Unit Cost Expectations: Firms' Perspectives on Inflation*

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Abstract

We propose a novel survey-based measure of nominal marginal cost expectations held by business decision makers to track building inflationary pressures and augment the existing set of inflation expectations data policymakers frequently monitor. Unlike other surveys of firms or households that elicit "aggregate" expectations, we focus on idiosyncratic costs that firms are well-aware of, plan for, and matter for price setting. We document four key findings. First, once aggregated, firms' unit cost realizations closely comove with U.S. inflation statistics. Second, in aggregate, firms' unit cost expectations significantly outperform households' inflation expectations when inflation is low and are at least as accurate as the expectations of professional forecasters in out-of-sample forecasting exercises in high and low inflation environments. Third, utilizing special questions, we find evidence that information treatments about aggregate inflation and policymakers' forecasts do little to alter firms' unit cost expectations. And, lastly, we show that unit costs, at the firm level, are an important determinant of their own price setting behavior.

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"*Price stability is that state in which expected changes in the general price level do not effectively alter business or household decisions.*"
–Federal Reserve Chairman Alan Greenspan, July 1996, FOMC Meeting[1]

1 Introduction

Inflation expectations play a central role in many macroeconomic models. For monetary policymakers, monitoring and understanding the public's inflation expectations are crucial to achieving their policy goals. However, much of the literature on survey measures of inflation expectations reveals that the public has trouble holding well-formed expectations that conform to economists' notions of aggregate inflation, especially when inflation is low. For households, expectations suffer from demographic differences (Bryan and Venkatu, 2001), are persistently biased relative to actual inflation (Thomas, 1999), are dispersed (Mankiw et al., 2004), reflect personal expenditure bundles (Cavallo et al., 2017) or salient price changes (D'Acunto et al., 2021), and contain respondents that may not fully comprehend the question at hand (Bruine de Bruin et al., 2010). In eliciting quantitative aggregate inflation expectations from firms, Coibion et al. (2018) and Candia et al. (2024) find many of these issues are present among business decision makers as well. In short, the existing literature points toward the existence of informational or processing impediments in the aggregate inflation expectations of the public, especially in low inflation environments (Weber et al., 2024). These impediments cast doubt on the ability for monetary policymakers to fully trust these expectations. As former Federal Reserve Chairman Alan Greenspan's quote implies, during (or following) times of low, stable inflation, inattention may be a feature of price stability (not a bug). Unfortunately, that also implies tracking survey measures of aggregate inflation expectations in a stable inflation environment is an exercise fraught with many challenges. This suggests the exploration of alternative approaches to eliciting forward-looking information on costs and price growth that both matter for respondents and connect up to the concept of aggregate inflation that policymakers care about.

In this paper, we investigate an alternative approach to tracking anticipated inflationary pressures in the economy. Specifically, our approach centers on eliciting own-firm unit cost expectations from business decision-makers. After motivating the rationale for eliciting own-firm unit cost expectations, we investigate both the firm-level and aggregated aspects of unit cost expectations, comparing aggregated unit cost expectations to closely-followed measures of inflation expectations.

As a preview of our results, we find:

1. Once aggregated, **firms' unit cost realizations closely comove with U.S. inflation statistics**. Firms' unit cost growth covaries quite closely with changes in the GDP Price Index and with other *official* U.S. price statistics.(Section 3.1)

[1] https://www.federalreserve.gov/monetarypolicy/files/FOMC19960703meeting.pdf

2. **Unit cost expectations provide unique insight into the likely trajectory of future inflation.** In aggregate, firms' unit cost expectations significantly outperform households' inflation expectations when inflation is low, and are at least as accurate as the expectations of professional forecasters in pseudo out-of-sample forecasting exercises in both high and low inflation environments. (see Section 3.2)

3. At the firm level, **unit costs are a primary determinant for own-firm price setting behavior.** (See Section 4.1)

4. Implementing a unique module of special questions in three separate years, we find evidence that **information treatments about aggregate inflation and policymakers' forecasts do little to alter firms' unit cost expectations.** (See Section 4.2)

In order to investigate unit cost expectations, we utilize the Federal Reserve Bank of Atlanta's Business Inflation Expectations (BIE) survey, which has been continuously collecting subjective probability distributions over own-firm future unit costs from a panel of business executives (CFOs, CEOs, and business owners) monthly since October 2011.[2] The BIE stands out across various dimensions by opting to concentrate on firms' own anticipated unit costs, rather than relying on an aggregate inflation expectation, and by eliciting firm-level expectations in a probabilistic format.

Throughout the paper, we forward the notion popularized by Mackowiak and Wiederholt (2009) and Coibion et al. (2018) that firms pay much more attention in all states of the world (i.e. high and low inflation environments) to their own, potentially idiosyncratic, business conditions. That focus on own-firm conditions implies a degree of inattention toward aggregates and creates challenges for interpreting measures of aggregate inflation expectations at least in low-inflation environments (Weber et al., 2024). Our approach offers a unique solution to inattention to aggregate conditions. We demonstrate the usefulness of this bottom-up approach to eliciting expectations regarding the nominal trajectory of the economy in comparison to current well-known survey measures of inflation expectations. Unlike survey measures of aggregate inflation expectations elicited from firms (Coibion et al., 2018) or households (Thomas, 1999), firms' unit cost expectations are tightly correlated with the inflation expectations of professionals and can be used to forecast the evolution of aggregate U.S. inflation statistics.

In addition to eliciting expectations of own-firm unit cost growth, we also gather information about own-firm realized unit cost growth over the past year. Both unit cost realizations and expectations differ significantly across industry in means, volatility, and time series behavior. However, once aggregated, firms' unit cost realizations covary strongly with official U.S. inflation statistics (i.e. CPI, PCE price index, and GDP deflator). Our interpretation of this finding is two-fold. First,

[2]We elicit unit cost expectations in a probabilistic format, following Manski (2004), utilizing a fixed-bin approach, which allows us to estimate a given firm's unit cost uncertainty and to assess the skewness associated with their forecast. We investigate properties on unit cost uncertainty and risk in forthcoming work. To our knowledge, the BIE survey is the first monthly survey of businesses in the United States that elicits probabilistic expectations.

much like Altig et al. (2022), it demonstrates the value of aggregating own-firm quantities to make inference about the aggregate economy. Second, it provides further support for "unit costs" as a concept that is intimately related to nominal price pressures in the economy.

In out-of-sample forecasting exercises, we find that businesses' unit cost expectations significantly outperform the aggregate inflation expectations of households when inflation is low and are at least as accurate as the expectations of professional forecasters in high and low inflation environments. Also, the evolution of unit cost expectations tends to co-move strongly with the inflation expectations of professional forecasters. Firms' unit cost expectations are essentially unrelated to households' inflation expectations prior to the COVID-19 pandemic. Our results are consistent with Borio et al. (2023)'s two-regime view of inflation. When inflation is very low, it may cease to be a significant factor influencing economic decisions. However, when inflation is high, it comes into sharp focus and becomes more representative of the changes in the price indices that individual agents care about.

Through unique randomized controlled trials posed to respondents in special questions, spaced one year and two years apart, we provide firms with information on the projections (first-moment) and attendant uncertainty (second-moment) from the FOMC's Summary of Economic Projections. We find evidence that these information treatments do little to alter firms' unit cost expectations or uncertainty.

Firms report that unit costs matter more than aggregate inflation or the CPI for pricing and business decisions, even during the highest, broadest-based inflationary environment the U.S. has witnessed since the early 1980s. Firm-level panel data are consistent with that notion. We find that unit cost realizations and expectations are related to realized and expected price changes. Firms' forecast error over unit costs is close to zero, on average. And, firms that operate in highly cyclical or volatile cost environments tend to be more uncertain ex ante and have larger absolute forecast errors, ex post.

One clear implication from our results is that even when firms are inattentive to aggregate conditions, eliciting firm-specific information related to the inflation process and aggregating across firms provides useful insight about the inflation process. The theoretical and empirical literature on rational inattention and information rigidities such as Sims (2003), Woodford (2003), Mackowiak and Wiederholt (2009), Kumar et al. (2015), Bachmann et al. (2015) and Afrouzi (2024) suggest the aggregate inflation expectations of agents in the economy (firms in this case) are not well-formed or meaningfully connected to their decisions. Rational inattention appears to be a feature of low, stable inflation environments like the U.S. has enjoyed from the mid-1990s until very recently. Mackowiak and Wiederholt (2009), in particular, develop a model where firms face a trade-off between paying attention to firm-specific or aggregate conditions and, in calibrating their model of rational inattention to micro pricing data, find evidence that prices react much more swiftly and forcefully to idiosyncratic shocks. Our findings can be seen as supporting their theoretical

framework. Particularly relevant to our work is a recent paper by Chen et al. (2021). They find information rigidities are much more prevalent in Japanese firms' forecasts of macro variables than their own-firm unit costs. Additionally, studies like Coibion et al. (2018) on New Zealand firms or Candia et al. (2024) on a panel of U.S. CEO's, document the pervasiveness of aggregate inflation inattention in surveys of firms.[3]

This is not to say that aggregate inflation expectations are unimportant. This paper is largely silent on that notion. However, much like Riggi and Tagliabracci (2022), Afrouzi (2022) and Dogra et al. (2023), we find firms' pricing decisions depend more on own-firm quantities, such as their beliefs over the future trajectory of unit costs, than aggregate inflation expectations. Our results are also supportive of the model of strategic inattention forwarded by Afrouzi (2024). Moreover, this paper provides an alternative approach to monitoring expectations in a way that circumvents issues around inattention to aggregates in low-inflation environments.

As highlighted above, the literature on survey-based measures of aggregate inflation expectations builds a strong case that informational or processing impediments create challenges in using these measures to assess the anchoring of inflation expectations. One potential solution to this problem put forth by Coibion et al. (2020a) is to lower the cost of information on inflation by improving central bank communication. Our results suggest another alternative. Survey firms on economic quantities that they care about and are connected to the aggregate phenomena that central bankers endeavor to monitor. Our work can be seen as the first firm-level survey to attempt to provide such information despite the challenges of inattention to aggregate inflation or official price statistics.

Interesting work out of Cleveland Fed, detailed by Hajdini et al. (2024), follows our approach to eliciting useful, respondent-specific information that connects up to inflation on the household side by first eliciting expectations about anticipated price changes of own-household consumption baskets and then asking households what increase in nominal income they need to keep their standard of living constant. This *indirect* measure of consumer inflation expectations, which has only existed since February 2021, covaries meaningfully with local-area CPI inflation.

Eliciting own-firm quantities to make inference about the aggregate economy or overall business activity is the direction that many firm-level studies of agent perceptions and expectations are heading. For example, Bachmann et al. (2021) and Altig et al. (2022) elicit business expectations and uncertainty on own-firm sales revenue and employment growth to make inferences for the aggregate economy. This is among the broader set literature that uses firm-level survey to study

[3]Bachmann et al. (2015), using the University of Michigan Survey of Consumers, note that idiosyncratic determinants of household spending decisions matter for economic decision making but, aggregate inflation expectations are either "reported truthfully, but do not matter for spending decisions, or they are reported inaccurately, because they are unimportant to households." Cavallo et al. (2017), through a series of survey experiments investigating rational inattention among households, suggest that if central banks wanted to affect household expectations, they should disseminate information about the price changes of specific products salient in the minds of households. And, D'Acunto et al. (2021) show a clear, strong relationship between consumers' grocery store expenditures and their individual expectations for aggregate inflation.

properties of agent perceptions and expectations. Notable examples also include Enders et al. (2019), Ma et al. (2020), Barrero (2022), Chen et al. (2021) and Fiori and Scoccianti (2023).

The rest of the paper proceeds as follows. Section 2 describes the Atlanta Fed's Business Inflation Expectations Survey and motivates the usage of unit cost expectations to glean information about future aggregate inflation. Section 3 compares aggregated unit cost expectations to well-known surveys of aggregate expectations. In this section we run simple out-of-sample forecasting exercises relative to an ARMA(1,1) benchmark for a variety of aggregate inflation statistics. We also provide a short overview of the dynamics of our measure relative to other survey measures of inflation expectations during the COVID-19 pandemic. Section 4 further justifies the use of unit cost as a relevant variable for firm-level pricing decisions and includes results from randomized controlled trials that provide information treatments about policymakers' forecasts. Section 5 concludes. Additional tables and figures are relegated to an online appendix.

2 Eliciting Unit Cost Expectations

2.1 The Business Inflation Expectations Survey

For this study, we utilize the Atlanta Fed's Business Inflation Expectations (BIE) Survey. The BIE is an online panel survey of roughly 500 CFOs, CEOs, and business owners of firms headquartered within the 6th Federal Reserve District in the southeastern United States.[4] The BIE has fielded monthly since October 2011. For this paper, we use data from October 2011 through December 2023, a total of 146 successive monthly waves (over 1 full decade worth of data). Nearly 75 percent of the panel consists of C-suite executives and business owners; see Figure A.1. Another roughly 20 percent of respondents carry titles like "Controller", "Director of Finance", and "Director of Forecasting". Given the forward-looking probabilistic nature of the BIE's main question of interest, it is important to reach decision makers within a firm engaged in strategic operations and planning for the future of the firm.

Panel coverage includes firms in every major industry in the private nonfarm sector and a full range of firm sizes (provided that the firm is an employer). The Atlanta Fed engages in a purposive sampling methodology in finding and recruiting new panel members, oversampling firms with 100 employees or more and from cyclically-sensitive industries (manufacturing, construction, retail, etc.), yet still attempting to maintain an industry and size composition that is broadly reflective of the national economy at the two-digit North American Industry Classification System (NAICS) level.

Table 1 reports the industry and size characteristics of the BIE survey panel. Relative to the physical count of establishments in the U.S. – according to the Census Bureau's Statistics of U.S.

[4]Specifically, the 6th Federal Reserve District's footprint consists of Alabama, Florida, and Georgia, the eastern two-thirds of Tennessee, 38 parishes of southern Louisiana, and 43 counties of southern Mississippi.

Businesses – the BIE panel under-weights small firms.[5] Despite comprising a sizeable share of establishments, small firms account for roughly 1/4 of annual payroll in the U.S., whereas firms with 500 or more employees are a much smaller fraction of U.S. establishments but account for the lion's share of employment and payroll. The composition of the BIE panel is broadly reflective of the U.S. economy with the exception of manufacturing, which due to its capital-intensive nature is a small share of establishments and employment, but accounts for a relatively large share of value-added output in the U.S. It is also worth noting that the 6th Federal Reserve district closely mirrors the composition of U.S. businesses in terms of firm size and industrial mix.[6]

Importantly, the BIE survey is a relatively short and simple survey for business decision makers to complete. The core questionnaire consists of just six questions and takes roughly 3-5 minutes to complete.[7] Brevity is quite important, as Candia et al. (2024) highlight, which does limit the scope of the survey and the variety of questions we are able to ask on an ongoing basis. We view the simplicity and brevity of the questionnaire as crucial elements to maintaining our relatively high response rate (see Figure A.2) and retention rate (see Figure A.3).[8] As Figure A.2 shows, the response rates have stayed steady close to 40 percent for the past 7 years. Our response rates compare favorably to other, voluntary surveys of businesses. For example, Coibion et al. (2018), in surveying New Zealand firms achieved a response rate of 20 percent in their first wave.[9] The BIE survey does have a high attachment rate, as the typical respondent stays with the panel between 1 and 2 years. Less than 5 percent of respondents fail to complete one survey once they agree to join the panel. And, we have two respondents that have stayed with the panel since its inception – completing every month survey we have fielded.

Our main question of interest from the BIE survey is the probabilistic 1-year ahead unit cost expectation question (see Figure 1 for the screenshot of how the question appears to respondents). The response quality to this question appears to be relatively high. Out of 29,158 observations there are just 612 cases (2.0 percent) where the probabilities did not sum to 100 percent.[10] We

[5] With the exception of the Census Bureau, practical probability sampling of firms in the United States is largely unfeasible, as business database providers such as Dunn and Bradstreet have difficulty capturing small firms and startups.

[6] One potential criticism of the BIE panel is that it only represents firms headquartered in the Southeast U.S. We address this criticism in two ways. First, many firms headquartered in the U.S. have national or international sales footprints or exposure beyond the Southeast U.S. through supply chains. Second, the aggregated unit cost expectations and measured uncertainty from the BIE panel are highly correlated with those from the Survey of Business Uncertainty, which is a larger, national panel of U.S. firms' expectations and uncertainty. See Appendix B for the details.

[7] The question wording and response options can be found in Appendix C. We include the core questionnaire, quarterly rotating questions, and special questions used in this paper.

[8] An AAPOR response rate 2 calculation is the second most restrictive (out of 6 levels) way to calculate response rates. It does include partial responses. For an overview or AAPOR response rates see: https://www.aapor.org/Education-Resources/For-Researchers/Poll-Survey-FAQ/Response-Rates-An-Overview.aspx

[9] There are myriad reasons for response rates to differ including survey mode, quality of contact information, and method of first contact. See Lessler and Kalsbeek (1992) for a fulsome discussion of nonresponse error.

[10] Failure of the probabilities to sum to 100 percent was due to erroneous keystrokes, such as adding an extra zero

also find only 242 instances of respondents assigning 20 percent to each bin.

The BIE elicits probabilistic unit cost expectations by asking firms to assign probabilities to pre-specified intervals (bins) for anticipated unit cost growth over the year ahead. This approach follows Manski (2004), Engelberg et al. (2009) and Armantier et al. (2013). These probability distributions provide richer detail than point forecasts on the uncertainty with which respondents hold expectations. Despite some efforts to quantify qualitative responses, such as the approach outlined in Mankiw et al. (2004), it is difficult to extract quantitative measures of expectations. In contrast, the subjective probability distributions in the BIE survey enable us to directly measure expected unit costs and attending uncertainty for each firm.

In our view, there are three key advantages to employing a fixed bin approach and one important drawback worth noting. First, it allows researchers to parametrically estimate firms' probabilistic expectations by employing a fixed bin approach, an important consideration highlighted by the above literature. Second, employing fixed bins in surveys with modest sample size increases the signal-to-noise ratio in the results by effectively truncating the influence of outliers on aggregated first-moment measures without needing to winsorize outliers. Third, given that this is a short survey that targets C-suite executives, the brevity of the survey is key to maintaining high response rates. By employing fixed bins we are able to capture complex and useful information about the likely trajectory of firms' unit costs in a less cognitively burdensome way.

However, there is an important drawback to employing fixed bins, as mentioned in Altig et al. (2022) and highlighted by the current surge in inflation. The initial construction of the bins and bin widths was motivated by initial test questions that elicited point estimates of unit cost growth during a low and sanguine period of inflation in 2011. As inflation has recently surged, the preponderance of firms assigning weight to the far right bin has increased markedly. The result does not alter the directional signal captured by this method, nor does it deter from the ability of fixed-bin probabilities to capture salient upside inflation risks. That said, it does impart a potential downward bias in expectations and mechanically lowers measured uncertainty in high inflation environments.

Before moving on to discuss the motivation for eliciting unit cost expectations and analyzing their aggregated properties, there are two additional aspects of the micro data that are worth highlighting. First, firms' ex ante probabilistic unit cost expectations are predictive of ex post unit cost realized outcomes. And second, ex ante firm-level uncertainty is closely related to ex post forecast errors. These facts suggest that firm executives are responding to our questionnaire in a thoughtful manner and give us further confidence in the usefulness of these measures.

Panel (a) in Figure 2 compares bin-scatters for the expected value of the 5-bin probabilistic distribution of a given firm's 1-year ahead unit cost growth to a given firm's ex post perceived unit cost growth over the past year. The unit cost expectations are on the horizontal axis and the

to a cell or an extraneous character in approximately 50 percent of those cases.

vertical axis plots unit cost growth over the ensuing 12 month time period. The bin-scatters show a tight positive relationship between firm's unit cost forecasts and their realized unit cost growth over that 12 month period. Mean forecast error (i.e. unit cost growth at time t minus expected cost growth at $t-12$) is close to zero.

Panel (b) in Figure 2 shows that the more uncertain a given firm is about their future unit costs – that is, the higher the variance of their subjective probability distribution – the larger their absolute forecast errors tend to be. In other words, firms tend to *know what they don't know*. Furthermore, firms at highly cyclical or volatile industries (manufacturing, construction, mining and finance) tend to have larger absolute forecast errors.

2.2 Why Unit Costs?

Our decision to track firms' unit cost expectations was motivated by a variety of factors including macroeconomic theory, the aforementioned issues the public seems to have in holding well-formed aggregate inflation expectations, and, importantly, by conversations with businesses themselves.

The Atlanta Fed conducted cognitive interviews with businesses in early development of the BIE survey that led us to conclude that firms' pricing decisions generally begin with their expectation of future costs.[11] Indeed, that prices depend on costs is far from controversial.[12] The new Keynesian Phillips curve has firms set price as a markup over their nominal marginal cost and adjust prices based on expected future marginal costs (Calvo, 1983; Clarida et al., 1999).

One impediment to this approach is firms' understanding of the term "marginal costs." Alan Blinder, in his landmark 1994 study, notes: "This turned out to be a tricky question because the term marginal cost is not in the lexicons of most business people...For purpose of the survey, we translated 'marginal cost' into 'variable costs of producing additional units'. " In specific questions, Blinder (1994) shortens that to "variable costs per unit." In the BIE questionnaire, based on initial cognitive interviews with business executives when developing the survey, we employ more parsimonious phrasing of "variable costs per unit," shortening that to "unit costs." In eliciting unit cost expectations, we are eliciting firms' views of the future growth in nonlabor and labor costs per unit of the year ahead, hence, firms' expected future nominal marginal costs.[13]

On a fundamental level, the micro-foundations of the New Keynesian model only require individual firms, denoted by f, set prices as a markup μ_f, over their own *nominal* marginal costs

[11] The setup of the survey also allows us to monitor cost expectations and changes in margin pressures as independent decision points in the price decisions by firms.

[12] We chose to elicit unit cost expectations rather than future selling prices for multiple reasons including: maintaining the brevity of the survey, price stickiness, and other motivations for price changes that may be unconnected to expectations over the future nominal environment.

[13] With constant returns in production, (log) unit labor costs are proportional to (log) marginal costs. Under more general assumptions, this proportionality no longer holds, but unit labor costs are likely to remain a more accurate gauge of the cost pressures faced by firms than nominal wage inflation," as aptly pointed out by Del Negro et al. (2020).

$MC_{f,t}$. Without frictions that would delay a firm's ability to adjust prices, a given firm's pricing decision is represented by

$$P_{f,t} = \mu_f MC_{f,t}. \tag{1}$$

Taking the logs of equation (1) and assuming a constant elasticity of demand, equation (1) becomes:

$$lnP_{f,t} = \gamma_f + lnMC_{f,t}, \tag{2}$$

where γ_f is the log of the firm-specific (constant) markup over nominal marginal costs.

To make the above more tractable and allow for price-setting frictions of the Calvo (1983)-type – where only a subset of firms can adjust prices in a given period, equation (2) becomes dependent on firms' expectations. Firms will consider the (nearly) optimal price today, taking into consideration expected changes in nominal marginal costs between today and an opportunity to adjust price in the future (with some attendant positive probability). As noted by Carlsson and Nordstrom Skans (2012), the popular Calvo economy representation of equation (2) can be expressed as:

$$lnP_{f,t} = \gamma_f + (1 - \beta\theta)E_t \sum_{k=0}^{\infty} (\beta\theta)^k lnMC_{f,t+k}, \tag{3}$$

where β is a discount factor and θ is the probability that a firm will be allowed to engage in a price adjustment. In the Calvo case, a firm sets prices based on a markup over the weighted average of the discounted stream of nominal marginal costs, where the weight of the kth term reflects the probability of being stuck with the reset price ($P_{f,t}$) over the next k periods.

From the perspective of individual firms, pricing decisions in the New Keynesian framework are based on expectations of their own future nominal marginal costs.[14] This exposition does not preclude firms from holding expectations about some notion of aggregate inflation measure as an input into firms' formulation of their own nominal marginal cost expectations. Indeed, that process is akin to Afrouzi (2024), where firms with multiple competitors have a greater likelihood of holding an inflation expectation closer to what economists consider "aggregate" inflation. However, as appears to be the case with rationally inattentive firms in a low inflation environment, the micro-foundations of the New Keynesian framework do not necessitate that firms hold an aggregate inflation expectation. One important consideration that led us to survey firms' unit cost expectations is that should a firm hold an aggregate inflation expectation it is likely to be nested in their own unit cost expectations.[15]

[14] Equations (1) – (3) assume a constant optimal desired markup, but this can be generalized to include a time-varying markup, as discussed in Smets and Wouters (2007). As a result, part of the variation in the optimal reset price can be attributed to markup shocks.

[15] Other potential considerations in our question design would include attempting to, in aggregate, tease out the nominal inflation expectations component and the real marginal cost component of unit cost expectations. We leave for future research. That said, the empirical performance of the aggregated unit cost expectations provides empir-

Perhaps as importantly, firms themselves indicate that unit costs are an important input into their price setting behavior, much more so than aggregate inflation concepts or metrics. In separate special questions we elicited firms' views of the importance of unit costs, aggregate inflation, or a price statistic such as the CPI.

For example, in September 2015, we asked,

> "On a scale of 1 to 5, with 1 being "no influence," please indicate what level of influence, if any, your expectation regarding the [economy's overall rate of inflation] or [unit costs] has (have) on your pricing decisions?"

The panel was split at random with half of the respondents receiving the "economy's overall rate of inflation" and the other half receiving "unit costs."

And, in January 2015, we posed the following,

> "On a scale of 1 to 5, with 1 being "no influence," please indicate what level of influence, if any, price statistics such as the Consumer Price Index have on your business decisions?"

The results, shown in Figure 3, indicate only a small minority of firms we sampled view the Consumer Price Index or the "economy's overall rate of inflation" as having a significant influence on their firm's business and pricing decisions. These results are consistent with the literature on rational inattention. Firms operating in, what was at the time a low, stable inflation environment viewed unit costs as a more informative input into their pricing decisions than aggregate inflation or the CPI.

We repeated these exercises again in the current, high-inflation environment. As Figure 3 shows, In January 2015, when headline CPI inflation was running at 1.7 percent over the past 6 years, more than 50 percent of firms said that changes in CPI had no or very little influence on their business decisions. As expected, this percentage declined from 2015 to 2022, amid a surge in inflationary pressures. Still, even in the high inflation environment in May 2022, with headline inflation at 40-year highs, one third of business executives still think aggregate inflation, as measured by the CPI, does not really matter for their business decisions, and just 12 percent of firms attach a significant influence to CPI inflation.

The views espoused by business decision-makers in response to these questions align well with recent quantitative survey work. For example, Riggi and Tagliabracci (2022), using survey of Italian firms, find what matters for current pricing choices are firms' beliefs about future developments in

ical support for the observed flatness of the Phillips curve. See Kiley (2015) for an overview or a 2018 speech by Chairman Powell addressing, "Monetary Policy and Risk Management at a Time of Low Inflation and Low Unemployment." https://www.federalreserve.gov/econresdata/notes/feds-notes/2015/low-inflation-in-the-united-states-a-summary-of-recent-research-20151123.html

their own output prices, rather than expectations of aggregate inflation. And, in a coordinated, multiple-survey effort to investigate cost-price pass through, Dogra et al. (2023) find that aggregate CPI inflation expectations have an insignificant effect on year-ahead expected price growth after controlling for expected cost growth. When inflation is very low and stable, firms pay attention to the general price level primarily for insights into how competitors might react or to assess their own costs. As inflation rises, it moves out of the zone of "rational inattention," and increases firms' incentives to adjust prices. This, in turn, contributes to higher inflation – a mechanism proposed by Blanco et al. (2024).

Related to concerns over relevancy and the potential for social desirability bias, Kim and Binder (2023) find significant panel conditioning effects for both household and firm inflation expectations. Respondents' inflation forecasts and attendant uncertainty decline with the number of previous responses, suggesting what they call "learning-through-survey" effects.[16] Yet, when it comes to households' own-earnings expectations, this effect does not exist. One interpretation is that aggregate inflation is a concept that holds little relevance in the minds of respondents, yet out of a desire to appear informed, these respondents appear to be educating themselves on the topic. Just as panel conditioning appears to be nonexistent for a relevant concept like households' own-earnings, we do not find a conditioning effect in the BIE when asking firms for their own unit cost expectations (see Figure A.4). Lack of survey tenure effects in the BIE gives us further confidence in the suitability of eliciting own-firm unit costs.

Business decision makers also directly indicate they focus keenly on costs, planning for and forecasting potential cost changes. In March 2015, roughly 94 percent of respondents indicated they plan for or forecast unit cost changes, with the 71 percent noting a planning frequency between daily and quarterly (see Figure A.5).

In sum, firms appear to hold differing notions of unit cost and aggregate inflation expectations in both high and low inflation environments. Moreover, as suggested by Mackowiak and Wiederholt (2009) and others, businesses focus on their own-firm quantities rather than aggregate developments in their decision-making processes.

3 Unit Costs Provide a Useful Lens into Inflation Developments

In this section, we show that aggregating own-firm unit cost realizations and expectations yields useful information about inflation developments in the U.S. Firms' unit costs realizations – unit cost growth over the previous year – comove closely with aggregate U.S. inflation statistics. In comparison to other well-known surveys of inflation expectations, we find that firms' unit cost expectations significantly outperform the inflation expectations of households and are about as

[16] They also find evidence that repeated respondents in a panel of CEOs carry nearly 1/2 percent point lower aggregate inflation expectations.

accurate as the expectations of professional forecasters in out-of-sample forecasting exercises. While others such as Kumar et al. (2015) highlight that firms' aggregate inflation expectations more closely resemble those of households, the evolution of aggregated unit cost expectations behaves similarly to that of professional forecasters.

3.1 Unit Cost Realizations and Overall Inflation

Firms' realized unit cost growth over the previous year varies across industry and firm size (see Figure 4).[17] This heterogeneity across- and within-industries can reflect differing conditions due to idiosyncratic, industry-level, or economy-wide differences (see Table A.1). There are differences, on average, in unit cost expectations and realizations by firm-size and smaller firms appear to be more confident in their expectations, most of the heterogeneity appears to be related to industry effects. Over the period from October 2011 until early 2020, construction costs outpaced costs in the financial services and insurance industry. Unit costs in the mining and utilities sector fluctuate with prices in energy markets. And, starting in the first quarter of 2021, amid intensifying supply chain disruption and shortages of qualified labor, unit costs for nearly every broad-industry grouping rose sharply until midway through 2022.

Despite this observed heterogeneity, aggregating up year-over-year unit cost growth across all firms in the panel each month and weighting by industry's share of overall gross output, yields an index of firms' unit cost growth that closely mirrors overall inflation. Figure 5 plots firms' year-over-year unit cost growth along with the year-over-year growth rate in the GDP deflator produced by the Bureau of Economic Analysis. The GDP deflator is the broadest measure of inflation as it tracks price changes of all goods and services newly produced in the U.S.[18]

Firms' unit cost growth covaries quite closely with changes in the GDP deflator, carrying a correlation coefficient of 0.96 using quarterly data from 2011Q4 through 2023Q4. The tightness of this relationship is exaggerated by exceedingly sharp increases in measured inflation rates and unit cost growth over the pandemic period. Prior to the onset of the pandemic, the correlation between firms' unit cost growth and the GDP deflator was a still strong 0.75. Figure A.7 plots the 5-year rolling correlation coefficient between realized unit cost growth and the GDP deflator. This relationship varies somewhat over time, but since late 2012 every 5-year window has posted a correlation coefficient above 0.80.

This strong relationship is reassuring from our point of view. To reiterate, we are simply eliciting firms' views on their own unit costs and taking an GDP-by-industry weighted-average. Yet, this

[17] Importantly, this heterogeneity across and within industries extends to firms' unit cost expectations as well. See Figure A.6.

[18] For purposes of comparison to the BIE panel, which includes firms operating in the business-to-business space, the GDP deflator is a more appropriate comparison metric than a measure of consumer price growth like the CPI or PCE price index. Still, firms' unit costs also covary highly with the PCE price index (correlation of 0.93) and the core PCE price index (0.94), calculated on a quarterly basis with data from 2011Q4 until 2023Q4.

aggregate measure of unit cost realizations closely tracks official U.S. inflation statistics. Firms clearly see the concept of "inflation" through the lens of unit cost developments. The fact that changes in firms' unit costs are closely related to the changes in prices we observe through aggregate inflation statistics provides validity to our approach of aggregating up own-firm information.

3.2 Comparing Unit Cost Expectations with Other Survey Measures of Inflation Expectations

We compare aggregated 1-year ahead unit cost expectations from firms in the BIE panel to well-known and long-standing survey measures of inflation expectations. The BIE's unit cost expectations measure is calculated as the industry-weighted average expected value from individual firms' 1-year ahead subjective probability distributions. Quarterly estimates are calculated by averaging over the three months in a given quarter. For household expectations, we use 1-year ahead price expectations from the University of Michigan's Survey of Consumers. And, for professional forecasters, we use the Blue Chip Panel of Economic Forecasters for monthly frequencies and the Philadelphia Fed's Survey of Professional Forecasters for quarterly comparisons.

Table 2 reports the pairwise correlations between inflation expectation measures along with the statistical significance.[19] We report these correlations over three sample periods. The first begins in 2011Q4 and ends in 2019Q4. The second panel covers the developments during the COVID-19 pandemic (from 2020Q1 through 2023Q4), a tumultuous period for inflation punctuated by sharp pandemic-induced price changes (induced by widespread supply chain disruption, lack of labor availability, and the reopening of the economy). And, the third panel covers the full sample from 2011Q4 through 2023Q4.[20] The table highlights three key points. First, prior to the pandemic, firms' unit cost expectations were essentially unrelated to households' "aggregate" inflation expectations. Second, firms' unit cost expectations are highly correlated with the forecasts of professional forecasters, especially the SPF's forecasts for the GDP deflator. This finding suggests firms' aggregated views over future costs contain a similar signal about the year-ahead inflationary pressures that professional forecasters anticipate over both low- and high- inflation environments. Third, as inflation rates rose sharply starting in early 2021, all expectations measures increased markedly, consistent with increased attention paid to aggregate conditions on the part of households (Weber et al., 2024).

Figure 6 provides a visual of how tightly the BIE measure co-moves with the expectations of professionals. Despite the very tight pre-COVID relationship, during the later part of 2020 the BIE 1-year ahead measure rose sharply, much more quickly and to a higher level than the SPF forecasts.

[19] Appendix Table A.2 shows that these correlations hold on a monthly time frequency as well and using a different set of professional forecasters' inflation expectations. And, Appendix Figure A.8 shows the comovement of firm, household, and professional expectations on a monthly frequency. The results are quantitatively similar.

[20] The sharp increases in all measures of survey inflation expectations beginning in 2021Q2 exaggerate the correlation between all these measures. See Meyer et al. (2023) for a more fulsome discussion.

This corresponds with a time period where professional forecasters, many policymakers, and other economists were viewing the incoming inflation information "transitory." Whereas, firms' views, conditioned on, perhaps, a clearer view of the supply disruption and shipping bottlenecks, saw these factors as being more persistent (Meyer et al., 2023). Divergence between professional forecasters' views and those of businesses operating in this volatile, high-inflation time period highlights the importance of gathering firm-level unit cost expectations.

Firms' unit cost expectations are uncorrelated with households' inflation expectations during the pre-COVID period, yet the correlation increases markedly following the onset of the COVID pandemic (see Figure A.8). Once inflationary pressures broadened out and became significant across much of the consumers' market-basket, households' inflation expectations became much more highly correlated with firms' unit cost expectations. This finding is similar to Coibion et al. (2018), who use the disconnect between a firm's cost expectations and aggregate inflation expectations in low inflation countries to argue for rational inattention.

Monetary policymakers pay a lot of attention to inflation expectations. In a 2007 speech, then Chairman Ben Bernanke noted, "Undoubtedly, the state of inflation expectations greatly influences actual inflation and thus the central bank's ability to achieve price stability."[21] Thomas (1999) and Ang et al. (2007) find that survey measures of inflation expectations generally outperform benchmarks in forecasting inflation. Recent work by Verbrugge and Zaman (2021) was the first to include the BIE's unit cost expectations in tests of in-sample fit and forecasting performance, finding that the BIE measure performs about as well as professional forecasters. Our own analysis demonstrates the usefulness of the BIE's unit cost expectations in out-of-sample forecasting exercises.

As is the case with many (pseudo) out-of-sample forecasting exercises, we employ an ARMA(1,1) benchmark to anchor our comparisons (Stock and Watson, 2007). We investigate relative forecasting performance on both a monthly and quarterly frequency. Our out-of-sample forecasting horizon is 1-year ahead and the sample runs from late 2011 until the third quarter of 2023. Different from many studies, we extend these analyses by including disaggregate subgroupings of the BIE and MSC data. For the BIE's firm-level expectations we include 4 industrial supersectors.[22] For households, we include subgroups of inflation expectations by income, motivated by Binder (2015). Also, given that in the BIE, firms are asked to provide their views over their own future unit costs and households are asked for their "prices in general" expectation, we compare forecasting performance for a variety of often used inflation statistics (CPI, core CPI, PCE, core PCE, and, on a quarterly frequency we include the GDP deflator).

Table 3 reports the out-of-sample root mean squared errors (RMSE) and mean absolute errors

[21] Inflation Expectations and Inflation Forecasting. Speech by Chairman Bernanke on July 10, 2007. https://www.federalreserve.gov/newsevents/speech/bernanke20070710a.htm

[22] The BIE 1-digit NAICS supersectors are defined as follows: (1) Construction, mining and utilities, and real estate, rental and leasing; (2) Durable and non-durable goods manufacturing; (3) Retail and wholesale trade and transportation and warehousing; (4) Educational services, finance and insurance, healthcare and social assistance, information, leisure and hospitality, other services except government, and professional and business services.

(MAE) relative to an ARMA(1,1) benchmark at the quarterly frequency.[23] We report forecasting performance for the pre-COVID time period (through the end of 2019), during the COVID-19 pandemic, and the full sample (which evaluates forecasts through the end of 2023). The top row of each panel reports the actual RMSE and MAE from the benchmark, and subsequent rows report the relative performance of the survey-based measures. A numerical value in these cells lower than 1 indicates more accurate forecasting performance and an asterisk symbol indicates statistically different performance using the Diebold and Mariano (1995) test statistic.[24]

Starting with Panel A, firms' aggregated unit cost expectations significantly outperform the ARMA(1,1) benchmark for a variety of inflation metrics including CPI, core CPI and GDP deflator over the pre-COVID time period. When PCE or core PCE inflation is the object of interest, the BIE measure tends to perform at least as well as the ARMA(1,1) benchmark, but carries RMSEs and MAEs that are often 30% of that of households. One potential explanation for the differences in forecasting performance when predicting a PCE-based metric relative to a CPI-based inflation metric may be the inclusion of nonmarket based components for health care and financial service prices that carry a large weight in the PCE-based measures (and a much higher weight after excluding food and energy prices).[25] Firms' unit cost expectations over the pre-COVID period carry a similar forecasting performance as that of professional forecasters, which is not surprising given how tightly these time series comove from the inception of the BIE survey through the beginning stages of the pandemic.[26]

When folding in the pandemic period (panel B), the forecasting performance of the benchmark model and all survey-based expectations measures deteriorates sharply. Notably, while the forecasting performance of firms' and professional forecasters' expectations are typically more accurate than the ARMA (1,1) benchmark, their performance during the pandemic period is statistically indistinguishable, but numerically worse than the simple benchmark model in terms of RMSE and MAE. Firms' relative RMSEs and MAEs are slightly lower than that of professionals in general, indicating the relative deterioration in firms' forecasting performance over this volatile, high-inflation time period was less severe than that of professional forecasters. While this is a nuanced point,

[23] We generate ARMA(1, 1) forecasts using all available data each period. For example, when forecasting CPI for the fourth quarter of 2012, our estimation sample is 1947:Q1 to 2011:Q4. We then forecast 4-quarter ahead and use the average of those forecasts as our point estimate. The estimation sample is updated recursively each quarter with the initialization being the price index's earliest observation. We generate forecasts of this type for the periods spanning 2012:Q4 to 2023:Q4. The same procedure is done for the monthly frequency data.

[24] Table A.3 reports the forecast accuracy results on a monthly basis, substituting in the Blue Chip Panel's expectations as the measure of professional forecasters' expectations.

[25] Roughly 20 percent of the PCE price index contains these nonmarket-based prices. The GDP deflator includes these prices as well, but they receive a much lower weight given the broad-based nature of this price index.

[26] We compare the forecasting performance of aggregated unit cost expectations to the median and mean 1-year ahead inflation expectations from the University of Michigan Survey of Consumers (MSC), the Blue Chip panel of forecasters median 1-year ahead inflation forecasts, and the Philadelphia Fed's median 1-year ahead inflation forecasts. In general, most references to survey measures of inflation expectations of household and professional forecasters utilize median expectations rather than the mean. For the BIE, the mean and median are nearly perfectly correlated and using either measure of central tendency would yield quantitatively similar results.

our interpretation is that while both firms and professional forecasters saw the onset of pandemic as, on net, a demand shock (see Meyer et al. (2022)), firms adjusted more quickly to the high (and persistent) inflation environment brought on by ample fiscal stimulus and widespread, severe supply chain disruption in 2021.

The combined weight of the evidence presented in this section suggests that eliciting own-firm unit cost expectations and aggregating them up is a useful exercise. In low inflation environments, firms' unit cost expectations covary closely with and are at least as accurate as those of professional forecasters, are uncorrelated with household measures of inflation expectations, and are more accurate than households. However, when inflation is high (and salient in the minds of households), the expectations of firms, households, and professionals covary strongly. Yet, we also saw during 2021 and through early 2022, firms' unit cost expectations rose more quickly than professionals' inflation forecasts, suggesting that information yielded from firms' unit cost expectations contains a unique signal about the evolution of inflation over the year ahead that warrants monitoring.

3.3 Expectations Since the Onset of COVID-19

The onset of the COVID-19 pandemic in early 2020 has ushered in a quite disruptive and disparate economic period for firms and households. The pandemic itself, attendant measures to control the virus (including shutdowns), and massive policy responses embody elements of both an aggregate demand shock and an aggregate supply shock. As highlighted by Meyer et al. (2022), in the early months of the pandemic, firms, on net, saw COVID-19 as largely a demand shock – lowering their unit cost expectations, actual and expected prices and wages, and was a large negative hit to sales revenue (for most firms). In these early months, both firms' unit cost expectations and the inflation expectations of professionals fell sharply, with the BIE measure falling to a series low by April 2020. During this period, the disconnect between firms' (and professionals') expectations and the expectations of households widened considerably. Households' inflation expectations jumped markedly at the onset of the pandemic, despite an observed stark decline in measured inflation, alongside a sharp increase in the prices of grocery store items (which, over the first 4 months of the pandemic comprised the entirety of the upper tail of the CPI price change distribution). Meyer et al. (2022) highlight that households may have disproportionately responded to sharp increases in these salient grocery store items rather than expressing a belief that aggregate inflation would rise (a finding also consistent with D'Acunto et al. (2021)).

However, as the pandemic wore on, global supply chain disruption and shipping bottlenecks grew more and more severe. As these disruptions, along with a growing disruption to labor supply, grew more widespread and increased in intensity, Meyer et al. (2023) repeatedly elicited firms' views on the impact these supply issues were having on business activity. They extended and fielded a set of special questions utilized by the Census Bureau's Small Business Pulse Survey,[27] designed to

[27] https://www.census.gov/data/experimental-data-products/small-business-pulse-survey.html

measure the breath and intensity of the supply-side disruptions in business activity. They find that, in sharp contrast to firms' views early in the crisis, the dramatic rise in firms' year-ahead unit cost expectations largely reflected the level of supply chain and labor disruption experienced. These results are related to Cavallo and Kryvtsov (2023), who study the recent supply chain disruption from a different angle, using high-frequency data on product shortages and stockouts to document their association with cost shocks and temporary inflationary pressure. However, alongside rampant supply chain disruption, consumer demand also rose sharply, especially for goods early in the pandemic and later transitioning to heightened demand for services consumption. The ISM's new orders indexes for the manufacturing and services sectors show the breadth of the surge in demand, as new manufacturing orders index, which had plummeted early in the pandemic rebounded sharply, peaking in late 2020. The new orders index for services peaked a year later.

These unusual and unusually large dual shocks had an outsized impact on firms' unit cost expectations. Over the span of just two years, unit cost expectations went from a series low (in April 2020) and nearly tripled, reaching a series high in April 2022. Interestingly, Meyer et al. (2023) find that supply shocks accounted for roughly 40 percent of the increase in manufacturers' unit cost expectations and nearly one-third of the increase in service-providers unit cost expectations. Despite a somewhat different conceptual basis, these results align well with data from the San Francisco Fed that decompose PCE inflation into demand- and supply-driven factors.[28] When year-over-year PCE inflation peaked at 7.1 percent in June 2022, the San Francisco Fed analysis attributes a little less than 40 percent of that to supply-driven groups of spending categories in the consumers' market-basket, another roughly 40 percent to demand-driven changes in prices, and the remainder to ambiguous factors.

While a fulsome exploration of the pandemic-era period is interesting but beyond the scope of the paper, it does warrant attention as it highlights the usefulness of gathering firm-level insights on the evolution of cost and cost expectations during the only true inflation shock the U.S. has experienced since the Great Inflation (1965-1982).

4 Unit Costs Matter for Firms

4.1 Unit Costs and Pricing: Firm-level Evidence

For unit cost expectations to be an important determinant of future inflation, these expectations must feed through into expectations and realizations for price changes. Surveying firms regarding price change expectations can be complicated by nominal frictions (i.e. price stickiness). For example, over the course of 2019 and into 2020 a battery of special questions were posed to the BIE panel that included a question eliciting firms' recent (3-month) price changes for the product/product

[28] https://www.frbsf.org/research-and-insights/data-and-indicators/supply-and-demand-driven-pce-inflation/

line or service responsible for the largest share of the firm's revenue (a "representative" price). This question was fielded once per quarter over a four quarter period and out of the resulting 1,112 usable responses, 367 or 1/3 were zero (indicating the potential presence of nominal frictions). This is consistent with studies such as Bils and Klenow (2004) and Klenow and Kryvtsov (2008) that suggest firms typically change their selling price less often than once a quarter (excluding temporary sale prices, the typical frequency of price change rises to nearly once a year). In surveys, this price stickiness is first documented by Blinder (1991).

Firms' unit cost expectations are related to their representative price change expectations. We aggregate the responses to special questions on the year-ahead price expectations of firms and relate them to year-ahead unit cost expectations.[29] Table 4 shows the results of simple OLS regressions of year-ahead price change expectations (for the given month) against firms' unit cost expectations and trailing year-over-year unit cost realizations. The final column of the table reports the pooled regression results including sector and time fixed effects. Also, Figure A.9 shows a binscatter of the results from specification (11) in Table 4.

As indicated by the regression results and binscatter, firms' year-ahead unit cost expectations covary strongly and consistently with year-ahead price expectations across all ten periods, despite changes in wording and question formatting. As suggested by the empirical investigation of unit costs and price changes of Carlsson and Nordstrom Skans (2012), expectations of future unit costs appear to play a role in firms' price formation strategies. However, this relationship is not one-for-one (likely due to aforementioned impediments to continuous price adjustments).

In a separate analytical exercise, utilizing the series of special questions elicited over the course of January 2019 through January 2020, we find little evidence that firms' year-ahead ex ante aggregate inflation expectations are related to their ex post year-over-year price changes. Table 5 shows the simple correlations between firms' realized price changes over the past year, aggregate (CPI-based) inflation expectations (elicited in January 2019), firms' year-ahead expected price changes as of February 2019, lagged unit cost expectations, and firms' unit cost growth over the past year. In stark contrast to firms' year-ahead price expectations, firms' expectations for aggregate (CPI) inflation are uncorrelated with reported price changes in the cross section. This result conforms to the notion that aggregate inflation expectations are not central to firms' price-setting behavior in low inflation environments. In addition, as they reported to direct questions on the usefulness of aggregate inflation (see Figure 3), firms appear to pay more attention to their own idiosyncratic

[29] In June 2013, the BIE elicited probabilistic year-ahead expectations of firms' average prices using the same format as the core BIE unit cost expectations question. In February 2019, the BIE elicited probabilistic year-ahead "representative" price change expectations using the same format as in the Survey of Business Uncertainty. And, in December 2020, April 2021, July 2021, November 2021, March 2022, May 2023, and October 2023 firms were asked to provide their point estimates for the percentage change in the product/product line or service responsible for the largest share of revenue. Given changes in question wording and formatting, we normalize the price responses in the analysis. Detailed wording for these special questions can be found in Appendix C. And, a full list of all special question can be found here: https://www.frbatlanta.org/research/inflationproject/bie/special-questions

conditions.

The results from our firm-level investigations of price changes are also consistent with the Mackowiak and Wiederholt (2009) rational inattention model. Firms in this model allocate almost all attention to idiosyncratic rather than aggregate conditions. As evidence of the dominance of idiosyncratic conditions, we decompose the variation in realized unit cost growth into its common (aggregate), sectoral, and idiosyncratic (firm-specific) components using the panel variance decomposition methods.[30] We find that the relative standard deviation of the sector-specific component is about 4 times as large as the aggregate component of unit cost growth. The relative variation of the idiosyncratic component is approximately 7 times that of the aggregate. These are similar to what Carlsson and Nordstrom Skans (2012) found using Swedish firm-level production data. Extending their work by applying this decomposition to firm-level unit cost expectations reveals a relative standard deviation of the sectoral component and the idiosyncratic component of 4 times and 9 times as large as the aggregate variation, respectively.

4.2 Informing Firms of the Policymakers' Views Does Not Change Firms' Unit Cost Expectations

Of key interest to monetary policymakers and economists alike is whether businesses respond to and incorporate information on the inflation projections and attendant uncertainty when forming their own expectations. Studies such as Coibion et al. (2018) and Coibion et al. (2020b) find mixed evidence that firms in a randomized controlled trial (RCT) setting incorporate information on the inflation expectations of professionals or the inflation projections (and goals) of monetary policymakers into firm's point estimates of inflation expectations. And, importantly, whether this new information provides a lasting, significant impact on key firm decisions, such as hiring plans. We advance these RCTs to study the impact of information about monetary policymakers' inflation expectations and the associated uncertainty on firms' own unit cost expectations and uncertainty.

In October 2020, we asked firms for their highest and lowest potential expectations for PCE inflation in 2021. In this experiment, we wanted to test whether giving business decision makers information on the *uncertainty* (in the form of confidence intervals) around monetary policymakers' projections influenced their inflation projections in October, and to see if this information impacted firms' own unit cost expectations over the year ahead a month later in November 2020. To make sure that the information we were supplying was about the second moment only, we provided both the control and the treatment groups with the median expectation for PCE inflation over calendar year 2021 from the FOMC's Summary of Economic Projections on September 15, 2020. For the treatment group we provided the 70 percent confidence interval around those projections based on

[30]The variance decomposition follows a two-stage panel regression strategy. First, the aggregate component is uncovered by regressing unit cost growth (unit cost expectations) on time dummies and clustering standard errors at the firm level. The second stage takes the residual series and separates it into sectoral (2-digit NAICS) component and an idiosyncratic component.

the historical forecast errors of professionals (excerpted from the minutes of the September 2020 FOMC meeting).

Specifically, we asked

> "The median expectation of monetary policymakers for inflation over calendar year 2021 was 1.7 percent (as of September 15th). [Treatment: Based on forecasts over the past 20 years, there is a 70 percent chance that actual inflation will be in the range of 0.7 percent to 2.7 percent over calendar year 2021.] What is your best estimate for the highest and lowest potential rate of inflation over calendar year 2021?"

Panel A of Table 6 provides some simple descriptive statistics on firms' inflation expectations for 2021, separated by whether they received the uncertainty treatment. Two interesting facts emerge from Panel A. First, firms' lowest and highest potential inflation expectations for 2021 are higher, on average, than that of professionals. This finding, in the light of other literature on household and business inflation expectations, is not all that unusual. However, firms' spread between "highest possible" and "lowest possible" is fairly similar to the 70 percent confidence interval provided to the treatment group. And, perhaps more interesting, is that the control group had a nearly identical spread between their projections for the highest and lowest possible inflation in calendar year 2021.

There is another, rather important, aspect of these results that we feel compelled to highlight. Table A.4 recreates Table 6 without excluding outliers. There were a handful of firms (four respondents in the treatment group and two in the control group) that, even after receiving policymakers' expectations for 2021 (and, for the treatment group a 70 percent confidence interval), responded with expectations for lowest or highest possible anticipated 2021 inflation in excess of 10 percent. We find this interesting because it implies that these firms either hold expectations for aggregate inflation that are roughly an order of magnitude above that of monetary policymakers, they still don't understand the guidance, or, perhaps most likely, that the concept of aggregate inflation isn't meaningful enough for them to answer thoughtfully. Thus, the uncertainty information treatment had little impact on firms' aggregate inflation expectations and uncertainty for 2021.

In October 2021 and October 2022, one year and two years, respectively, after our first RCT, we performed similar experiments. In October 2021, we asked firms for their "annual rate of inflation" in 2022, and in October 2022 we asked for their 2023 calendar year projections. The purpose of these RCTs was to test whether giving business decision makers information on the monetary policymakers' first-moment expectations of inflation influenced their aggregate inflation projections and their own unit cost expectations. For the treatment group we provided the policymaker's inflation projections from the most recent FOMC's Summary of Economic Projections from the September 2021 (and, for the October 2022 RCT, the September 2022) meeting.

Specifically, we asked

> "[Treatment: The median expectation of monetary policymakers (as of September 22)

(September 21 in October 2022) for the annual rate of inflation over calendar year 2022 is 2.2 percent.(2.8 percent for calendar year 2023 in the October 2022 RCT)] What do you think the annual rate of inflation will be over calendar year 2022 (2023)?"

Note that the RCTs in October 2021 and October 2022 are different from the October 2020 RCT in two aspects. First, the inflation environment changed rapidly. In the early months of the pandemic, firms, on net, saw COVID-19 as largely a demand shock – lowering their unit cost expectations. In contrast, as the pandemic wore on, global supply chain disruption and shipping bottlenecks made firms increase their unit cost expectations. Second, the information treatment is different. Firms were treated with information on the uncertainty (second moment) around monetary policymakers' inflation projections in October 2020, but, in October 2021 and October 2022, were treated with information on the median (first moment) inflation expectations of monetary policymakers.

Panels B and C of Table 6 report the results from these new experiments. The new information treatment had little impact on firms' aggregate inflation expectations in 2021 and had moderate impacts on firms' aggregate inflation expectations in 2022. Taking advantage of the panel dimension of the BIE survey, we can compare the responses from three different groups of firms: those who were in the control group in the previous year, those who were in the treatment group in the previous year, and the rest of newly-added firms (who did not participate in previous iterations of the experiment). For example, the firms who received the treatment in both 2020 and 2021 predicted a 3.8% aggregate inflation rate in 2022. Despite the small size of these groups, we are able to detect a statistically significant difference in the means. Cavallo et al. (2017) find the impact of informational treatments given to households to be short-lived. Here, we find similar (albeit suggestive, given the size of the groups) evidence. In October 2021, only the group that was repeatedly given policymakers' first-moment projections responded to treatment.

Again, consistent with Cavallo et al. (2017), much like consumers who chose to pay attention to specific prices at the supermarket, we find these treatments leave unit cost expectations and uncertainty unaltered. Interestingly, in October 2022, firms in the control group that received the treatment one year prior still had statistically higher inflation expectations for calendar year 2023 than firms that received information on policymakers' inflation projections in October 2021 and October 2022.

Importantly, to evaluate whether informational treatments on policymakers' inflation projections meaningfully altered firms' unit cost expectations and uncertainty, we evaluate the informational treatments provided in October 2020, October 2021 and October 2022 on subsequent (November 2020, November 2021 and November 2022) unit cost expectations and uncertainty using regressions that control for firm size and industry fixed-effects. Table 7 reports the regression results. The coefficients on the treatment dummy variable are insignificant for all subsequent (post-treatment) unit cost expectations and uncertainty (and when pooling over all periods), suggesting

that firms do not incorporate information about the forward trajectory of year-ahead aggregate inflation from policymakers in their projections for unit cost growth and uncertainty over the year-ahead time horizon. This result is quite interesting to consider given the sharp increase in aggregate inflation from October 2020 through October 2022.

Firms themselves tell us that providing information about aggregate inflation through the projections of monetary policymakers does not heavily influence forecasts of unit costs and prices; see Figure 7. Only a small share of respondents suggested these inflation projections directly influenced their own-firm cost or price expectations. And, while that share rose modestly from October 2020 through October 2022, it is against a backdrop of the sharpest increase in overall (measured) inflation since the early 1980s. These results suggest that policymakers' views of the inflationary environment are not a material input into businesses' forecasts for unit costs or prices. One interpretation of these results is that U.S. firms operating in both low and high inflation environments appear to be inattentive to aggregate inflation statistics (paying much more attention to own-firm conditions), and thus, policymakers' expectations for aggregate inflation do not alter firms' unit cost expectations and uncertainty.

5 Conclusion

The viewpoint espoused by Chairman Greenspan on price stability that opened this paper has direct implications for monetary policymakers attempting to measure the extent to which inflation expectations are "anchored." In particular, if firms do not pay attention to aggregate inflation in low-inflation environments (perhaps due to the lack of a perceived benefit to acquiring this information) or if aggregate inflation measures such as the CPI are not significant inputs into pricing decisions, then drawing inferences about the state of inflation expectations from firms' *aggregate* inflation expectations becomes challenging. Instead, we show that by asking business decision makers about important price-setting determinants they care about – in this case their own-firm unit costs – we can aggregate these firm-specific views into series that are closely related to the aggregate inflation dynamics central bankers care about. In this sense, our work is supportive of the notion forwarded in Mackowiak and Wiederholt (2009), Riggi and Tagliabracci (2022), Afrouzi (2024) and others, that firms pay much more attention to idiosyncratic conditions. However, drawing on the lessons gleaned from survey work eliciting firm-level expectations (such as Altig et al. (2022)) we argue that firm-level unit cost expectations warrant inclusion into the existing suite of survey inflation expectations measures economists and policymakers use to monitor inflation developments.

We find that firms are well aware of, plan for, and form meaningful expectations for their own unit costs. These expectations provide insight into relevant price pressures in the economy and are an important series for policymakers to monitor. Using the Atlanta Fed's Business Inflation

Expectations survey, we aggregate own-firm probabilistic unit cost expectations. This measure is a useful predictor of future aggregate inflation – outperforming statistical benchmarks and household inflation expectations in out-of-sample forecasting exercises. And, own-firm unit cost realizations aggregate up into a series that comoves closely with official inflation statistics, further emphasizing the real-world connection between these survey responses and official (measured) inflation. Importantly, at the micro level, we find unit cost realizations and expectations matter in price-setting behavior.

Firms' unit cost expectations do not resemble the inflation expectations of households in low-inflation environments. Instead, this measure is highly correlated with the inflation expectations of professional forecasters. Informing businesses about the aggregate inflation expectations and attendant uncertainty of policymakers' forecasts, via a series of randomized controlled trials, do little to alter firms' unit cost expectations.

Chairman Powell, in an August 2022 address at the Jackson Hole Symposium, discussed the role inattention plays in aggregate inflation expectations. In particular, he noted,"*One useful insight into how actual inflation may affect expectations about its future path is based in the concept of "rational inattention." When inflation is low and stable, they are freer to focus their attention elsewhere.*"[31] This notion aligns with our perspective. In a low-inflation environment, households and firms appear to hold aggregate inflation expectations that are disconnected from the underlying inflation environment. During these low inflation periods, eliciting expectations from firms (or households) that they pay attention to and connect up to the aggregate inflation statistics that monetary policymakers endeavor to monitor is crucial. Aggregating up own-firm unit cost expectations does just this. Moreover, during the current high inflation environment, we show that unit cost expectations perform similarly to other measures that elicit aggregate inflation concepts, highlighting its durability as an essential determinant of the inflation expectations of firms.

[31] https://www.federalreserve.gov/newsevents/speech/powell20220826a.htm

References

H. Afrouzi. Firms' inflation expectations: Which expectations matter when? *Conference Presentation at New York Fed's Inflation: Risks, Implications and Policies Conference*, 2022.

H. Afrouzi. Strategic inattention, inflation dynamics and the non-neutrality of money. *Journal of Political Economy*, forthcoming, 2024.

D. Altig, J. M. Barrero, N. Bloom, S. J. Davis, B. H. Meyer, and N. Parker. Surveying business uncertainty. *Journal of Econometrics*, 231:282–303, 2022.

A. Ang, G. Bekaert, and M. Wei. Do macro variables, asset markets or surveys forecast inflation better? *Journal of Monetary Economics*, 54(4):1163–1212, 2007.

O. Armantier, W. B. de Bruin, S. Potter, G. Topa, W. van der Klaauw, and B. Zafar. Measuring inflation expectations. *Annual Review of Economics*, 5:273–301, 2013.

R. Bachmann, T. O. Berg, and E. R. Sims. Inflation expectations and readiness to spend: Cross-sectional evidence. *American Economic Journal: Economic Policy*, 7(1):1–35, 2015.

R. Bachmann, K. Carstensen, S. Lautenbacher, and M. Schneider. Uncertainty and change: Survey evidence of firms' subjective beliefs. *NBER Working Paper 29430*, 2021.

J. M. Barrero. The micro and macro of managerial beliefs. *Journal of Financial Economics*, 143: 640–667, 2022.

M. Bils and P. J. Klenow. Some evidence on the importance of sticky prices. *Journal of Political Economy*, 112(5):947–985, 2004.

C. Binder. Whose expectations augment the Phillips curve? *Economics Letters*, 136:35–38, 2015.

A. Blanco, C. Boar, C. Jones, and V. Midrigan. The inflation accelerator. *NBER Working Paper No. 32531*, 2024.

A. S. Blinder. Why are prices sticky? preliminary results from an interview study. *American Economic Review*, 81(2):89–96, 1991.

A. S. Blinder. On sticky prices: Academic theories meet the real world. In N. G. Mankiw, editor, *Monetary Policy*, pages 117–154. The University of Chicago Press, 1994.

C. Borio, M. Lombardi, J. Yetman, and E. Zakrajsek. The two-regime view of inflation. *BIS Papers No. 133*, 2023.

W. Bruine de Bruin, W. Vanderklaauw, J. Downs, B. Fischhoff, G. Topa, and O. Armantier. Expectations of inflation: The role of demographic variables, expectation formation, and financial literacy. *Journal of Consumer Affairs*, 44(2):381–402, 2010.

M. F. Bryan and G. Venkatu. The curiously different inflation perspectives of men and women. *Economic Commentary, Federal Reserve Bank of Cleveland*, 2001.

G. Calvo. Staggered prices in a utility maximizing framework. *Journal of Monetary Economics*, 12:383–398, 1983.

B. Candia, O. Coibion, and Y. Gorodnichenko. The inflation expectations of U.S. firms: Evidence from a new survey. *Journal of Monetary Economics*, 145(103569), 2024.

M. Carlsson and O. Nordstrom Skans. Evaluating microfoundations for aggregate price rigidities: Evidence from matched firm-level data on product prices and unit labor cost. *American Economic Review*, 102(4):1571–1595, 2012.

A. Cavallo and O. Kryvtsov. What can stockouts tell us about inflation? evidence from online micro data. *Journal of International Economics*, 146(103769), 2023.

A. Cavallo, G. Cruces, and R. Perez-Truglia. Inflation expectations, learning, and supermarket prices: Evidence from survey experiments. *American Economic Journal: Macroeconomics*, 9(3): 1–35, 2017.

C. Chen, T. Hattori, and Y. Luo. Information rigidity and elastic attention: Evidence from Japan. *Working Paper*, 2021.

R. Clarida, J. Gali, and M. Gertler. The science of monetary policy: A new Keynesian perspective. *Journal of Economic Literature*, 37(4):1661–1707, 1999.

O. Coibion, Y. Gorodnichenko, and S. Kumar. How do firms form their expectations? new survey evidence. *American Economic Review*, 108:2671–2713, 2018.

O. Coibion, Y. Gorodnichenko, S. Kumar, and M. Pedemonte. Inflation expectations as a policy tool? *Journal of International Economics*, 124:103297, 2020a.

O. Coibion, Y. Gorodnichenko, and T. Ropele. Inflation expectations and firm decisions: New causal evidence. *Quarterly Journal of Economics*, 135(1):165–219, 2020b.

F. D'Acunto, U. Malmendier, J. Ospina, and M. Weber. Exposure to daily price changes and inflation expectations. *Journal of Political Economy*, 129(5):1615–1639, 2021.

M. Del Negro, M. Lenza, G. Primiceri, and A. Tambalotti. What's up with the phillips curve? *Brookings Papers on Economic Activity*, Spring, 2020.

F. Diebold and R. Mariano. Comparing predictive accuracy. *Journal of Business & Economic Statistics*, 13(3):253–263, 1995.

K. Dogra, S. Heise, E. S. Knotek, B. H. Meyer, R. W. Rich, R. S. Schoenle, G. Topa, W. van der Klaauw, and W. B. de Bruin. Estimates of cost-price passthrough from business survey data. *Atlanta Federal Reserve Working Paper Series*, 2023(5), 2023.

Z. Enders, F. Hunnekes, and G. Muller. Monetary policy announcements and expectations: Evidence from German firms. *Journal of Monetary Economics*, 108:45–63, 2019.

J. Engelberg, C. F. Manski, and J. Williams. Comparing the point predictions and subjective probability distributions of professional forecasters. *Journal of Business & Economic Statistics*, 27:30–41, 2009.

G. Fiori and F. Scoccianti. The economic effects of firm-level uncertainty: Evidence using subjective expectations. *Journal of Monetary Economics*, 140:92–105, 2023.

I. Hajdini, E. S. Knotek II, M. Pedemonte, R. Rich, J. Leer, and R. Schoenle. Indirect consumer inflation expectations: Theory and evidence. *Journal of Monetary Economics*, 145(103568), 2024.

M. T. Kiley. Low inflation in the United States: A summary of recent research. *FEDS Notes, Board of Governors of the Federal Reserve System*, 2015.

G. Kim and C. Binder. Learning-through-survey in inflation expectations. *American Economic Journal: Macroeconomics*, 15(2):254–278, 2023.

P. J. Klenow and O. Kryvtsov. State-dependent or time-dependent pricing: Does it matter for recent U.S. inflation? *Quarterly Journal of Economics*, 123(3):863–904, 2008.

S. Kumar, H. Afrouzi, O. Coibion, and Y. Gorodnichenko. Inflation targeting does not anchor inflation expectations: Evidence from firms in New Zealand. *Brookings Papers on Economic Activity*, pages 151–225, 2015.

J. T. Lessler and W. D. Kalsbeek. *Nonsampling Error in Surveys*. Wiley, 1992.

Y. Ma, T. Ropele, D. Sraer, and D. Thesmar. A quantitative analysis of distortions in managerial forecasts. *NBER Working Paper 26830*, 2020.

B. Mackowiak and M. Wiederholt. Optimal sticky prices under rational inattention. *American Economic Review*, 99(3):769–803, 2009.

N. G. Mankiw, R. Reis, and J. Wolfers. Disagreement about inflation expectations. In M. Gertler and K. Rogoff, editors, *NBER Macroeconomics Annual*, volume 18, pages 209–248. MIT Press, 2004.

C. F. Manski. Measuring expectations. *Econometrica*, 72(5):1329–1376, 2004.

B. H. Meyer, B. Prescott, and X. S. Sheng. The impact of the COVID-19 pandemic on business expectations. *International Journal of Forecasting*, 38:529–544, 2022.

B. H. Meyer, B. Prescott, and X. S. Sheng. The impact of supply chain disruptions on business expectations during the pandemic. *Energy Economics*, 126(106951):1–14, 2023.

M. Riggi and A. Tagliabracci. Price rigidities, input costs, and inflation expectations: Understanding firms' pricing decisions from micro data. *Bank of Italy Occasional Papers Series*, Number 733, 2022.

C. Sims. Implications of rational inattention. *Journal of Monetary Economics*, 50:665–690, 2003.

F. Smets and R. Wouters. Shocks and frictions in US business cycles: A Bayesian DSGE approach. *American Economic Review*, 97(3):586–606, 2007.

J. H. Stock and M. W. Watson. Why has U.S. inflation become harder to forecast? *Journal of Money, Credit and Banking*, 39(s1):3–33, 2007.

L. B. Thomas. Survey measures of expected U.S. inflation. *Journal of Economic Perspectives*, 13 (4):125–144, 1999.

R. Verbrugge and S. Zaman. Whose inflation expectations best predict inflation? *Economic Commentary, Federal Reserve Bank of Cleveland*, 2021(19):1–7, 2021.

M. Weber, B. Candia, T. Ropele, R. Lluberas, S. Frache, B. Meyer, S. Kumar, Y. Gorodnichenko, D. Georgarakos, O. Coibion, G. Kenny, and J. Ponce. Tell me something I don't already know: Learning in low- and high-inflation settings. *Econometrica*, forthcoming, 2024.

M. Woodford. Imperfect common knowledge and the effects of monetary policy. In P. Aghion, R. Frydman, J. Stiglitz, and M. Woodford, editors, *Knowledge, Information, and Expectations in Modern Macroeconomics: In Honor of Edmund S. Phelps*, pages 25–58. Princeton University Press, 2003.

Panel A: Representativeness by Firm Size

	BIE	United States			Sixth Federal Reserve District States		
		Establishments	Employment	Annual Payroll	Establishments	Employment	Annual Payroll
Small (1–99 employees)	50.9	78.0	33.0	26.7	77.2	31.2	26.5
Medium (100–499 employees)	27.4	4.9	14.1	13.6	4.4	12.7	12.5
Large (500+ employees)	21.6	17.1	52.9	59.7	18.4	56.2	61.0

Panel B: Representativeness by Industry

	BIE	United States			Sixth Federal Reserve District States			Private (Nonfarm) GDP
		Establishments	Employment	Annual Payroll	Establishments	Employment	Annual Payroll	
Construction	11.9	9.1	5.1	5.9	8.5	5.1	5.9	5.1
Manufacturing	18.0	3.7	9.1	10.2	3.0	8.0	9.4	18.8
Educational services	1.7	1.3	2.9	2.1	1.2	2.1	1.7	1.6
Finance and Insurance	11.9	6.1	5.0	9.6	6.5	4.4	7.5	9.5
Health care and social assistance	3.2	11.5	15.8	14.8	11.1	14.5	15.6	7.9
Information	1.3	2.0	2.7	5.3	1.8	2.2	3.7	5.8
Leisure and hospitality	3.0	11.1	12.8	5.3	10.1	13.5	6.0	4.7
Mining and utilities	2.0	0.6	1.0	1.8	0.5	0.8	1.5	3.3
Other services except government	2.8	9.8	4.3	2.7	9.4	4.2	2.7	2.3
Professional and business services	13.0	17.8	18.9	23.8	18.8	22.4	26.4	12.9
Real estate and rental and leasing	7.8	5.2	1.7	1.7	5.7	1.8	1.9	12.4
Retail and wholesale trade	18.4	18.8	17.0	13.1	20.3	17.2	13.4	12.2
Transportation and warehousing	5.0	3.0	3.8	3.6	3.0	4.0	4.4	4.1

Sources: Census Bureau Statistics of U.S. Businesses 2017; Bureau of Economic Analysis; Federal Reserve Bank of Atlanta's Business Inflation Expectations Survey.

Notes: This table reports the share of U.S. firms. The Atlanta Fed territory covers the Sixth Federal Reserve District, which includes Alabama, Florida, Georgia, and portions of Louisiana, Mississippi, and Tennessee.

Table 1: BIE Panel Representativeness

Panel A: 2011Q4 – 2019Q4

Surveys	(1)	(2)	(3)	(4)	(5)	(6)	(7)
(1) BIE	1.000						
(2) UM	-0.014	1.000					
(3) SPF CPI	0.550***	-0.380**	1.000				
(4) SPF PCE	0.464***	-0.085	0.723***	1.000			
(5) SPF PGDP	0.818***	-0.470***	0.809***	0.589***	1.000		
(6) SPF Core CPI	0.645***	-0.622***	0.780***	0.678***	0.799***	1.000	
(7) SPF Core PCE	0.590***	-0.4738***	0.742***	0.780***	0.790***	0.907***	1.000

Panel B: 2020Q1 – 2023Q4

Surveys	(1)	(2)	(3)	(4)	(5)	(6)	(7)
(1) BIE	1.000						
(2) UM	0.955***	1.000					
(3) SPF CPI	0.882***	0.811***	1.000				
(4) SPF PCE	0.796***	0.747***	0.909***	1.000			
(5) SPF PGDP	0.948***	0.852***	0.960***	0.905***	1.000		
(6) SPF Core CPI	0.789***	0.749***	0.922***	0.980***	0.895***	1.000	
(7) SPF Core PCE	0.795***	0.741***	0.922***	0.9991***	0.906***	0.992***	1.000

Panel C: 2011Q4 – 2023Q4

Surveys	(1)	(2)	(3)	(4)	(5)	(6)	(7)
(1) BIE	1.000						
(2) UM	0.915***	1.000					
(3) SPF CPI	0.906***	0.723***	1.000				
(4) SPF PCE	0.842***	0.713***	0.922***	1.000			
(5) SPF PGDP	0.946***	0.715***	0.958***	0.902***	1.000		
(6) SPF Core CPI	0.821***	0.583***	0.919***	0.940***	0.908***	1.000	
(7) SPF Core PCE	0.822***	0.599***	0.913***	0.957***	0.911***	0.979***	1.000

Note: The sample period for Panel A starts in 2011Q4 and ends in 2019Q4 (right before the start of the pandemic). Panel B starts in 2020Q1 and includes the 16 quarters following the onset of the pandemic (through 2023q4). Panel C is the full sample, 2011Q4 through 2023Q4. The comparisons use the mean BIE and the median measures for the University of Michigan's Survey of Consumers (UM) and Philadelphia Fed Survey of Professional Forecasters (SPF), as the medians are more widely cited in academic research, by policymakers, and in newswires. Using the mean UM and SPF measures does not qualitatively (or quantitatively) alter the results. Additionally, we use the highest frequency data available when estimating the correlation. This implies that the SPF comparisons use quarterly data while the comparison between the BIE and UM measures use monthly data. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

Table 2: Time Series Correlations between One-year Ahead Inflation Expectations

Model	RMSE CPI	RMSE Core CPI	RMSE PCE	RMSE Core PCE	RMSE PGDP	MAE CPI	MAE Core CPI	MAE PCE	MAE Core PCE	MAE PGDP
Panel A: 2012q4 – 2019q4										
Benchmark										
ARMA(1, 1)	1.22	0.45	0.87	0.40	0.76	1.05	0.39	0.73	0.34	0.65
Firms										
BIE	0.66***	0.50***	0.96	1.03	0.77***	0.55***	0.47***	0.89	1.05	0.67***
BIE:Supersector 1	**0.63*** **	**0.46*** **	0.94	1.04	0.77***	**0.53*** **	**0.42*** **	0.88	1.11	0.67***
BIE:Supersector 2	0.64***	0.95	**0.93**	1.18	0.72***	0.62***	0.85	0.90	1.15	0.71***
BIE:Supersector 3	0.72***	0.69**	1.03	1.21	0.84**	0.63***	0.65*	0.94	1.21	0.74**
BIE:Supersector 4	0.67***	0.50***	0.98	1.04	0.81***	0.56***	0.50***	**0.88**	1.04	0.71**
Consumers										
MSC:Mean	1.82***	3.76***	2.75***	5.09***	2.73***	1.88***	4.06***	3.04***	5.84***	3.00***
MSC:Median	1.30*	2.26**	1.99***	3.40***	1.88***	1.26	2.35***	2.13***	3.86***	1.97***
MSC:1st qtile income	2.41***	5.43***	3.61***	6.96***	3.71***	2.60***	5.99***	4.08***	8.08***	4.16***
MSC:2nd qtile income	1.93***	4.07***	2.91***	5.43***	2.91***	2.01***	4.40***	3.23***	6.24***	3.20***
MSC:3nd qtile income	1.64***	3.28**	2.48***	4.52***	2.43***	1.65**	3.42***	2.70***	5.10***	2.61***
MSC:4rd qtile income	1.36**	2.45**	2.08***	3.62***	1.98***	1.34*	2.53***	2.23***	4.08***	2.08***
Professional forecasters										
BCEI	0.71***	–	–	–	**0.70*** **	0.62***	–	–	–	**0.64*** **
SPF	0.70***	0.60***	0.96	**0.90**	0.75***	0.61***	0.61***	0.90	**0.97**	0.68***
Panel B: 2020q1 – 2023q4										
Benchmark										
ARMA(1, 1)	2.64	1.77	2.06	1.46	2.22	2.23	1.4	1.7	**1.03**	**1.85**
Firms										
BIE	1.22	1.21	1.16	1.18	1.22	1.07	1.25	1.10	1.34	1.13
BIE:Supersector 1	1.17	1.16	1.11	1.14	1.17	1.06	1.23	1.06	1.32*	1.09
BIE:Supersector 2	1.09	1.02	1.01	0.97	1.08	**0.97**	1.04	1.00	1.08	1.04
BIE:Supersector 3	1.17	1.14	1.1	1.12	1.16	1.04	1.19	1.05	1.29	1.08
BIE:Supersector 4	1.27	1.28	1.22	1.26	1.28	1.12	1.29	1.16	1.42	1.18
Consumers										
MSC:Mean	1.00	0.96	1.14	1.36	1.12	1.07	1.05	1.21	1.64	1.15
MSC:Median	0.97	**0.79***	**0.92**	**0.87**	**0.97**	0.97	**0.84***	**0.99**	1.08	1.02
MSC:1st qtile income	1.21	1.4	1.51	1.96	1.42	1.21	1.41	1.45	2.23	1.37
MSC:2nd qtile income	0.95	0.92	1.10	1.33	1.07	1.01	0.98	1.14	1.62	1.09
MSC:3nd qtile income	0.97	0.87	1.07	1.22	1.06	1.03	0.98	1.15	1.47	1.11
MSC:4rd qtile income	**0.95**	0.79	0.98	1.03	1.00	0.98	0.87	1.06	1.31	1.07
Professional forecasters										
BCEI	1.29	–	–	–	1.36	1.15	–	–	–	1.26
SPF	1.28	1.38	1.32	1.48	1.34	1.15	1.45	1.29	1.75*	1.24
Panel C: 2012q4 – 2023q4										
Benchmark										
ARMA(1, 1)	1.86	**1.12**	1.41	0.93	**1.46**	1.47	0.75	1.07	**0.59**	1.08
Firms										
BIE	1.09	1.16	1.12	1.17	1.15	0.83	0.99	1.01	1.23	0.95
BIE:Supersector 1	1.05	1.11	1.07	1.12	1.11	0.81	**0.96**	0.98	1.24	0.92
BIE:Supersector 2	**0.99**	1.01	**0.99**	**1.00**	1.03	**0.81***	0.98	**0.95**	1.11	**0.91**
BIE:Supersector 3	1.06	1.11	1.09	1.13	1.11	0.85	1.01	1.00	1.26	0.95
BIE:Supersector 4	1.13	1.22	1.17	1.24	1.21	0.86	1.02	1.04	1.28	1.00
Consumers										
MSC:Mean	1.28	1.52	1.68**	2.19***	1.53**	1.44**	2.06**	2.01***	3.21***	1.87***
MSC:Median	1.07	1.05	1.27	1.44	1.18	1.10	1.35	1.49**	2.12***	1.39**
MSC:1st qtile income	1.64**	2.20***	2.21***	3.05***	2.02***	1.85***	2.95***	2.60***	4.40***	2.45***
MSC:2nd qtile income	1.30	1.58	1.72**	2.27***	1.55**	1.47**	2.13**	2.05***	3.34***	1.91***
MSC:3nd qtile income	1.20	1.34	1.53**	1.95**	1.40**	1.31*	1.80**	1.83***	2.82***	1.69***
MSC:4rd qtile income	1.08	1.09	1.33*	1.59**	1.23**	1.15	1.43	1.57***	2.34***	1.46***
Professional forecasters										
BCEI	1.16	–	–	–	1.27	0.91	–	–	–	1.02
SPF	1.15	1.32	1.24	1.42	1.26	0.90	1.16	1.12	1.46	1.02

Notes: Refer to the notes to Table A.3, as this table presents an analogous exercise, only on a quarterly basis. The Blue Chip Economic Indicators (BCEI) series reports the average forecast for CPI and PGDP inflation specifically. With the exception of "MSC:Median", all reported Michigan Survey of Consumers (MSC) values are the mean. The most accurate measures (in terms of RMSE/MAE) are shown in **bold**. The stars in the table represent the significance of the Diebold-Mariano test for the forecast accuracy between the survey and the benchmark. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

Table 3: Pseudo Out-of-sample Forecasting at the Quarterly Frequency

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Unit cost expectations	0.420***	0.253***	0.281***	0.129*	0.331***	0.238***	0.284***	0.197**	0.174***	0.224***	0.224***
	(0.109)	(0.084)	(0.055)	(0.074)	(0.064)	(0.053)	(0.045)	(0.061)	(0.058)	(0.064)	(0.0317)
Unit cost growth	0.027	0.064	-0.021	0.012	-0.033	0.077*	0.024	0.054	0.046	0.057	0.030
	(0.073)	(0.076)	(0.046)	(0.047)	(0.046)	(0.041)	(0.039)	(0.047)	(0.045)	(0.044)	(0.017)
Sales level	0.178*	0.022	-0.066	0.062	0.002	-0.034	-0.054	-0.005	-0.029	-0.085	-0.008
	(0.096)	(0.124)	(0.065)	(0.060)	(0.060)	(0.068)	(0.062)	(0.063)	(0.071)	(0.069)	(0.016)
Sector-Time FE	N	N	N	N	N	N	N	N	N	N	Y
Period	Jun 2013	Feb 2019	Nov 2019	Dec 2020	Apr 2021	Jul 2021	Nov 2021	Mar 2022	May 2023	Oct 2023	Pooled
Observations	184	90	240	200	197	175	181	180	177	163	1,972
R^2	0.196	0.180	0.120	0.047	0.190	0.252	0.253	0.137	0.147	0.189	0.429

Source: FRBA Business Inflation Expectations (BIE) Survey.

Notes: In Columns (1) to (10), regressions are estimated via OLS of the form: $E_t p_{f,t+h} = \beta E_t uc_{f,t+1} + \theta uc_{f,t}^{perc} + \lambda s_{f,t} + \epsilon_{f,t}$, where $E_t p_{f,t+h}$ is year-ahead price change expectations (for a given month), $E_t uc_{f,t+1}$ is firms' unit cost expectations, $uc_{f,t}^{perc}$ is year-over-year unit cost realizations, and $s_{f,t}$ is sales level. Columns (1) through (10) use the responses to special questions on expected prices elicited in June 2013, February 2019, November 2019, December 2020, April 2021, July 2021, November 2021, March 2022, May 2023, and October 2023 respectively. Column (11) reports the result from a pooled regression across these ten special surveys that includes sector-time fixed effects. Given changes in question formatting, responses to all covariates except the discrete "Sales level" variable were normalized. For the period corresponding to February 2019, we only consider price expectations less than or equal to 10 percent. We then normalize the values reported. For periods after February 2019, the price expectations were also winsorized at the 5% and 95% levels prior to normalization. The "Sales level" variable is a qualitative core monthly question. We transform it into an indicator variable denoting whether a firm had sales levels that were higher than "normal" during the given month. Heteroskedasticity-robust standard errors are reported in parenthesis for Columns (1)–(10). Cluster-robust standard errors are reported in Column (11) and they are are clustered at the firm-level. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

Table 4: Relationship Between Unit Cost Expectations and Price Change Expectations

Variables	(1)	(2)	(3)	(4)	(5)
(1) Realized Price Change	1.000				
(2) Aggregate Inflation Expectation	0.010	1.000			
(3) Expected Price Change	0.468***	0.046	1.000		
(4) Lagged Unit Cost Expectation	0.101	0.065	0.235**	1.000	
(5) Unit Cost Growth	0.171**	0.031	0.248**	0.307***	1.000

Source: FRBA Business Inflation Expectations (BIE) Survey.
Notes: (1) Realized price change is the winsorized (2.5%, 97.5%) and annualized 3-month price change realizations gathered from respondents quarterly from January 2019 to January 2020. (2) Aggregate Inflation is probabilistic 1-year ahead CPI expectations elicited in January 2019. (3) Expected price change is the probabilistic 1-year ahead price change expectations elicited in February 2019. (4) Lagged 1-year ahead unit cost expectations were gathered from respondents in January 2019. (5) Unit cost growth is the perceived unit cost growth over the past 12 months from the January 2020 survey. Pairwise correlations reported. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

Table 5: Realized Price Changes and Expectations: January 2019 to January 2020

Panel A: Forecasts for 2021 Aggregate Inflation				
	Mean	P25	P75	N
Treatment Group				
Lowest potential rate of inflation	1.22	1.00	1.50	101
Highest potential rate of inflation	3.07	2.50	3.50	101
Spread (highest - lowest)	1.85	1.50	2.00	101
Control Group				
Lowest potential rate of inflation	1.17	1.00	1.50	99
Highest potential rate of inflation	3.01	2.00	3.50	99
Spread (highest - lowest)	1.84	1.00	2.00	99
Panel B: Forecasts for 2022 Aggregate Inflation				
	Mean	P25	P75	N
October 2021 Treatment Group				
All firms	4.40	3.00	5.00	92
Existing firms that received the treatment in 2020	**3.77**	3.00	5.00	40
Existing firms in the control group in 2020	4.27	2.95	5.00	35
Newly added firms	6.14	3.70	6.25	17
October 2021 Control Group				
All firms	4.92	3.00	5.00	89
Existing firms that received the treatment in 2020	**5.12**	3.00	5.50	33
Existing firms in the control group in 2020	4.67	3.00	5.00	46
Newly added firms	5.42	3.25	7.50	10
Panel C: Forecasts for 2023 Aggregate Inflation				
	Mean	P25	P75	N
October 2022 Treatment Group				
All firms	**5.29**	3.75	6.00	88
Existing firms that received the treatment in 2021	**5.42**	4.00	6.00	38
Existing firms in the control group in 2021	5.74	3.5	6.00	29
Newly added firms	**4.43**	3.00	5.00	21
October 2022 Control Group				
All firms	**6.43**	5.00	8.00	82
Existing firms that received the treatment in 2021	**7.42**	5.00	8.00	24
Existing firms in the control group in 2021	5.68	4.00	7.00	31
Newly added firms	**6.41**	5.00	8.00	27

Note: Results obtained via RCT special questions posed to the panel during October 2020, October 2021, and October 2022. In October 2020, Treatment: [Based on forecasts over the past 20 years, there is a 70 percent chance that actual inflation will be in the range of 0.7 percent to 2.7 percent over calendar year 2021.] Question: What is your best estimate for the highest and lowest potential rate of inflation over calendar year 2021? 206 panelists responded to the BIE special questions in October 2020. Responses above 10% were excluded from these tables (4 from the treatment group and 2 from the control group). In October 2021 (and October 2022), Treatment: [The median expectation of monetary policymakers (as of September 22 (September 21) for the annual rate of inflation over calendar year 2022 (2023) is 2.2 percent (2.8 percent).] Question: What do you think the annual rate of inflation will be over calendar year 2022 (2023)? T-tests were performed on all control-treatment pairings above with the exception of "Newly added firms" in panel B due to the small sample size. Instances where we reject the null hypothesis of equal expectations at the 5% significance level are highlighted in bold.

Table 6: Impact of Monetary Policymakers' Inflation Projections on Firms' Aggregate Inflation Expectations

	Nov. 2020		Nov. 2021		Nov. 2022		Pooled	
	Exp.	Unc.	Exp.	Unc.	Exp.	Unc.	Exp.	Unc.
Information treatment	-0.078	0.035	0.030	0.072	0.332	-.312	-0.06	-0.04
	(0.14)	(0.16)	(0.16)	(0.16)	(.25)	(0.27)	(0.10)	(0.10)
Pre-treat unit cost expectation	0.685***		0.788***		0.743***		0.791***	
	(0.05)		(0.05)		(0.05)		(0.03)	
Pre-treat unit cost uncertainty		0.754***		0.812***		0.771***		0.774***
		(0.04)		(0.04)		(0.06)		(0.03)
Observations	173	173	154	154	127	127	454	454
R^2	0.596	0.676	0.718	0.743	0.721	0.667	0.676	0.670

Notes: This table reports the regression results of information treatments on own-firm unit cost expectations and uncertainty. The above results are obtained via panel and pooled OLS regression of post-treat unit cost expectation (or uncertainty) on information treatment and pre-treat unit cost expectation (or uncertainty). Under each date (Nov 2020, Nov 2021, Nov 2022, and Pooled), the first column (Exp.) uses post-treament unit costs as the dependent variable. Unit cost uncertainty is the dependent variable in the second column under each date heading (Unc.). Post-treat unit cost expectations/uncertainty are obtained in November 2020, November 2021, and November 2022. Information treatment is a dummy variable corresponding to whether or not a given firm received information treatment in October 2020, October 2021, and October 2022. For details on information treatment, see the notes in Table 6. Pre-treat unit cost expectations/uncertainty are obtained in October 2020, October 2021, and October 2022 elicited prior to the information treatment in the questionnaire. In the reported regressions, we control for firm size and industry fixed effects, but the results without controls are quantitatively similar. Cluster-robust standard errors are reported and they are clustered at the firm level. *** denotes significance at the 1% level.

Table 7: Influence of Monetary Policymakers' Inflation Projections on Firms' Unit Cost Expectations and Uncertainty

Projecting ahead, to the best of your ability, please assign a percent likelihood to the following changes to UNIT COSTS over the next twelve months. (Values should sum to 100%)

For example, if you think each of these is equally likely, you might answer 20% for each:

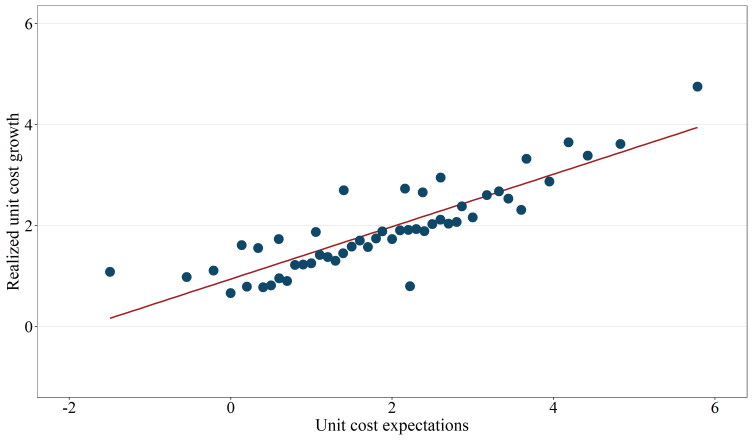
Unit costs down (less than -1%)	20
Unit costs about unchanged (-1% to 1%)	20
Unit costs up somewhat (1.1% to 3%)	20
Unit costs up significantly (3.1% to 5%)	20
Unit costs up very significantly (more than 5%)	20
Total	100

Unit costs down (less than -1%)	0	%
Unit costs about unchanged (-1% to 1%)	0	%
Unit costs up somewhat (1.1% to 3%)	0	%
Unit costs up significantly (3.1% to 5%)	0	%
Unit costs up very significantly (more than 5%)	0	%
Total	0	%

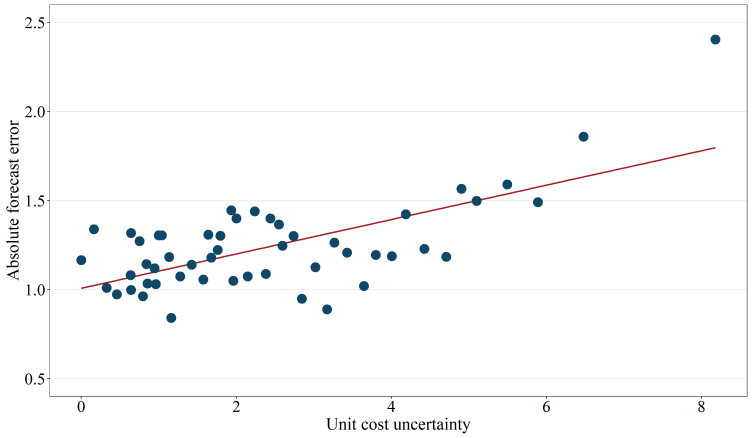
Source: FRBA Business Inflation Expectations (BIE) Survey.
Notes: The above figure is a screenshot of the actual current questionnaire fielded using Qualtrics. A sum of probabilities is calculated in real-time and shown in red if it does not sum to 100 percent. A respondent is not required to have probabilities sum to 100 percent before continuing on with the questionnaire. In practice, approximately 2 percent of responses to this question sum to something other than 100 percent.

Figure 1: BIE Survey Questionnaire: Probabilistic Unit Cost Expectations

(a) Firm's Unit Cost Expectations vs. Realizations (Perceptions)

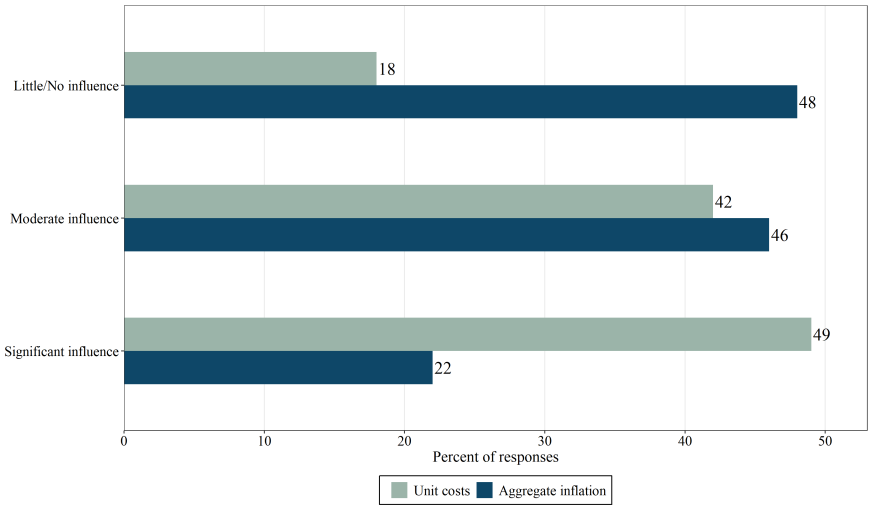


(b) Firm's Uncertainty vs. Absolute Forecast Errors



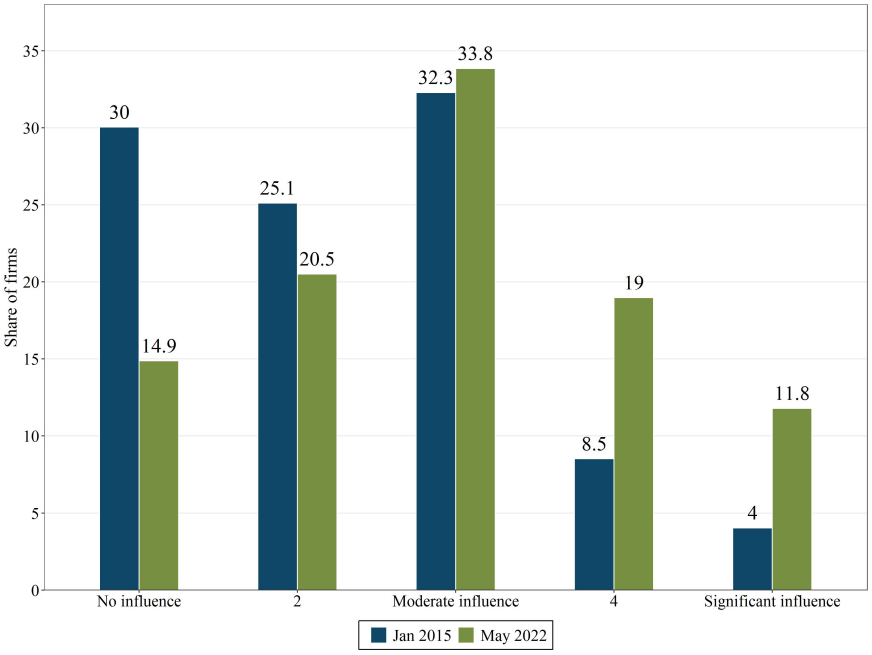
Source: FRBA Business Inflation Expectations (BIE) Survey
Note: The binscatters (51 bins) in panel (a) compare respondents' 1-year ahead unit cost expectations (lagged by 12 months) to their realized (perceived) year-over-year unit cost growth outcomes. For panel (a), the regression statistics are: $\beta = 0.633$, $R^2 = 0.215$, t-value $= 22.94$, and N $= 18930$. The binscatters (51 bins) in panel (b) compare respondents' 1-year ahead unit cost uncertainty (lagged by 12 months) to their realized absolute forecast errors (unit cost outcome minus 12-month lagged unit cost projection). For panel (b), the regression statistics are: $\beta = 0.084$, $R^2 = 0.016$, t-value $= 4.42$, and N $= 18930$.

Figure 2: Firms' Unit Cost Expectations, Uncertainty and Realizations



(a) Influence of Inflation on Firms' Pricing Decisions

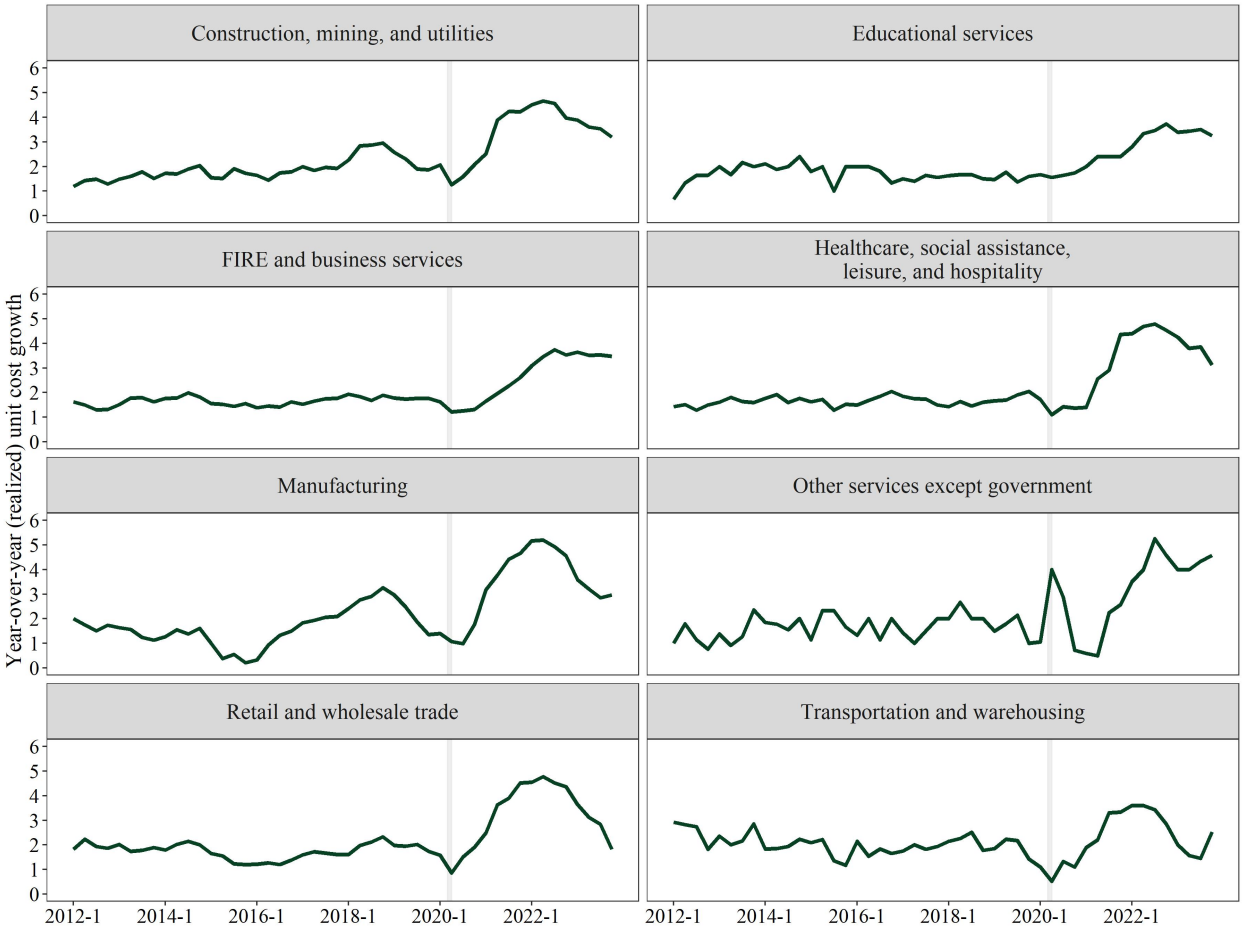
Source: FRBA Business Inflation Expectations (BIE) Survey, September 2015.
Notes: The above bar graph plots the results of a September 2015 special question. Question: On a scale from 1 to 5, with 1 being "no influence," please indicate what level of influence, if any, your expectation regarding [the economy's overall rate of inflation (given to panel A)] [your own unit costs (given to panel B)] has (have) on your pricing decisions? 1 - no influence; 2, 3- moderate influence, 4, 5-significant influence.



(b) Influence of Inflation on Business Decisions

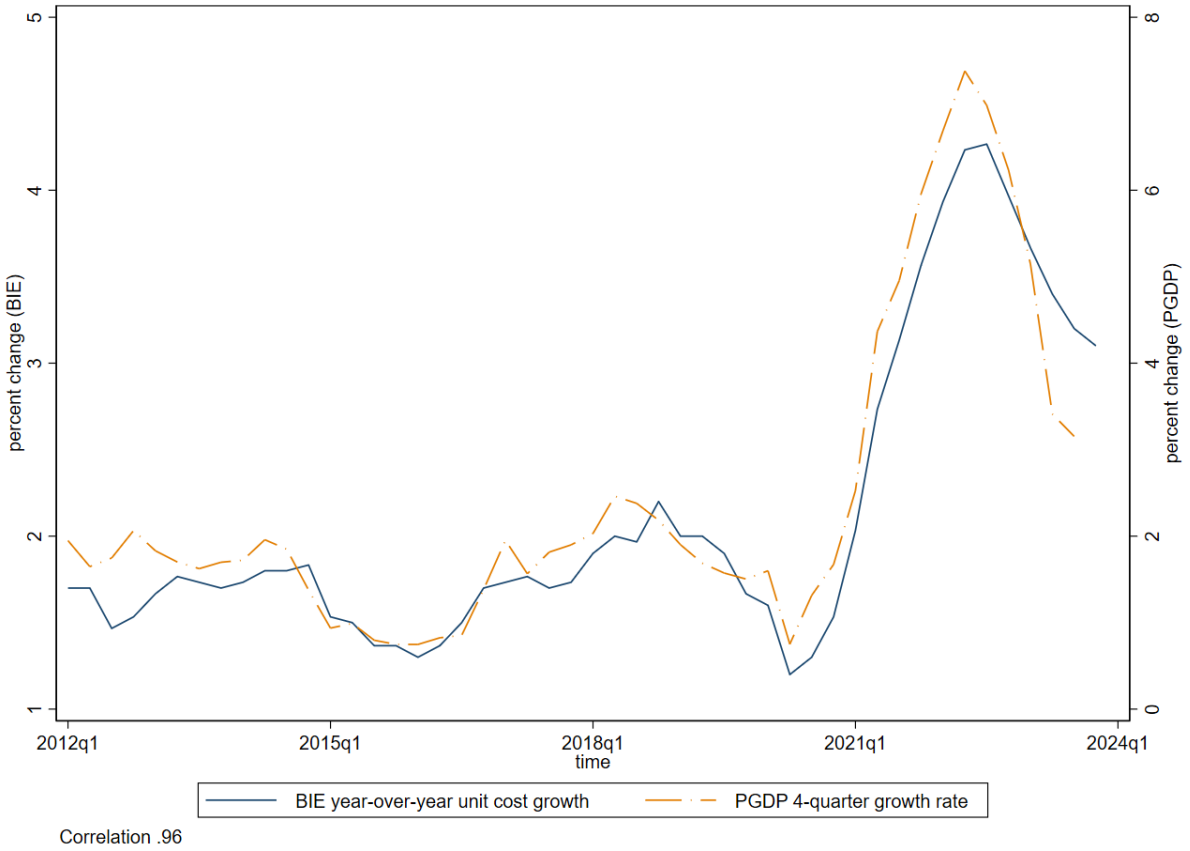
Source: FRBA Business Inflation Expectations (BIE) Survey, January 2015 and May 2022.
Notes: The above bar graph plots Likert scale responses to the following question which was asked in both a low and high inflation environment: "What level of influence do price indexes (like the Consumer Price Index, or CPI) have on your business decisions." Response options ranged from 1 (none) to 5 (significant).

Figure 3: Influence of Inflation on Business Decisions and Pricing Decisions



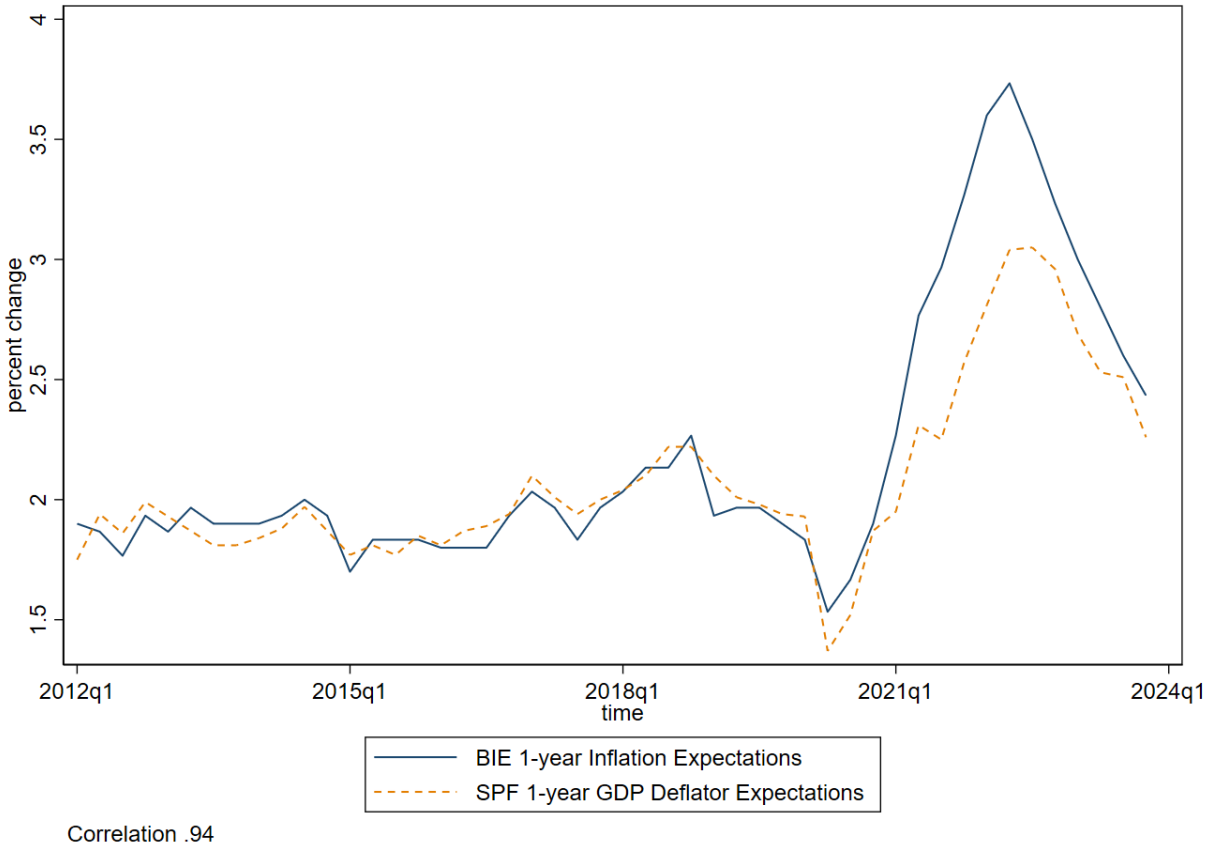
Source: FRBA Business Inflation Expectations (BIE) Survey.
Notes: The sample period is from 2012q1 to 2023q4. The term "FIRE" refers to finance and insurance and real estate, rental and leasing firms.

Figure 4: Sectoral-level Year-over-year Unit Cost Growth



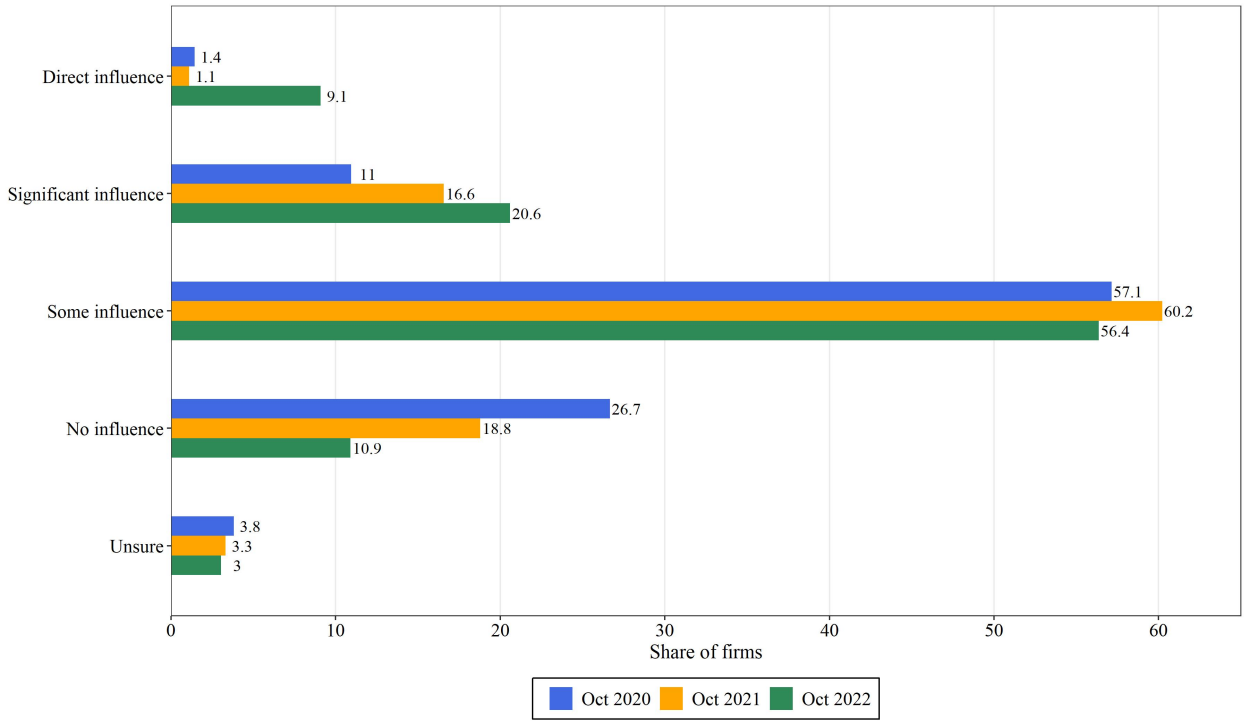
Sources: Bureau of Economic Analysis; FRBA Business Inflation Expectations (BIE) Survey.
Notes: The sample period begins in 2011q4 and ends in 2023q4. The BIE series are weighted by industry-share of GDP and quarterly averages are plotted. Given the nature of the panel, the most apt comparison is to the broadest notion of overall inflation (i.e. GDP price index). The BIE series is plotted on the left axis and the GDP Price Index is plotted on the right axis.

Figure 5: Firms' Realized Unit Cost Growth vs Actual Inflation



Sources: FRBA Business Inflation Expectations (BIE) Survey; FRBP Survey of Professional Forecasters
Notes: Data from 2011q4 through 2023q4. The SPF data is quarterly. For comparison, we plot the BIE using quarterly averages.

Figure 6: Year-Ahead Inflation Expectations of Firms and Professionals



Sources: FRBA Business Inflation Expectations (BIE) Survey
Notes: The above bar graph plots the results of an October 2020, October 2021, and October 2022 special question. During all waves the respondents were asked the exact same question. Question: Which of the following best describes how useful, if at all, the inflation expectations of monetary policymakers are when forecasting potential changes to your own unit costs and/or prices?

Figure 7: Influence of Monetary Policymakers' Inflation Projections on Unit Costs and/or Prices Expectations

Online Appendix

Unit Cost Expectations: Firms' Perspectives on Inflation

by Brent Meyer and Xuguang Simon Sheng

This online appendix contains three sections. In Appendix A we provide additional tables and graphs. In Appendix B we compare the Atlanta Fed's BIE Survey probabilistic binned response approach to a more flexible approach used by the Survey of Business Uncertainty. Finally, Appendix C provides the screenshot of additional questions posed to respondents in the BIE survey.

Appendix A Additional Tables and Graphs

Business Inflation Expectations Survey: Descriptive Statistics (Weighted Mean)						
	Unit cost expecta-tions	Unit cost percep-tions	Uncertainty	Forecast error	Abs. forecast error	N
Overall BIE panel	2.199	2.126	2.108	0.031	1.289	18930
	(0.0106)	(0.0141)	(0.0128)	(0.013)	(0.00901)	
By Firm Size						
Small (1-99 employees)	2.312	2.230	1.984	0.038	1.178	8127
	(0.017)	(0.0208)	(0.019)	(0.0179)	(0.0122)	
Medium (100-499 employees)	2.203	2.085	2.334	-0.02	1.458	5600
	(0.0188)	(0.0275)	(0.0249)	(0.027)	(0.0187)	
Large (500+ employees)	1.988	1.986	2.056	0.085	1.286	5203
	(0.019)	(0.0263)	(0.0233)	(0.0248)	(0.0172)	
By Nonfarm Private Industry (2-Digit NAICS)						
Construction	2.665	2.708	2.176	0.135	1.369	1649
	(0.0425)	(0.0517)	(0.0472)	(0.0478)	(0.034)	
Durable goods manufacturing	2.229	2.132	2.243	-0.09	1.733	1944
	(0.0372)	(0.0539)	(0.0365)	(0.0534)	(0.0362)	
Educational services	2.484	2.122	1.870	-0.14	0.946	556
	(0.046)	(0.0488)	(0.061)	(0.0555)	(0.0387)	
Finance and insurance	1.662	1.440	1.930	-0.06	1.239	1912
	(0.0314)	(0.0435)	(0.0441)	(0.0381)	(0.0255)	
Health care and social assistance	2.131	1.969	2.611	-0.01	1.280	784
	(0.043)	(0.0595)	(0.0669)	(0.0611)	(0.0405)	
Information	2.954	2.995	1.839	0.216	1.027	553
	(0.0626)	(0.0778)	(0.0733)	(0.0579)	(0.039)	
Leisure and hospitality	2.333	2.234	1.617	0.035	1.165	581
	(0.0625)	(0.0733)	(0.0618)	(0.0701)	(0.0508)	
Mining and utilities	1.752	1.418	2.232	-0.27	1.123	488
	(0.0532)	(0.073)	(0.0611)	(0.0679)	(0.0466)	
Nondurable goods manufacturing	2.218	2.281	2.587	0.210	1.556	1361
	(0.0434)	(0.0613)	(0.0699)	(0.057)	(0.0387)	
Other services except government	2.517	2.328	2.285	0.148	1.124	201
	(0.0776)	(0.111)	(0.154)	(0.118)	(0.0879)	
Professional and business services	2.525	2.333	2.184	-0.05	1.178	2376
	(0.0295)	(0.0385)	(0.0346)	(0.0334)	(0.0231)	
Real estate and rental and lease	1.955	1.830	1.850	-0.01	1.159	1780
	(0.0319)	(0.0369)	(0.0368)	(0.0371)	(0.025)	
Retail and wholesale trade	2.168	2.237	2.112	0.149	1.301	3976
	(0.0224)	(0.0308)	(0.0267)	(0.0287)	(0.02)	
Transportation and warehousing	2.411	2.159	1.690	-0.16	1.217	769
	(0.0458)	(0.0589)	(0.0551)	(0.0639)	(0.0468)	

Source: Authors' calculations.
Note: This sample begins in October 2011 and runs through December 2023 but restricts the observations to those for which we are able to calculate direct(t, t+12) forecast errors. The resulting 18,930 observations comprise 66 percent of all useable observations (complete responses to the questionnaire). Responses are weighted by industry-share of GDP.

Table A.1: Descriptive Statistics

Panel A: 2011m10 – 2019m12					
Variables	(1)	(2)	(3)	(4)	(5)
(1) BIE 1yr	1.000				
(2) BlueChip 1yr CPI	0.132	1.000			
(3) BlueChip 1yr PGDP	0.677***	0.401***	1.000		
(4) UM 1yr	0.007	-0.529***	-0.297***	1.000	
(5) TIPS 5yr forward	0.142	-0.526***	-0.219**	0.791***	1.000
Panel B: 2020m1 – 2023m12					
Variables	(1)	(2)	(3)	(4)	(5)
(1) BIE 1yr	1.000				
(2) BlueChip 1yr CPI	0.870***	1.000			
(3) BlueChip 1yr PGDP	0.914***	0.923***	1.000		
(4) UM 1yr	0.915***	0.817***	0.801***	1.000	
(5) TIPS 5yr forward	0.753***	0.688***	0.752***	0.699***	1.000
Panel C: 2011m10 – 2023m12					
Variables	(1)	(2)	(3)	(4)	(5)
(1) BIE 1yr	1.000				
(2) BlueChip 1yr CPI	0.852***	1.000			
(3) BlueChip 1yr PGDP	0.905***	0.898***	1.000		
(4) UM 1yr	0.884***	0.750***	0.741***	1.000	
(5) TIPS 5yr forward	0.220**	0.130	0.186**	0.389***	1.000

Sources: FRBA Business Inflation Expectations (BIE) Survey; Blue Chip Economist Panel; University of Michigan's Survey of Consumers; Haver Analytics

Notes: The sample starts in October 2011 and ends in December 2023. Panel A restricts the sample to the pre-COVID timeperiod; panel B restricts the sample to the COVID timeperiod (January 2020 through December 2023); and panel C uses the full sample. The comparisons use the mean BIE and the median measures for the University of Michigan's Survey of Consumers (UM). The Blue Chip 1-year ahead is calculated from consensus forecasts. TIPS breakeven and forward inflation rate calculated by Haver Analytics. *, **, *** denote significance at the 1%, 5%, and 10% levels, respectively.

Table A.2: Time Series Correlations between Monthly Inflation Expectations

Model	RMSE CPI	RMSE Core CPI	RMSE PCE	RMSE Core PCE	MAE CPI	MAE Core CPI	MAE PCE	MAE Core PCE
Panel A: Oct. 2012 – Dec. 2019								
Benchmark								
ARMA(1, 1)	1.47	0.46	1.05	**0.40**	1.23	0.39	0.88	**0.34**
Firms								
BIE	0.57***	**0.54*** **	0.80***	1.07	0.50***	**0.52*** **	0.75**	1.04
BIE:Supersector 1	**0.55*** **	0.59***	**0.80*** **	1.13	**0.49*** **	0.54***	0.75**	1.12
BIE:Supersector 2	0.56***	1.00	0.79***	1.27	0.55***	0.91	0.76***	1.18
BIE:Supersector 3	0.62***	0.75	0.87	1.27	0.56***	0.71	0.80*	1.24
BIE:Supersector 4	0.58***	0.56***	0.82**	1.09	0.50***	0.55***	**0.75** **	1.05
Consumers								
MSC:Mean	1.52***	3.73***	2.27***	5.14***	1.61***	4.10***	2.53***	5.73***
MSC:Median	1.10	2.24***	1.65***	3.44***	1.09	2.38***	1.77***	3.79***
MSC:Low income	1.94***	5.15***	2.87***	6.77***	2.14***	5.76***	3.26***	7.59***
MSC:Medium income	1.51***	3.69***	2.24***	5.07***	1.58***	3.97***	2.48***	5.59***
MSC:High income	1.18*	2.57***	1.77***	3.80***	1.20	2.70***	1.91***	4.15***
Professional forecasters								
BCEI	0.60***	0.61***	0.91	1.45***	0.54***	0.55***	0.92	1.59***
Panel B: Jan. 2020 – Nov. 2023								
Benchmark								
ARMA(1, 1)	2.57	1.79	1.95	1.48	**2.18**	1.40	**1.64**	**1.10**
Firms								
BIE	1.26	1.21	1.24	1.17	1.13	1.25	1.16	1.27
BIE:Supersector 1	1.22	1.16	1.19	1.12	1.12	1.23	1.12	1.25
BIE:Supersector 2	1.14	1.02	1.09	0.97	1.04	1.05	1.04	1.05
BIE:Supersector 3	1.21	1.14	1.18	1.10	1.09	1.19	1.10	1.21
BIE:Supersector 4	1.31	1.28	1.30	1.24	1.17	1.29	1.22	1.35
Consumers								
MSC:Mean	1.06	0.98	1.24	1.37	1.09	1.06	1.25	1.58
MSC:Median	1.01	0.80	**0.99**	**0.87**	1.01	**0.84** **	1.06	1.02
MSC:Low income	1.21	1.34	1.54	1.85	1.20	1.39	1.46	2.05
MSC:Medium income	1.03	0.94	1.20	1.31	1.07	1.02	1.21	1.49
MSC:High income	**1.00**	**0.81**	1.07	1.06	1.03	0.88	1.12	1.26
Professional forecasters								
BCEI	1.34	1.33	1.34	1.3	1.21	1.38	1.27	1.45
Panel C: Oct.2012 – Dec. 2023								
Benchmark								
ARMA(1, 1)	1.93	**1.13**	1.44	**0.94**	1.57	**0.75**	1.15	**0.61**
Firms								
BIE	1.06	1.16	1.11	1.16	0.81	1.01	0.96	1.19
BIE:Supersector 1	1.02	1.12	1.07	1.13	0.80	1.00	0.94	1.20
BIE:Supersector 2	**0.96**	1.02	**0.99**	1.01	**0.79***	1.00	**0.90**	1.10
BIE:Supersector 3	1.03	1.11	1.08	1.12	0.82	1.03	0.95	1.22
BIE:Supersector 4	1.10	1.22	1.16	1.23	0.83	1.04	0.99	1.24
Consumers								
MSC:Mean	1.25**	1.53*	1.67***	2.18***	1.36**	2.07***	1.88***	3.09***
MSC:Median	1.04	1.06	1.26**	1.43*	1.05	1.35*	1.41***	2.02***
MSC:Low income	1.53***	2.10***	2.10**	2.89***	1.67***	2.85***	2.35***	4.06***
MSC:Medium income	1.23**	1.50*	1.64***	2.12***	1.33**	2.00***	1.83***	2.98***
MSC:High income	1.07	1.14	1.35***	1.64**	1.12	1.49**	1.51***	2.31***
Professional forecasters								
BCEI	1.12	1.27	1.21	1.32	0.87	1.10	1.10	1.50**

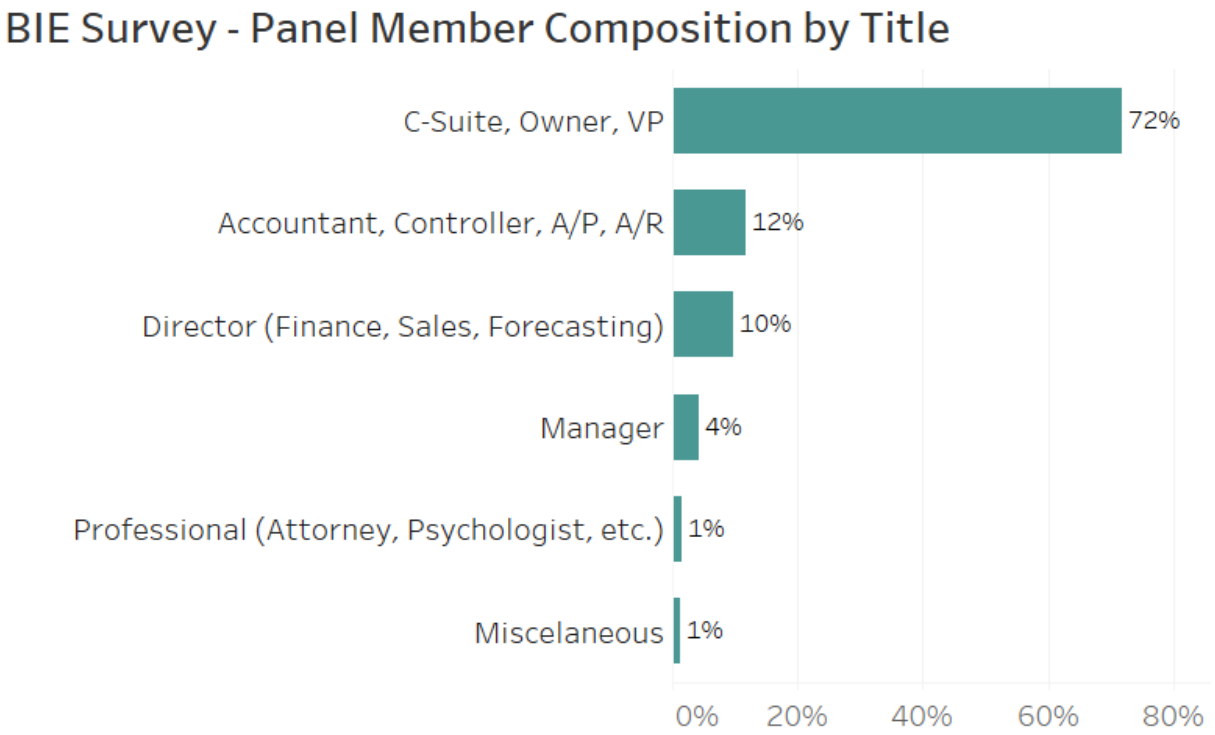
Note: The table compares survey expectations with an ARMA(1,1) benchmark. We do this by comparing, for example, the BIE 1-year ahead unit cost expectation made in October 2011 to realized inflation in October 2012. The ARMA(1,1) model is estimated using all data available for a given price index prior to December 2022. We generate year-ahead forecast for each month from October 2012 through December 2023 which are then taken as the benchmark values. The estimation sample is updated recursively each period with the initialization being the price index's earliest observation. The reported values, with the exception of the benchmark, are the ratio of the forecasts accuracy statistic to that of the benchmark. If the value is less than 1, then that survey was more accurate than the ARMA(1,1). The Blue Chip Economic Indicators (BCEI) series reports the average forecast for CPI inflation, specifically. We apply it to other measures of inflation due to data availability. With the exception of "MSC:Median", all reported Michigan Survey of Consumers (MSC) values are the mean. The BIE supersectors are defined as follows: (1) Construction, mining and utilities, and real estate, rental and leasing; (2) Durable and non-durable goods manufacturing; (3) Retail and wholesale trade and transportation and warehousing; (4) Educational services, finance and insurance, healthcare and social assistance, information, leisure and hospitality, other services except government, and professional and business services. The sample for Panel A runs from Oct. 2012 through Dec. 2019, panel B runs from Jan. 2020 through Dec. 2023 (the pandemic period), and panel C covers the full sample. The most accurate measures (in terms of RMSE/MAE) are shown in **bold**. The stars in the table represent the significance of the Diebold-Mariano test for the forecast accuracy between the survey and the benchmark. *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

Table A.3: Pseudo Out-of-sample Forecasting at the Monthly Frequency with ARMA(1, 1) Benchmark

Panel A: Lowest and Highest Forecasts for 2021 inflation				
	Mean	P25	P75	N
Treatment Group				
Lowest rate of potential inflation	1.77	1.00	2.00	105
Highest rate of potential inflation	4.37	2.50	3.50	105
Spread (highest - lowest)	2.60	1.00	2.00	105
Control Group				
Lowest rate of potential inflation	3.19	1.00	1.70	101
Highest rate of potential inflation	4.89	2.00	4.00	101
Spread (highest - lowest)	2.66	1.00	3.00	101
Panel B: Revisions to Expectations and Uncertainty				
	Mean	P25	P75	N
Treatment Group				
Difference in unit cost expectations (Nov - Oct)	0.14	-0.40	0.70	85
Difference in unit cost uncertainty (Nov - Oct)	-0.19	-0.60	0.32	85
Control Group				
Difference in unit cost expectations (Nov - Oct)	0.02	-0.40	0.20	82
Difference in unit cost uncertainty (Nov - Oct)	-0.03	-0.28	0.15	82

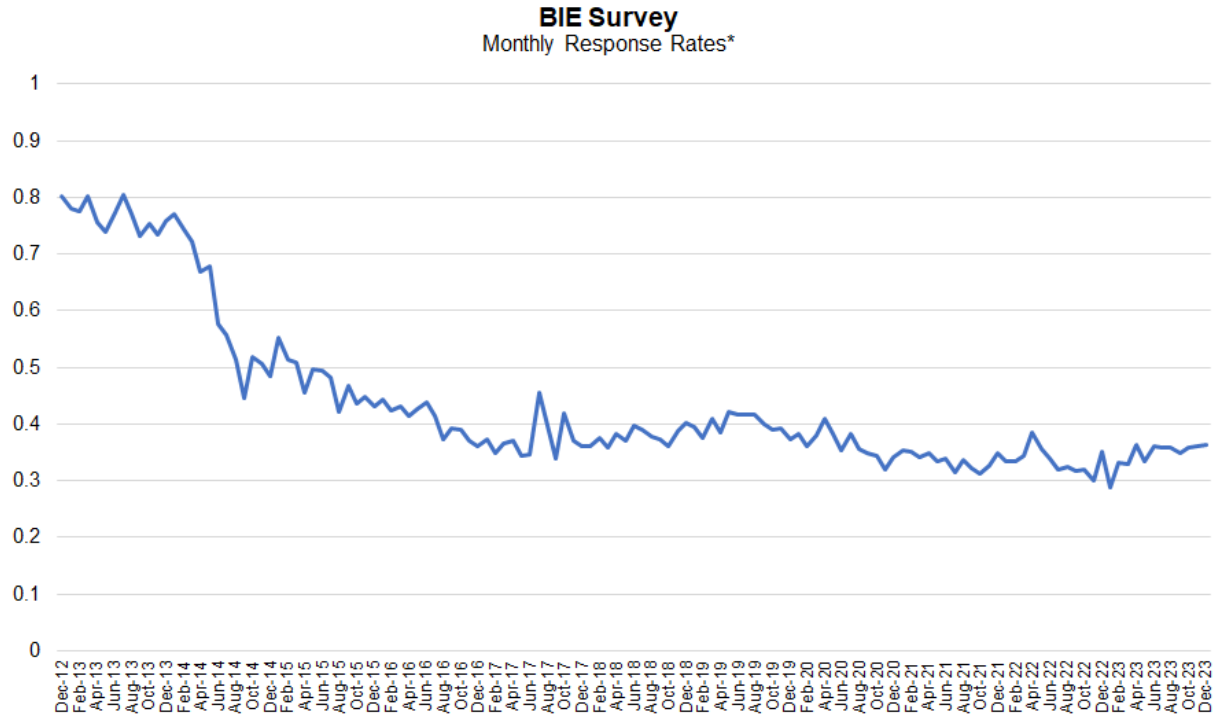
Source: FRBA Business Inflation Expectations (BIE) Survey
Notes: Results obtained via RCT special questions posed to the panel in October 2020. The median expectation of monetary policymakers for inflation over calendar year 2021 was 1.7 percent (as of September 15th, 2020). Treatment: [Based on forecasts over the past 20 years, there is a 70 percent change that actual inflation will be in the range of 0.7 percent to 2.7 percent over calendar year 2021.] Question: What is your best estimate for the highest and lowest potential rate of inflation over calendar year 2021? 206 panelists responded to the core BIE questionnaire in October 2020. T-tests fail to reject the hypothesis that the treatment group expected outcomes that were different from the control group.

Table A.4: Influence of Monetary Policymakers' Inflation Forecast Uncertainty on Unit Costs and/or Prices Expectations (With All Observations)



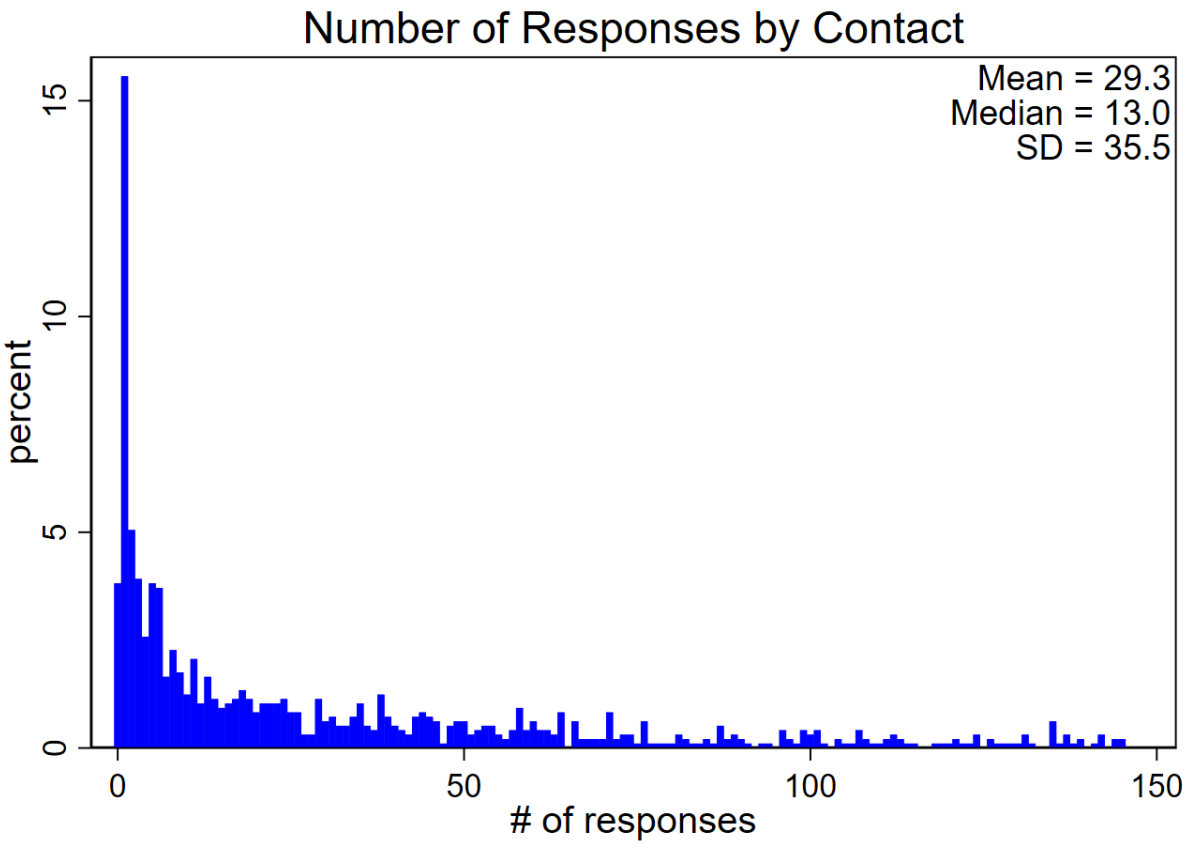
Source: FRBA Business Inflation Expectations (BIE) Survey
Notes: These shares are reflective of the existing panel as of December 2019. Titles are reported and confirmed during the recruiting process. Of "C-suite" respondents, we aim at garnering participation from CFOs in particular.

Figure A.1: BIE Panel Member Composition by Title



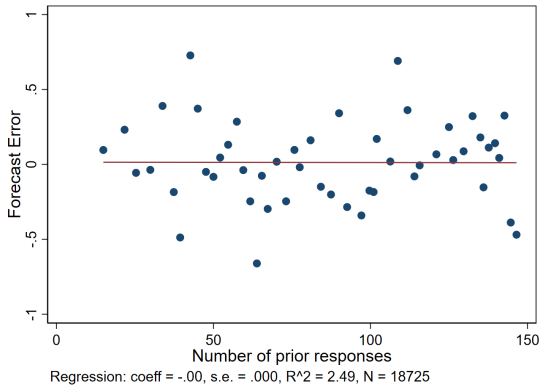
Source: FRBA Business Inflation Expectations (BIE) Survey
Notes: AAPOR Response Rate 2 Calculation = (partial and completed responses)/(number of survey invitations sent). See the American Association for Public Opinion Research 2016 Standard Definitions: Final Dispositions of Cases and Outcome Rates for Surveys. 9th edition. In late 2012, the BIE Survey transitioned to a web-hosted survey software. Prior to this transition, it was not possible to assess noncontact rates. Response rates from November 2012 to June 2014 were higher than average due to the culling of unresponsive panel members prior to the transition to a new survey platform.

Figure A.2: BIE Survey Monthly Response Rate

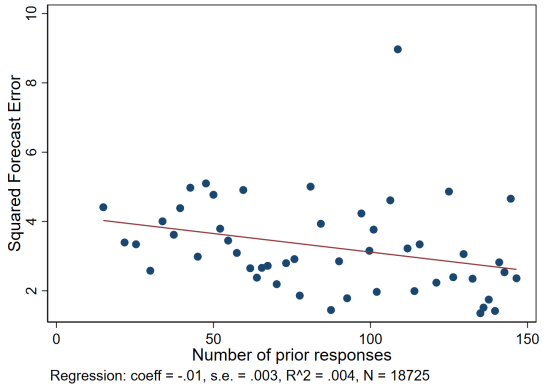


Source: FRBA Business Inflation Expectations (BIE) Survey
Notes: The above bar graph uses the complete history of the BIE from October 2011 through November 2023. A "complete" response means a respondent filled out the entire core questionnaire.

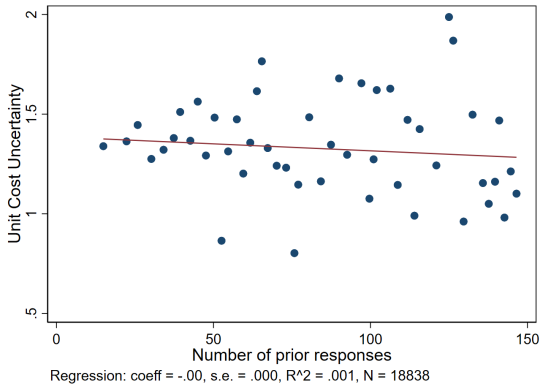
Figure A.3: Survey Retention: Number of Complete Responses by Panelist



(a) Forecast Error



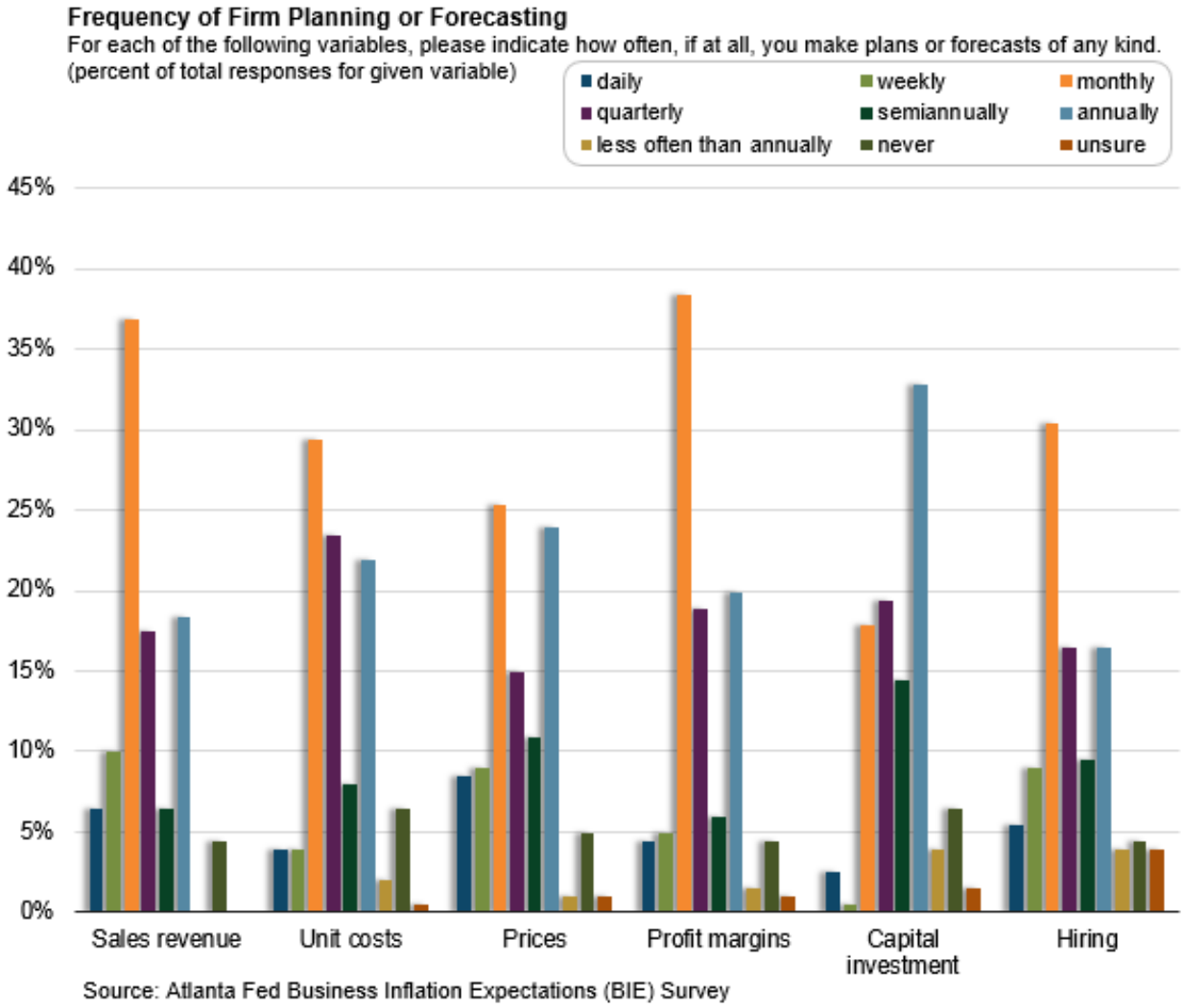
(b) Squared Forecast Error



(c) Unit Cost Uncertainty

Source: FRBA Business Inflation Expectations (BIE) Survey
Notes: These binscatters (50 bins) compare respondents' (a) forecast error, (b) squared forecast error, and (c) uncertainty. Statistics below the figure correspond to the population OLS regression. Data are from October 2011 through January 2021.

Figure A.4: Tenure Effects

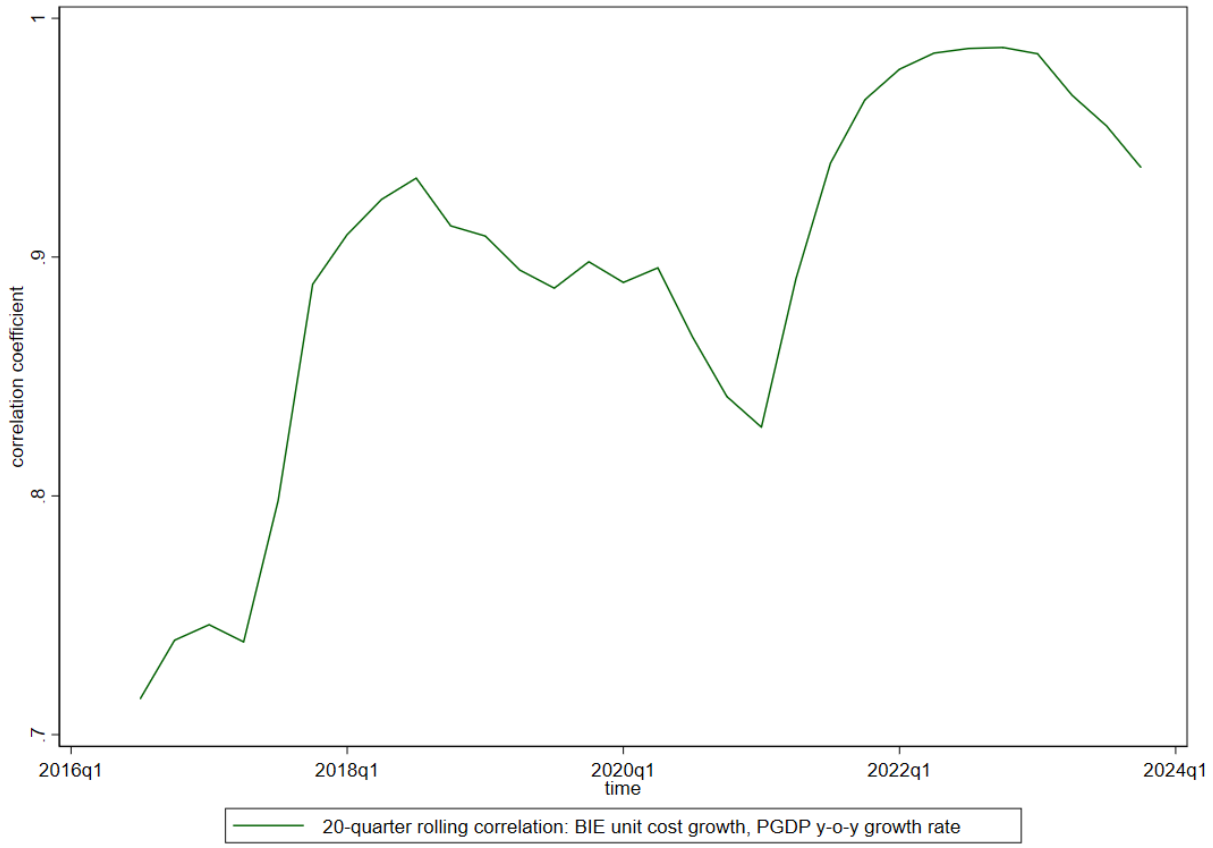


Source: FRBA Business Inflation Expectations (BIE) Survey
Note: Elicited from panelists as of March 2015.

Figure A.5: Firms Planning and Forecasting Frequencies

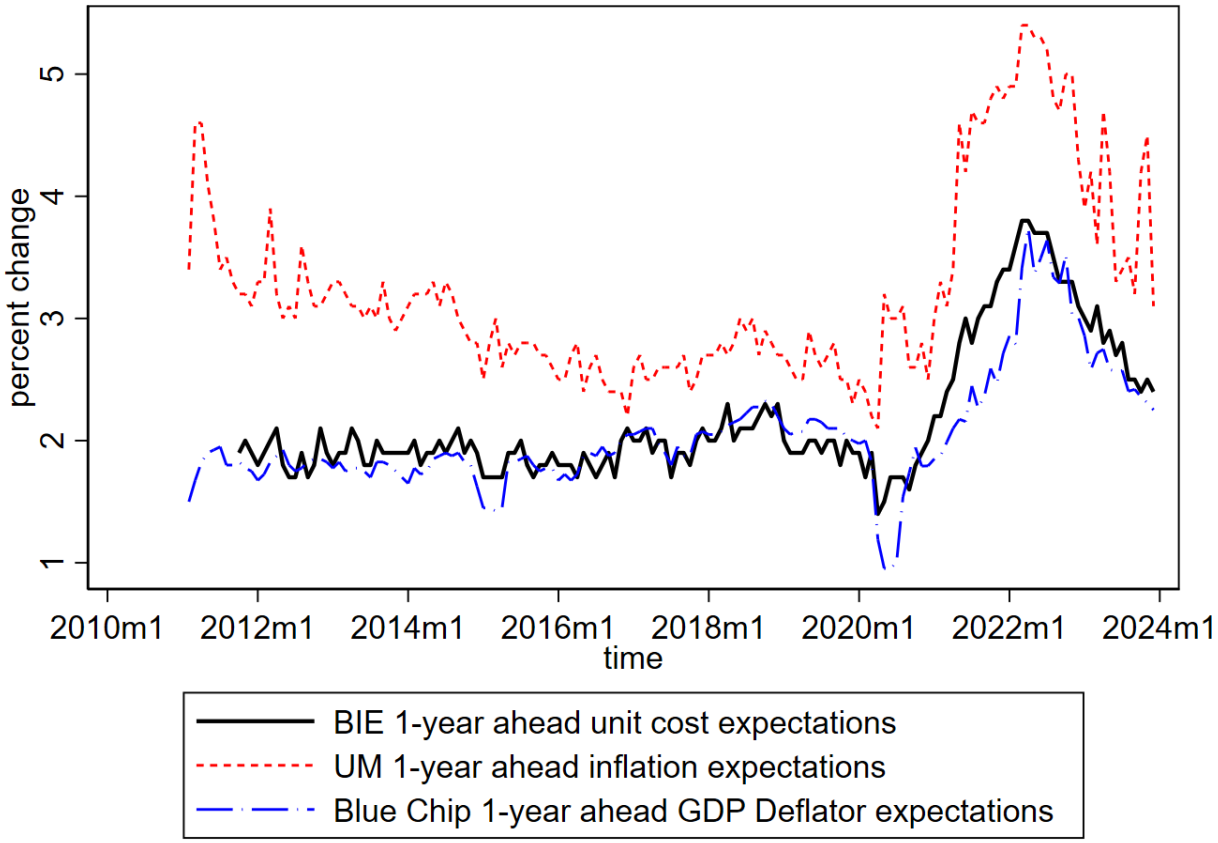
Source: FRBA Business Inflation Expectations (BIE) Survey.
Notes: The sample period is 2012q1 to 2023q4. The term "FIRE" refers to finance and insurance and real estate, rental and leasing firms.

Figure A.6: Sectoral-level Year-ahead Unit Cost Expectations



Sources: Bureau of Economic Analysis; FRBA Business Inflation Expectations (BIE) Survey
Note: The sample period goes from 2011Q4 through 2023Q4. Rolling correlation coefficients are calculated using a 20-quarter window between firms' realized unit year-over-year unit cost growth and the 4-quarter growth rate in the GDP Price Index.

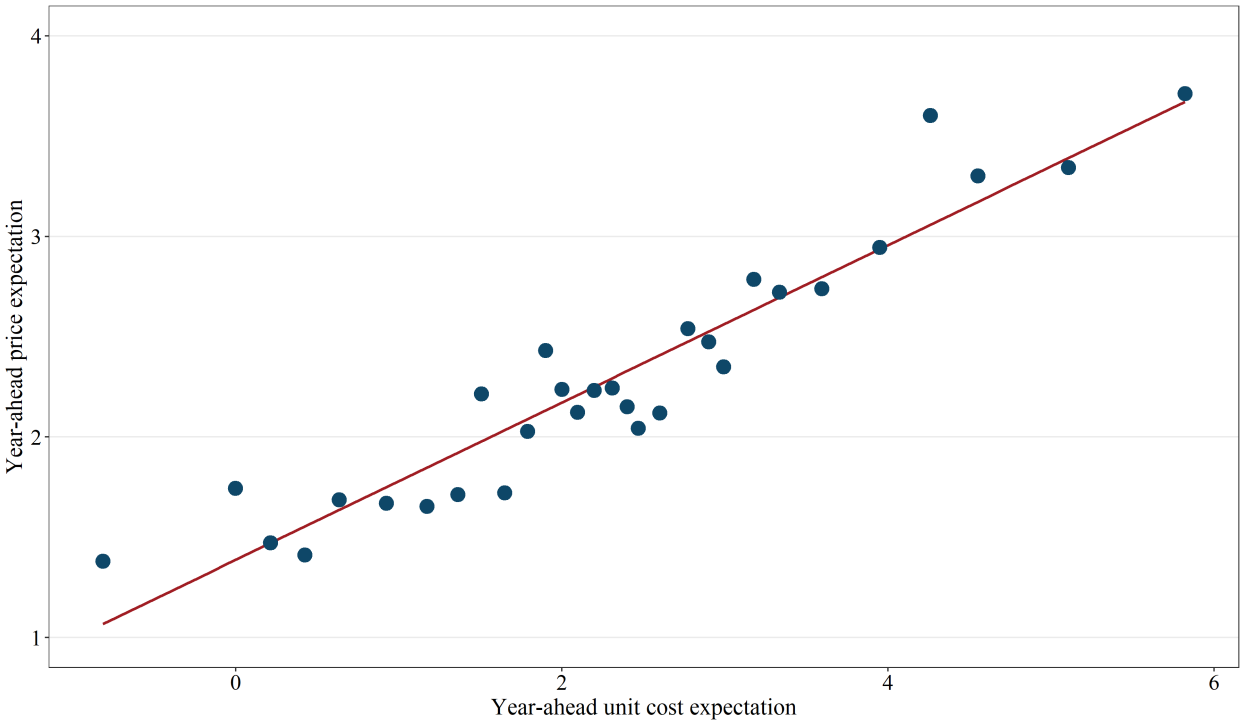
Figure A.7: 20-Quarter Rolling Correlation Between Realized Unit Cost Growth and Actual Inflation



Sources: Blue Chip Economist Panel; University of Michigan Survey of Consumers; FRBA Business Inflation Expectations (BIE) Survey

Note: The sample period goes from October 2011 through December 2023. The pre-COVID (Oct. 2011 through Feb. 2020) correlation between the BIE and UM is 0.03 and rises to 0.88 after including data from March 2020 through December 2023. The pre-COVID correlation between the BIE and Blue Chip is 0.66 and rises to 0.91 after including data from March 2020 through December 2023.

Figure A.8: Short-Run (1-year ahead) Survey Inflation Expectations (Monthly Frequency)



Source: FRBA Business Inflation Expectations (BIE) Survey.
Notes: The above binscatter (30 bins) compare respondents' 1-year ahead unit cost expectations to their 1-year ahead representative price expectations. Special questions on expected prices were elicited in June 2013, February 2019, November 2019, December 2020, April 2021, July 2021, November 2021, March 2022, May 2023, and October 2023. Given changes in question formatting, responses were normalized and winsorized at the 2.5% and 97.5% levels.

Figure A.9: Unit Cost and Price Expectations

Appendix B Comparison of BIE to SBU

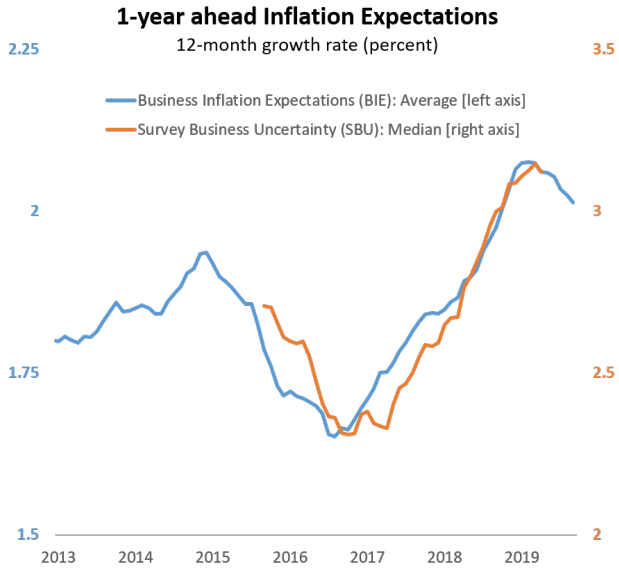
Two potential concerns arise in using the BIE survey. First, because the BIE only covers firms in the Southeast, it might not be nationally representative and the signal quality of the survey will likely suffer. Second, the question design itself – which is favored by Manski (2004) – is subject to framing bias. Because the quantitative suggestions for each bin width may be too narrow relative to the observed (perceived) distribution of actual unit cost expectations, the binned approach may potentially bias the results.

In an attempt to address both of these concerns, we compare the Atlanta Fed's BIE Survey probabilistic binned response approach to a more flexible approach used by the Survey of Business Uncertainty (SBU); see Altig et al. (2022) for details regarding this survey. The SBU is a national survey of businesses that draws from every major industry in the nonfarm private sector and covers a full range of firm sizes. From its inception in 2014 until April of 2019, the SBU elicited responses for 1-year ahead unit costs expectations from a very flexible probabilistic setup – first asking firms for 5 quantitative estimates (support points) ranging from "lowest" to "highest" for the possible outcomes of unit costs over the year ahead and then asking respondents to fill in the attendant probabilities that correspond to each one of those outcomes.[32]

Figure B.1 addresses, to a large extent the framing bias in the BIE relative to the SBU, as the mean for the aggregate time series for BIE unit costs expectations is roughly a full percentage point lower than its SBU counterpart. However, there appears to be a tradeoff between framing bias and inflation signal. Table B.1 shows the correlations between the BIE and SBU unit cost 1-year ahead expectations and uncertainty measures over various moving averages (1-, 3-, 6-, and 12-month growth rates). The BIE aggregate is a simple weighted average and the SBU aggregate is either a 2-percent winsorized (1-percent on each tail) weighted average or weighted median. All series are weighted by industry share of GDP.

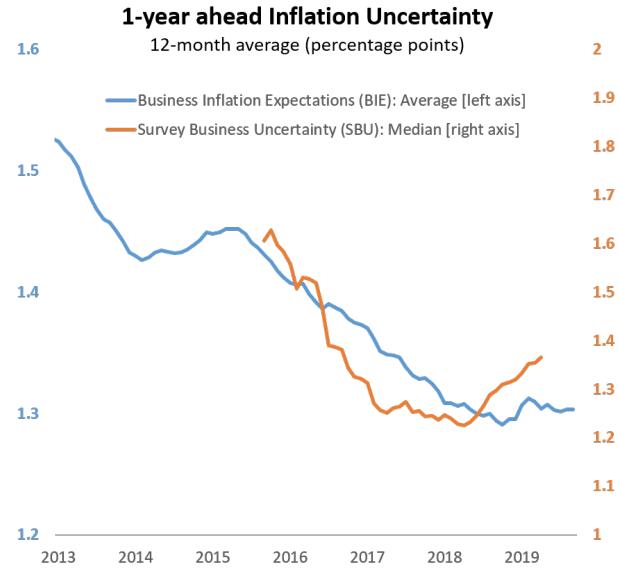
Table B.1 reveals that the BIE aggregate is more highly correlated with the SBU median than the mean and that correlations between the two surveys grows over time. This holds for both the first and second moments of these survey responses. The results suggest that while framing bias from a probabilistic binned approach may alter the level of the aggregate expectation and uncertainty, it comes with a positive tradeoff of a stronger signal-to-noise ratio.

[32]The SBU group, including researchers at Stanford University, the University of Chicago's Booth School, and the Federal Reserve Bank of Atlanta, jointly agreed to retire the unit-cost question in April 2019, in an effort to streamline the survey instrument and in large part due to the seeming redundancy between the BIE and SBU output for unit costs.



Sources: FRBA Business Inflation Expectations (BIE) Survey and Survey of Business Uncertainty (SBU).

(a) Inflation Expectations



(b) Inflation Uncertainty

Sources: FRBA Business Inflation Expectations (BIE) Survey and Survey of Business Uncertainty (SBU).
Notes: The BIE data are the smoothed average of the cross section of individual expected values. The SBU data are the smoothed median of the cross section of individual expected values. SBU data sample runs from October 2014 through April 2019. Both data series are weighted by industry-share of GDP.

Figure B.1: Comparison between BIE and SBU Unit Cost Expectations and Uncertainty

BIE 1-year Ahead Unit Cost Expectations		BIE 1-year Ahead Unit Cost Uncertainty	
1-month growth rates		**1-month averages**	
SBU: Median	0.68	SBU: Median	0.43
SBU: Winsorized Mean	0.26	SBU: Winsorized Mean	0.40
3-month growth rates		**3-month averages**	
SBU: Median	0.84	SBU: Median	0.66
SBU: Winsorized Mean	0.34	SBU: Winsorized Mean	0.57
6-month growth rates		**6-month averages**	
SBU: Median	0.90	SBU: Median	0.78
SBU: Winsorized Mean	0.42	SBU: Winsorized Mean	0.64
12-month growth rates		**12-month averages**	
SBU: Median	0.93	SBU: Median	0.81
SBU: Winsorized Mean	0.44	SBU: Winsorized Mean	0.71

Sources: FRBA Business Inflation Expectations (BIE) Survey and Survey of Business Uncertainty (SBU).
Notes: The Survey of Business Uncertainty (SBU) fielded probabilistic unit cost expectations questions from its inception until April 2019. The data period we analyze is from October 2014 through April 2019. The 3-, 6-, and 12-month samples begin in December 2014, March 2014, and September 2015, respectively. For more information on the SBU, see Altig et al. (2022)

Table B.1: Comparison between BIE and SBU Probabilistic Inflation Expectations

The higher correlation between the mean BIE measures and the median SBU measures suggests that there are some idiosyncratic responses to unit cost growth that are pushing the averages away from the median. This type of idiosyncratic volatility is bounded in the BIE survey (as a response of "unit costs up significantly" is coded as 6 percent). Also encouraging from the standpoint of the BIE survey is that time series smoothing leads to very high correlations (coefficients as high as 0.93 over 12-month windows) between the BIE and the SBU median. These results suggest that at the very least *directionally* the BIE survey is yielding actionable information on the inflation expectations and uncertainty of firms. Eliciting this information using a probabilistic binned response approach dampens the inflation and its volatility when compared to a much more flexible probabilistic question design. Perhaps as important is that, while the BIE is a regional survey, the inflation expectations signal is very similar to that we would take from a national surveying effort.

Appendix C Business Inflation Expectations (BIE) survey questions

C.1 BIE core monthly questions

Question: How do your current SALES LEVELS compare with sales levels during what you consider to be "normal"times?
Response options:

- o Much less than normal
- o Somewhat less than normal
- o About normal
- o Somewhat greater than normal
- o Much greater than normal

Question: How do your current PROFIT MARGINS compare with "normal" times?
Response options:

- o Unit costs down (less than -1%)
- o Unit costs about unchanged (-1% to 1%)
- o Unit costs up somewhat (1.1% to 3%)
- o Unit costs up significantly (3.1% to 5%)
- o Unit costs up very significantly (more than 5%)

Question: Projecting ahead, to the best of your ability, please assign a percent likelihood to the following changes to UNIT COSTS over the next twelve months. (Values should sum to 100%)
For example, if you think each of these is equally likely, you might answer 20% for each:

20% Unit costs down (less than -1%)

20% Unit costs about unchanged (-1% to 1%)

20% Unit costs up somewhat (1.1% to 3%)

20% Unit costs up significantly (3.1% to 5%)

20% Unit costs up very significantly (more than 5%)

Response options:

☐% Unit costs down (less than -1%)

☐% Unit costs about unchanged (-1% to 1%)

☐% Unit costs up somewhat (1.1% to 3%)

☐% Unit costs up significantly (3.1% to 5%)

☐% Unit costs up very significantly (more than 5%)

C.2 BIE core quarterly questions

Question: Projecting ahead, to the best of your ability, please assign a percent likelihood to the following changes to UNIT COSTS per year, over the next five to 10 years. (Values should sum to 100%)
Response options:

☐% Unit costs down (less than -1%)

☐% Unit costs about unchanged (-1% to 1%)

☐% Unit costs up somewhat (1.1% to 3%)

☐% Unit costs up significantly (3.1% to 5%)

☐% Unit costs up very significantly (more than 5%)

Question: By roughly what percent are your firm's sales levels ABOVE "normal"?
Response options:

☐ Percent

Question: By roughly what percent are your firm's sales levels BELOW "normal"?
Response options:

☐ Percent

Question: You indicated that your sales levels are "about normal." By roughly what percent are your firm's sales levels above/below "normal", if at all?
Response options:

☐ Above/Below/Neither

☐ Percent

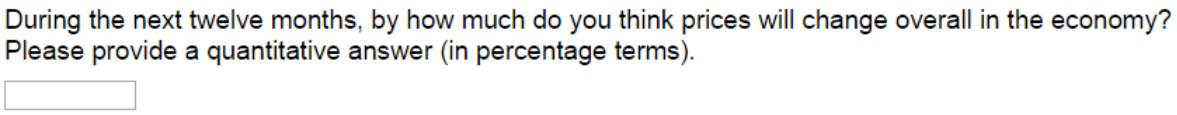
C.3 Special questions

Projecting ahead, over the next 12 months, please assign a percent likelihood to the following changes to the AVERAGE PRICE of the products and/or services you sell? *values should sum to 100%*

Average price down (less than -1%)	0 %
Average price about unchanged (-1% to 1%)	0 %
Average price up somewhat (1.1% to 3%)	0 %
Average price up significantly (3.1% to 5%)	0 %
Average price up very significantly (more than 5%)	0 %
Total	0 %

Sources: FRBA Business Inflation Expectations (BIE) Survey; June 2013.

Figure C.1: June 2013: Own-price expectations



Sources: FRBA Business Inflation Expectations (BIE) Survey; September 2014.

Figure C.2: September 2014: University of Michigan sequence with "prices overall in the economy"

On a scale from 1 to 5, with 5 being "very familiar", please choose the option that best describes your level of familiarity with the Consumer Price Index, commonly referred to as CPI.

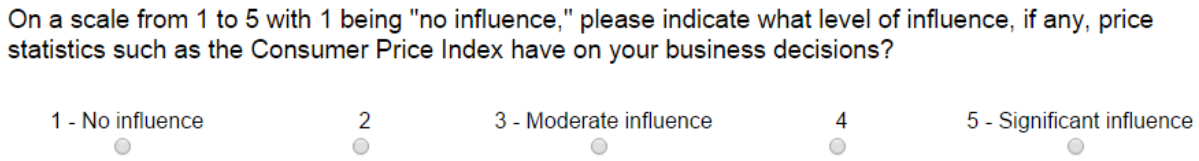
1 - Unfamiliar	2	3	4	5 - Very familiar
○	○	○	○	○

Please indicate what probabilities you would attach to the various possible percentage changes to the CORE (excluding food and energy) CONSUMER PRICE INDEX over the next 12 months. (Values should sum to 100%)

4 percent or more	0 %
3.5 to 3.9 percent	0 %
3.0 to 3.4 percent	0 %
2.5 to 2.9 percent	0 %
2.0 to 2.4 percent	0 %
1.5 to 1.9 percent	0 %
1.0 to 1.4 percent	0 %
0.5 to 0.9 percent	0 %
0 to 0.4 percent	0 %
Will decline	0 %
Total	0 %

Sources: FRBA Business Inflation Expectations (BIE) Survey; October 2014.

Figure C.3: October 2014: SPF's probabilistic core CPI question



Sources: FRBA Business Inflation Expectations (BIE) Survey; January 2015.

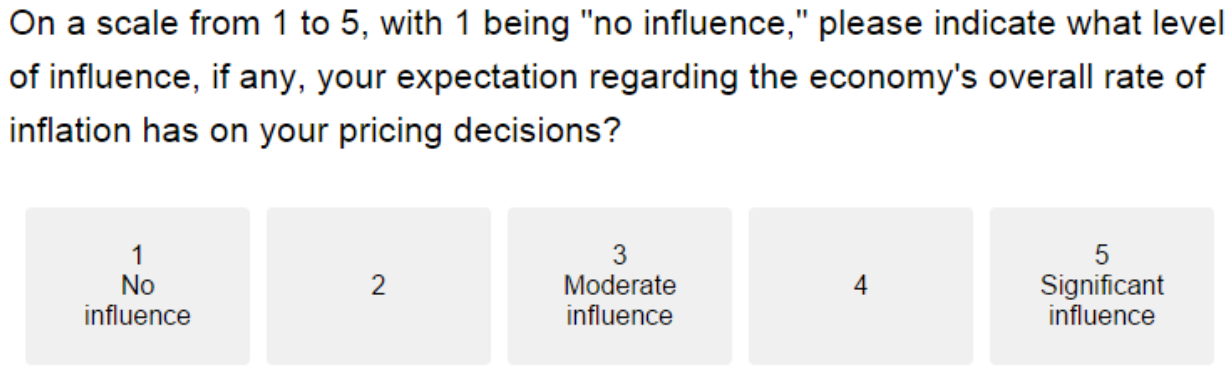
Figure C.4: January 2015: CPI's influence on pricing decisions

For each of the following variables, please indicate how often, if at all, you make plans or forecasts of any kind?

	daily	weekly	monthly	quarterly	semiannually	annually	less often than annually	never	Unsure
Sales Revenue	○	○	○	○	○	○	○	○	○
Unit Costs	○	○	○	○	○	○	○	○	○
Prices	○	○	○	○	○	○	○	○	○
Profit Margins	○	○	○	○	○	○	○	○	○
Capital Investment	○	○	○	○	○	○	○	○	○
Hiring	○	○	○	○	○	○	○	○	○

Sources: FRBA Business Inflation Expectations (BIE) Survey; March 2015.

Figure C.5: March 2015: Frequency of firm planning/forecasting activity



Sources: FRBA Business Inflation Expectations (BIE) Survey; September 2015.
Note: In September 2015, we split the panel at random, asking half for the influence of the "overall rate of inflation" on their pricing decisions and the other half was asked for the influence of "your own unit costs" have on pricing decisions.

Figure C.6: September 2015: Overall rate of inflation/Unit Costs' Influence on pricing decisions

Looking ahead, over the next 12 months, what aggregate rate of inflation, as measured by the Consumer Price Index, would you assign to each of the following scenarios?

The LOWEST aggregate rate of inflation would be about:	1 %
A LOW aggregate rate of inflation would be about:	2 %
A MIDDLE aggregate rate of inflation would be about:	3 %
A HIGH aggregate rate of inflation would be about:	4 %
The HIGHEST aggregate rate of inflation would be about:	5 %

Please assign a percentage likelihood to the potential aggregate rates of inflation you entered. (Values should sum to 100%)

LOWEST: The likelihood of realizing a **1%** aggregate rate of inflation rate would be:	10 %
LOW: The likelihood of realizing a **2%** aggregate rate of inflation rate would be:	20 %
MIDDLE: The likelihood of realizing a **3%** aggregate rate of inflation rate would be:	40 %
HIGH: The likelihood of realizing a **4%** aggregate rate of inflation rate would be:	20 %
HIGHEST: The likelihood of realizing a **5%** aggregate rate of inflation rate would be:	10 %
Total	100 %

Sources: FRBA Business Inflation Expectations (BIE) Survey; January 2019.

Figure C.7: January 2019: Aggregate Inflation Expectations

The LOWEST percentage change in my price would be about:	1 %
A LOW percentage change in my price would be about:	2 %
A MIDDLE percentage change in my price would be about:	3 %
A HIGH percentage change in my price would be about:	4 %
The HIGHEST percentage change in my price would be about:	5 %

Please assign a percentage likelihood to the percentage price changes you entered in the prior question. (Values should sum to 100%)

LOWEST: The likelihood of about a **1%** change in my price would be:	10 %
LOW: The likelihood of about a **2%** change in my price would be:	20 %
MIDDLE: The likelihood of about a **3%** change in my price would be:	40 %
HIGH: The likelihood of about a **4%** change in my price would be:	20 %
HIGHEST: The likelihood of about a **5%** change in my price would be:	10 %
Total	100 %

Sources: FRBA Business Inflation Expectations (BIE) Survey; February 2019.

Figure C.8: February 2019: Own-Price Expectations

By what percentage has your firm changed the price of the product/product line or service responsible for the largest share of sales revenue over the last 3 months?

[ ] %

By what percentage has your firm changed its total number of employees (full and part time) over the last 3 months?

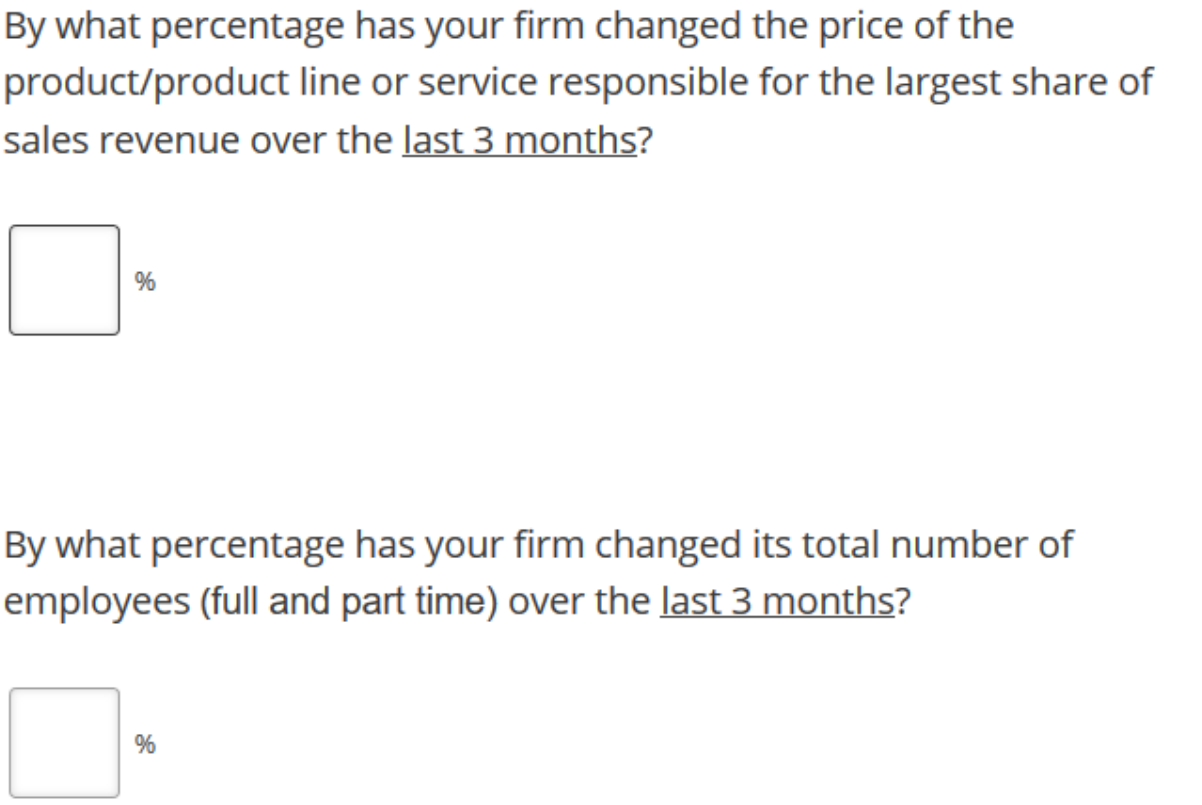
[ ] %

What do you think the aggregate rate of inflation, as measured by the Consumer Price Index, will be over the next 12 months?

[ ] %

Sources: FRBA Business Inflation Expectations (BIE) Survey; April 2019.

Figure C.9: April 2019: Price and Aggregate Inflation Expectations



Sources: FRBA Business Inflation Expectations (BIE) Survey; July 2019, October 2019, and January 2020.

Figure C.10: July 2019, October 2019, and January 2020: Own-Price and Employment Expectations

Do you expect the price of the product/product line or service responsible for the largest share of your revenue to increase, remain the same, or decrease over the next 12 months?

- Increase ○
- Remain the same ○
- Decrease ○

If the respondent indicated increase, we asked:

By roughly what percentage do you expect the price of the product/product line or service responsible for the largest share of your revenue to increase over the next 12 months?

[ ] %

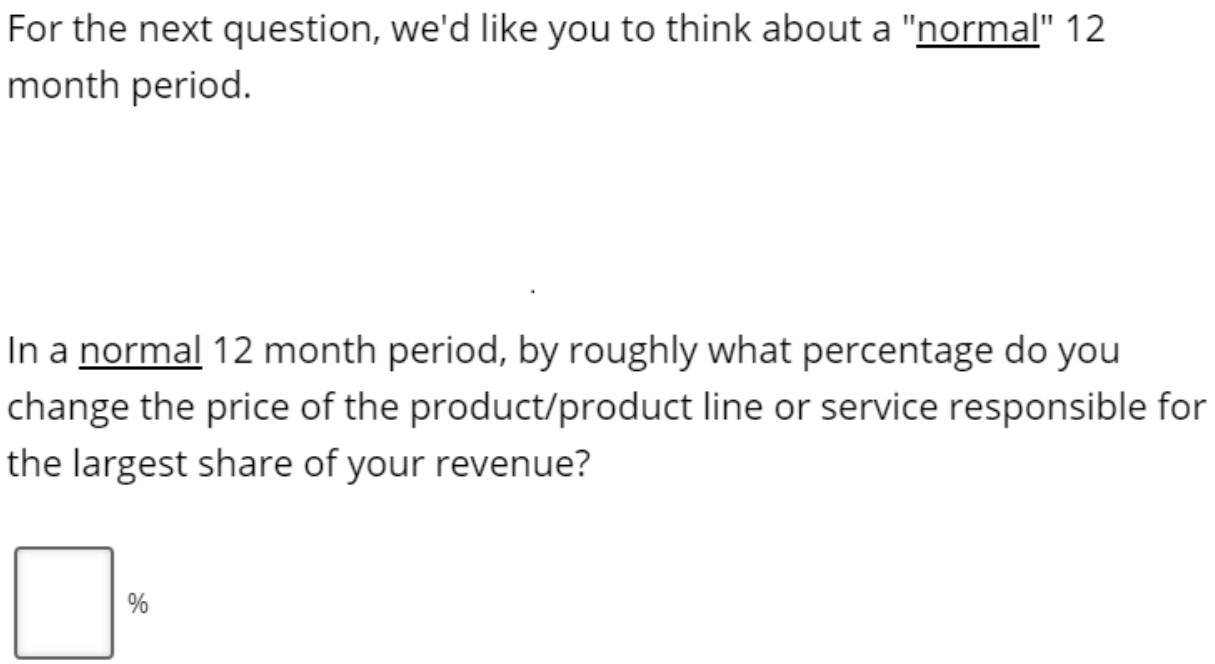
If the respondent indicated decrease, we asked:

By roughly what percentage do you expect the price of the product/product line or service responsible for the largest share of your revenue to decrease over the next 12 months?

[ ] %

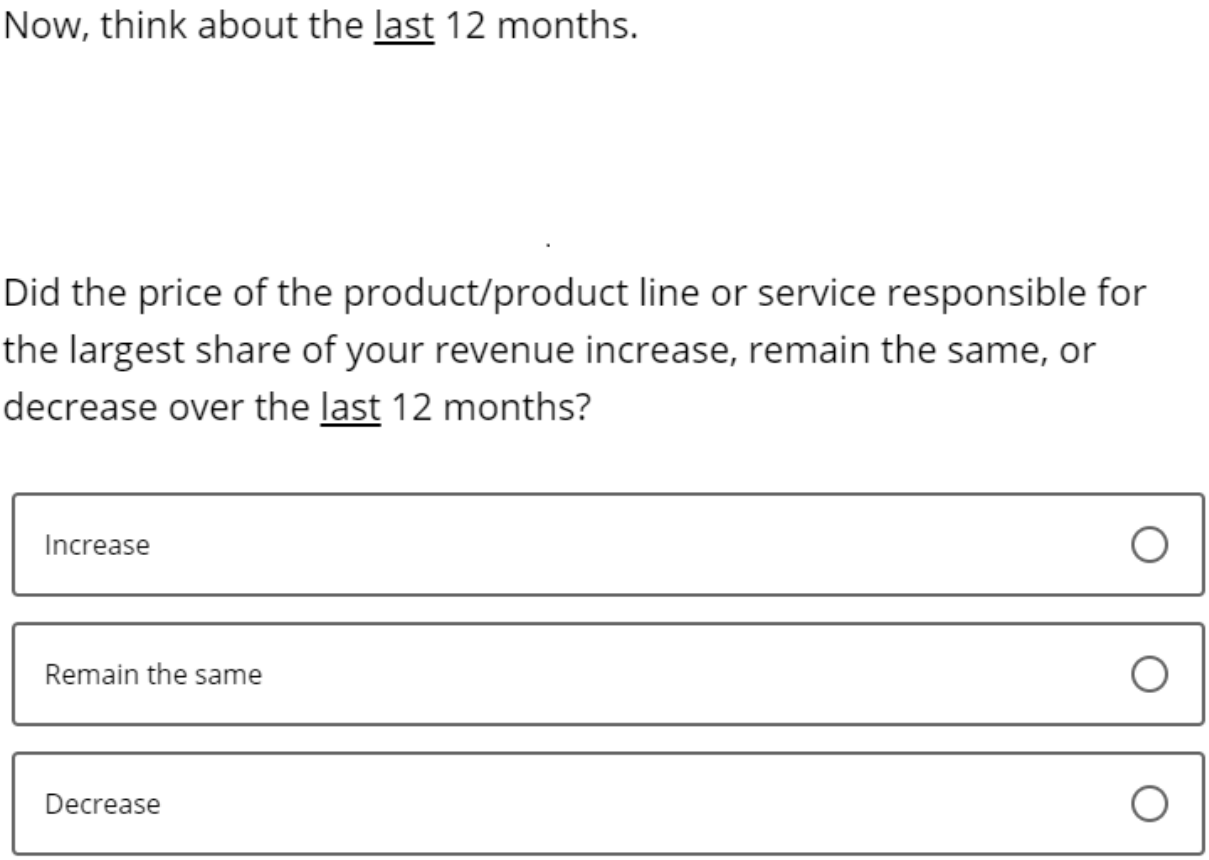
Sources: FRBA Business Inflation Expectations (BIE) Survey; November 2019.

Figure C.11: November 2019: Own-Price Expectations



Sources: FRBA Business Inflation Expectations (BIE) Survey; December 2020, July 2021, and November 2021.
Note: We only elicited firms' "normal" price perceptions in December 2020.

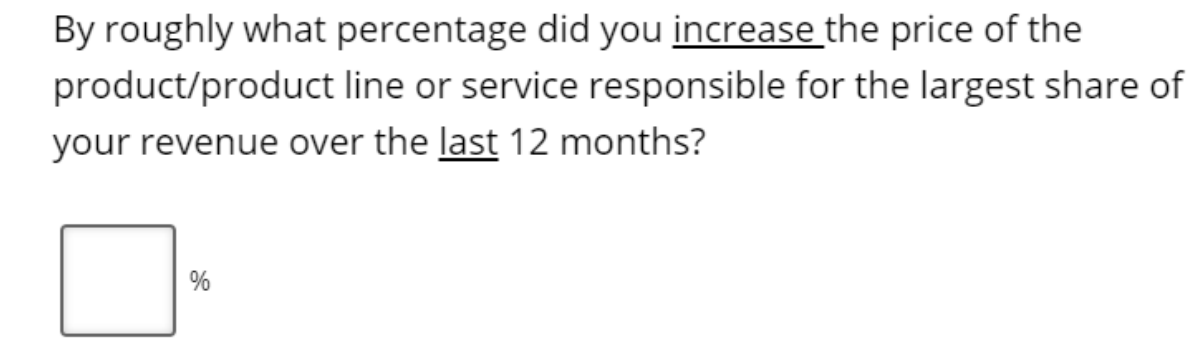
Figure C.12: December 2020, July 2021, and November 2021: Own-Price Realizations and Expectations (part 1)



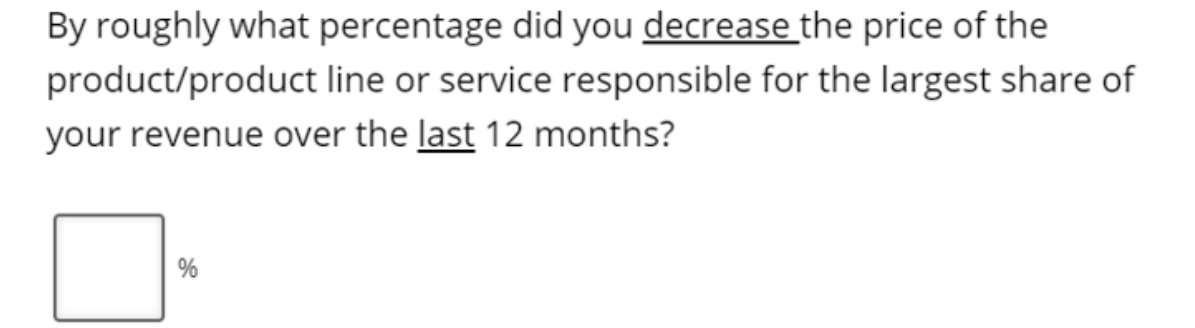
Sources: FRBA Business Inflation Expectations (BIE) Survey; December 2020, July 2021, and November 2021.
Note: We only elicited firms' "normal" price perceptions in December 2020.

Figure C.13: December 2020, July 2021, and November 2021: Own-Price Realizations and Expectations (part 2)

If the respondent indicated increase, we asked:

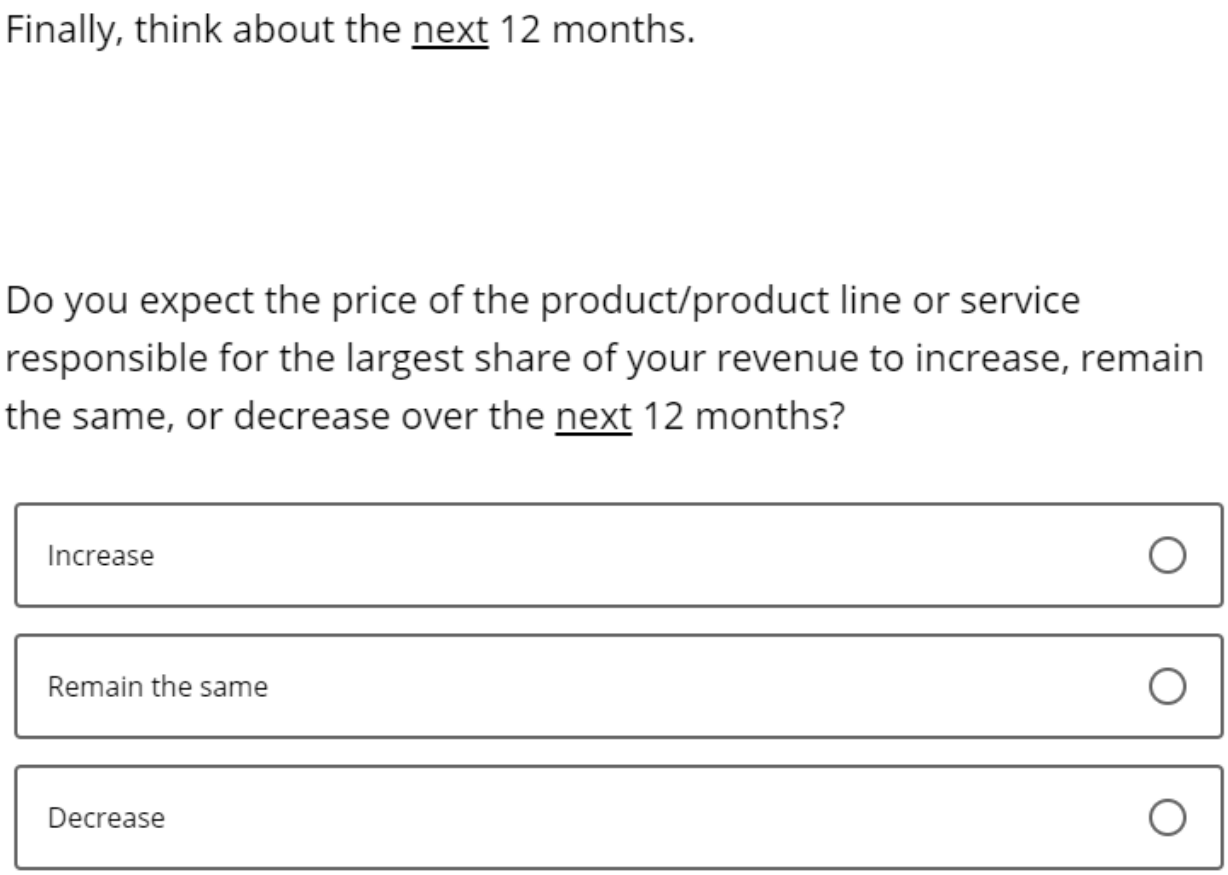


If the respondent indicated decrease, we asked:



Sources: FRBA Business Inflation Expectations (BIE) Survey; December 2020, July 2021, and November 2021.
Note: We only elicited firms' "normal" price perceptions in December 2020.

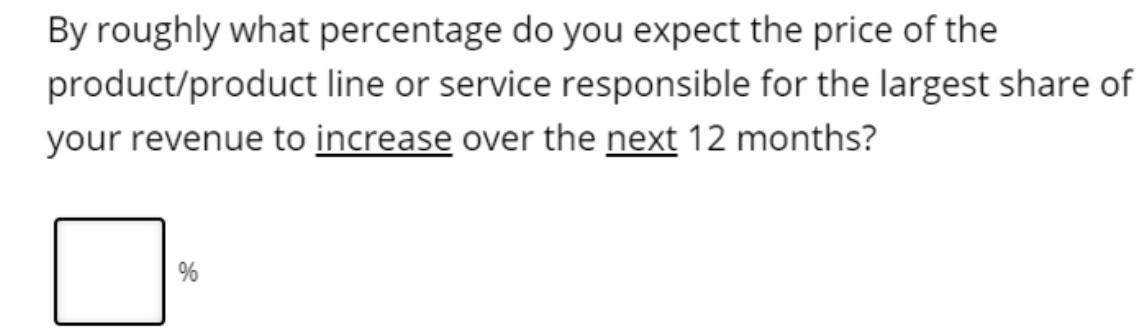
Figure C.14: December 2020, July 2021, and November 2021: Own-Price Realizations and Expectations (part 3)



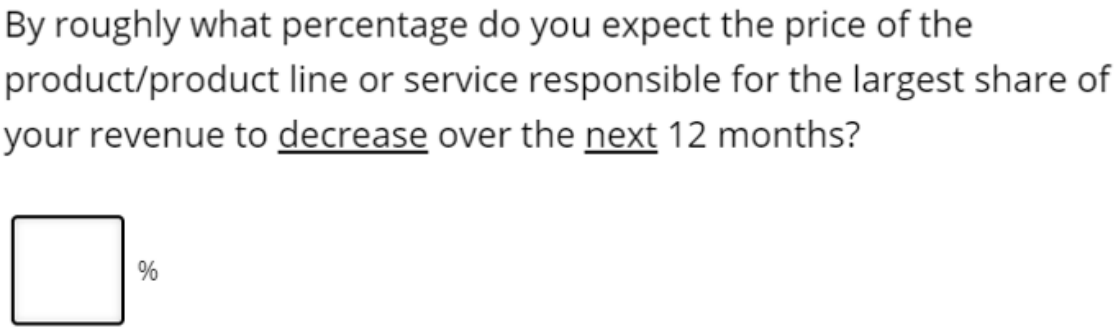
Sources: FRBA Business Inflation Expectations (BIE) Survey; December 2020, July 2021, and November 2021.
Note: We only elicited firms' "normal" price perceptions in December 2020.

Figure C.15: December 2020, July 2021, and November 2021: Own-Price Realizations and Expectations (part 4)

If the respondent indicated increase, we asked:

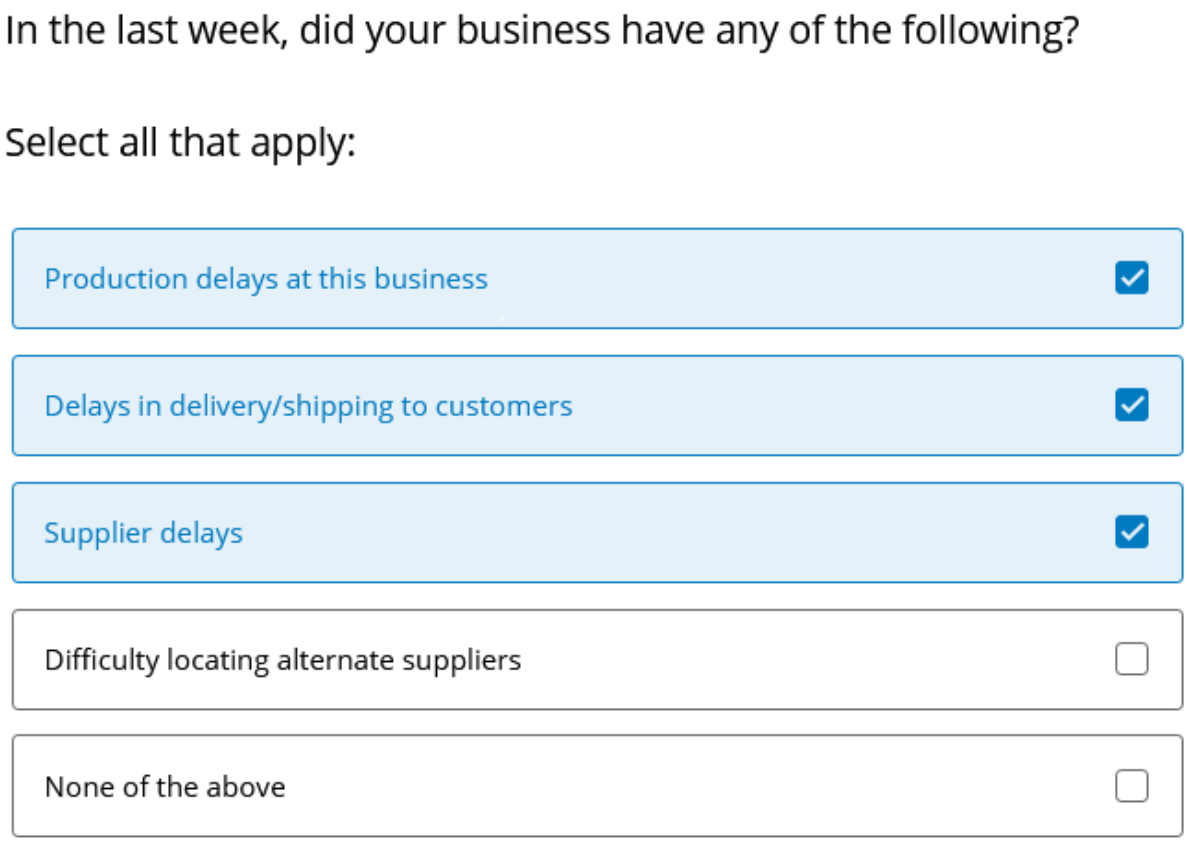


If the respondent indicated decrease, we asked:



Sources: FRBA Business Inflation Expectations (BIE) Survey; December 2020, July 2021, and November 2021.
Note: We only elicited firms' "normal" price perceptions in December 2020.

Figure C.16: December 2020, July 2021, and November 2021: Own-Price Realizations and Expectations (part 5)



Sources: FRBA Business Inflation Expectations (BIE) Survey; March, June, and August 2021.

Figure C.17: March, June, and August 2021: Supply Disruption and Labor Constraints (part 1)

If they answered yes, respondents received this follow-up:

How would you describe the impact of each disruption your business encountered?

	Little to none	Mild	Moderate	Severe
Supplier delays	○	○	○	○
Production delays at your business	○	○	○	○
Delays in deliver/shipping to customers	○	○	○	○

And were asked how long they anticipated the disruption to persist:

How long do you anticipate these disruptions will continue to impact your business?

	Less than a month	1-3 months	3-6 months	6-12 months	Longer than one year
Supplier delays	○	○	○	○	○
Production delays at your business	○	○	○	○	○
Delays in deliver/shipping to customers	○	○	○	○	○

Sources: FRBA Business Inflation Expectations (BIE) Survey; March, June, and August 2021.

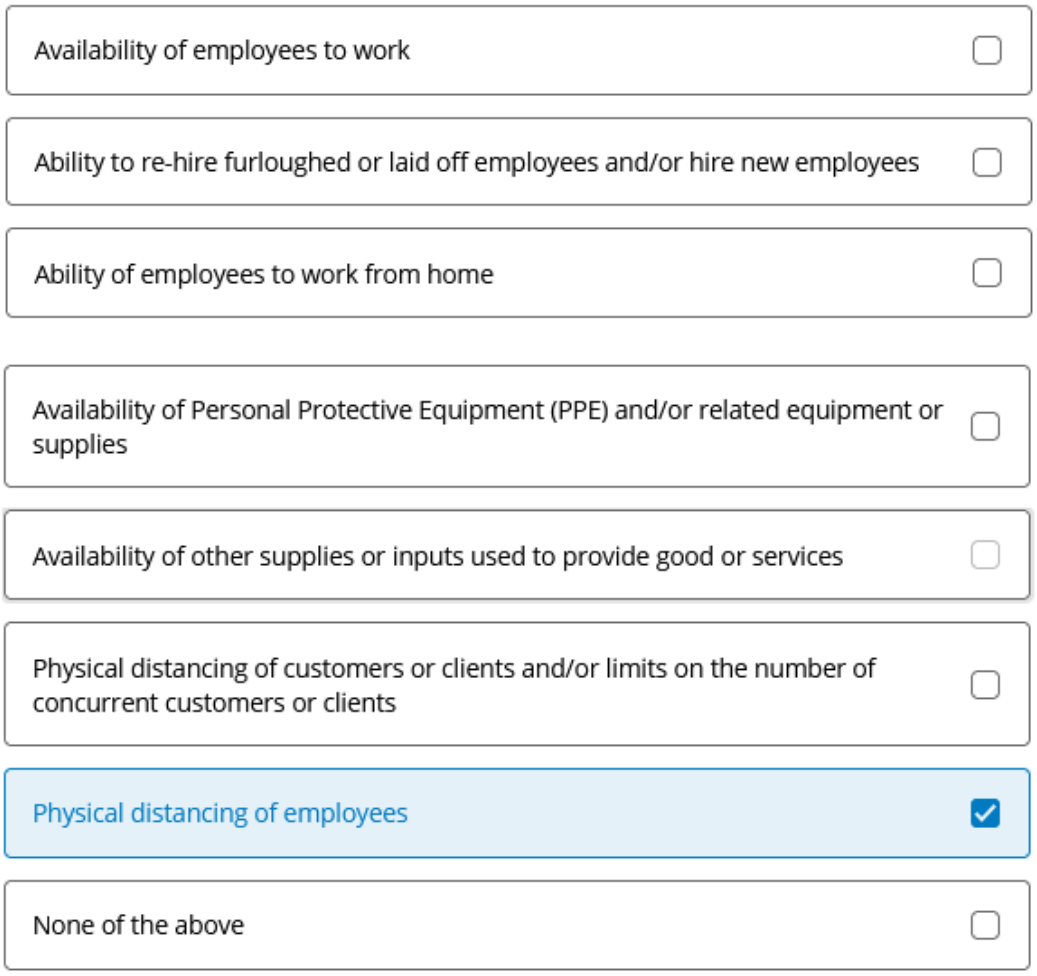
Figure C.18: March, June, and August 2021: Supply Disruption and Labor Constraints (part 2)

Respondents were also asked:

In the last week, was your business's operating capacity affected by any of the following?

Note: Operating capacity is the maximum amount of activity your business could conduct under realistic operating conditions.

Select all that apply:



Sources: FRBA Business Inflation Expectations (BIE) Survey; March, June, and August 2021.

Figure C.19: March, June, and August 2021: Supply Disruption and Labor Constraints (part 3)

If they answered yes, respondents received this follow-up:

How would you describe the impact on operating capacity of each disruption your business encountered?

	Little to none	Mild	Moderate	Severe
Physical distancing of employees	○	○	○	○

And were asked how long they anticipated the disruption to persist:

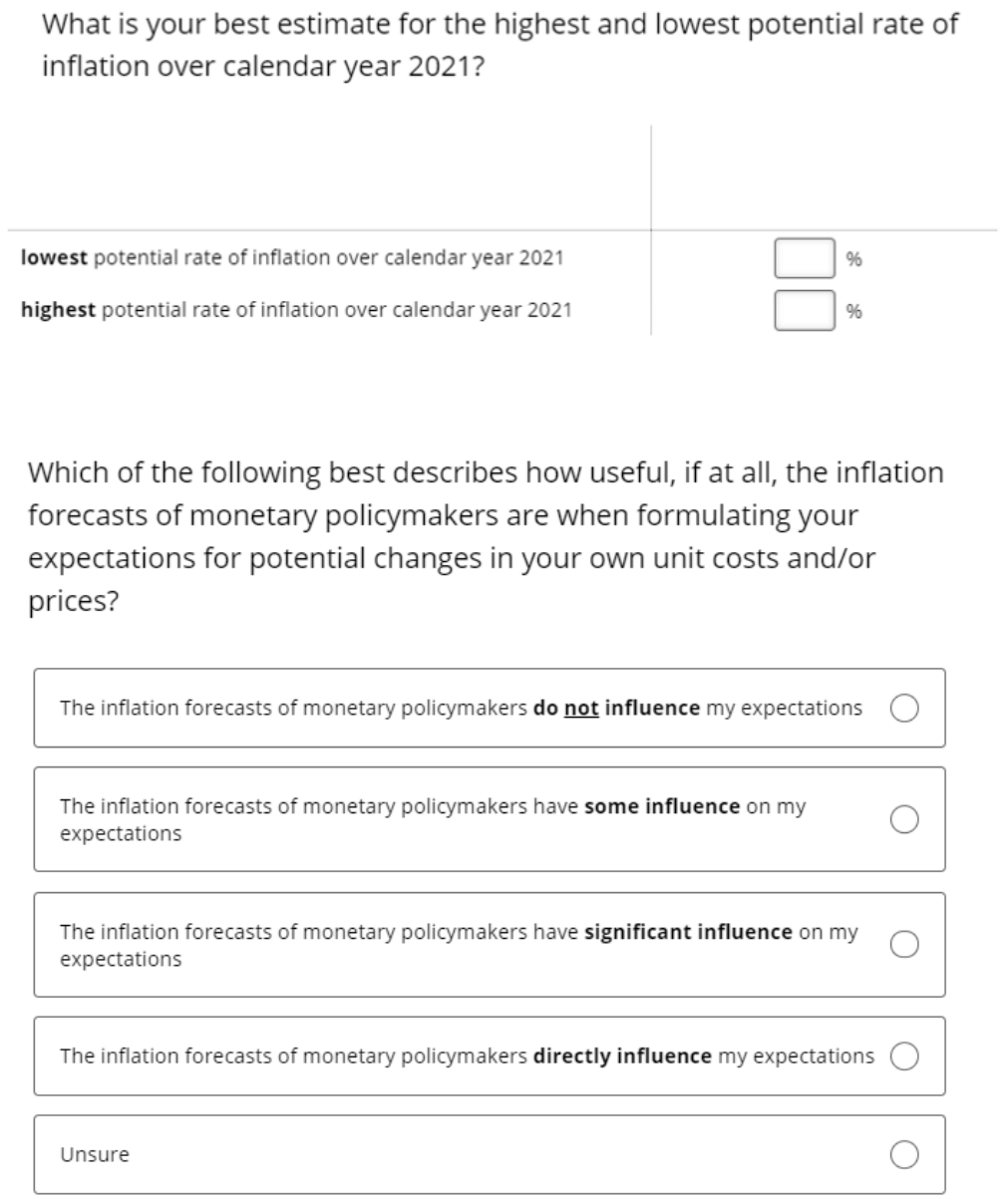
How long do you anticipate these disruptions will continue impact your business?

	Less than one month	1-3 months	3-6 months	6-12 months	Longer than one year
Physical distancing of employees	○	○	○	○	○

Sources: FRBA Business Inflation Expectations (BIE) Survey; March, June, and August 2021.

Figure C.20: March, June, and August 2021: Supply Disruption and Labor Constraints (part 4)

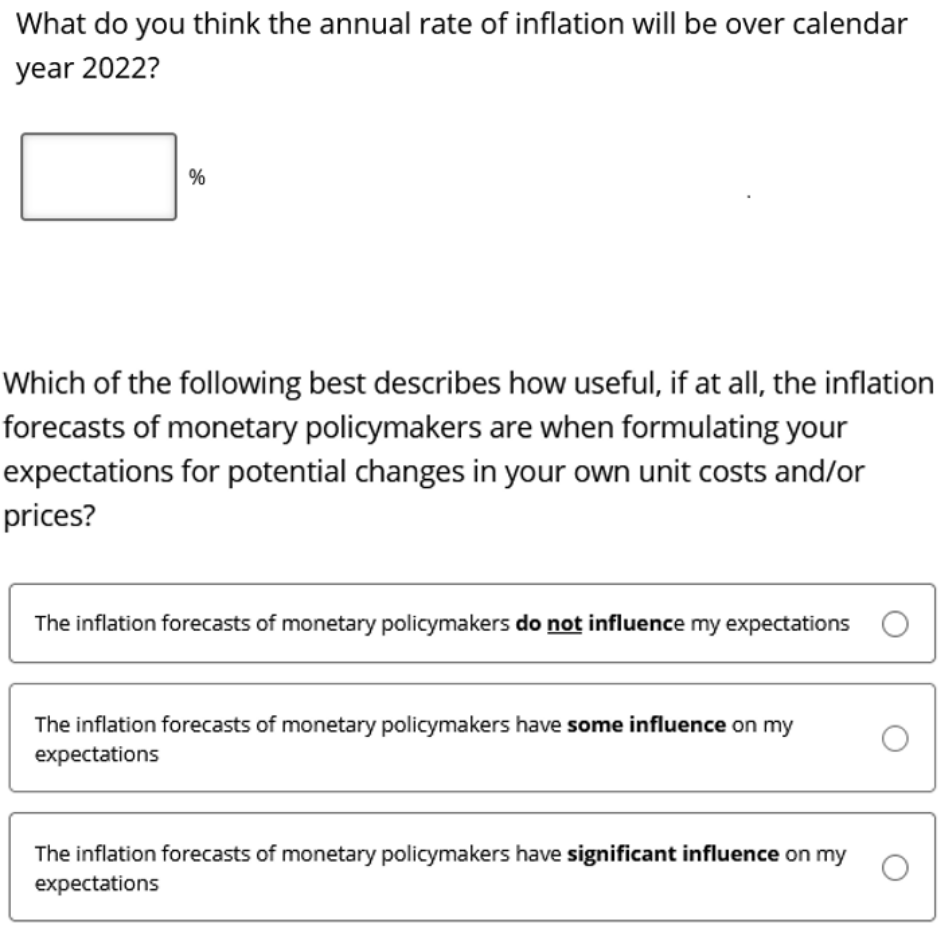
"The median expectation of monetary policymakers for inflation over calendar year 2021 was 1.7 percent (as of September 15th). [Treatment: Based on forecasts over the past 20 years, there is a 70 percent chance that actual inflation will be in the range of 0.7 percent to 2.7 percent over calendar year 2021.] "



Sources: FRBA Business Inflation Expectations (BIE) Survey; October 2020.

Figure C.21: October 2020: Randomized control trial (RCT) - Policymakers' views on uncertainty

"The median expectation of monetary policymakers (as of September 22) for the annual rate of inflation over calendar year 2022 is 2.2 percent."



Sources: FRBA Business Inflation Expectations (BIE) Survey; October 2021.

Figure C.22: October 2021: Randomized control trial (RCT) - Policymakers' views on inflation expectations