Unit Cost Expectations and Uncertainty: Firms' Perspectives on Inflation

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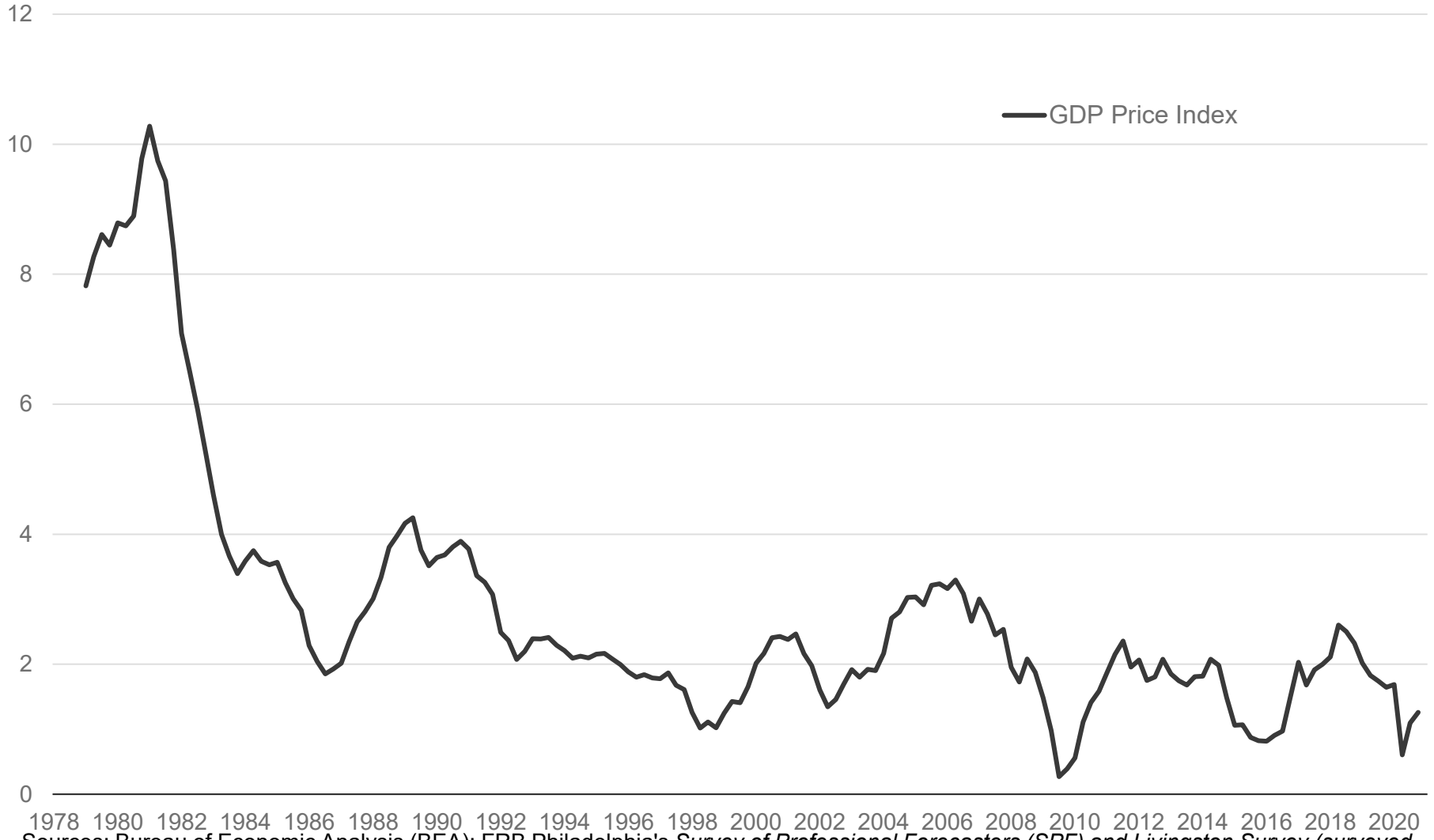
Inflation and Inflation Expectations in the U.S.



Sources: Bureau of Economic Analysis (BEA); FRB Philadelphia's *Survey of Professional Forecasters (SPF) and Livingston Survey (surveyed in June and December, interpolated);* Univ. of Michigan, *Survey of Consumers;* Federal Reserve Board

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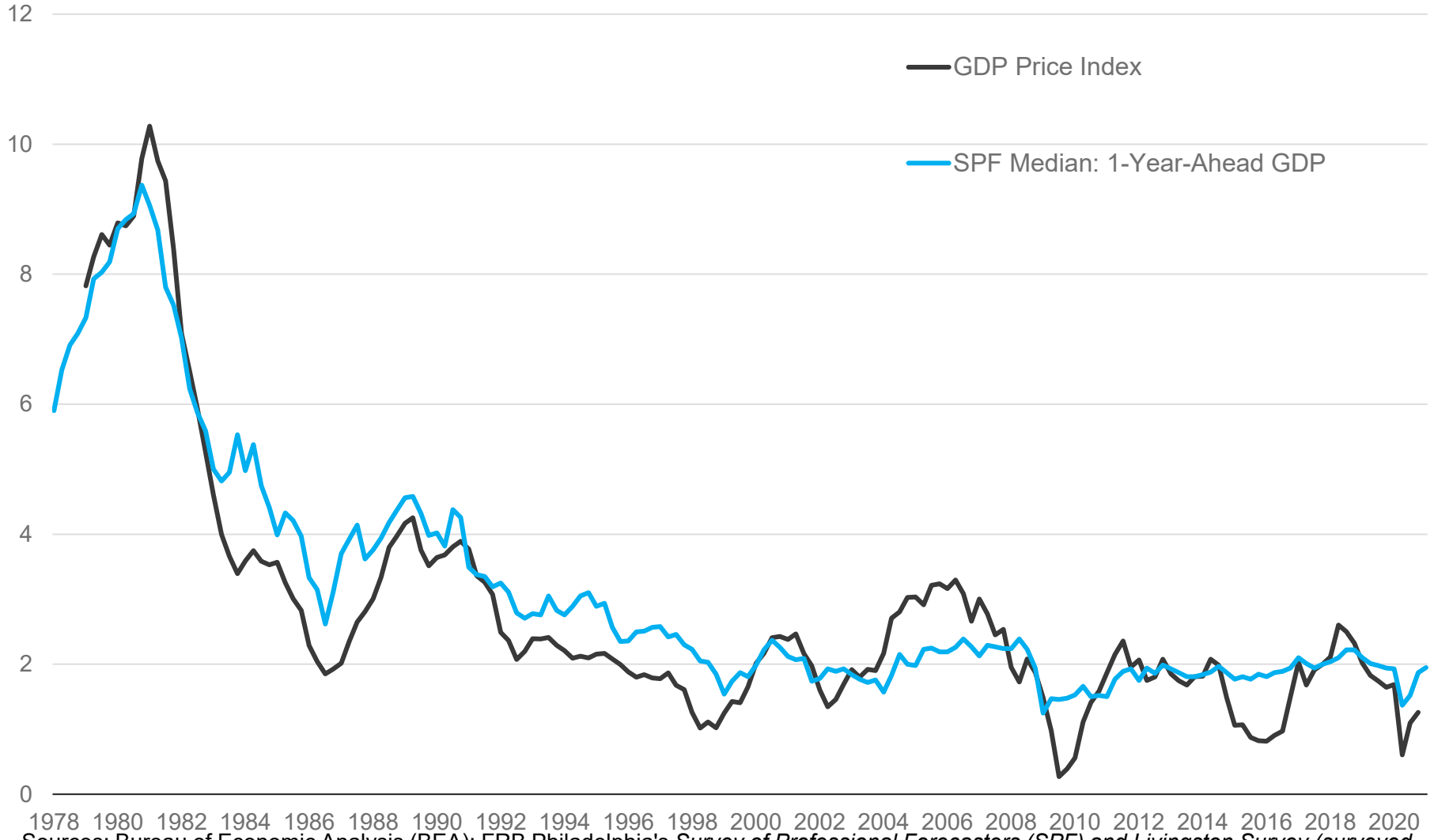

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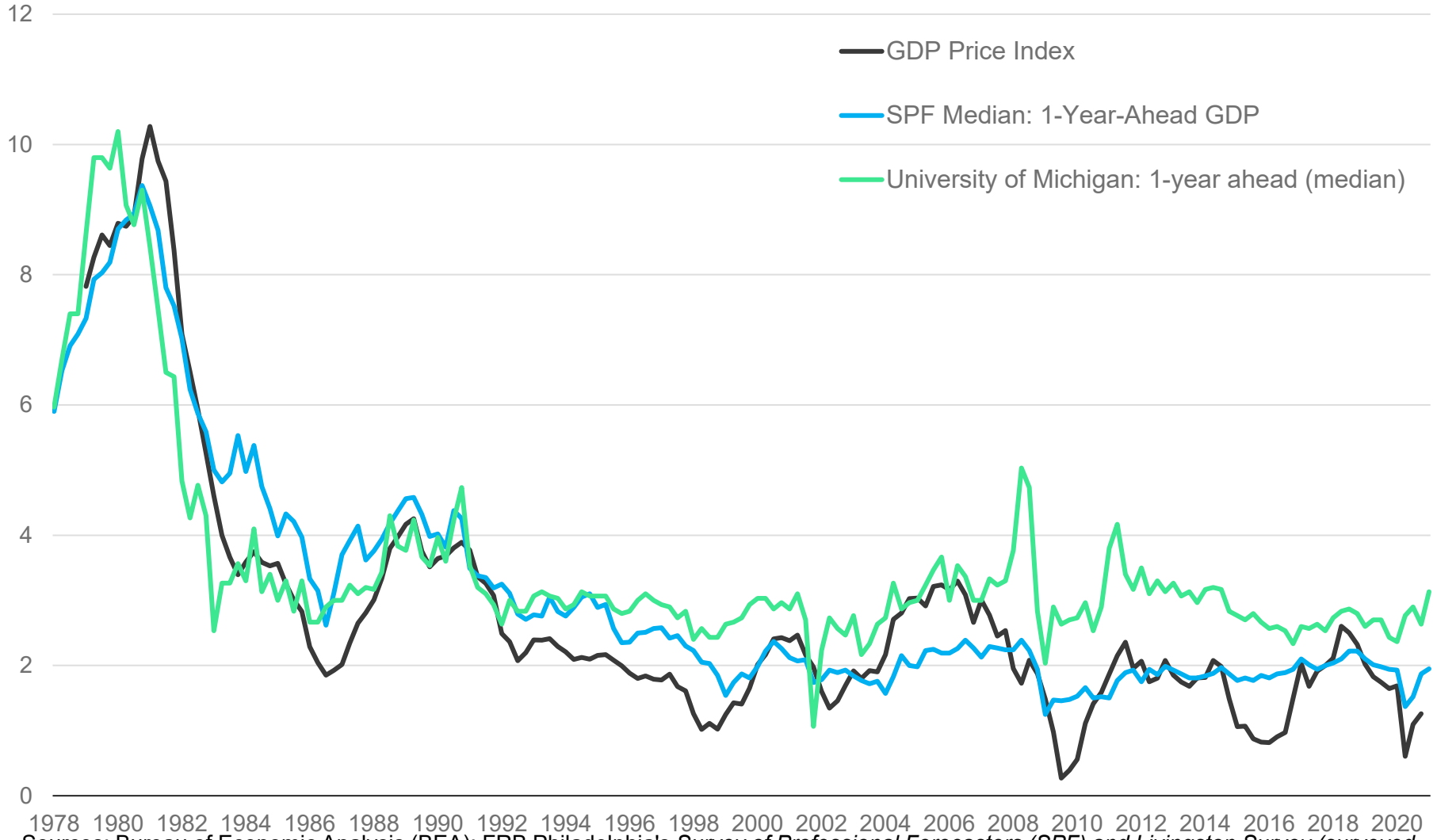

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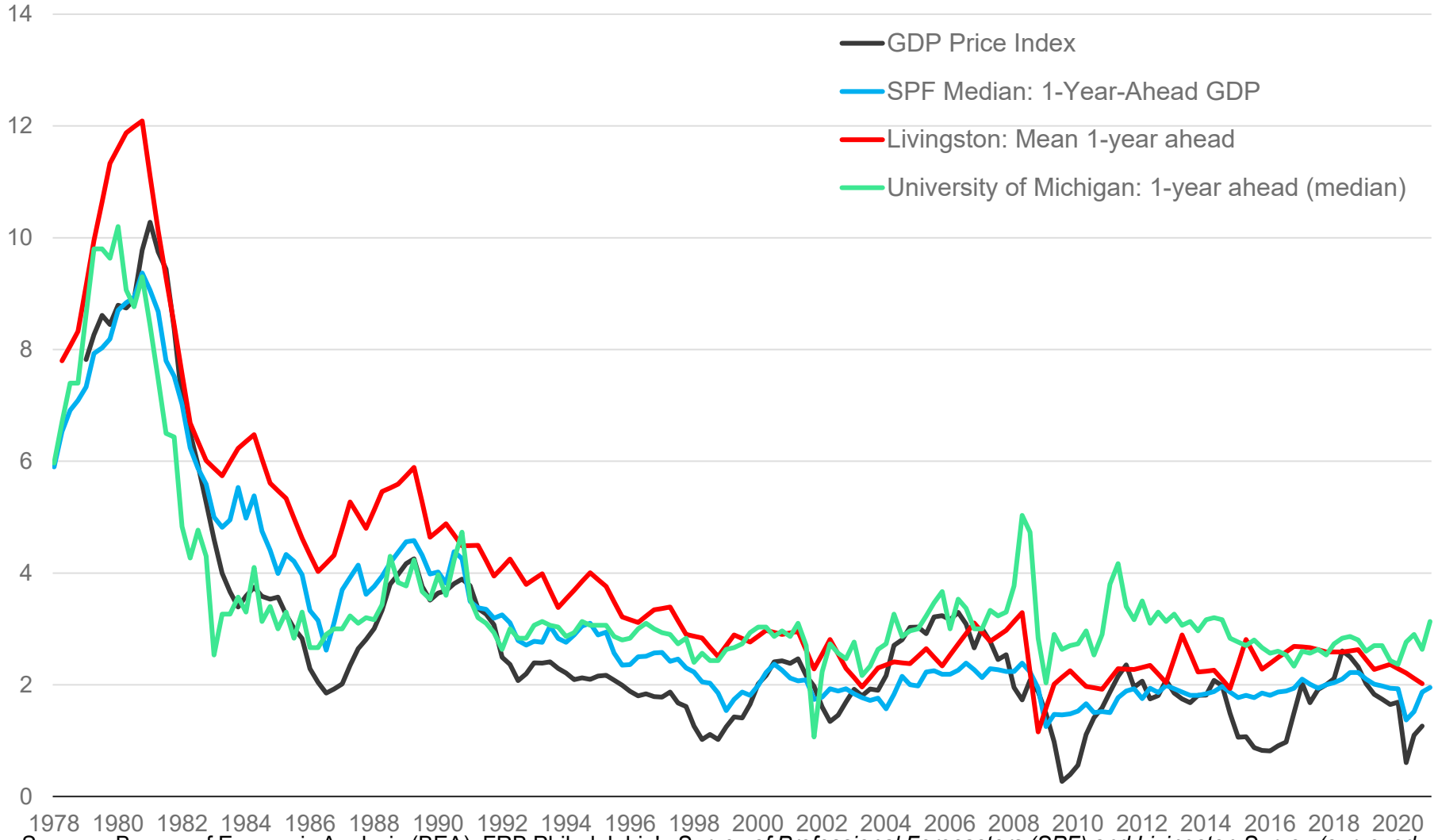

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Puzzle on Inflation Expectations

Why do firms and households hold ``aggregate inflation'' expectations that appear disconnected from actual measured inflation and inflation expectations of professional forecasters?

Our Answers to the Puzzle

- Short answer: aggregate inflation in the low-inflation environment in the U.S. since the mid-90s has made that concept irrelevant in the minds of economic actors. Firms and households have become rationally ignorant.
- Long answer: due to the lack of relevance that firms place on aggregate inflation, studying the nominal expectations requires a different lens. In the case of firms, that lens is unit cost, including both labor cost and non-labor cost. Unit cost, for firms, is equivalent to how we'd think about marginal cost. When developing the survey, that was the language firms most widely used to identify the cost of producing the next unit of a good or service.

Supporting Evidence

- On a micro level, the majority of firms report planning around anticipated unit cost changes, and report unit cost changes influence future price changes.

- On a macro level by aggregating firms' perceptions and expectations of unit costs, we are able to uncover a tight connection to actual measured inflation statistics and the inflation expectations of professionals and market participants.

Background on the BIE Survey

- We conduct a monthly, online survey of roughly 500 corporate c-suite execs (CFOs, CEOs, COOs, etc) and owners in the Fed's 6th District (Southeast US) since October 2011.

- Our survey is not very taxing on the business executive—it takes less than 4 minutes to complete (often much less).

- We ask a probabilistic question about firm "unit cost" expectations, and a "special question" for use in research and for policy guidance.

About the *Business Inflation Expectations* (BIE) Panel

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	%

Three Unique Features of the BIE Survey

- Focusing on own-firm unit costs -- a relevant concept to firms, rather than aggregate inflation or price level in general.

- Asking firms to assign probabilities to the pre-specified bins about year-ahead unit costs, in contrast to all other firm-level surveys that elicit qualitative (or quantitative) responses.

- Having a panel structure, contrasting with repeated cross sections in typical surveys of households and firms.

BIE Panel Representativeness by Firm Size

Business Inflation Expectations (BIE) Panel Representativeness
By Firm Size

		United States			6th Federal Reserve District States*		
	Share of firms in the BIE Panel	Share of Establishments	Share of Employment	Share of Annual Payroll	Share of Establishments	Share of Employment	Share of Annual Payroll
Small (1-99 employees)	58.2	78.1	33.2	27.1	77.2	31.2	26.7
Medium (100-499 employees)	25.7	4.7	14.0	13.5	4.3	12.5	12.4
Large (500+ employees)	16.1	17.1	52.7	59.3	18.5	56.2	60.9

Sources and Notes: Census Bureau *Statistics of U.S. Businesses 2016;* Federal Reserve Bank of Atlanta's *Business Inflation Expectations Survey. *The Atlanta Fed territory covers the Sixth Federal Reserve District, which includes Alabama, Florida, and Georgia, and portions of Louisiana, Mississippi, and Tennessee.*

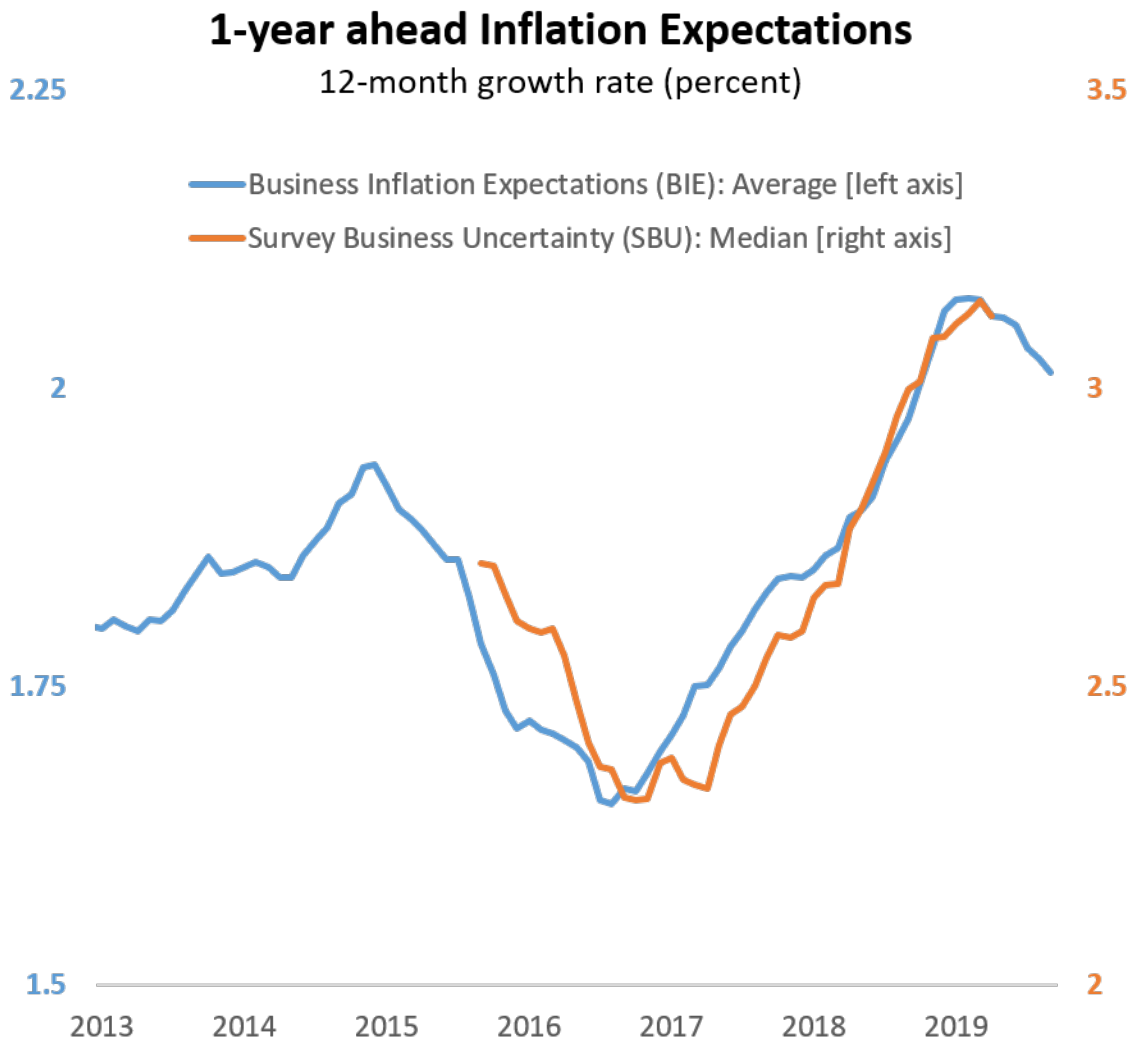
BIE Panel Representativeness by Industry

Business Inflation Expectations (BIE) Panel Representativeness
By Industry

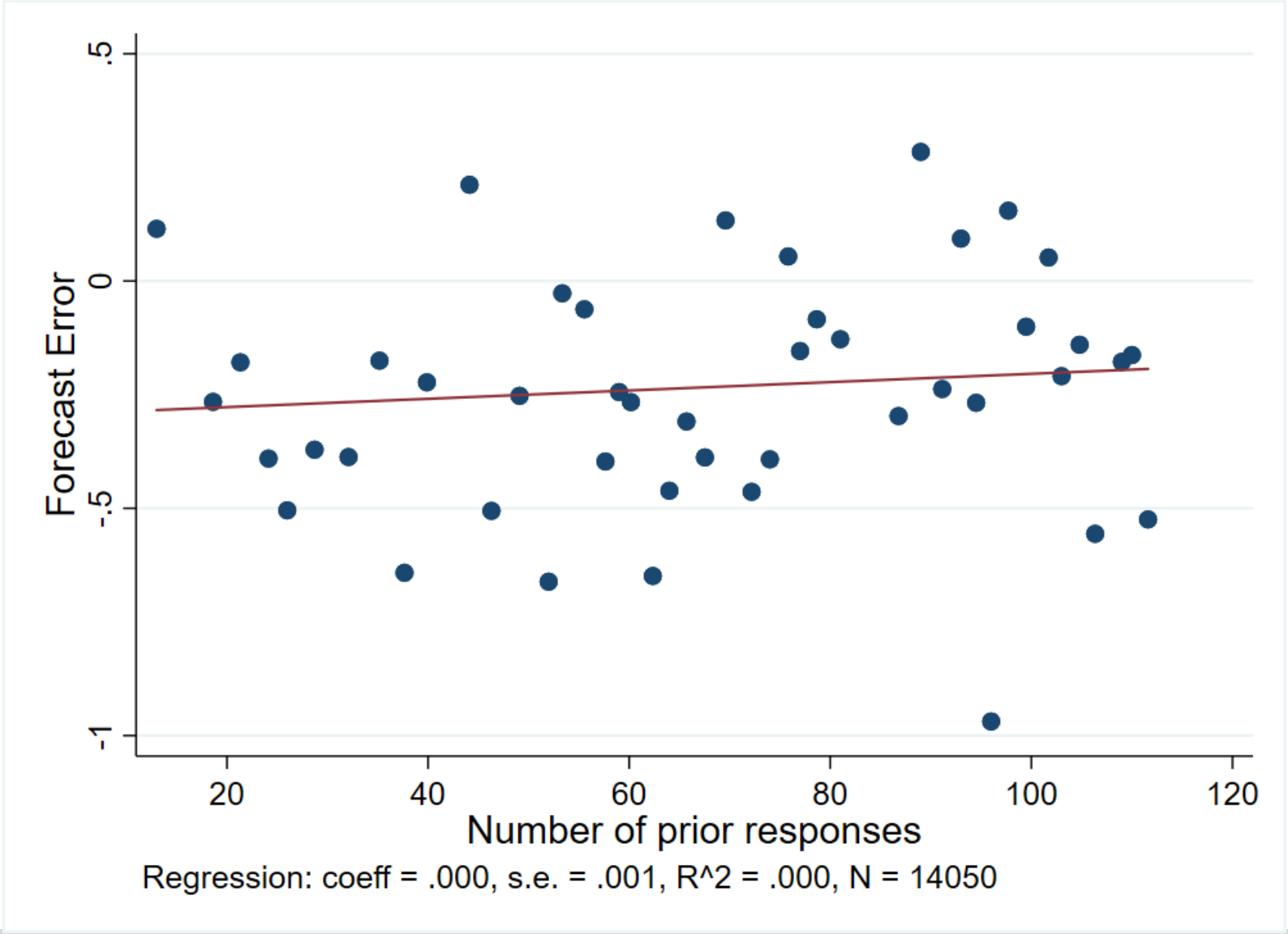
	Share of firms in the BIE Panel	United States			6th Federal Reserve District States**			Share of Private (Nonfarm) GDP*
		Share of Establishments	Share of Employment	Share of Annual Payroll	Share of Establishments	Share of Employment	Share of Annual Payroll	
Construction	11.7	9.0	5.0	5.8	8.3	5.0	5.7	4.7
Manufacturing	17.5	1.3	2.9	2.2	1.2	2.2	1.8	13.0
Educational services	2.3	6.2	5.0	9.5	6.6	4.4	7.4	1.4
Finance and Insurance	8.4	11.5	15.6	14.6	11.1	14.3	15.2	8.8
Health care and social assistance	3.8	1.9	2.7	4.9	1.7	2.2	3.6	8.6
Information	2.1	10.9	12.7	5.3	9.9	13.2	5.9	6.0
Leisure and hospitality	2.4	3.8	9.2	10.3	3.1	8.0	9.5	4.8
Mining and utilities	1.8	0.6	1.0	1.8	0.5	0.8	1.6	3.8
Other services except government	3.4	9.8	4.3	2.7	9.4	4.2	2.7	2.4
Professional and business services	13.7	17.7	18.8	24.1	18.8	22.2	26.7	14.4
Real estate and rental and leasing	7.1	5.1	1.7	1.7	5.6	1.7	1.8	15.3
Retail and wholesale trade	21.3	19.2	17.4	13.5	20.8	17.8	13.9	13.1
Transportation and warehousing	4.7	3.0	3.7	3.6	3.0	3.9	4.3	3.7

Sources and Notes: Census Bureau Statistics of U.S. Businesses 2016; Bureau of Economic Analysis; Federal Reserve Bank of Atlanta's Business Inflation Expectations Survey. *Calculated using 2018 nominal values for all private industries excluding agriculture, forestry, fishing, and hunting (NAICS 11). **The Atlanta Fed territory covers the Sixth Federal Reserve District, which includes Alabama, Florida, and Georgia, and portions of Louisiana, Mississippi, and Tennessee.

Highly Correlated with A National Firm-level Survey



No Evidence of Tenure (or Conditioning) Effect



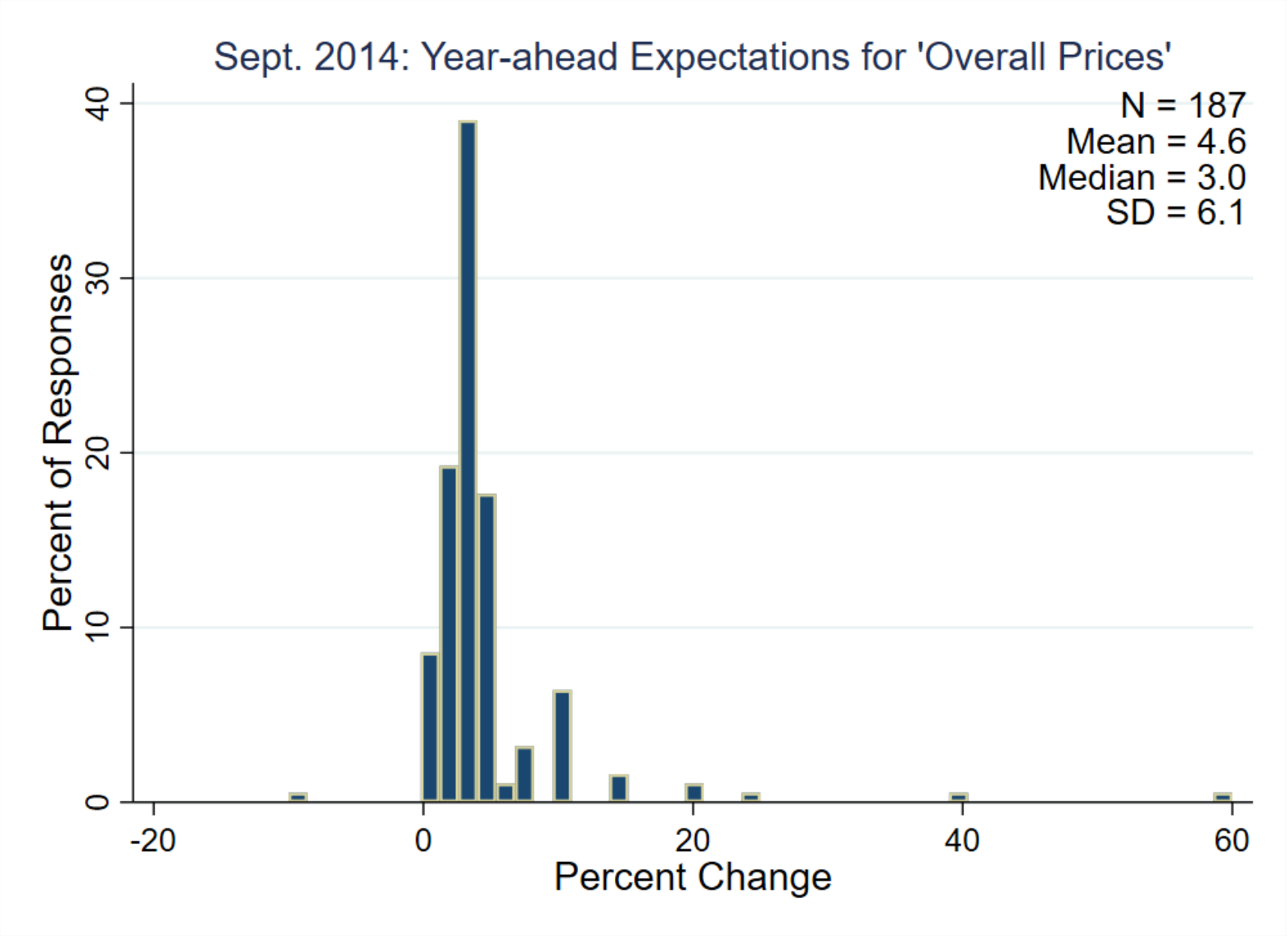
Wording and Inflation Expectations: Experimental Evidence

- In September 2014, the following special question was asked:

  > "During the next twelve months, by how much do you think prices will change overall in the economy? Please provide a quantitative answer."

- Firms in the BIE panel expected prices ``overall in the economy'' to increase by 4.6 percent over the year ahead, compared to a 3.7 percent increase reported by the University of Michigan in September 2014.
- There was a tremendous amount of heterogeneity and digit-preference. These results are similar to Coibion et al. (2018) and households surveyed by the University of Michigan; see Armantier et al. (2013).

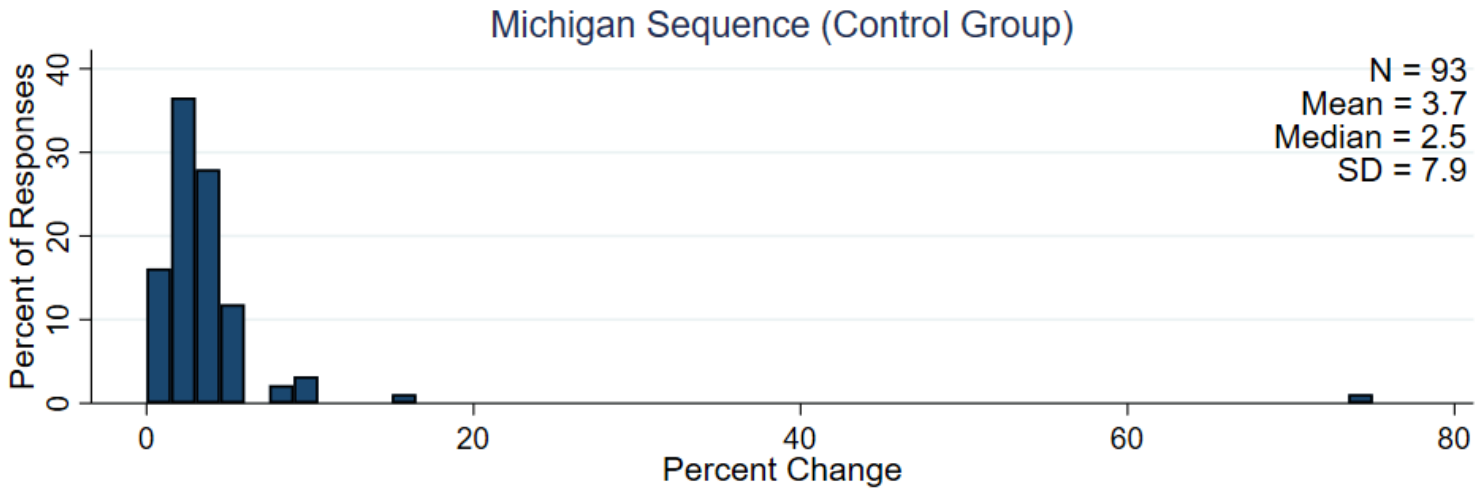
Firms' Expectations for "Prices Overall in the Economy"

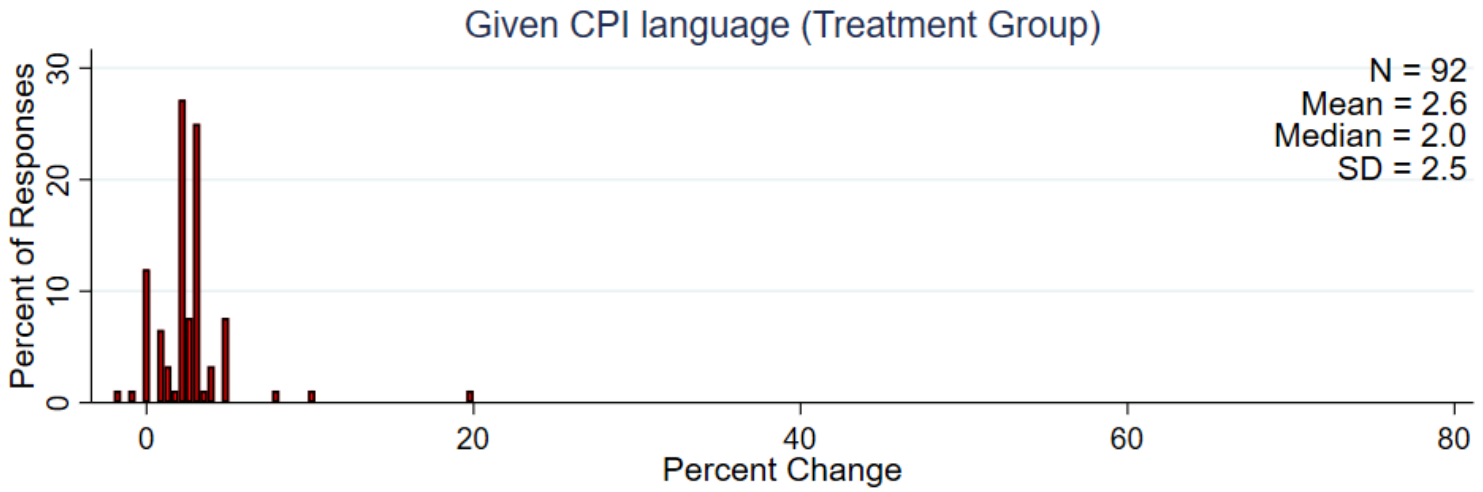


Wording and Inflation Expectations: A Randomized Control Trial

- In July 2015, the panel (185 responses) was randomly assigned to two groups.
- Control group: got the Michigan sequence for “prices in general.”
- Treatment group: received information that prices in general is equivalent to inflation as measured by the CPI.
- Inclusion of the phrase ``like those measured by the Consumer Price Index" has a sizeable effect on the distribution of responses to the ``prices in general" expectations question, leading to a mean response that is 1.1 percentage points lower and a range of responses that is more tightly distributed.

Providing a Clue that ``Prices in General'' Means CPI

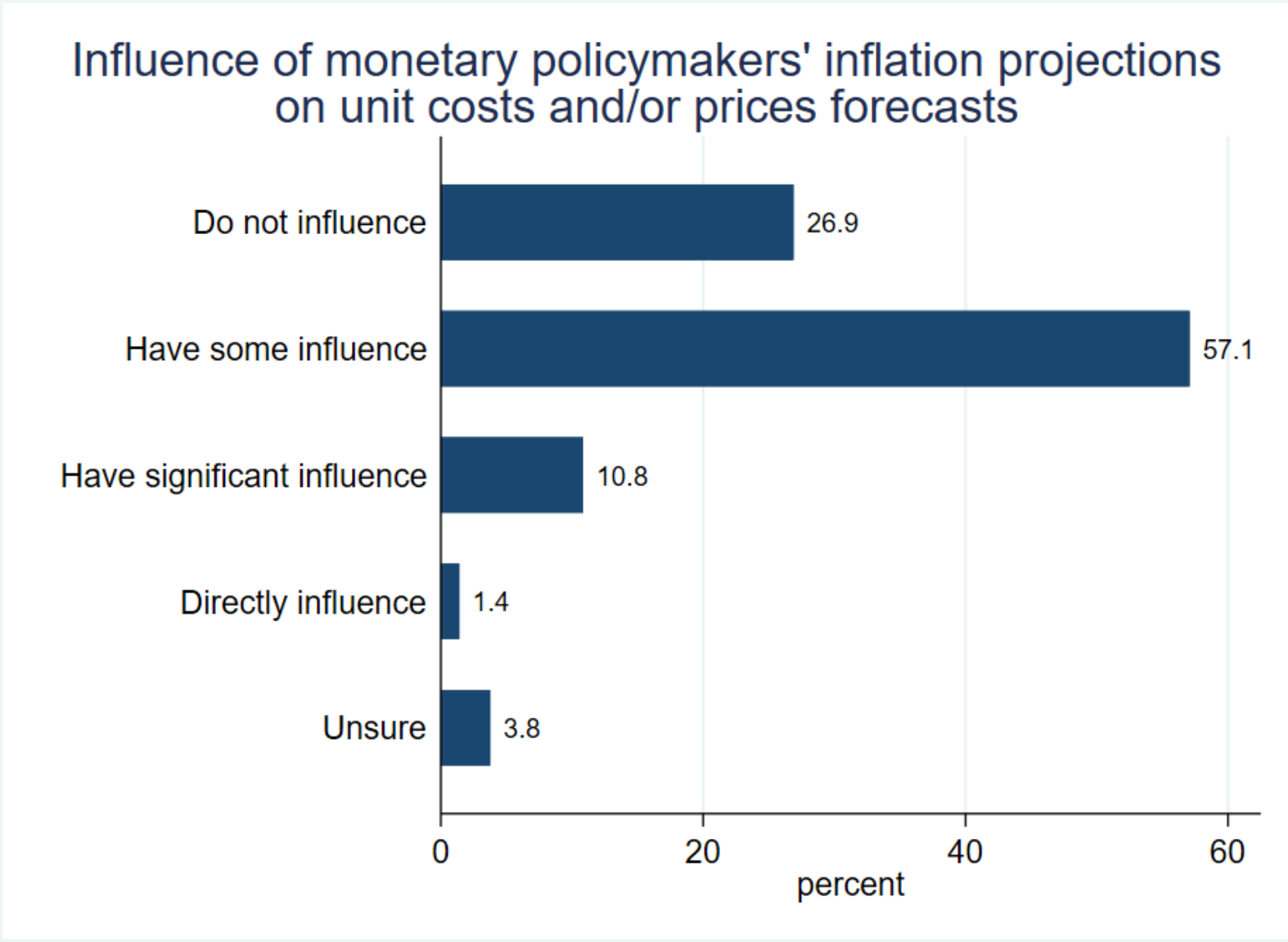




Informing Firms of the Views of Professionals: Another RCT

- In October 2020, we asked firms for their highest and lowest expectations for PCE inflation in 2021.
- Control and treatment groups: got median expectation for PCE inflation (1.7%) in 2021 from the FOMC.
- Treatment group: received the 70 percent confidence interval around those projections (0.7%, 2.7%).
- Goal: test whether giving firms information on the **uncertainty** around monetary policymakers' projections affected firms' PCE inflation projections in October, and their own unit cost expectations a month later in November 2020. The answer is "No."

Influence of Monetary Policymakers' Inflation Projections

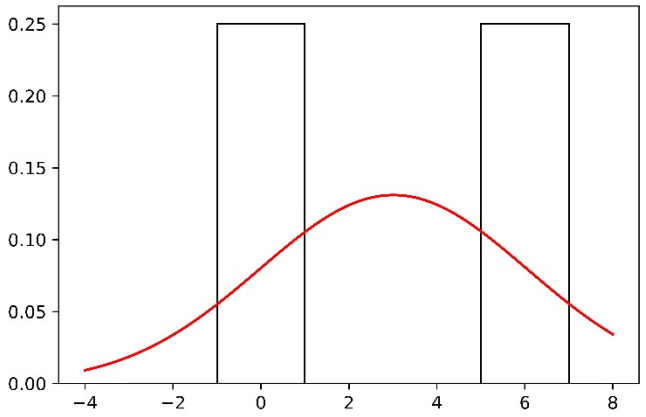


Analyzing the Probability Forecasts

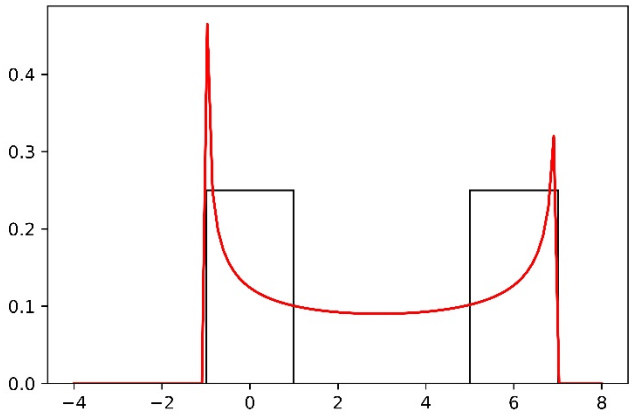
- Nonparametric estimation by assuming that the probability is concentrated at the midpoint of each interval.
- Parametric estimation by assuming uni-modality:
  - Normal distribution, e.g. Giordani and Soderlind (2003)
  - Beta distribution, e.g. Engelberg, Manski and Williams (2009)
  - Both distributions work well for experts' density forecasts, Binder, McElroy and Sheng (2021).
- Some firms, however, give bimodal distributions. To accommodate the bimodality, we adopt the bimodal asymmetric power normal (BAPN) distribution, proposed by Bolfarine, Martnez-Flrez and Salinas (2018).

An Example of Bimodality

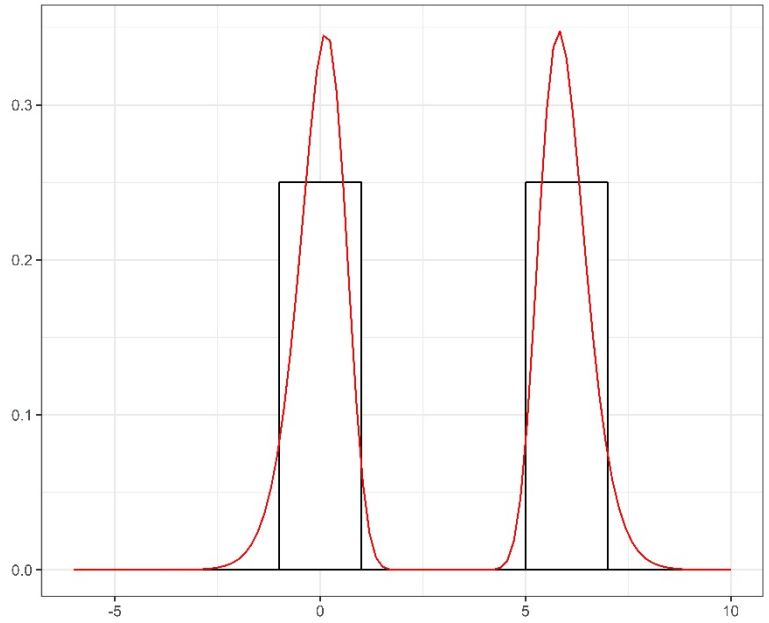
Normal distribution



Beta distribution



BAPN distribution



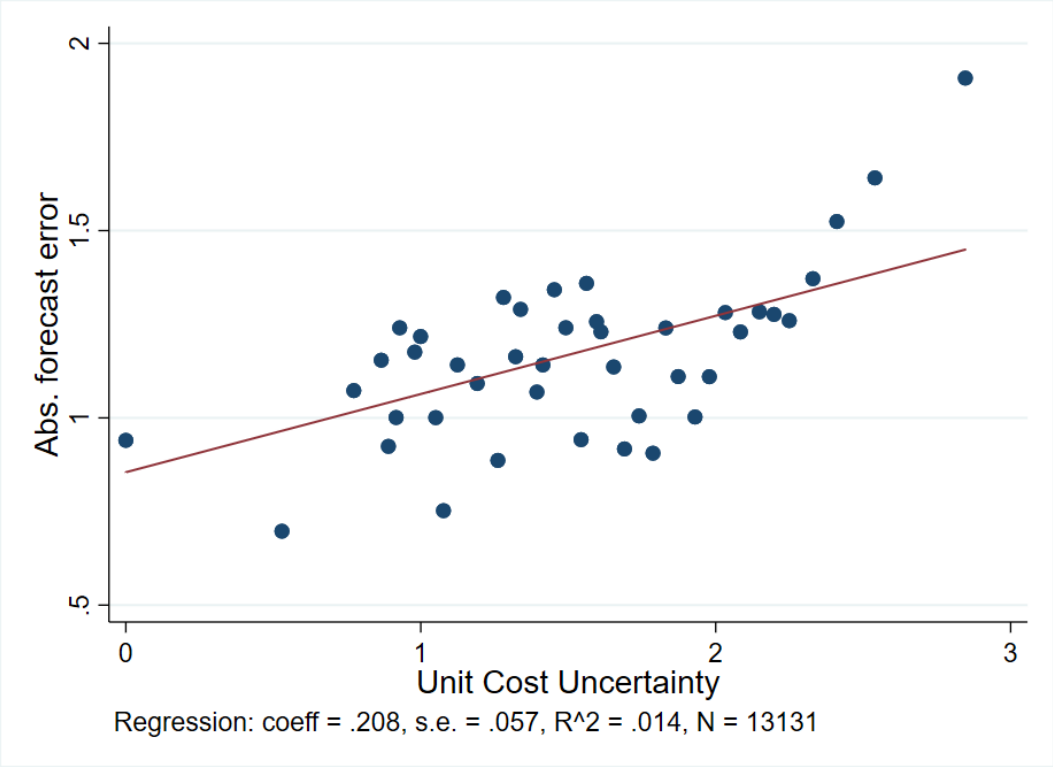
All three summary statistics below point to bimodal asymmetric power normal (BAPN) distribution:
(1) Lowest BIC, obtained from the likelihood function when fitting each parametric distribution;
(2) Lowest MSE between the fitted and the empirical cumulative distribution function; and
(3) Highest *p*-value from the Kolmogorov-Smirnov test having the fitted model as the null model against the two-sided alternative.

Causal Factors of Bimodality

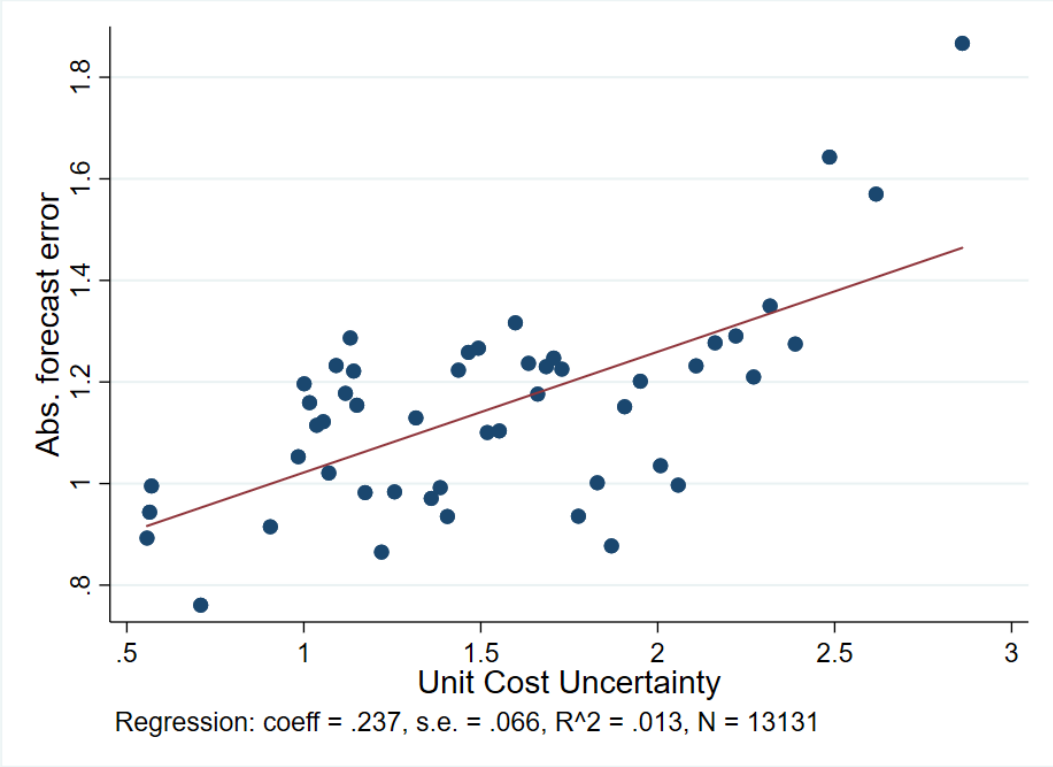
- 338 histograms show bimodality.
- Instances of bimodality vary by industry, with manufacturing sector displaying most bimodality, followed by finance and insurance.
- Respondents that have bimodal distributions are typically much more uncertain.
- We followed up with roughly 10 interviews having firms tell us more about their expectations. The majority (8 out of 10) gave us some notion of a range of conditional outcomes (e.g. if “x” happened, then my costs would likely be really high; but if “y” happened, then my costs would be low).

More uncertain firms have larger absolute forecast errors.

Nonparametric



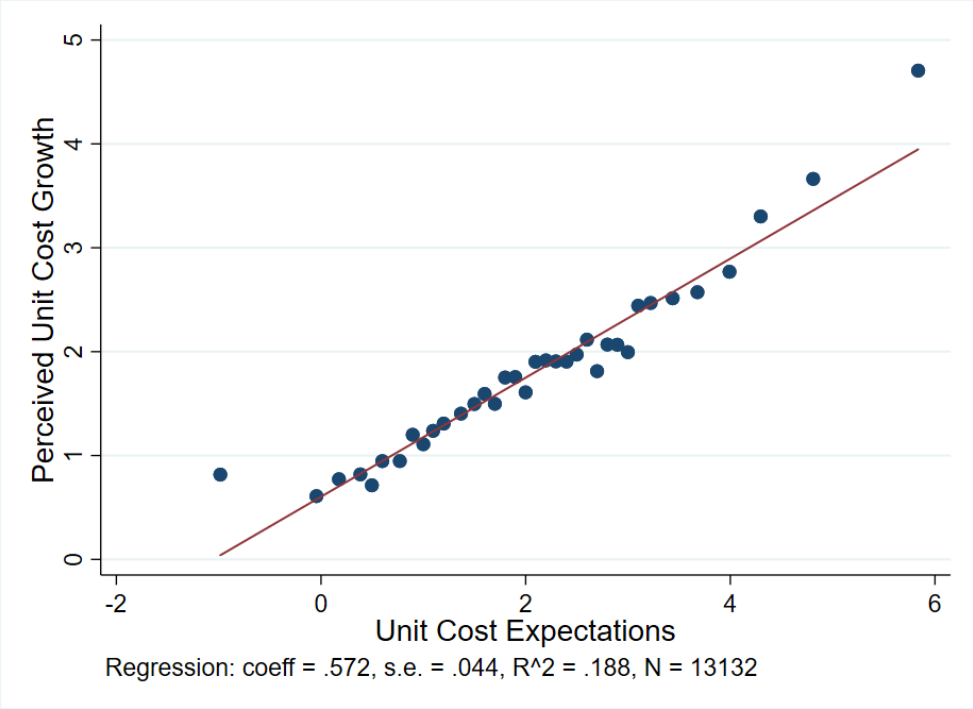
Parametric



Notes: These binscatters compare a firm's unit cost forecast uncertainty with their absolute forecast errors.

Firms' expectations are related to their outcomes.

Nonparametric



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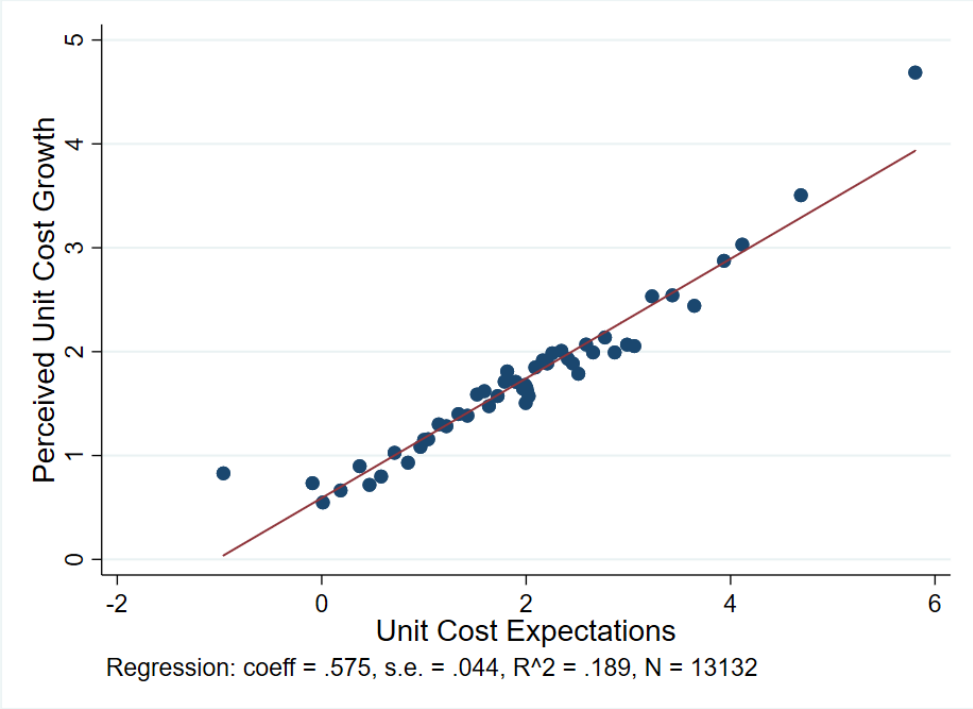


Notes: These binscatters compare a firm's unit cost expectations at time (t) with their perceived unit cost growth over the previous year.

Unit Costs and Expected Price Changes on a Firm Level

	(1)	(2)	(3)	(4)	(5)
Unit cost expectation	0.4261***	0.2615**	0.1479**	0.3242***	0.3828**
	(0.0808)	(0.1039)	(0.0737)	(0.0568)	(0.1614)
Year-over-year unit cost change	0.0438	0.0751	0.0205	0.0198	0.4198***
	(0.687)	(0.0818)	(0.0486)	(0.0376)	(0.1224)
Sales level	0.1762**	−0.0147	0.1242*	0.1091**	–
	(0.2826)	(0.10678)	(0.0647)	(0.0507)	–
Sector FE	N	N	N	N	Y
N	184	91	183	458	864
R^2	0.2015	0.1755	0.0835	0.1574	0.0360

Source: FRBA Business Inflation Expectations (BIE) Survey.

Notes: In Columns (1) to (4), regressions are estimated via OLS of the form: $E_t p_{f,t+h} = \beta E_t \pi_{f,t+1} + \theta \pi^{perc}_{f,t} + \lambda s_{f,t} + \epsilon_{f,t}$, where $E_t p_{f,t+h}$ is year-ahead price change expectations (for a given month), $E_t \pi_{f,t+1}$ is firms' unit cost expectations, $\pi^{perc}_{f,t}$ is year-over-year unit cost realizations, and $s_{f,t}$ is sales level. Columns (1) through (3) use the responses to special questions on expected prices elicited in June 2013, February 2019 and December 2020, respectively. Column (4) reports the result from a pooled regression across these three special surveys. In Column

Unit Costs and Realized Price Changes on a Firm Level

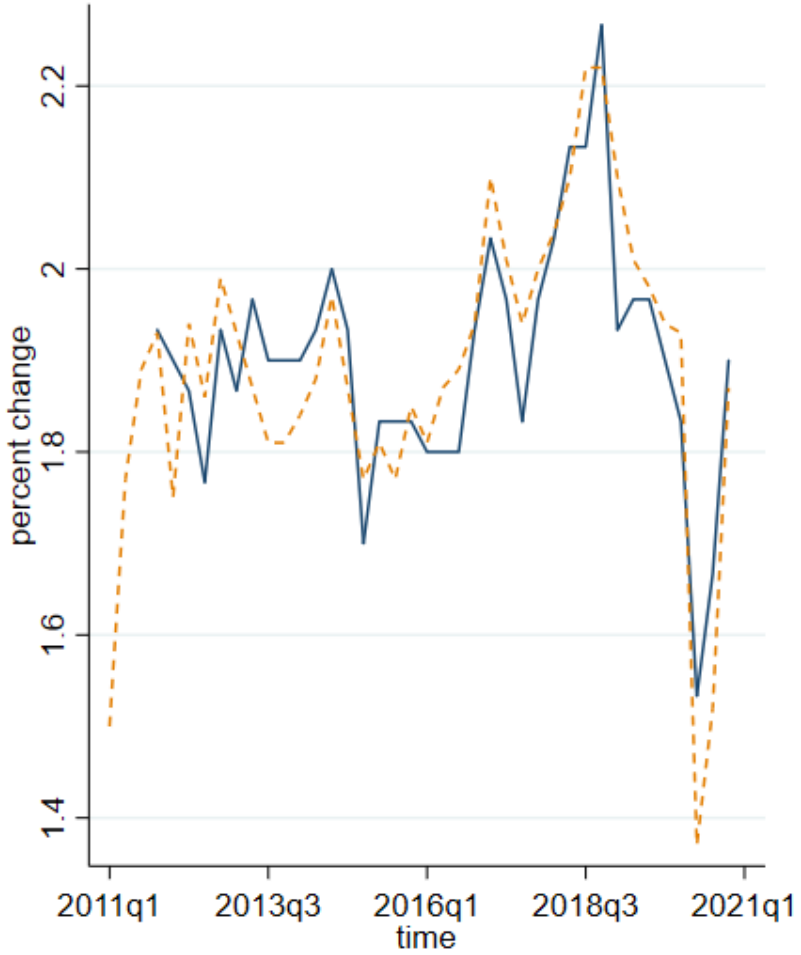
Variables	(1)	(2)	(3)	(4)	(5)
(1) Realized Price Change	1.000				
(2) Aggregate Inflation Expectation	0.010	1.000			
(3) Expected Price Change	0.468***	0.046	1.000		
(4) Lagged Unit Cost Expectation	0.101	0.065	0.235**	1.000	
(5) Unit Cost Growth	0.171**	0.031	0.248**	0.307***	1.000

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 * correspond to statistical significance at the 1%, 5%, and 10% levels, respectively.

Consistent with Rational Inattention Theory

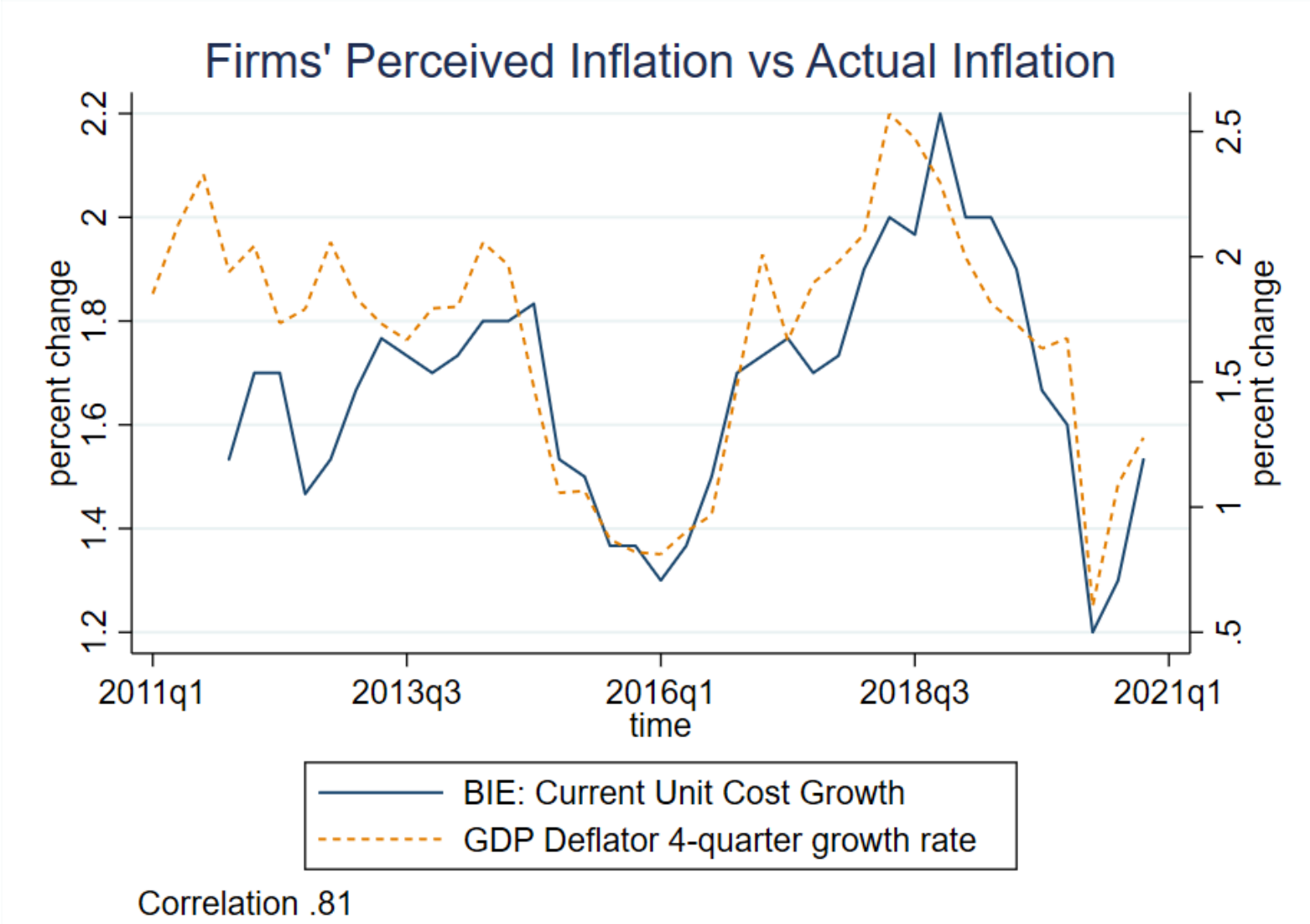
- Aggregate inflation expectations are not central to firms' price-setting behavior.
- Firms pay more attention to firm-specific conditions.
- Further evidence: We decompose the variation in realized unit cost growth into its aggregate, sectoral, and firm-specific components.
- The relative standard 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 firm-specific component is about **7 times** that of the aggregate.

Firms' unit cost expectations tend to move in step with those of professionals.

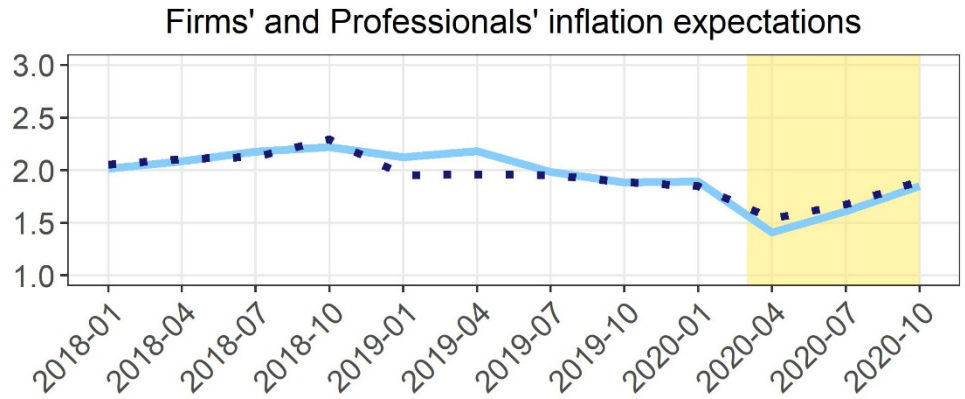


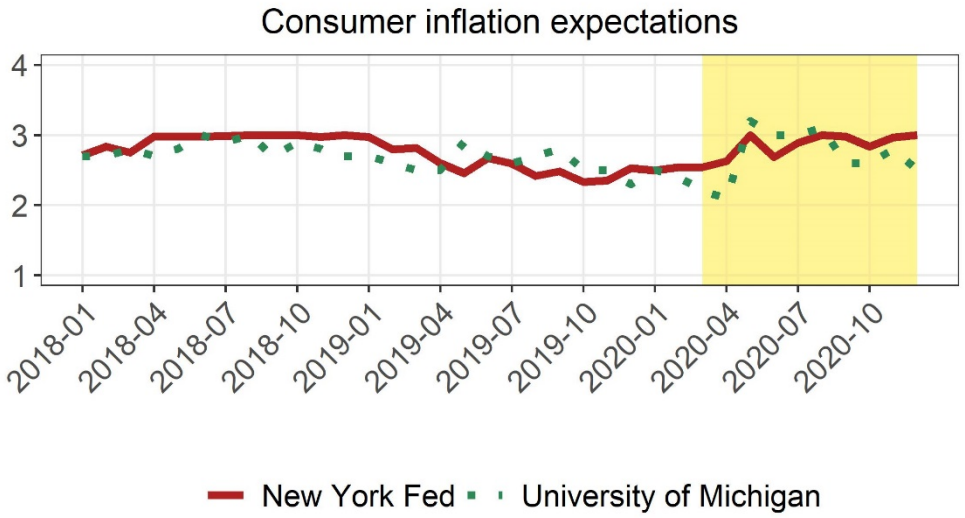
Correlation .81

Movements in firms' unit cost perceptions mirror changes in actual inflation.



Comparison of Inflation Expectation Measures during the COVID-19 Pandemic





Sources: Atlanta Fed's Business Inflation Expectations Survey, Ney York Fed Survey of Consumer Expectations, Philadelphia Fed's Survey of Professional Forecasters, and the University of Michigan Survey of Consumers

Concluding Remarks

- Do firms understand the concept of inflation?

  "No" for aggregate inflation or price level in general;

  "Yes" for firms' unit cost.

- Once properly identified, does the concept of inflation influence their decision making?

  "Yes". Firms' pricing and business decisions depend on their unit cost expectations.

Concluding Remarks (cont.)

- We introduce a new monthly firm level survey: Atlanta Fed Business Inflation Expectations (BIE) since October 2011.
- On aggregate, business inflation expectations covary strongly with the expectations of experts, but differ from those of households.
- We see substantial heterogeneity across firms, as evidenced by bimodal probability distributions.
- Using Randomized Controlled Trials (RCT), we find that question wording matters for inflation expectations measurement.
- On net, firms see COVID-19 largely as a demand shock during the first 8 months, as firms lower their inflation expectations, cut wages and lower prices. But the latest evidence seems to be moving in the other direction.

References

- Meyer, Parker and Sheng (2021), “Unit Cost Expectations and Uncertainty: Firms' Perspectives on Inflation,” Atlanta Fed working paper.
- Meyer, Prescott and Sheng (2021), “The Impact of the COVID-19 Pandemic on Business Expectations,” forthcoming in *International Journal of Forecasting.*
- Binder, McElroy and Sheng (2021), “The Term Structure of Uncertainty: New Evidence from Survey Expectations,” forthcoming in *Journal of Money, Credit and Banking*.