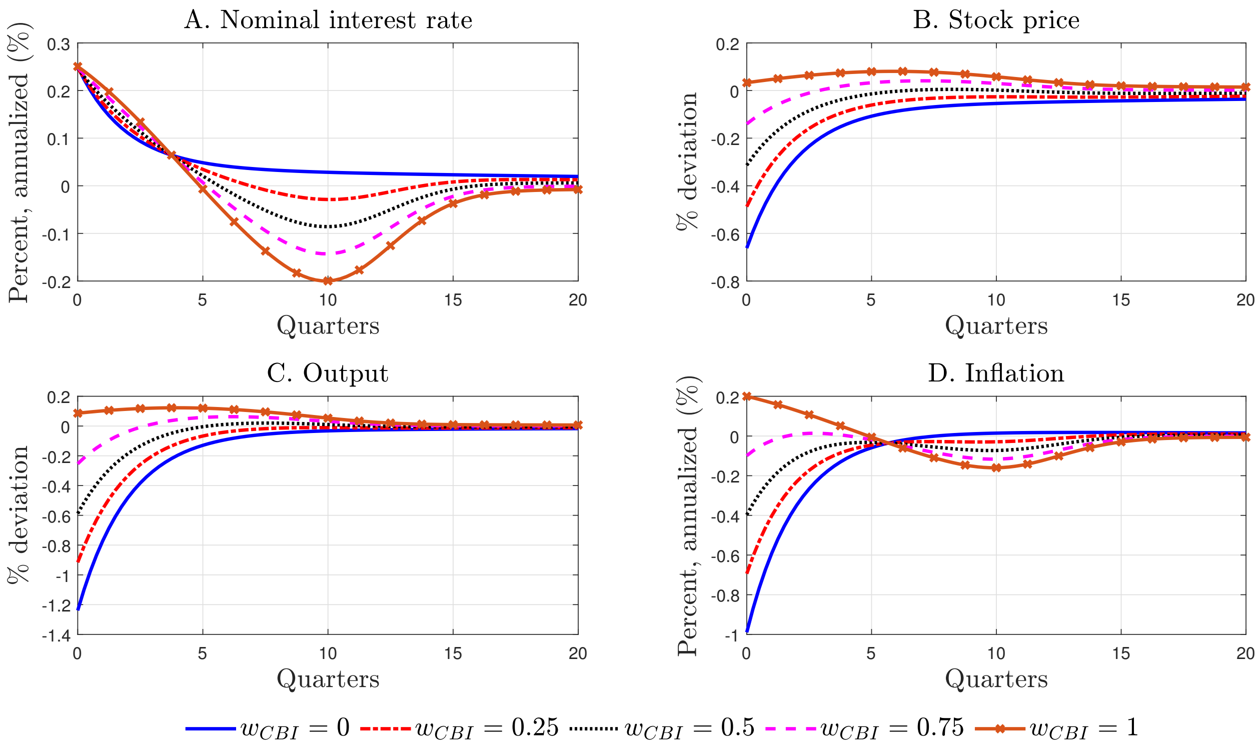

right panel shows that $\delta_{MP,h}$ is insignificant over this range of $h$; that is, there is no difference in the investment rate response between more and less cyclical firms to an MP shock over the 12 quarters following FOMC announcements.

# 6 Fed information effect and inflation

While we have analyzed pure monetary and CBI shocks in Section 4.2, interest rate shocks are, more generally, combinations of pure monetary and CBI shocks. In this section, we analyze the impact of mixtures of pure monetary and CBI shocks. We show that the presence of information in a given interest rate shock can dampen the response of inflation. That is, the presence of the Fed information effects implies that policy makers must respond more strongly to inflation that would be otherwise necessary. This is consistent with concerns recently raised by policy makers.[10]

[10]For example, Fed Governor Christopher J. Wallace stated at the European Economics and Financial Center, London, United Kingdom on October 18, 2023: "[b]ut I also can't avoid thinking about the second scenario, where demand and economic activity continue at their recent pace, possibly putting persistent upward pressure on inflation and stalling or even reversing progress toward 2 percent... Thus, more action

**Figure 9: Fed information effect and inflation.** This figure plots the transition path following a mixed interest rate shock consisting of a CBI shock of size $w_{CBI} \times \varepsilon^{CBI}(t)$ and a MP shock of size $(1 - w_{CBI}) \times \varepsilon^{m}(t)$.




We define a mixed interest rate shock as follows. Consider the calibrated MP and CBI shocks, $\varepsilon^{m}(t)$ and $\varepsilon^{CBI}(t)$, respectively. An economy hit by a mixed interest rate shock simultaneously encounters a CBI shock of size $w_{CBI} \times \varepsilon^{CBI}(t)$ and a MP shock of size $(1 - w_{CBI}) \times \varepsilon^{m}(t)$. Here, the weight $w_{CBI} \in [0, 1]$ parameterizes the strength of the information effect in the mixed interest rate shock.

Figure 9 shows the impulse responses following mixed interest rate shocks as we vary $w_{CBI}$. Although all values of $w_{CBI}$ result in an initial interest rate spike of 25 basis points (see panel A), the inflation response is very different (see panel D). For example, when $w_{CBI} = 0.75$ so

would be needed on the policy rate to ensure that inflation moves back to target and expectations remain anchored." Also see Section 1 for a related quote by Fed Chair Jerome H. Powell.

that the information effect is strong, we see that inflation remains almost unchanged (see the dashed line in panel D). In contrast, inflation decreases significantly when the information effect is weak. The reason for the sluggish inflation response when the information effect is strong can be seen panel C. Specifically, output responds strongly when the information effect is strong. This increase in economic activity increases inflation and offsets the dampening effect of higher interest rates on inflation. Finally, panel B shows that the strength of the information effect can be gleamed from the stock price response with stock prices responding more positively when the information effect is stronger.

## 6.1 How hard does the Fed have to push?

In this section, we examine how much more aggressively the monetary authority must act to achieve a desired inflation outcome when monetary policy is influenced by Fed information effects. We find that for every 1 basis point increase in news about peak future productivity revealed through Fed information, the monetary authority must raise nominal interest rates by an additional 3.7 basis points to reach the same inflation outcome as in a scenario without Fed information effects. We provide details below.

First, we define the desired inflation outcome as the reduction in inflation resulting from a contractionary MP shock (17) that causes a 25 basis point increase in the nominal interest rate. In this setup, we disable the CBI shock (19) so that the desired inflation outcome reflects conditions without Fed information effects. As shown in Panel A of Figure 5, this setup results in a 1% per annum reduction in inflation upon impact which we take as the desired inflation outcome.

Next, we incorporate information effects by gradually increasing the peak value of the CBI shock $\Delta_{CBI}$. For each value of $\Delta_{CBI}$, the monetary authority adjusts the size of its MP

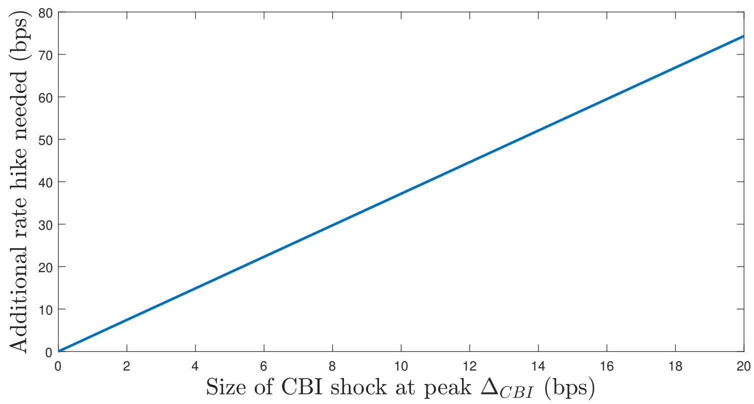



**Figure 10: Additional increase in the nominal interest rate that is needed to offset Fed information effects.** This figure illustrates the additional increase in the nominal interest rate that is required to offset the influence of Fed information effects and achieve a 1% reduction in inflation.

shock $\Delta_m$ so as to achieve the desired inflation outcome. All other parameters remain fixed at their values in Table 3.

Figure 10 illustrates the additional interest rate hike that is necessary (over and above the 25 basis points needed in the absence of Fed information effects) to achieve the desired inflation outcome. We see that the relation between the magnitude of the Fed information effect and the additional required interest rate increase is linear with a slope of 3.7—every 1 basis point increase in news about peak future productivity requires an additional 3.7 basis points interest rate increase. This is because a larger nominal rate increase is needed to achieve the same desired inflation outcome, as Fed information effects dampen the inflation response.

# 7 Conclusion

The economic outlook provided by the Federal Reserve is widely followed by financial markets and corporate managers, and constitutes an important communication tool of monetary policy. In this paper, we show that the Fed's private information released during FOMC announcements affects firm investment.

We first show that equity analysts covering individual firms revise their forecasts of future sales following FOMC announcements in a manner consistent with the existence of Fed information. Specifically, we show that more cyclical firms see a greater upward (downward) revision in analyst forecasts of sales following the release of positive (negative) economic news. We view our analysis of analyst forecast revisions to be an important first step in testing if Fed information has real effects since expectations are expected to respond sooner to Fed information than the actual implementation of investment plans. Furthermore, expectations are also observed at a higher frequency—monthly rather than the quarterly investment series.

We use our evidence of analyst forecast revisions to construct a New Keynesian heterogeneous firm model to analyze Fed information's effect on firm investment. Our model makes two predictions. First, it predicts more cyclical firms to have a higher sensitivity of firm profitability to Fed information. We find evidence of this profitability channel of monetary policy. Second, it predicts more cyclical firms to have a higher sensitivity of their investment rate to Fed information. We provide evidence for this prediction.

At the aggregate level, our model predicts a muted response of inflation to a Fed Funds rate increase when Fed announcements signal higher than average future productivity. Quantitatively, we find that every 1 basis point increase in news about peak future productivity requires an additional 3.7 basis points increase in the Fed Funds rate to achieve the same inflation outcome as in a scenario without news about higher than average future productivity. Our model therefore provides a potential reason for inflation's slow decline in 2022-2023 despite aggressive rate hikes.

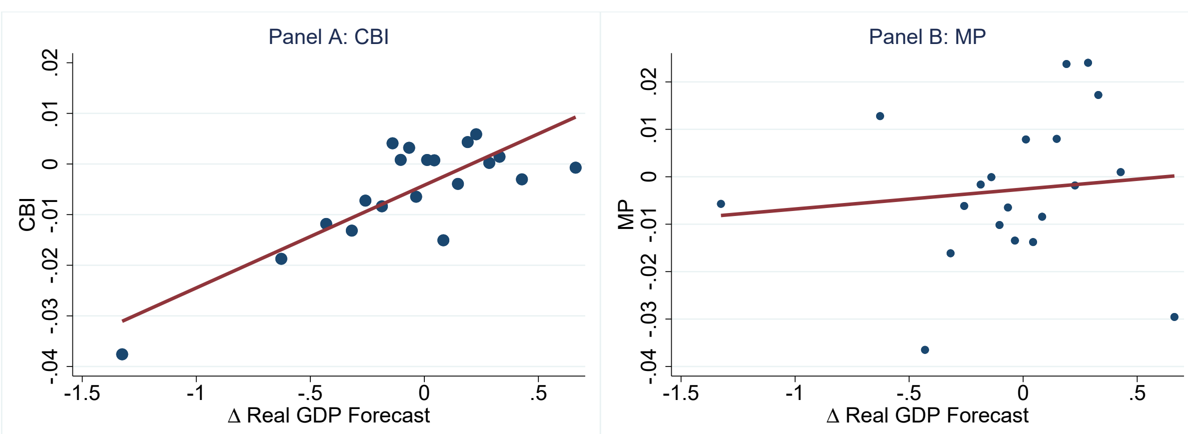
# Appendix

## A Revisions in Fed forecasts and the CBI shock

In this section, we provide new evidence that the Fed information shock that they identify is correlated with revisions in the Fed's internal forecasts. To do so, we use forecasts contained in the Tealbook (formerly, the Greenbook) which contains the Fed's future economics projections prepared prior to each FOMC meeting. Tealbook forecasts are not available to the public in real time; they are made available to the public with a five year lag. The hypothesis we want to test here is that the Fed's assessment of future economic outlook contained in the Tealbook is at least partially communicated to the public during FOMC announcements which are then reflected in movements of the S&P 500 and interest rates.

We analyze the period January 1990—June 2019. We follow the literature and restrict our empirical analysis to scheduled FOMC meetings (see, e.g., Nakamura and Steinsson 2018 and Bauer and Swanson 2023). We use Tealbook forecasts of real GDP growth that have been made public and are available from the Philadelphia Fed. We analyze the correlation between revisions in the Tealbook forecast of real GDP and the CBI (MP) shocks. We compute the revision in real GDP growth forecast as the change in the real GDP growth forecast from the previous FOMC meeting to the current meeting. Following Nakamura and Steinsson (2018), we focus on the forecast for the next three quarters, and compute the average of the revisions for each of those three quarters.

**Figure A.1: Tealbook revisions in real GDP forecasts and monetary policy shocks.** Panels A and B show the binned scatter plot of revisions in Tealbook forecasts of real GDP growth over the three quarters following a FOMC meeting against the corresponding CBI and MP shocks, respectively. Both the CBI and MP shocks are standardized.




Panel A of Figure A.1 shows that revisions in the Fed's internal forecast of real GDP are positively correlated with the CBI shock, while panel B shows that there is almost no correlation between the Tealbook revisions in real GDP forecasts and the MP shock. This suggests that even though Tealbook forecasts are not publicly available in real-time, the Fed's assessment of future economic outlooks is at least partially communicated to the public during FOMC announcements, and the CBI shock captures some of the information shock. In addition to the results in this section, we refer the reader to Jarociński and Karadi (2020) who provide evidence that a positive (negative) CBI shock forecasts an increase (decrease) in future GDP. Their paper also discusses examples showing that realizations of the CBI shock aligns with the Fed's economic assessment in FOMC announcements.

# B Derivations

## B.1 Wholesalers' value function

Apply the Feynman-Kac formula to write equation (6) in recursive form, as follows:

$$\begin{aligned} r(t)V(t,K;\beta) = \max_{\iota}\ & \Phi(z(t),p_w(t),w(t);\beta)K(t) - \left(\iota + \frac{\kappa}{2}\iota^2\right)K \\ & + V_t(t,K;\beta) + (\iota-\delta)KV_K(t,K;\beta) - \chi V(t,K;\beta), \end{aligned} \tag{B.1}$$

where $V_x$ denotes the partial derivative of $V$ with respect to $x \in \{t, K\}$. Next, substitute $V(t,K;\beta) = Kv(t;\beta)$ into equation (B.1) to obtain equation (7) .

## B.2 New Keynesian Phillips curve

To derive the New Keynesian Phillips curve (12), write the retailer's problem (11) recursively:

$$r(t)\widetilde{V}(t,p) = \max_{\pi}\left[\frac{p}{P(t)} - p_w(t)\right]Y(t)\left(\frac{p}{P(t)}\right)^{-\epsilon} - \frac{\theta}{2}\pi^2 Y(t) + \widetilde{V}_t(t,p) + \pi p\widetilde{V}_p(t,p) \tag{B.2}$$

where $\widetilde{V}$ denotes retailers' value function. The first order condition is

$$\theta\pi(t,p)Y(t) = p\widetilde{V}_p(t,p). \tag{B.3}$$

The envelope condition gives

$$r(t)\widetilde{V}_p(t,p) = \left[1-\epsilon+\epsilon\frac{p_w(t)P(t)}{p}\right]\frac{Y(t)}{P(t)}\left(\frac{p}{P(t)}\right)^{-\epsilon} + \widetilde{V}_{tp}(t,p) + \pi(t,p)\widetilde{V}_p(t,p) + p\pi(t,p)\widetilde{V}_{pp}(t,p) \tag{B.4}$$

Let $\pi(t) = \pi(t,\pi(t))$ denote inflation along the optimal price path $p(t)$. Then, differentiating equation (B.3) with respect to time along the optimal price path gives

$$\theta\pi'(t)Y(t) + \theta\pi(t)Y'(t) = p'(t)\widetilde{V}_p(t,p(t)) + p(t)\left[\widetilde{V}_{tp}(t,p(t)) + p'(t)\widetilde{V}_{pp}(t,p(t))\right]. \tag{B.5}$$

Substituting equations (B.3) and (B.4) into equation (B.5) gives

$$\theta\pi'(t)Y(t) + \theta\pi(t)Y'(t) = \theta r(t)\pi(t)Y(t) - p(t)\left[1 - \epsilon + \epsilon\frac{p_w(t)P(t)}{p(t)}\right]\frac{Y(t)}{P(t)}\left(\frac{p(t)}{P(t)}\right)^{-\epsilon}. \tag{B.6}$$

In a symmetric equilibrium, we have $p(t) = P(t)$. Substituting this condition into equation (B.6) leads to the New Keynesian Phillips curve (12).

## B.3 Household's problem

The household's problem in recursive form is

$$\rho U(t,B) = \max_{C,N} \frac{C^{1-\gamma}}{1-\gamma} - \varphi N + U_t(t,B) + \left[r(t)B - C + w(t)N + \Pi(t)\right]U_B(t,B), \tag{B.7}$$

where $U(t,B)$ denotes the household's value function. The first order conditions for $C$ and $N$ are

$$C(t,B)^{-\gamma} = U_B(t,B), \tag{B.8}$$

$$\text{and} \quad \varphi = w(t)U_B(t,B), \tag{B.9}$$

respectively. Combining equations (B.8) and (B.9) gives the labor supply condition (13).

To derive the consumption Euler equation (14), note that the envelope condition for the household's problem (B.7) is

$$\rho U_B(t,B) = U_{tB}(t,B) + r(t)U_B(t,B) + \left[r(t)B - C + w(t)N + \Pi(t)\right]U_{BB}(t,B). \tag{B.10}$$

Next, differentiating the first order condition (B.8) with respect to $t$ along the optimal path $C(t) = C(t, B(t))$ gives

$$-\gamma C(t)^{-\gamma-1}C'(t) = U_{tB}(t,B(t)) + B'(t)U_{BB}(t,B(t)). \tag{B.11}$$

The consumption Euler equation (14) follows from combining equations (B.10) and (B.11).

# C Numerical solution

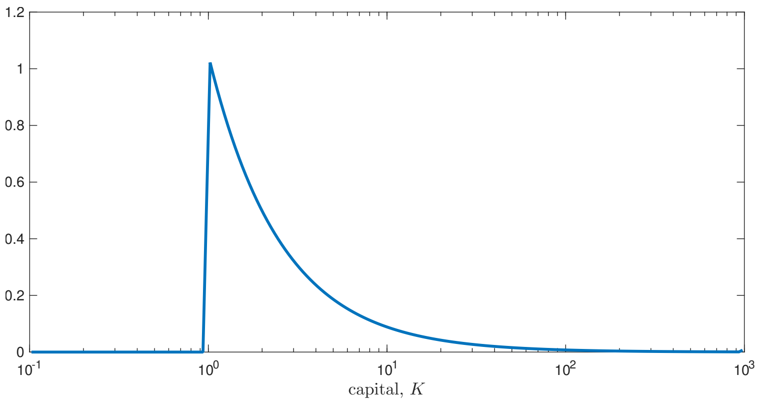
## C.1 Computing the steady state

The stationary version of the wholesalers' problem (7) is

$$r_{ss}v_{ss} = \max_{\iota} \Phi(z_{ss}, p_w^\star, w_{ss}) - \iota - \frac{\kappa}{2}\iota^2 + (\iota - \delta)v_{ss} - \chi v_{ss}. \tag{C.1}$$

Note that the normalization for steady state productivity $z_{ss} \equiv 0$ implies that profitability (5) is independent of $\beta$ in steady state. As a result, the steady state value function $v_{ss}$ is also independent

**Figure C.1: Steady state cross-sectional distribution of capital.**




of $\beta$. Plugging in the first order condition for steady state investment $1 + \kappa \iota_{ss} = v_{ss}$ into equation (C.1) characterizes $\iota_{ss}$ as the solution to a quadratic equation:[11]

$$\iota_{ss} = r_{ss} + \delta + \chi - \sqrt{(r_{ss} + \delta + \chi)^2 + \frac{2}{\kappa} \left[ r_{ss} + \delta + \chi - \Phi(z_{ss}, p_w^{\star}, w_{ss}) \right]}. \tag{C.2}$$

The steady state distribution of capital $f_{ss}(K)$ solves the stationary version of the Kolmorogov forward equation (KFE) (9),

$$0 = -\frac{\partial}{\partial K} \left[ (\iota_{ss} - \delta) K f_{ss}(K) \right] + \chi \left[ \delta(K; K_{init}) - f_{ss}(K) \right]. \tag{C.3}$$

As is the case with the value function $v_{ss}$, the stationary distribution is also independent of $\beta$. We solve equation (C.3) numerically using the algorithm described in Appendix C.2 (see equation (C.10)). Figure C.1 plots the solution for the baseline parameters listed in Table 3.

Steady state wages $w_{ss}$ solve the steady state version of the labor supply condition (13),

$$w_{ss} C_{ss}(w_{ss})^{-\gamma} = \varphi, \tag{C.4}$$

where $C_{ss}(w_{ss})$ is the aggregate consumption implied by firm policies when wages equal $w_{ss}$:

$$C_{ss}(w_{ss}) = Y_{ss}(w_{ss}) - I_{ss}(w_{ss}). \tag{C.5}$$

Here, $Y_{ss}(w_{ss}) = \int n(z_{ss}, p_w^{\star}, w_{ss})^{1-\alpha} K f_{ss}(K; w_{ss})\, dK$ and $I_{ss}(w_{ss}) = \int \left[ \iota_{ss}(w_{ss}) + \frac{\kappa}{2} \iota_{ss}(w_{ss})^2 \right] K f_{ss}(K; w_{ss})\, dK$ are the steady state aggregate output and aggregate investment when wages equal $w_{ss}$, respectively.

[11] The other root of the quadratic equation is not the correct solution as it implies an infinite value function.

## C.2 Computing the transition path

There are two steps. First, we solve for policies and aggregate outcomes under arbitrary price paths. Second, we use equilibrium conditions to solve for equilibrium price paths.

**Step 1: outcomes given price paths.** We solve the associated problems using upwind finite difference schemes (see, e.g., https://benjaminmoll.com/codes/ for examples).

Let $\mathcal{P} = \{z^n, (\varepsilon^m)^n, p_w^n, w^n, r^n : \ n = 0, 1, ..., \overline{N}\}$ be a given discretized path of shocks and prices where $x^n$ denotes $x(n\Delta)$, $\Delta$ is the time step, and $\overline{N}$ is the maximum number of time steps to consider. In our numerical implementation, we set $\Delta = 0.25$ quarters and set $\overline{N}$ to be large enough such that the economy is sufficiently close to steady state when $n = \overline{N}$.

The discretized version of the wholesalers' problem (7) is

$$r^n v^n(\beta) = \max_{\iota} \Phi(z^n, p_w^n, w^n; \beta) - \iota - \frac{\kappa}{2}\iota^2 + \frac{v^{n+1}(\beta) - v^n(\beta)}{\Delta} + (\iota - \delta)v^n(\beta) - \chi v^n(\beta). \tag{C.6}$$

The solution to equation (C.6) gives the update scheme

$$v^n(\beta) = \frac{\Phi(z^n, p_w^n, w^n; \beta) + \frac{\kappa}{2}\iota^n(\beta)^2 + v^{n+1}(\beta)/\Delta}{r^n + \delta + \chi + 1/\Delta}, \quad v^{\overline{N}}(\beta) = v_{ss}, \tag{C.7}$$

with $\iota^n(\beta) = \kappa^{-1}\left[v^n(\beta) - 1\right]$. In implementing the scheme (C.7), we noticed that arbitrary off-equilibrium price paths $\mathcal{P}$ can generate extremely large values for $\iota^n(\beta)$ which makes it difficult to achieve convergence in the second step below. For this reason, we restrict $\iota^n(\beta)$ to the interval $[\iota_{min}, \iota_{max}]$ where $\iota_{min}$ and $\iota_{max}$ are numerical parameters. After convergence in step 2, we verify that the numerical bound $[\iota_{min}, \iota_{max}]$ never binds along the actual equilibrium price path.

After computing the policy $\iota^n(\beta)$, we solve the nonstationary KFE (9) to obtain the path for the capital distribution in order to compute aggregate outcomes. The discretized nonstationary KFE is

$$\frac{f^{n+1}(k_j; \beta) - f^n(k_j; \beta)}{\Delta} = \left[\mathscr{L}^n(\beta)\right]^{\dagger} f^{n+1}(k_j; \beta), \tag{C.8}$$

where we work with an evenly-spaced grid $\{k_j : j = 1, ..., J\}$ for log capital $k = \log K$, and $[\mathscr{L}^n(\beta)]^{\dagger}$ denotes the adjoint of the infinitesimal generator $\mathscr{L}^n(\beta)$ for log capital, which equals $[\mathscr{L}^n(\beta)]f(k) = [\iota^n(\beta) - \delta]f'(k) + \chi\left[f(k_{init}) - f(k)\right]$ where $k_{init} = \log K_{init}$.

Equation (C.8) leads to the following implicit scheme:

$$\mathbf{f}^{n+1}(\beta) = \left\{\mathbf{I} - \Delta\left[\mathbf{L}^n(\beta)\right]^T\right\}^{-1} \mathbf{f}^n(\beta), \quad \mathbf{f}^0(\beta) = \mathbf{f}_{ss}. \tag{C.9}$$

Here, $\mathbf{f}^n(\beta)$ denotes $f^n(k_j; \beta)$ stacked as column vector and $\mathbf{I}$ is the $J \times J$ identity matrix. The matrix $\mathbf{L}^n(\beta)$ is an upwinded finite difference approximation of $\mathscr{L}^n(\beta)$ over the capital grid; its transpose $\left[\mathbf{L}^n(\beta)\right]^T$ is then an approximation of $[\mathscr{L}^n(\beta)]^{\dagger}$. In solving equation (C.9), we take the grid for log capital to be an evenly spaced grid with $J = 201$ points between $k_1 = \log 0.1$ and $k_J = \log 1000$. For numerical purposes, we also impose reflecting boundary conditions at $k_1$ and $k_J$;

such boundary conditions are innocuous so long as we choose the capital grid to be sufficiently wide.

The steady state distribution, which appears as the initial condition in the scheme (C.9), can be computed as

$$\mathbf{f}_{ss} = \frac{\widetilde{\mathbf{f}}_{ss}}{\mathbf{1}^T \widetilde{\mathbf{f}}_{ss}}, \quad \widetilde{\mathbf{f}}_{ss} = \left[ \left( \widetilde{\mathbf{L}^{ss}} \right)^T \right]^{-1} \mathbf{e}_{\underline{j}}. \tag{C.10}$$

Here, $\mathbf{1}$ denotes a $J \times 1$ column vector of ones. The matrix $\widetilde{\mathbf{L}^{ss}}$ modifies the matrix $\mathbf{L}^{ss}$, a upwinded finite difference approximation to $\mathscr{L}^n$ with $\iota^n$ set to $\iota_{ss}$, as follows. Let $\underline{j}$ be any index for which the steady state log capital distribution takes positive mass (e.g., setting $\underline{j} = \min\{j \in \{1, ..., J\} : k_j \geq k_{init}\}$ suffices). Then, the rows of $\left( \widetilde{\mathbf{L}^{ss}} \right)^T$ are identical to that of $(\mathbf{L}^{ss})^T$ for all rows $j \neq \underline{j}$. Row $\underline{j}$ is, however, modified to be $\mathbf{e}_{\underline{j}}^T$ where $\mathbf{e}_{\underline{j}}$ denotes a $J \times 1$ column vector whose entries are all zero except for a value of one at entry $\underline{j}$.

After computing $\iota^n(\beta)$ and $f^n(k, \beta)$, we compute aggregate investment $I^n$ and aggregate output $Y^n$. During this step, we use a trapezoidal quadrature rule when evaluating the integrals over capital. We also compute the inflation implied by the path $\mathcal{P}$ through the Taylor rule (15) and the Fisher equation (16): $\pi^n = (r^n - \rho - \varepsilon^{m,n}) / (\phi_\pi - 1)$. Finally, with $I^n$, $Y^n$, and $\pi^n$ in hand, we compute the implied aggregate consumption through the equilibrium good market clearing condition $C^n = Y^n \left(1 - \frac{1}{2}\theta \pi^n\right) - I^n$.

**Step 2: equilibrium price paths.** In the second step, we compute the equilibrium price path as the solution to the following root finding problem $\mathbf{F}(\mathbf{x}) = \mathbf{0}$ where $\mathbf{x} = [(r^n)_{n\in\mathcal{N}} \; (\log w^n)_{n\in\mathcal{N}} \; (\log p_w^n)_{n\in\mathcal{N}}]'$ stacks the price paths along all time nodes $n \in \mathcal{N} = \{0, 1, ..., \overline{N}\}$, and

$$\mathbf{F}(\mathbf{x}) = \begin{bmatrix} \left(\varphi (C^n)^{-\gamma} - w^n\right)_{n\in\mathcal{N}} \\ \left(r^n - \rho - \gamma \frac{\log C^{n+1} - \log C^n}{\Delta}\right)_{n\in\mathcal{N}} \\ \left(\frac{\pi^{n+1} - \pi^n}{\Delta} + \frac{\epsilon}{\theta}\left(p_w^n - p_w^\star\right) - \left(r^n - \frac{\log Y^{n+1} - \log Y^n}{\Delta}\right)\pi^n\right)_{n\in\mathcal{N}} \end{bmatrix} \tag{C.11}$$

stacks the equilibrium condition for labor market clearing (13), the consumption Euler equation (14), and the New Keynesian Phillips curve (12) along the entire transition path. Note that given $\mathbf{x}$, $\mathbf{F}(\mathbf{x})$ is computed following the procedure outlined in step 1 above. We solve the root finding problem using Broyden's method.

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