

PERCEIVED AND EXPECTED RATES OF INFLATION OF U.S. FIRMS

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Abstract: The seminal work of Jonung (1981) showed that households' perceptions of inflation are the strongest predictor of households' inflation expectations. This fact has been a key ingredient for testing and developing theoretical models of how economic agents form expectations (e.g., the famous Lucas island model). However, little is known about whether perceptions play a similar role for firms. Using a new survey of American CEOs, we document that inflation perceptions shape the inflation expectations of firms just as Jonung found for households. Furthermore, perceptions about past inflation predict perceptions of the Fed's inflation target and uncertainty about future inflation. These results suggest that information rigidities apply not only for households but also for CEOs.

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Ordering of authors has been randomly selected.

Jonung (1981) identified a striking feature of household inflation expectations: the best predictor of what households forecast about future inflation was their different beliefs about what inflation had *recently* been. More than forty years later, Jonung's (1981) finding has been repeatedly confirmed in household surveys, not just in Sweden as in his original paper but in many other countries as well. In the midst of the rational expectations revolution, Jonung's seminal paper presented some of the most striking evidence against full information rational expectations. Despite the ready and public availability of information about aggregate inflation, households' economic expectations are heavily shaped by their vastly different information sets and experiences.

While evidence for households confirming Jonung's (1981) finding is pervasive, much less is known about firms' expectations. This reflects the cost and difficulty of running surveys of firms, as a result of which these surveys tend to be quite short. Asking about firms' perceptions about recent economic conditions is therefore quite rare, with most surveys focusing only on forward-looking expectations. In this paper, we use a recent survey of U.S. firms that measures not only firms' expectations about future inflation but also their beliefs about recent inflation to revisit Jonung's (1981) finding. Despite the fact that we are using a completely different time period (recent years instead of 1970s), a different country (USA instead of Sweden), and different set of economic agents (firms instead of households), our results largely confirm Jonung's central insight: U.S. firms' inflation expectations are heavily shaped by their different beliefs about recent inflation dynamics. These results support a growing literature, building on Mankiw and Reis (2001), Woodford (2001) and Sims (2003), focusing on the role played by the imperfect information of firms in shaping macroeconomic outcomes.

To replicate Jonung's (1981) findings for firms, we rely on a quarterly survey of U.S. firms that started in 2018: the Survey of Firms' Inflation Expectations (SoFIE) managed by the Federal Reserve Bank of Cleveland. This survey measures the 12-month-ahead inflation expectations of firms every quarter and, crucially, also asks once a year about their perceptions of aggregate inflation over the last 12 months. Because we also have information about the industry of each firm, we can study the role of both aggregate and industry-specific information in shaping their aggregate expectations. We find that an industry's recent cost experiences help predict a firm's perceived aggregate inflation expectations. Much like households rely on recently observed price changes in their consumption basket to form inflation expectations (D'Acunto et al. 2021, Weber

et al forthcoming), firms seem to base their aggregate inflation expectations in part on the changing costs of their inputs. But when one conditions on firms' perceived inflation, these industry-level cost changes do not help predict firms' inflation expectations above and beyond their contribution in shaping firms' beliefs about past inflation. In other words, as found by Jonung (1981) for households, perceptions of firms work as a summary statistic of recent aggregate inflation and play a key role in predicting firms' expectations about the future.

I Survey of Firms' Inflation Expectations (SoFIE)

To revisit Jonung's finding, we rely on a survey of U.S. firms managed by the Federal Reserve Bank of Cleveland known as the Survey of Firms' Inflation Expectations (SoFIE). This survey has been running on a quarterly basis since 2018Q2. The survey relies on the repeated participation of a panel of firms, with around 300 firms participating each quarter. More detail about the survey is provided in Candia et al. (2021).

The survey includes two questions each quarter. One question is asked every quarter: what do firms expect that aggregate inflation will be over the next twelve months. For the second question, there is a rotation across four different questions that are each asked once per year. In the first quarter, firms are asked about the probability that inflation one year later will exceed 5%. In the second quarter, they are asked what inflation rate they think the Federal Reserve is targeting on average. In the third quarter, they are asked what they think the inflation rate has been over the last twelve months. In the fourth quarter of each year, they are asked about what they think inflation will be over the next five years on average. With these questions, we are therefore able to compare firms' inflation expectations with their inflation perceptions, as done in Jonung (1981).

II Firms' Inflation Expectations and Perceptions

We plot firms' inflation expectations and perceptions from SoFIE in Figure 1. Results from the survey indicate that firms' average inflation expectations fell from around 3.5% in 2018 to 2% at the start of the pandemic, since which they have been progressively increasing, reaching nearly 7% in 2022Q2. Firms' average perceptions of inflation seem to closely track their average inflation expectations, but only four observations are available for this measure given the limited time series and the fact that this question is asked only once per year. However, because we have a large cross-

section of firms surveyed, we can still study the importance of inflation perceptions in shaping inflation expectations.

One thing that is striking about firms' perceptions of aggregate inflation is how dispersed they are: as documented by Candia et al. (2021), the cross-sectional standard deviation of firms' inflation perceptions ranges from 1 to 2 percentage points over this time. Disagreement about recent inflation is therefore pervasive among firms and of the same order of magnitude as disagreement among firms about future inflation. Where do firms' perceptions about aggregate inflation come from? In the Lucas (1972) island model, firms form expectations about aggregate prices from the subset of prices that they observe in their production process. Since we observe each firm's industry in the survey, we construct an industry-specific cost inflation measure that uses the input-output matrix to measure each industry's exposure to other sectors as inputs and combines it with PPI inflation in each industry.

Figure 2 then plots a binscatter for firms' perceptions of recent aggregate inflation against their industry's cost inflation. We find a strong correlation between the two: firms in industries that experienced higher cost inflation tend to believe that aggregate inflation has been higher. We also find a positive correlation between recent aggregate inflation and firms' perceptions of recent aggregate inflation, but the slope of the relationship is flatter than the corresponding estimate for firms' industry cost inflation. This finding suggests that, much as hypothesized in Lucas (1972), firms look to their own experiences with prices in their industry to form beliefs about recent aggregate price changes.

[INSERT FIGURE 2 HERE]

III The Role of Perceptions in Explaining Firms' Inflation Expectations

What explains firms' inflation expectations? Following Jonung (1981), we regress firms' aggregate inflation expectations ($E_t^i \pi_{t+12}$) on their perceptions of recent aggregate inflation ($E_t^i \pi_t$), controlling for actual CPI aggregate inflation over the previous 12 months (π_t) and the actual cost inflation for firm i 's industry (π_{it}^{Cost}):

$$E_{it} \pi_{t+12} = \alpha + \beta E_{it} \pi_t + \gamma \pi_t^{CPI} + \phi \pi_{it}^{Cost} + error$$

In Table 1 below, we report Huber-robust regressions (column 1) as well as OLS regressions (column 2). Huber regressions endogenously reduce the impact of outliers on empirical results. We find strong predictive power for firms' perceived levels of recent inflation for their

expectations of future inflation. The coefficient is 0.6-0.7, indicating a high pass-through of firms' beliefs about recent dynamics, even after controlling for actual aggregate inflation. Aggregate inflation, as one might expect, also shapes firms' aggregate inflation expectations. In short, these results confirm the key finding of Jonung (1981) but now for the case of U.S. firms. At the same time, we find no predictive power for experienced industry cost inflation over the last 12 months. This result indicates that the influence of the industry level prices observed by firms on their aggregate expectations operates through their perceptions of aggregate inflation, as in Lucas (1972).

[INSERT Table 1 HERE]

These effects broadly extend to firms' longer run inflation expectations, i.e. replacing $E_{it}\pi_{t+12}$ as the dependent variable with firms' expectations of average inflation over the next five years (columns 3 and 4). When controlling for outliers with Huber regressions, the coefficient on firms' beliefs about recent inflation help predict firms' longer-run inflation expectations. The pass-through is still quite high given the long-time horizon: around 0.2, with the OLS estimate being somewhat higher at 0.3. In a similar spirit, according to Huber-robust estimates (column 5), higher perceptions of inflation are associated with higher perceptions of the inflation target of the Federal Reserve, thus also indicating that perceptions can spill over into beliefs about longer-term inflation. Although these results suggest potentially unanchored inflation expectations, the right tail of the distribution for expected inflation (i.e., the probability that inflation will exceed 5 percent over the next 12 months), a metric suggested by Reis (2021) to capture a lack of anchoring of inflation expectations, does not show a clear statistically significant association with perceived inflation.

IV Conclusion

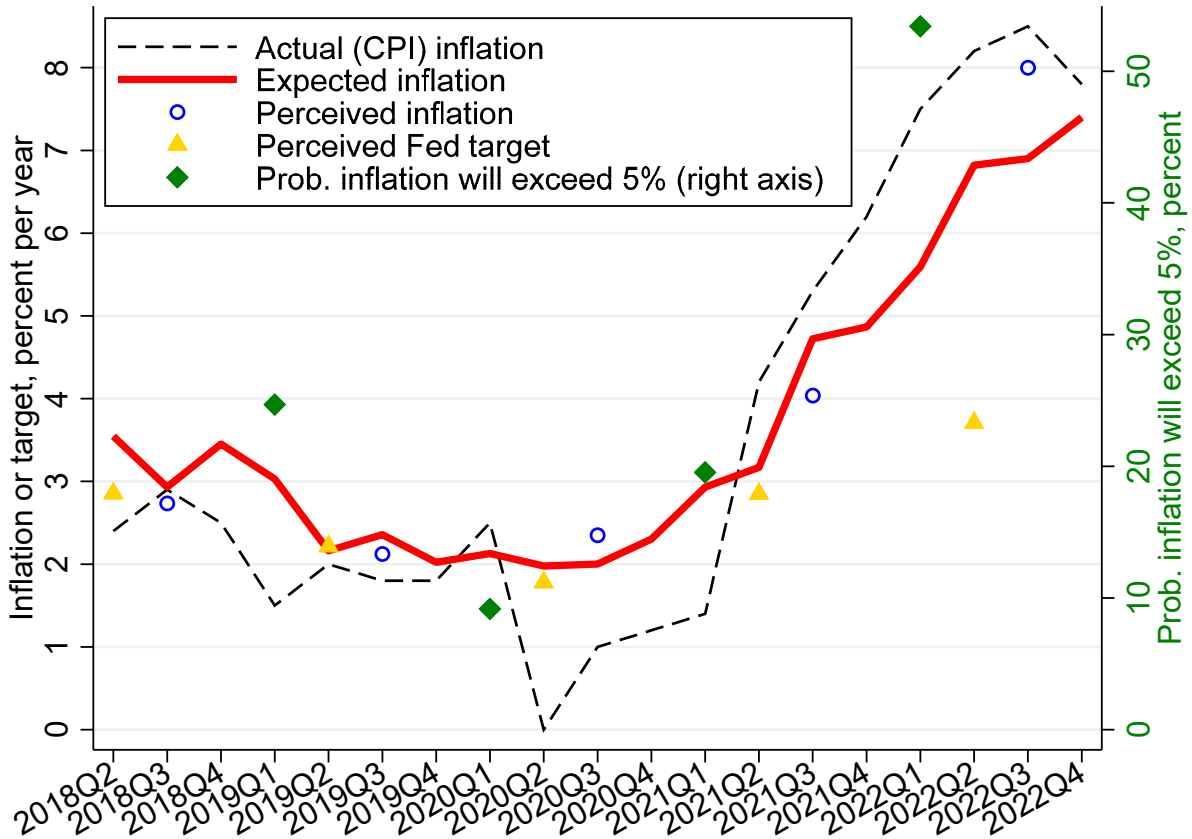
Jonung's (1981) seminal work documented a new empirical fact that has withstood the test of time: households' different expectations about future inflation primarily reflect their different beliefs about what inflation has been in recent periods. Because information about aggregate inflation is publicly available, the stylized fact found by Jonung has helped motivate a large literature on imperfect information and rational inattention that both tries to explain and builds off of this apparent inattention to information about aggregate conditions. In this paper, we provide new evidence that this finding extends to U.S. firms, thereby complementing a growing body of work that has extended Jonung's initial findings well beyond Swedish households. The pervasiveness

and robustness of this result will likely continue to spur future work to help us better understand how agents form their beliefs about the future and how these beliefs affect their decisions. This key result also suggests that a bout of inflation can be propagated over time via a build-up of perceived inflation, which may call for an aggressive response to inflationary shocks.

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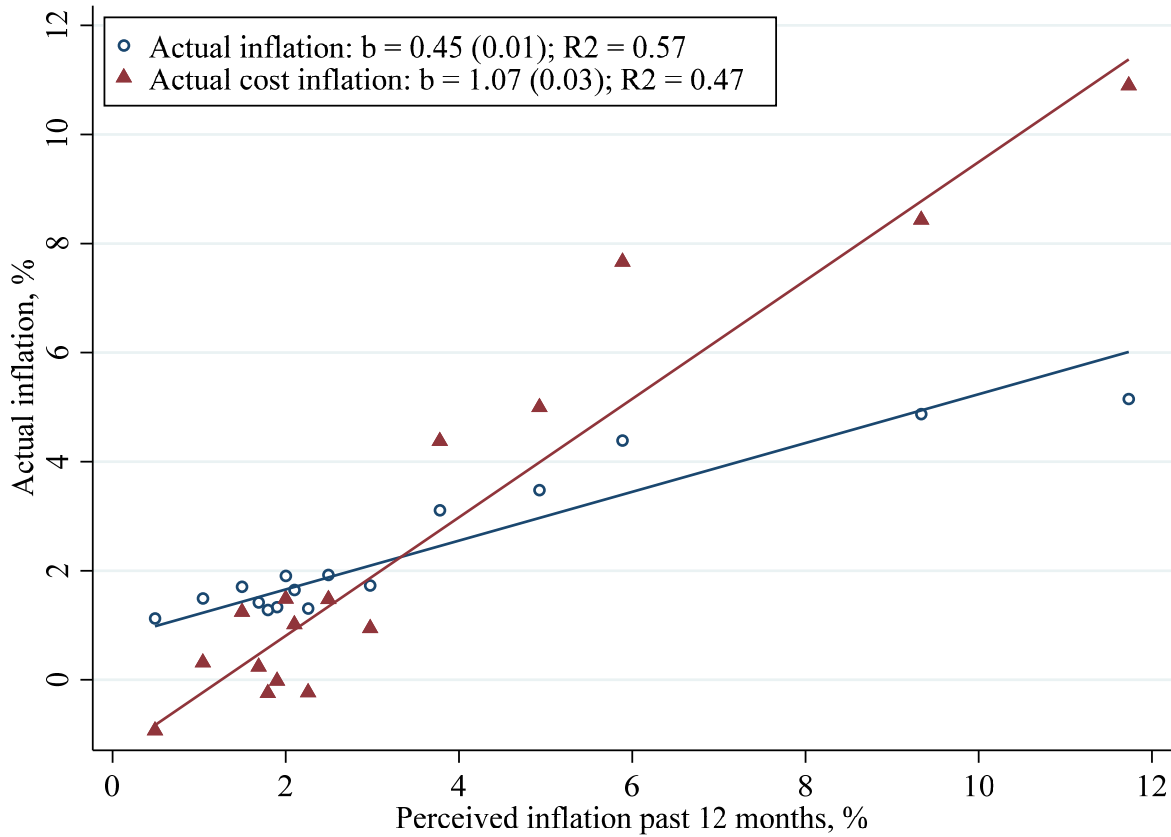
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Figure 1. Time series for actual, expected and perceived inflation.



Notes: Actual inflation is CPI inflation rate over the last 12 months (percent). Expected inflation is the expected CPI inflation rate over the next 12 months (percent). Perceived inflation is the perceived CPI inflation rate over the last 12 months (percent). Perceived Fed target is the perceived U.S. Federal Reserve annual inflation rate target (percent). Prob. inflation will exceed 5% is the probability that the annual inflation rate (for the CPI) over the next 12 months will exceed 5% (percent). Expected inflation, perceived inflation, perceived inflation target and prob. inflation will exceed 5% are reported in SoFIE.

Figure 2. Actual and perceived inflation.



Notes: The cost (PPI) inflation rate is a weighted average of PPI inflation rates at the industry level, where the weight of each industry is the share of input expenditure from that industry. The weights come from the BLS 2019 (nominal) input-output matrix. The cost inflation is over the last 12 months (percent) at the industry level. Actual inflation is CPI inflation rate over the last 12 months (percent). Perceived inflation is the perceived CPI inflation rate over the last 12 months (percent) reported in SoFIE.

Table 1. Predictors of inflation expectations.

	Dependent variable							
	Expected inflation (1 year ahead)		Expected inflation (5 year ahead)		Fed inflation target		Probability inflation (one year ahead) will exceed 5%	
	Huber	OLS	Huber	OLS	Huber	OLS	Huber	OLS
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Perceived inflation	0.738*** (0.024)	0.596*** (0.058)	0.222*** (0.052)	0.298*** (0.088)	0.061** (0.024)	0.112 (0.075)	-0.057 (0.350)	-0.578 (0.899)
Actual inflation	0.462*** (0.060)	0.390*** (0.129)	0.161 (0.112)	0.049 (0.199)	0.036 (0.069)	-0.037 (0.132)	0.624 (1.083)	-2.134 (3.409)
Cost inflation	-0.029 (0.021)	0.021 (0.046)	-0.013 (0.041)	0.046 (0.073)	0.005 (0.026)	0.030 (0.041)	0.057 (0.397)	1.863 (1.353)
Observations	838	867	382	395	264	274	211	242
R-squared	0.764	0.526	0.164	0.120	0.064	0.027	0.030	0.055

Notes: Robust standard errors are reported in parentheses. ***, **, * denote statistical significance at 1, 5, and 10 percent levels.