Low Passthrough from Inflation Expectations to Income Growth Expectations: Why People Dislike Inflation[*]

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Abstract

We implement a novel methodology to disentangle two-way causality in inflation and income expectations in a large, nationally representative survey of US consumers. We find a 20 percent passthrough from expected inflation to expected income growth, but no statistically significant effect in the other direction. Passthrough is higher for higher-income individuals and men. Higher inflation expectations increase consumers' likelihood to search for higher-paying new jobs. In a calibrated search-and-matching model, dampened responses of wages to demand and supply shocks translate into greater output fluctuations. The survey results and model analysis provide a labor market channel for why people dislike inflation.

JEL codes: E31, E24, E71, C83

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1 Introduction

The rapid economic recovery in the US from the COVID-19-induced recession has seen inflation rates rise to multi-decade highs. These high inflation readings have been accompanied by increases in inflation expectations, and strong wage gains in tight labor markets, raising concerns about the potential for a wage-price spiral that may be partially driven by expectations (e.g., Curtin (2022); Blanchard (1986)).[1] However, disentangling the causal effect of inflation expectations on income growth expectations and vice-versa is challenging.[2] More generally, while the literature on expectations formation has made progress in examining how expectations respond to directly related information, it has made little progress in understanding how individuals perceive the relationship between different variables. This paper takes a step forward in both directions by implementing a novel methodology to identify how consumers perceive the causal relationship between inflation expectations and income growth expectations, and how those expectations affect their labor market decisions.

Using a novel experimental setup in a large-scale survey conducted in early 2022, we measure US consumers' inflation and income growth expectations, and we provide them with information to overcome the two-way causality and establish the driving causal linkage between them. Our key novel finding is that exogenous variations in inflation expectations causally affect income expectations such that the passthrough from the former to the latter is far less than one-for-one, on the order of 20 percent. We do not find a statistically significant effect going in the other direction. Our novel evidence of a low passthrough from expected inflation to expected income growth is consistent with the belief that higher future inflation will reduce consumers' future real income growth and thereby leave them worse off. As a result, our central finding suggests that consumers dislike high inflation due to nominal wage rigidity. Furthermore, we bring forward new empirical evidence that higher inflation expectations cause a rise in the probability that consumers will search for a new job that pays more, but higher inflation expectations do not affect the likelihood that they will negotiate for a higher wage with their current employer. This finding also reinforces the idea that substantial nominal wage rigidity is at the heart of consumers' dislike for inflation. We calibrate a canonical search-and-matching model to fit our empirical findings, formalizing a labor market channel that explains why households are averse to inflation.

[1]See Lorenzoni and Werning (2023) for a theoretical analysis on the wage price spiral in the context of a New Keynesian model.

[2]See, for example, Werning (2022) for a discussion on the challenges related to pinning down the passthrough from inflation expectations to current inflation.

Our empirical findings come from a module designed specifically to study the relationship between inflation expectations and income growth expectations, placed within a large, nationally representative survey of the US population. This online survey was fielded in two stages in January and March 2022 by the decision intelligence company Morning Consult.[3] Together, the two stages collected responses from more than 25,000 US consumers. The survey module had four parts. The first part elicited estimates of an individual's inflation expectations and income growth expectations over the next 12 months. We find a positive correlation between these two variables, but it is unclear from the responses whether one is driving the other because inflation expectations and income growth expectations can simultaneously affect each other.

To determine the causal relationship between inflation expectations and income growth expectations, the second and third parts of the survey comprised a novel experiment. In the second part, we implemented a randomized controlled trial (RCT) that allowed us to control the information provided to different respondents. Building upon the approach of Coibion et al. (2022) who provide monetary policy communications information, we instead provided some of our survey participants with information on one of two objects: inflation or income growth. We randomly assigned information treatments to six groups: one control group, one placebo group, three groups that received different pieces of information on inflation, and one group that received information on wage growth, which for most consumers is their primary source of income growth.

Following the treatments, the third part of the survey again elicited each individual's inflation expectations and income growth expectations, using questions with slightly different wording compared with the first part. This experimental technique allows us to measure how consumers' posterior inflation expectations and income growth expectations react to information treatments while conditioning on their prior beliefs. We find that the information treatments, with the exception of the placebo group, affect consumers' inflation expectations to varying degrees. By contrast, only the wage growth information treatment has a statistically significant effect on income growth expectations.

Exploiting this exogenously induced, experimental variation in beliefs as an instrument allows us to estimate the causal link between inflation expectations and income growth expectations. The notion of causality is established through a combination of factors, some by design and others by our empirical results in the first stage. First, the information assignment or lack thereof to the respondents in the survey is random. Second, we use targeted, carefully worded treatments con-

[3]We also performed a follow up exercise in September 2022 that confirmed the results from March.

taining information about inflation only to instrument for inflation expectations, and likewise for income growth expectations. Third, and in line with the findings of other RCT work on inflation expectations, we show that providing people with publicly available information treatments–even at a time when inflation was particularly salient–tends to move their beliefs, thus invalidating full information rational expectations. Fourth, we find that treatments about inflation in the first stage only affect inflation expectations and not income growth expectations, which also serves as a test of exclusion restrictions in instrumentation.[4] Based on these findings, our setup allows us to measure the effect that the variation in inflation expectations due to exogenously imposed information treatments has on income growth expectations, and vice versa.

We find that a 1.0 percentage point increase in inflation expectations increases income growth expectations, but only by 0.2 percentage points – implying an expected decrease in real income growth of 0.8 percentage points. This passthrough varies systematically with the socio-demographic characteristics of the respondent. The rate of passthrough is larger for higher-income respondents than for lower-income respondents, suggesting that the former group believes it is better protected from increases in expected inflation than the latter group. We also find larger passthrough for male respondents than for female respondents.[5] However, in all cases, passthrough remains incomplete and is well below one-for-one. We find no statistically significant evidence for a causal relationship running in the other direction from income growth expectations to inflation expectations.

Finally, in the fourth part of our survey, we asked respondents about the likelihood that they would pursue different labor market actions over the following year to increase their incomes and potentially offset the effects of inflation. Again exploiting the exogenously induced variation in beliefs coming from our treatments, we find that higher inflation expectations moderately increase the perceived likelihood that an individual will apply for another job that pays a higher wage.[6] However, higher inflation expectations do not increase the perceived likelihood of two other actions aimed at increasing total income to offset higher inflation: working longer hours, or asking for a raise from one's current employer. These results suggest that consumers' mental model (see for example Andre et al. (2022) for a general study of subjective models) is one in which consumers

[4] Jain et al. (2022) find that it is difficult to predict consumers' income growth expectations. The findings from that paper and our survey evidence suggest that consumers hold strong priors over their personal income growth prospects, consistent with a belief in high nominal wage rigidity.

[5] Our result is consistent with evidence in the literature that highlights different characteristics in the labor market for women and men. For instance, Biasi and Sarsons (2022) find that in the US women engage less frequently in pay negotiations, whereas Card et al. (2016) find that, in Portugal, women are less likely to work at firms where workers have high bargaining power.

[6] Pilossoph and Ryngaert (2023) find that higher inflation expectations are correlated with workers' likelihood to search for other jobs in the short-term.

believe there is a high degree of rigidity in their nominal wages with their current employer.

To evaluate the importance of our findings for economic adjustment dynamics in the context of a structural framework, we adapt a relatively standard New Keynesian model with search-and-matching in labor markets as in Mortensen and Pissarides (1994), following papers such as Christoffel and Kuester (2008) and Christoffel et al. (2009), among many others. We also view this exercise as an opportunity to see the extent to which a canonical model can fit our empirical facts. The model features several frictions: For one, because the provision of publicly available information moves consumers' expectations–in contrast with a full-information, rational-expectations view of the world–we allow for sticky information in the inflation expectations formation process, similar to Mankiw and Reis (2002). In a novel interpretation of how information stickiness can play out, we calibrate the degree of information stickiness to be consistent with the estimated effect that new information from treatments has on our respondents' inflation expectations.[7] Futher, matching our survey findings requires sluggish wage adjustments. We model wage rigidity as infrequent nominal wage renegotiation in a Calvo (1983) fashion, calibrated to match our estimate of empirical passthrough as a moment.[8] Finally, to capture the impact of inflation expectations on labor market actions, we assume that workers who cannot renegotiate their wages and who apply for other jobs due to higher inflation expectations generate an outside contract with certainty. This wage-push factor puts upward pressure on their nominal wage with the current employer, with an elasticity that we calibrate to match our empirical findings.

We examine the responses of key macroeconomic variables in this setup to a positive demand shock and a positive (adverse) supply shock that are meant to broadly capture the prevailing inflationary disturbances in the US economy at the time of our survey in early 2022. We find that nominal wage rigidity plays a crucial role in driving the dynamics of macroeconomic variables within the model. When we subject the model to an inflationary demand shock, this friction causes a decline in real wages relative to a counterfactual scenario of unit passthrough from inflation expectations to nominal wage growth (absent wage stickiness); when we subject the model to an inflationary supply shock, sticky wages temper the movements in real wages compared to the unit-passthrough counterfactual. In both cases, the responses of real wages under imperfect passthrough help to amplify the fluctuations in output and consumption, generating additional volatility in the wake of the original shock. Whether looking at supply or demand shocks, greater

[7]We find that the degree of information stickiness is about 0.28.

[8]We would note that, in contrast to the experiment in our survey, it is impossible within the model setting to isolate the causal effect of inflation expectations on income growth expectations.

wage rigidity produces a stronger negative relationship between inflation expectations and expected utility, highlighting this labor market channel through which consumers dislike inflation.[9]

Our analysis makes several contributions. First, we introduce a novel experimental setup for measuring consumers' inflation expectations and income growth expectations, aiming to disentangle causation among these variables using an RCT in a large-scale survey. Our empirical findings imply an expected net decline in real income growth – due to limited passthrough from inflation expectations to income growth expectations – while our theoretical model further develops this link through a labor market channel. The empirical finding directly relates to the earlier survey work of Shiller (1997), who documented a strong negative perception of inflation. However, the survey approaches differ substantively. The consumer surveys used in Shiller (1997) were more directly focused on eliciting the reasons why people dislike inflation, which can raise difficult questions around framing and confirmation bias in survey design and analysis, alongside selection bias (e.g., those more concerned about inflation may have been more likely to respond). By contrast, our survey design is 1) more indirect, treating inflation expectations and income growth expectations symmetrically; 2) more flexible, allowing us to test for two-way causation; but also 3) more quantitative, compared with the narrative approach in Shiller (1997).

Second, our survey results – taken together with the results from our model exercises – provide deeper theoretical and empirical insight into *why* consumers and firms associate higher inflation expectations with lower output and well-being. For example, Shiller (1997), Candia et al. (2020), and Coibion et al. (2020a) provide consistent evidence with our results, though that evidence is non-causal. Other studies, such as Savignac et al. (2021), look at the relationship between firms' inflation expectations and wage expectations (through the lens of the latter as a cost of production), finding a low correlation in the case of France. We complement these findings by providing evidence of a causal relationship from inflation expectations to income growth expectations from the consumers' point of view. We further explore the mechanisms through which consumers may endogenously seek to affect their income growth by linking exogenous changes in inflation expectations to anticipated labor market actions. Our novel empirical evidence shows that frictions in nominal wages can explain why consumers' mental models associate higher inflation with worse economic outcomes, without the need for behavioral biases or inattention as in Kamdar (2019). While this negative association seems straightforward from a supply-side view, the perceived

[9]Following a *one-time* exogenous shock occurring in the present period, realized inflation h periods ahead co-moves with current expectations about inflation h periods ahead, in the presence of information stickiness. Therefore, within the context of the model, we refer to the two variables interchangeably.

frictions affecting nominal incomes found in the empirical analysis help explain why consumers associate inflation with worse economic outcomes even in the presence of demand shocks.

Our paper is related to two other strands of the literature. First, our work fits into a growing literature that focuses on survey data to understand how economic agents form expectations about key variables, such as inflation; see, e.g., Coibion and Gorodnichenko (2015), Bordalo et al. (2020), Coibion et al. (2020a), Angeletos et al. (2021), Coibion et al. (2022), among many others. Relying on the overwhelming evidence of imperfect information presented by this branch of the literature, our paper uses information treatments to exogenously vary beliefs about two variables – expected inflation and expected income growth – and then to estimate the causal link between these two variables.

Second, our paper is linked to the New Keynesian body of literature that incorporates Mortensen and Pissarides (1994) types of labor market search-and-matching frictions. Our model is largely adapted from papers such as Trigari (2006), Christoffel and Kuester (2008), Christoffel et al. (2009), and Gertler and Trigari (2009). In contrast to these papers, we calibrate the model, namely, the nominal wage stickiness and elasticity of the wage-push factor with respect to inflation expectations, to match our new empirical facts.[10] Papers such as Christiano et al. (2005), Smets and Wouters (2007), and Gali et al. (2012) have shown that wage rigidities play an important role in explaining US aggregate data. Our paper provides additional evidence that wage rigidity is deeply embedded in consumers' inflation and income growth expectations, at least as of the time of our survey in 2022, amid a period of elevated inflation.

2 Data Description

The primary data for this paper come from survey questions that we were able to ask in online surveys conducted by Morning Consult and fielded in two stages during January and February 2022. A third stage was fielded in September 2022 as a follow-up to the second stage. In each case, the survey data come from a large, nationally representative sample of the US population. Our survey questions focus on inflation expectations, income expectations, and potential labor market actions.

Our prior question on inflation expectations borrows the approach of Hajdini et al. (2022a) by indirectly eliciting consumers' inflation expectations. The idea underlying these expectations

[10] The assumption of a wage-push factor plays a similar role to within-quarter job-to-job transition probabilities being affected by inflation expectations. Krusell et al. (2017), for instance, consider within-period job-to-job transitions with a fixed probability.

data is not to ask about overall inflation expectations directly, but rather to ask for the change in income that consumers think will be required to buy the same goods and services a year from the date of the survey. Details of the implementation and analysis of the results of this survey-based measure of indirect consumer inflation expectations (ICIE) are described in Hajdini et al. (2022b). The question, elicited from approximately 20,000 respondents a week starting in February 2021, is the following:

"Next we are asking you to think about changes in prices during the next 12 months in relation to your income. Given your expectations about developments in prices of goods and services during the next 12 months, how would your income have to change to make you equally well-off relative to your current situation, such that you can buy the same amount of goods and services as today? (For example, if you consider prices will fall by 2% over the next 12 months, you may still be able to buy the same goods and services if your income also decreases by 2%.) To make me equally well off, my income would have to"

Respondents then select from three options, filling in the percentages if they select (1) or (3), while (2) is coded as zero:

1. Increase by %;
2. Stay about the same; and
3. Decrease by %.

Importantly, rather than asking about the more abstract concept of aggregate inflation, this question seeks to be more tangible and relevant to an individual consumer by asking about the prices to which the individual is most exposed. This difference might matter for the effectiveness of our treatments which are worded in terms of aggregate inflation as discussed in Section 4. Fortunately, as D'Acunto et al. (2021) show, local experiences – in particular, changes in local prices through individuals' shopping experience – affect consumers' expectations about aggregate prices. This association allows us to use our respondents' individual experiences as a good measure of their prior beliefs about inflation. Ultimately, the correlation between the prior and the posterior in our survey will confirm the D'Acunto et al. (2021) finding. Hajdini et al. (2022b) discuss this measure in detail, showing how it relates to questions about aggregate inflation and also how the local environment, individual experience, and aggregate prices affect the responses, making it a good prior for aggregate inflation.

In January 2022, a second question was added to the ongoing ICIE survey to allow for an investigation into the relationship between consumers' inflation expectations and income growth expectations. The second question is the following:

Do you expect your income to increase, decrease, or stay about the same over the next 12 months?

The question comes with the same options as in the previous question. If respondents indicated they expect their income to increase or decrease, then they were subsequently asked to provide a quantitative percentage response.

While the second question refers to income, we note that wages are the main source of income for most individuals. Panel A in Table 1 reports various summary statistics for expected inflation, expected nominal income growth, and an implied expected real income growth series derived by subtracting expected inflation from expected nominal income growth at the individual level. We winsorize 5 percent of the data, which leaves us with 20,550 observations from January 2022 where outliers with answers that are above the 97.5 percentile or below the 2.5 percentile of the distribution were assigned the value of that percentile. In addition, Panel B in Table 1 reports the results from a regression of expected nominal income growth on expected inflation.

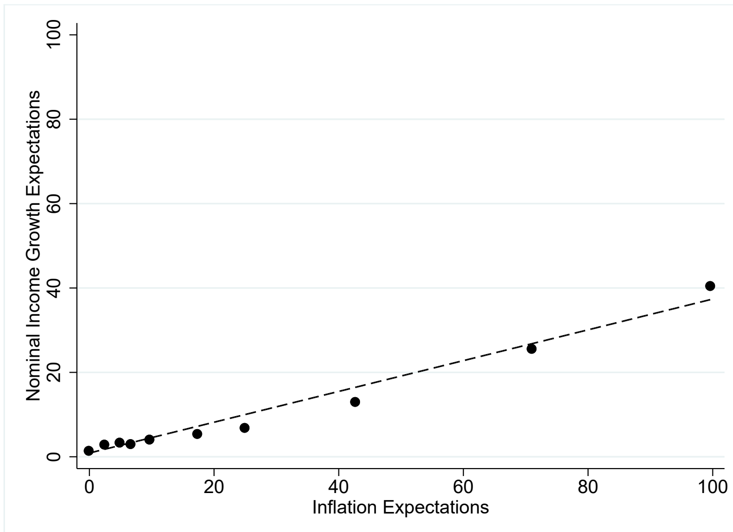
Table 1: Summary Statistics and Relationship between Price and Wage Inflation

	Panel A			Panel B	
	Inflation Exp	Nominal Income Growth Exp	Real Income Growth Exp		Nominal Income Growth Exp
1st percentile	-2	-12	-100	Inflation Exp	0.365***
First quartile	0	0	-7		(0.012)
Median	0	0	0	Constant	0.891***
Third quartile	10	2	0		(0.104)
99th percentile	100	100	50		
Mean	12.692	5.523	-7.169		
Standard deviation	24.536	18.822	22.735		
Observations	20,550	20,550	20,550		20,550

Notes: This table shows summary statistics for expectations of inflation and nominal income growth. We also report a measure of expected real income growth derived as the difference between expected nominal income growth and expected inflation at the individual level. The right part of the table shows a regression of expected nominal income growth on expected inflation. Huber-robust standard errors in parentheeses. *** denotes statistical significance at the 1 percent level.

Summary statistics of the data in Panel A of Table 1 show that on average expected inflation is higher than expected income growth, indicating that expected real income growth is negative on average. As shown by the estimated regression in Panel B, the relationship between expected inflation and expected nominal income growth is positive but the estimated coefficient on expected inflation is noticeably less than one. Figure 1 illustrates this feature of the relationship between the two series. At high levels of expected inflation, expected nominal income growth is noticeably lower than expected inflation.

Figure 1: Relationship between Inflation Expectations and Income Growth Expectations



Notes: The figure shows a bin-scatter graph between nominal income growth expectations and indirect consumers inflation expectations. The dashed line shows the linear fit of the data.

It is important to note that the estimated regression only captures a correlation between the expectations series. Reverse causality is likely present in this relationship. That is, expected income growth could influence inflation expectations, biasing the estimated effect of expected inflation on income growth expectations. In addition, the error term affects both variables, as inflation and income growth expectations may be jointly determined. In order to circumvent these biases, we next experimentally look at factors, one at a time, that can affect each of those variables directly to determine the causal relationship between inflation expectations and income growth expectations.

3 Experiment Description

To address potential reverse causality and to clarify the direction of causality – from income growth expectations to inflation expectations and/or from inflation expectations to income growth expectations – we introduced an experimental component to the survey via a randomized controlled trial (RCT). In a second stage survey in March 2022, we added an information treatment and then asked two additional questions intended to capture posterior beliefs. While not repeating the precise wording of the two initial questions described above to avoid confusing respondents, the two additional questions are similar and aim to capture comparable information.

In terms of inflation expectations, the added question is the following:

"In the next year, do you think prices in general will increase, decrease, or stay about the same?"

If respondents' answers indicated an expected increase or decrease, then they were subsequently asked to provide a quantitative percentage response. This question is slightly different from the initial question about inflation expectations. First, it asks directly about prices. In addition, it asks about prices in general, instead of the prices they are exposed to. We expected that answers to this question would not be identical to the indirect measure of inflation expectations. Nevertheless, we expected the responses to be strongly positively correlated, which would allow us to capture the (potential change in) posterior beliefs after an information treatment.

In terms of income growth expectations, the added question is the following:

"Between December 2022 and December 2023, do you expect your income to increase, decrease, or stay about the same over the next 12 months?"

Compared to the initial question on income growth expectations, this question mainly differs in its reference to a fixed time period. This period partially overlaps with the previous income growth question, so we expected a positive correlation with the previous question given the overlap as well as the fact that many wages are adjusted infrequently and at a particular time of the year.

The structure of the experiment is then the following: First, the survey administers two initial questions (priors) about inflation and income growth expectations to all respondents. Second, we apply different information treatments to respondents. Third, we ask the two additional survey questions (posteriors) just described. The total sample for the experiment in March 2022 contains 6,629 respondents who were split up and randomly received one of the following treatments that included being part of a control group:

1. Control (N=1,075)
2. The Federal Reserve targets an inflation rate of 2% per year in the long run. (1,155)
3. A recent survey from the Conference Board found that wages were expected to rise 3.9% in 2022. (1,093)

4. Between January 2021 and January 2022, the Consumer Price Index (CPI), which measures the average change in prices over time that consumers pay for goods and services, showed the inflation rate in the US was 7.5%. (1,112)
5. According to the Survey of Professional Forecasters, the Consumer Price Index (CPI), which measures the average change in prices over time that consumers pay for goods and services, showed the inflation rate will be 3.7% by the end of 2022. (1,074)
6. According to the US Census Bureau, the United States population was 332,402,978 as of December 31, 2021. (1,120)

Treatment 2 aims to inform respondents about the price stability objective of the Federal Reserve and potentially influence their long-run inflation expectations. Treatment 3 provides information about a forecast of future aggregate wage growth. Treatment 4 provides information about past inflation that may affect future inflation expectations as well as perceived real income in case the reported inflation rate was not known. Treatment 5 provides information about a forecast of future aggregate inflation. Last, treatment 6 provides information that should not be relevant and is intended to work as a placebo, allowing us to determine whether consumers react to receiving any information. A priori, we would expect that information about aggregate wage growth in treatment 3 could affect an individual's expected wage growth, while information about aggregate inflation in treatments 2, 4, and 5 could affect the individual's inflation forecast.

In addition to these questions, we ask respondents about labor market decisions. After the question about the posterior beliefs, we ask consumers, "How likely are you to do the following to increase your income over the next three months?" We provided three actions they could potentially take and one open-ended, fill-in response, where for each action they had to answer whether it was *very likely*, *somewhat likely*, *somewhat unlikely*, *very unlikely*, or they *do not know*. The actions we asked for were are:

- Apply for a job(s) that pays more
- Work longer hours
- Ask for a raise

In addition to these actions, we left an open-ended answer option to record any further possibilities that survey respondents might offer. The order of the experiment can be summarized as follows:

1. **Prior Inflation**: Indirect measure of inflation expectations question
2. **Prior Wages**: Income over the next year question
3. **Information Treatment or Control**
4. **Posterior Inflation**: Prices in general inflation expectations question
5. **Posterior Wages**: Income December 2022-December 2023 question
6. **Actions**: Options about labor market outcomes question

With this design we are able to determine the causal effect from inflation and wage growth expectations to each of the posterior responses and labor market actions while controlling for respondents' priors, in case the information treatments affect respondents' expectations.

4 Results

Following in the tradition of the RCT literature as applied to inflation expectations, we assess the extent to which the provision of information exogenously moves individuals' expectations. This exercise allows us to disentangle the potential bidirectionality between inflation expectations and income growth expectations, allowing us to determine the causal chain through which beliefs flow. To do so, we first evaluate the effect of the treatments on inflation and income growth expectations, and then their effect on labor decisions. Three main results emerge. First, passthrough of inflation expectations to income growth expectations is positive and statistically significant but less than unity; there is no statistically significant passthrough from income growth expectations to inflation expectations. Second, passthrough of inflation expectations to income growth expectations varies with respondent characteristics; it is increasing in the consumer's level of current income, and it is higher for male respondents than for female respondents. Third, higher inflation expectations cause consumers to report a moderately higher probability that they will search for a new job that pays more, but they do not increase the perceived probability of working more hours or asking for a raise from one's current employer.

4.1 Main Analysis

To arrive at these results, our analysis takes three steps. First, we verify that our additional "posterior" questions capture information similar to that of the baseline "a priori" questions. Second, we establish which treatments affect the posterior beliefs. Third, we use the information from the treatments to infer the causal effect of inflation expectations on income growth expectations, and vice versa.

As a first step, we estimate two specifications that relate prior beliefs to posterior beliefs. For inflation expectations, we estimate the following specification:

$$E\left[\pi_i^{Prices}\right] = \alpha + \beta E\left[\pi_i^{ICIE}\right] + \varepsilon_i \tag{1}$$

and for income growth expectations, we estimate the following specification:

$$E\left[\pi_i^{Income2y}\right] = \alpha + \beta E\left[\pi_i^{Income1y}\right] + \varepsilon_i \tag{2}$$

where π_i^{ICIE} denotes the inflation expectations from the ICIE question for respondent i, π_i^{Prices} denotes the general price growth expectations in the next year for respondent i. $\pi_i^{Income2y}$ contains the answer to the question concerning income growth expectations between December 2022 and December 2023 and $\pi_i^{Income1y}$ denotes the income growth expectations over the next 12 months for person i. We estimate these specifications for the full sample of respondents as well as the control group. As columns 1-2 and 5-6 in Table 2 show, we find positive and statistically significant correlations between prior and posterior expectations, for both income growth and inflation expectations. This result holds for the full sample and for the control group.

As a second step, we establish that some but not all of our treatments affect posterior beliefs. In the case of inflation expectations, we estimate the following specification:

$$E\left[\pi_i^{Prices}\right] = \alpha + \beta\pi_i^{ICIE} + \sum_{j=2}^{6}\gamma_\pi^j \times T_i^j + \sum_{j=2}^{6}\theta_\pi^i \times T_i^j \times E\left[\pi_i^{ICIE}\right] + \varepsilon_i \tag{3}$$

and for income growth expectations, we estimate the following specification:

$$E\left[\pi_i^{Income2y}\right] = \alpha + \beta\pi_i^{Income1y} + \sum_{j=2}^{6}\gamma_I^j \times T_i^j + \sum_{j=2}^{6}\theta_I^j \times T_i^j \times E\left[\pi_i^{Income1y}\right] + \varepsilon_i \tag{4}$$

where for respondent i, T_i^j is a variable that takes value 1 if respondent i received treatment j and 0 otherwise. The control group $j = 1$ is the reference group. We winsorize 2.5 percent of the highest and lowest answers and we also conduct Huber-robust regressions. Regressions (3) and (4) examine the relationship between the prior and the posterior. Ideally, if the treatment represents new information to the respondent, then providing that information will elicit a response and move the posterior away from the prior. In that case, if treatment j is effective, then we should expect a negative coefficient for θ^j_π and θ^j_I, as the prior will have a reduced role for the treated group in explaining the posterior compared with the control group. The results are reported in columns 3-4 and 7-8 in Table 2.[11]

[11]Table 9, in Appendix B show that these results are robust to trimming the bigger changes and quantile regressions. Figure 6 in Appendix C show the distribution of the posterior for each treatment group.

Table 2: Effects of Treatments on Expectations

	(1) $E\left[\pi_i^{Prices}\right]$	(2) $E\left[\pi_i^{Prices}\right]$	(3) $E\left[\pi_i^{Prices}\right]$	(4) $E\left[\pi_i^{Prices}\right]$	(5) $E\left[\pi_i^{Income2y}\right]$	(6) $E\left[\pi_i^{Income2y}\right]$	(7) $E\left[\pi_i^{Income2y}\right]$	(8) $E\left[\pi_i^{Income2y}\right]$
$E\left[\pi_i^{ICIE}\right]$	0.264***	0.262***	0.262***	0.505***				
	(0.010)	(0.026)	(0.026)	(0.007)				
$E\left[\pi_i^{Income1y}\right]$					0.705***	0.775***	0.775***	0.960***
					(0.022)	(0.048)	(0.048)	(0.010)
T2: Target			-0.627	0.126			-0.203	-0.081
			(0.460)	(0.138)			(0.248)	(0.104)
T3: Wages			-0.695	0.771***			-0.208	0.146
			(0.450)	(0.153)			(0.230)	(0.108)
T4: CPI			-0.825*	0.586***			-0.109	-0.048
			(0.456)	(0.150)			(0.254)	(0.112)
T5: SPF			-0.749	0.720***			-0.100	-0.049
			(0.465)	(0.149)			(0.247)	(0.106)
T6: Placebo			0.133	0.498***			-0.373	-0.182*
			(0.465)	(0.148)			(0.248)	(0.106)
T2 x prior			0.002	-0.023***			-0.127*	-0.003
			(0.036)	(0.008)			(0.072)	(0.015)
T3 x prior			-0.003	-0.213***			-0.047	-0.029*
			(0.035)	(0.013)			(0.071)	(0.017)
T4 x prior			-0.015	-0.258***			-0.114	0.013
			(0.035)	(0.011)			(0.074)	(0.013)
T5 x prior			-0.025	-0.281***			-0.039	0.005
			(0.036)	(0.011)			(0.071)	(0.016)
T6 x prior			0.047	-0.008			-0.078	0.006
			(0.035)	(0.008)			(0.074)	(0.015)
Constant	5.203***	5.667***	5.667***	1.343***	0.761***	0.925***	0.925***	0.274***
	(0.129)	(0.337)	(0.337)	(0.098)	(0.068)	(0.185)	(0.185)	(0.075)
Sample	All	Control	All	All	All	Control	All	Trimmed
Regression	OLS	OLS	OLS	Huber	OLS	OLS	OLS	OLS
Observations	6,620	1,072	6,620	5,892	6,622	1,074	6,622	6,355
R-squared	0.256	0.236	0.261	0.7856	0.557	0.604	0.559	0.922

Notes: The table shows estimates of equations 1 and 2 that relate priors and posteriors, as well as estimates of equations 3 and 4 that gauge the effect of treatments and their interaction with prior beliefs.

We first find a high correlation of the posteriors with the priors. After controlling for outliers (column (4)), we find that for the control group, a 1 percentage point increase in the prior of inflation expectations (based on the ICIE measure) increases the posterior by 0.5 percentage points. In the case of income growth, the correlation is even higher, with a 0.6 percentage point increase after controlling for outliers (column (8)). This result confirms that the ICIE measure is a good prior for aggregate inflation expectations.

In terms of the effect of the treatment, the following results emerge. With regard to inflation expectations, we find no statistically significant effects in the OLS regressions when we control for prior expectations interacted with the treatments. This result is largely due to the presence of outliers. It motivates our adoption of Huber-robust regressions, as in Coibion et al. (2020a). When we apply this estimation technique to the data, we now observe that all of the treatments have a statistically significant effect except for the placebo (comparing columns 3 and 4). Moreover, the estimated coefficients on the interacted treatment and prior are negative, indicating that consumers who received one of the treatments place less weight on their prior expectations. We can also see that there is variation in the magnitude of the effects across treatments. In particular, while the interacted prior and treatment with the Federal Reserve's inflation target is negative and statistically significant, the coefficient is an order of magnitude smaller compared with those reported for treatments 3-5. The interacted prior and placebo does not seem to affect posteriors compared to the control group.

With regard to the income question, the OLS regressions provide little evidence that the treatments display statistically significant effects, similar to the results from our analysis of inflation expectations. This result is again affected by the presence of outliers. However, Huber-robust regressions fail to run here because there are many respondents who answer "stay about the same," which is coded as 0, invalidating the Huber approach by eliminating the necessary variation. As an alternative to the Huber-robust regressions, we perform a regression that we consider to be similar in spirit but somewhat different in practice: instead of reducing the influence of outlier observations, we trim the sample by dropping respondents who reported extreme absolute changes between their prior and their posterior (in our case, we drop observations at or above the 95th percentile). As shown, we find little effect of the information treatments other than the wage inflation treatment on respondents' posteriors for income growth. Overall, the results in Table 2 suggest that the information treatments have a greater effect on inflation expectations than on income growth expectations; effectively, respondents' views on their income growth expectations are relatively sticky, even when presented with additional information. In addition, this result could suggest that consumers' are very informed about their income trajectories, making their forecast less responsive to information treatment about aggregate variables.

A main insight from studying the effect of our treatments on income growth expectations and inflation expectations is that respondents are subject to some type of information friction as all treatments contain public information. In fact, even though inflation was high at the time of the experiment and salient because of elevated news coverage and the impact it was having on consumers' budgets, the results suggest that consumers were not fully informed about price developments.

Each treatment effect elucidates relevant aspects of how these frictions manifest in consumers' expectations. From our treatment about the Fed's inflation target, we see uncertainty about the Fed's objectives, a point studied in Coibion et al. (2020b). From the SPF treatment, we see that there is uncertainty about the inflation outlook going forward. Moreover, the fact that consumers do not overreact when presented with this information treatment, by continuing to put some weight on their priors, indicates that they face sluggish or costly inflation expectations formation, as in Coibion and Gorodnichenko (2015). Finally, while past inflation can affect expectations in many ways, the fact that it affects expectations over 12 months indicates over-extrapolation, as in Angeletos et al. (2021).

Revealing the type of information friction that consumers have is not the main objective of the paper. We use these findings to obtain variation in expectations to measure the relationship between inflation expectations, income growth expectations, and labor market actions. In Section 5, we model and estimate the degree of information rigidity explicitly, to understand the role of those information frictions in this context.

As a third step, we use the information from the effective treatments as instruments to infer the causal effect of inflation expectations on income growth expectations, and vice versa. To estimate the effect of inflation expectations on income growth expectations, we use the following instrument:

$$E\left[\widehat{\pi^{Prices}_{\pi,i}}\right] = \begin{cases} \sum_{j=2,4,5} \gamma^j_\pi \times T^j_i + \sum_{j=2,4,5} \theta^j_\pi \times T^j_i \times E\left[\pi^{ICIE}_i\right] & if \quad T_i = 2,4,5 \\ 0 & if \quad T_i = 1,6 \end{cases}$$

where we exclude the treatment providing information on wage inflation because that treatment directly affects income growth expectations as shown in Table 2. To evaluate the effect of income growth expectations on inflation expectations, we use the wage treatment as an instrument:

$$E\left[\widehat{\pi_i^{Income2y}}\right] = \begin{cases} \gamma_I^3 \times T_i^3 + \theta_I^3 \times T_i^3 \times E\left[\pi_i^{Income1y}\right] & if \quad T_i = 3 \\ 0 & if \quad T_i = 1{,}6 \end{cases}$$

Given these instruments, we run instrumental-variable (IV) regressions. The instrument captures the exogenously induced variation in beliefs created by the randomly assigned information treatment(s). In addition, we control for the priors in the regressions in order to gauge their importance.

Given this setup, our results will indicate the changes in the wage or price inflation expectations for a certain path or prior. In particular, we run the IV regression for the inflation treatment using the coefficients obtained by the Huber regression and presented in column (4) of Table 2. In the case of the wage treatment, we run IV regressions with the coefficients from the trimmed sample in column (8) of Table 2. This approach is similar in spirit to the approach used in Coibion et al. (2019) who use the prior as an instrument. In our case, because we have multiple instruments, we can weight them according to their importance in affecting the prior.[12] Table 3 shows the results.

[12] Coibion et al. (2020a) use the past inflation treatment as an instrument. Unfortunately, we do not have the time series dimension that they have to generate enough predictive power for the instrument.

Table 3: Effect of Inflation on Income Growth Expectations

	(1)	(2)	(3)	(4)
	$E\left[\pi^{Income2y}\right]$	$E\left[\pi^{Income2y}\right]$	$E\left[\pi^{Prices}\right]$	$E\left[\pi^{Prices}\right]$
$E\left[\pi^{Prices}\right]$	0.085***	0.203***		
	(0.014)	(0.069)		
$E\left[\pi^{Income1y}\right]$	0.674***	0.636***		
	(0.025)	(0.033)		
$E\left[\pi^{Income2y}\right]$			0.147***	0.128
			(0.039)	(0.091)
$E\left[\pi^{ICIE}\right]$			0.255***	0.266***
			(0.015)	(0.018)
Constant	0.109	-0.805	5.271***	5.088***
	(0.101)	(0.521)	(0.185)	(0.184)
Regression	OLS	IV	OLS	IV
F-test		120.584		1082.095
Observations	5,525	5,525	3,238	3,159
R-squared	0.558	0.539	0.286	0.299

Notes: This table shows results from OLS and IV regressions. Columns (1) and (2) are the results of regressing the posterior of income growth expectations on the prior of income growth expectations and the posterior of inflation expectations. In column (2) we use IV, instrumenting with $E\left[\pi_i^{Prices}\right]$. Columns (3) and (4) are the results of regressing the posterior of inflation expectations on the prior of inflation expectations and the posterior of income growth expectations. In column (4) we use IV, instrumenting with $E\left[\pi_i^{Income2y}\right]$. Robust standard errors in parentheses.

Here, the main empirical finding of our paper emerges: There is a causal positive relationship from inflation expectations to income growth expectations with only partial passthrough, while there is no statistically significant passthrough from income growth expectations to inflation expectations. As shown in column (1), inflation expectations appear to have a very low correlation with income growth expectations, after controlling for priors. However, as shown in column (2), using the instrument yields a coefficient that is significantly higher. As expected, the instrument displays a relatively high F-test statistic. Quantitatively, a 1 percentage point increase in inflation expectations increases income growth expectations by 0.2 percentage point. This result suggests that passthrough is positive, but considerably lower than one-to-one.[13] Therefore, the same 1 percentage point increase in inflation expectations implies a 0.8 percentage point reduction in real income growth expectations. Consumers' dislike of inflation is thus neatly captured in the finding that they expect that high inflation will make them poorer in real terms.

When we run a similar exercise with the wage treatment, we find no evidence of a statistically significant causal relationship from income growth expectations to inflation expectations. As shown in column (3), the OLS regression suggests a positive and moderate relationship between expectations of income growth and price inflation. However, when we use the instrument derived from the wage information treatment, which also comes with a high F-test as shown in column (4), we now observe that the statistical significance in the OLS results vanishes. While the point estimate is similar, the standard error is larger, and the estimate is not statistically different from zero at typical confidence levels. Hence, we conclude that there is no statistically significant causality running from income growth expectations to inflation expectations.

The lower point estimate compared with the passthrough from inflation expectations to income growth expectations suggests that any causal relationship from personal income to prices is probably small. This small passthrough might result from a complex calculation that consumers need to do in order to infer the relationship from their income to others' income and then to higher prices due to economy-wide cost pressures. Our experiment shows that consumers are also very certain about their incomes, as treatments about the aggregate economy seem to have little impact on moving their posteriors away from their priors when it comes to their incomes. Because the treatment has a noisy effect on the posterior of income growth expectations, we run a sensitivity exercise to account for that noise in Appendix E. We find that the conclusion is in general the same: as we account for uncertainty associated with the estimates coming from the treatment, we consistently find a small point estimate for the passthrough from expected income growth to expected inflation that tends to be statistically indistinguishable from zero.[14]

These results support the view that consumers believe that inflation will translate into some movement of their nominal incomes. In that sense, even though the information treatments are about aggregate variables, consumers understand that aggregate price changes are likely to affect

[13]In Table 16 in Appendix D, we calculate the passthrough for each of the treatments individually, rather than combining them as in Table 3. Each of the inflation treatments produce very similar estimates, pointing to incomplete passthrough in each treatment, with the magnitudes similar to the main result of 0.2.

[14]While our focus is on the relationship between inflation expectations and income growth expectations, our results suggest that further work is needed to more completely understand the expectation formation process for salient, individual-level variables such as income growth.

their nominal incomes, even if the passthrough is not complete. This result shows that they expect a reduction of their real incomes after an increase in inflation expectations. In the case of income expectations, however, we do not see the same pattern. In that sense, the results suggest that consumers fail to connect changes in their expectations for income growth to broader macroeconomic conditions, including expected inflation, as might be expected in general equilibrium if all individuals held the same beliefs regarding their income growth prospects.

Finally, we find evidence that demographic characteristics are strongly associated with the relationship between inflation expectations and income growth expectations. For this exercise, we separate our sample based on how the survey respondents identified themselves as male or female and their self-reported annual income (less than \$50,000, between \$50,000 and \$100,000, and more than \$100,000). We only report the IV results, displayed in Table 4.

Table 4: Passthrough from Inflation Expectations to Income Growth Expectations, by Demographics

	$E\left[\pi^{Income2y}\right]$					
	All	Male	Female	<50k	50k-100k	>100k
$E\left[\pi^{Prices}\right]$	0.201***	0.267***	0.156	0.129	0.309*	0.336***
	(0.070)	(0.103)	(0.097)	(0.091)	(0.171)	(0.122)
$E\left[\pi^{Income1y}\right]$	0.637***	0.621***	0.634***	0.656***	0.579***	0.589***
	(0.034)	(0.054)	(0.045)	(0.041)	(0.067)	(0.102)
Constant	-0.792	-1.079	-0.534	-0.314	-1.562	-1.503**
	(0.530)	(0.660)	(0.843)	(0.741)	(1.278)	(0.766)
F-test	117.408	51.174	61.95	64.121	27.205	42.654
Observations	5,525	2,724	2,801	2,503	1,894	1,128
R-squared	0.540	0.600	0.483	0.528	0.452	0.657

Notes: This table shows results from IV regressions from different demographic subsamples. The regression used is the same in Column (2) in Table 3. Robust standard errors in parentheses.

Large differences exist across these groups. Male respondents have a higher and statistically significant passthrough compared with female respondents, with the former coefficient almost 70 percent higher, and the latter not statistically significantly different from zero. In the case of income groups, we also see very heterogeneous effects. Respondents in the highest income group have a perceived passthrough that is more than 2.5 times higher compared with the lowest-income respondents. The passthrough coefficient is statistically different from zero only for respondents in the middle or highest income group, but not the lowest income group. These results suggest that higher-income individuals expect that their incomes will be better insulated from higher inflation than lower-income individuals do, though with passthrough less than one-for-one, even higher-income individuals do not believe their incomes will fully keep up.

These heterogeneous results might reflect some characteristics of the labor market that these groups face. For example, Card et al. (2016) find that, in Portugal, women tend to work less in firms where workers have high bargaining power. In the case of the US, Biasi and Sarsons (2022) find that women are engaged in less frequent negotiations over pay, which helps to determine workers' ability to bargain for higher wages. In the next section, we explore some of the labor market actions to see how these bargaining dynamics can potentially explain the passthrough results.

4.2 Labor Market Decisions

Following the posterior question about income, we elicited the likelihood of three different labor market actions that our survey respondents might take: "Apply for a job(s) that pays more," "Work longer hours," and "Ask for a raise." For each of these actions, respondents were asked to indicate the respective likelihood, as explained in Section 3.

We run regressions of the reported likelihood to undertake each action, y_i^j, on expected inflation to assess the extent to which expected inflation drives labor market decisions. The intuition behind these regressions is clear: if consumers believe that higher inflation will reduce their real wages, then they may take actions to make up for those lost real wages. Here, y_i^j takes values from 1 to 4, indicating qualitative probabilities ranging from *very unlikely* to *very likely*. We use the same instrument for expected inflation as before. This leads us to estimate the following specification:

$$y_i^j = \alpha + \beta E\left[\widehat{\pi_i^{Prices}}\right] + \varepsilon_i \tag{5}$$

Our results, shown in Table 5, indicate that higher inflation expectations increase the likelihood that consumers may apply for another job that pays more. To gauge the associated magnitudes, we derive an elasticity by taking the partial effect found in the estimated regression and multiplying and dividing by the average values of the relevant variables in the sample. In the case of "Apply for a job(s) that pays more," the estimated OLS regression shows that a 1 percentage point increase in inflation expectations increases the probability of applying for another job by 2 percent, assuming that the minimum value is equal to a zero probability of applying for another job and the highest value is equal to complete certainty of applying for another job. When we run the IV regression, the estimated coefficient of the effect of inflation expectations on the likelihood of applying for another job is higher and the elasticity increases to 11 percent. This coefficient is also statistically significant. Our instrument is valid, with an F-test of 143.3. Overall, we find evidence that higher inflation expectations increase the likelihood that consumers will consider applying for a new and higher-paying job, which also implies an increase in the probability of a consumer moving to another job.

Table 5: Effect of Inflation Expectations on Wage Increase Actions

	Apply for a job(s) that pays more		Work longer hours		Ask for a raise	
	(1)	(2)	(3)	(4)	(5)	(6)
$E\left[\pi_i^{Prices}\right]$	0.005***	0.030***	0.004**	0.009	-0.002	0.002
	(0.002)	(0.006)	(0.002)	(0.005)	(0.002)	(0.006)
Constant	2.231***	2.013***	2.263***	2.216***	2.111***	2.072***
	(0.022)	(0.053)	(0.022)	(0.050)	(0.022)	(0.051)
Regression	OLS	IV	OLS	IV	OLS	IV
F-Test		143.3		149.8		143.3
$\frac{dy}{dx}\frac{\bar{x}}{\bar{y}}$	0.019	0.114	0.015	0.034	-0.009	0.011
Observations	4,651	4,651	4,573	4,573	4,409	4,409

Notes: This table shows OLS and IV regressions from equation 5. y_i^j is a value that ranges from 1 to 4, where 1 is "Very unlikely, " 2 is "Somewhat unlikely," 3 is "Somewhat likely" and 4 is "Very Likely." For columns (1) and (2) y_i^j is the answer to the question about "apply for a job(s) that pays more," columns (3) and (4) are the answers to the question about "work longer hours," and columns (5) and (6) are the answers about "ask for a raise." Robust standard errors in parentheses.

In terms of the other margins, we find no evidence that respondents plan to undertake these labor market actions. While the OLS regression reveals a significant effect of expected inflation on respondents' plans to work longer hours, the result is not robust under IV estimation. Similarly, and perhaps surprisingly to economists who are accustomed to negotiating for higher wages, we do not find evidence of a channel through which expected inflation will lead respondents to ask for a raise in their current jobs. The estimates that these effects are not statistically different from zero do not come from a high degree of variation in the variable, but from a very small point estimate. The implied elasticity for "Work longer hours" is 0.03 and for "Ask for a raise" only 0.01, while the standard errors are similar to those of "Apply for a job(s) that pays more." We view these as rather precisely estimated zero responses.

We view these labor market action results as providing further context for why people dislike inflation. Applying for a new job requires search time and effort, which is costly. Furthermore, the elasticity that we document is not very high, consistent with a view that relatively few workers will ultimately undertake this application process to offset higher expected inflation. With little evidence that people will work longer hours or ask for a raise, they generally expect that higher inflation will reduce their standard of living.

We also see if there is demographic heterogeneity in terms of the effect of inflation expectations on labor market actions. Tables 10, 11, and 12 in Appendix B show the results. We find that female and middle income workers have a higher coefficient and elasticity in terms of the causal effects of inflation expectations on the likelihood of applying for another job and working longer hours. Meanwhile, we find a statistically significant effect of inflation expectation on asking for a raise for higher-income workers, consistent with the view that they may have more negotiating power by being in a salaried position, but the elasticity is relatively small.

In addition to the question concerning consumers' potential labor market actions, we added a complementary open-ended question to investigate if respondents were undertaking any other actions beyond those listed to increase their incomes. From the 6,629 total responses, 5,993 (90.4 percent) decided not to provide any additional information. From the 636 who responded, 199 (3.0 percent) said that they were going to look for a second job in different ways, while 112 (1.7 percent) said that they received some type of fixed income, such as retirement or Social Security.[15] Among the other answers, some individuals named different forms of investments, adjusting their billing rates (likely for independent contractors, who have the power to set their wages), or some others associated this situation with adjusting their spending. Only one respondent claimed that their income is adjusted automatically every year to keep up with inflation.

Finally, in September 2022, we conducted a follow-up exercise to our original survey. The de-

[15] Survey respondents did not indicate whether these payments were indexed for inflation or not. Notably, Social Security payments are indexed to inflation, but with a lag.

tails and results of this exercise are described in Appendix Section D. In this follow up we repeated the survey questions in the same order as described above. We updated treatments to the latest information available. We conducted the same empirical exercise using a pseudo-panel structure, which allows us to take advantage of our doubled sample size while controlling by time fixed effects. We found very similar effects, suggesting that the findings remained relevant in the environment of September 2022, when the COVID situation had improved further and after a year of relatively high inflation, suggesting that persistently high inflation didn't change consumers' perceptions of the indexation of their incomes to inflation or their attitudes on how inflation would affect their labor market actions.

5 Why Do Households Dislike Inflation?

This section uses a structural model to assess the role of our empirical findings, and in particular the role of inflation expectations, for the macroeconomic adjustment process to shocks. The analysis employs an off-the-shelf DSGE model with search-and-matching in the labor market. While we thus do not purport to provide a model more sophisticated than conventional search-and-matching models, we do explicitly allow for inflation expectations to affect nominal wage growth expectations. To capture our finding that consumers' inflation expectations are affected by publicly available information, we also allow for sticky information in inflation expectations similar to Mankiw and Reis (2002). The model is calibrated to match key features of the US economy in early 2022, when our survey was conducted, the reaction of our respondents' inflation expectations to information treatments, and our three main empirical facts:[16]

1. **Less than unity passthrough to income growth expectations:** A 1 percentage point increase in inflation expectations causes nominal income growth expectations to rise by about 0.20 percentage point.
2. **Passthrough to income growth expectations increases in consumers' current income:** For low- (high-) income respondents, a 1 percentage point increase in inflation expectations leads to a statistically insignificant (statistically significant 0.34 percentage point) increase in nominal income growth expectations.

[16]The purpose of the model is to qualitatively understand the macroeconomic implications of the moderate passthrough from inflation expectations to income growth expectations. In contrast to the experiment, within the model setting it is impossible to isolate the causal effect of inflation expectations to income growth expectations (see, for instance Werning (2022) for a discussion on the difficulties of isolating the effects of inflation expectations). However, we can match the empirical passthrough as a moment along the impulse response functions in the model.

3. **Small impact on labor market actions:** A 1 percentage point increase in inflation expectations raises the probability of applying for another job by about 0.11 percentage point.

Two lessons emerge when we focus our analysis on the responses of key macroeconomic variables to a positive demand shock and a positive (adverse) supply shock, which we view as the prevailing shocks hitting the US economy around the time of our survey. First, regardless of the source of the shock, the dampened response of real wages due to nominal wage rigidity necessary to match Fact 1 translates into an amplified responsiveness and volatility of output and consumption. Inflationary shocks, whether coming from either the demand side or the supply side, produce a decline in consumers' utility. In the case of a demand-side shock, the utility decline is greater for higher degrees of nominal wage rigidity. Second, the mechanism we propose to capture the relationship between inflation expectations and labor market actions has a negligible effect on the macroeconomic dynamics of the model; on average, consumers' efforts to increase their wages due to higher inflation expectations do not improve their utility, real wage, or consumption. Overall, we view the lessons coming from this modeling exercise as helping us further understand why consumers dislike current and future inflation.

5.1 A Search-and-Matching Model

We employ a New Keynesian model featuring a Mortensen and Pissarides (1994) type of search-and-matching frictions in labor markets. We further incorporate a right-to-manage feature as developed in Trigari (2006), where firms and workers bargain over nominal wages and then firms demand labor hours that are guaranteed to be supplied for the bargained wage.[17] A matched firm-worker pair negotiates wages infrequently in a Calvo fashion. Finally, as in Christoffel and Kuester (2008), we account for firms' fixed costs of maintaining a job.[18]

The economy in the model is composed of representative families that make optimal decisions on behalf of their members with respect to consumption and one-period riskless bond holdings. There are three types of firms: labor goods firms produce a homogeneous labor intermediate

[17] For our purposes, the right-to-manage (RTM) framework differs from, for instance, "efficient bargaining" (EB), where labor supply always equals labor demand. The advantage of the RTM over EB is that it generates more realistic movements in inflation dynamics, which facilitates matching the model-implied passthrough with the empirical estimates. On the other hand, RTM can trigger fluctuations in labor hours that are larger than what is observed in the data. The increased variability in labor hours is a particularly important limitation that we return to below, especially because our empirical results suggest that consumers do not expect to increase their hours when they raise their inflation expectations. See de Walque et al. (2009) for an instructive review of such tensions in this group of models.

[18] The RTM framework can counterfactually dampen the response of employment in the extensive margin, and, as shown in Christoffel and Kuester (2008), the presence of a fixed cost amplifies the response of unemployment over the business cycle.

good; wholesalers use the labor good as an intermediate to produce differentiated goods and face Calvo price rigidity; and retailers bundle the differentiated goods into a homogeneous consumption basket sold to households and the government. Monetary policy sets the nominal interest rate following a Taylor rule, and government spending is exogenous. Because these parts of the model are standard in the literature and are not central to our paper, we describe them in more detail in Appendix F.

We now lay out some key features of the labor market because they directly connect the model with our empirical findings presented in Section 4. The matching process between workers and labor firms is governed by a Cobb-Douglas function:

$$m_t = \sigma_m u_t^{\xi} v_t^{1-\xi} \tag{6}$$

where m_t are matches formed in period t; u_t is unemployment; v_t are vacancies; $\xi \in [0,1]$ is the elasticity of matching with respect to unemployment; and $\sigma_m > 0$ is matching efficiency. Matches become productive in the following period, so employment in the extensive margin evolves according to

$$n_t = (1-\mu)n_{t-1} + m_{t-1} \tag{7}$$

where $\mu \in [0,1]$ is the employment separation rate. Labor market tightness is defined as:

$$\theta_t = \frac{v_t}{u_t} \tag{8}$$

Then, the probabilities that a vacancy is filled and that an unemployed worker matches with a firm are, respectively,

$$q_t = \frac{m_t}{v_t}, \quad s_t = \frac{m_t}{u_t} \tag{9}$$

To match our findings in Table 2 that providing an individual a treatment consisting of publicly available information at time t has an effect on our respondents' inflation expectations, we assume that inflation expectations are subject to sticky information, such that:

$$\widetilde{\mathbb{E}}_t \hat{\pi}_{t+h} = (1-\lambda)\mathbb{E}_t \hat{\pi}_{t+h} + \lambda \widetilde{\mathbb{E}}_{t-1} \hat{\pi}_{t+h}, \qquad \text{for any } h \geq 1 \tag{10}$$

where $\mathbb{E}_t$ is the full-information rational expectations operator, $\lambda \in [0,1]$ denotes the probability that our agents do *not* update their information set in period t, and $\hat{\pi}_t$ is inflation in log-linear deviation from its steady state value.

To match **Fact 1**, we assume that agents in the economy face nominal wage rigidities. If a worker is not separated from employment, she can bargain her nominal wage to W^*_{t+1} in period $(t+1)$ with probability $(1-\gamma) \in [0,1]$. In contrast, the nominal wage of the γ share of workers who cannot bargain partially adjusts for past inflation such that $W_{t+1} = W_t(e^w_t \pi_t^{\zeta^w} \bar{\pi}^{1-\zeta^w})$, where $\zeta^w \in [0,1]$ denotes time-varying wage indexation to past inflation and e^w_t is a newly introduced wage-push factor explained further in the subsequent paragraph. In our setup, different combinations of the nominal wage stickiness parameter, γ, generate different levels of model-implied passthrough from inflation expectations to nominal wage growth expectations. This model feature allows us to study the macro implications of **Fact 2** and of a counterfactual scenario of unit passthrough.

To match **Fact 3**, we assume that, given that a worker cannot renegotiate her nominal wage and applies for another job due to higher inflation expectations, she generates an outside contract with certainty which is used to put upward pressure on the nominal wage with her current employer. Our wage-push factor e^w_t introduced above captures this idea.[19] The wage-push factor is persistent and is affected by inflation expectations as follows

$$\hat{e}^w_t = \rho_w \hat{e}^w_{t-1} + \bar{e}_\pi \mathbb{E}_t \hat{\pi}_{t+1} \tag{11}$$

where $\hat{e}^w_t$ is the wage-push factor in log deviations from its steady-state value; $\bar{e}_\pi$ is the elasticity between inflation expectations and the wage-push factor; and $\rho_w \in [0,1)$ is the persistence in the wage-push factor.

For workers who bargain in a given period, the nominal wage is set according to Nash bargaining,

$$W^*_t = argmax_{W_t}(\mathcal{V}^E_t - \mathcal{V}^U_t)^{\eta_t}(J_t)^{1-\eta_t} \tag{12}$$

where $\mathcal{V}^E_t$ and $\mathcal{V}^U_t$ denote, respectively, the value of employment and unemployment for a worker; J_t is the market value of a labor firm matched to a worker; and η_t is the time-varying bargaining power of workers.[20]

[19] The wage-push factor plays a role similar to having within-quarter job-to-job transitions with a time-varying transition probability that is only affected by inflation expectations. Within-period job-to-job transitions with constant probability have been incorporated in Krusell et al. (2017). Another interpretation would be to have a non-bargaining worker's nominal wage indexed to a base, fixed real wage growth that is greater than 1, along with indexation to past inflation. Time variation in this case would only be induced by inflation expectations.

[20] Under EB, optimal nominal wages satisfy $\eta_t J_t = (1-\eta_t)(\mathcal{V}^E_t - \mathcal{V}^U_t)$. In our case of an RTM framework, the optimal nominal wage condition is $\eta_t \delta^W_t J_t = (1-\eta_t)\delta^F_t(\mathcal{V}^E_t - \mathcal{V}^U_t)$, where δ^W_t and δ^F_t denote, respectively, the net marginal

5.2 Calibration

Our calibration of the model aims to capture US labor market trends around the time of our survey in early 2022 while also matching our three empirical findings. In terms of steady-state values, we set the unemployment and vacancy rates to their respective quarterly realizations in 2021:IV of 4.2 percent and 7 percent. The separation rate in the steady state is set to 4.1 percent, matching the quarterly separation rate in 2021:IV. Table 6 summarizes these choices. Due to high labor market tightness these choices imply that in steady state the probability of finding a job is very high (s = 93.52 percent), whereas the likelihood that a firm finds a worker is very low (q = 0.27 percent).

Table 6: Parameters

Variable	Value	Description
u	4.2 %	Unemployment rate; US quarterly unemployment rate in 2021:IV
v	7 %	Vacancy rate; US quarterly vacancy rate in 2021:IV
μ	4.1 %	Quarterly separation rate; US data in 2021:IV
s	0.9352	Probability of finding a job (implied by the steady-state model equilibrium)
q	0.0027	Probability of finding a worker (implied by the steady-state model equilibrium)
ξ	0.6	Elasticity of matches w.r.t. unemployment; see Petrongolo and Pissarides (2001)
η	0.5	Bargaining power of workers; conventional value
σ_m	0.0037	Efficiency of matching; reconciles m with $u = 4.2$ percent and $v = 7$ percent
ρ_w	0.9	Persistence of the wage-push factor
$\bar{e}_\pi$	0.0228	Elasticity of wage-push w.r.t. inflation expectations across all respondents; Tables 3, 5
$\bar{e}_\pi$	0.114	Elasticity of wage-push w.r.t. inflation expectations for counterfactual analysis; Table 5
γ	0.875	Nominal wage stickiness; passthrough across all respondents in Table 3
γ	0.65	Nominal wage stickiness; unit passthrough for counterfactual analysis
ζ_w	0.675	Wage indexation; passthrough across all respondents in Table 3
ζ_w	0.306	Wage indexation; passthrough for counterfactual analysis
λ	0.285	Information stickiness; Table 7

In terms of labor market parameters, as shown in Table 6, we parameterize the model as fol-

benefits from an increase in the wage to the worker and the firm. See Christoffel and Kuester (2008) for more details.

lows: The elasticity of matches with respect to unemployment, ζ, is set to 0.6, consistent with Petrongolo and Pissarides (2001). Wage bargaining power is set to its conventional value in the literature, i.e., $\eta = 0.5$. The implied efficiency of matching, σ_m, is set to 0.0037 to be consistent with the steady-state values of the unemployment and vacancy rates, and matching. We assume the wage-push factor process is persistent with an autocorrelation coefficient of 0.9.

A few more parameters remain to be calibrated in a way that directly relates to our empirical results. First, to calibrate λ, we investigate how our respondents react to new information . Specifically, we rearrange equation (10) to read as:

$$\underbrace{\widetilde{\mathbb{E}}_t \pi_{t+h} - \widetilde{\mathbb{E}}_{t-1} \pi_{t+h}}_{\text{(posterior - prior)}} = (1-\lambda) \underbrace{\left(\mathbb{E}_t \pi_{t+h} - \widetilde{\mathbb{E}}_{t-1} \pi_{t+h} \right)}_{\textit{new} \text{ info in period } t}$$

with $(1-\lambda)$ capturing the effect of *new* information made available in period t on inflation expectations. To discipline λ consistently with our experiment, we use the estimates from the following regression:

$$\mathbb{E}_i \left(\pi^{Prices} \right) - \mathbb{E}_i \left(\pi^{ICIE} \right) = \alpha + \beta T_i \left[I_{ij} - \mathbb{E}_i \left(\pi^{ICIE} \right) \right] + \varepsilon_i \tag{13}$$

where T_i is an indicator that takes value 1 if individual i is treated by treatments 2, 4, and 5 (and 3, depending on the specification), and takes a value of zero if the individual i is in the control or placebo group. $\left[I_{ij} - \mathbb{E}_i \left(\pi^{ICIE} \right) \right]$ captures new information due to information treatment j. I_{ij} is the numerical information contained in treatments 2, 3, 4, or 5. In this specification, $\beta = (1-\lambda)$. Table 7 presents the estimates of β. As our benchmark calibration, we use the estimate in column (4) of $\lambda = 0.285$, where we account for the control, placebo, and wage treated groups.[21]

[21] Coibion et al. (2022) argue that the inclusion of the control group is important since the prior and posterior questions about inflation expectations are worded differently. Our results remain qualitatively similar if we calibrate λ to a lower value of about 0.26.

Table 7: Effect of new information in inflation expectations

	(1)	(2)	(3)	(4)
New information	0.742***	0.711***	0.742***	0.715***
	(0.014)	(0.014)	(0.012)	(0.012)
Constant	1.581***	-0.678***	1.702***	-0.251
	(0.163)	(0.208)	(0.139)	(0.181)
Wage Treatment	No	No	Yes	Yes
Control and Placebo	No	Yes	No	Yes
Observations	3,338	5,528	4,430	6,620
R-squared	0.730	0.432	0.735	0.483

Notes: The table shows estimates of equations (13). Column (1) only contain information for treatments 2, 4 and 5. Column (2) includes the placebo and control group. Column (3) is (1) plus treatment 3 and column (4) contains all treated and control groups. We use robust standard errors.

Second, we calibrate nominal wage stickiness, γ, and wage indexation to past inflation, ζ_w, to match **Fact 1** and **Fact 2** *quantitatively* along the IRFs of nominal wage growth to various shocks. Solving the model under rational expectations, one can show under general assumptions (see details in Appendix G) that the response of nominal wage growth expectations to a change in inflation expectations is given by:

$$\frac{\partial \widetilde{\mathbb{E}}_t(\hat{W}_{t+7} - \hat{W}_{t+3})}{\partial \widetilde{\mathbb{E}}_t \hat{\pi}_{t+4}} = \frac{a_1 - a_2}{1 - \lambda} + 1 + a_3 \tag{14}$$

where the elements a_1, a_2, and a_3 are convoluted functions of the many structural parameters of the model.[22,23] However, wage indexation to past inflation, and especially nominal wage stickiness, γ, are key parameters in these functions, and it is possible to calibrate them such that we are able to match **Fact 1** and **Fact 2** quantitatively. In particular, we can match the inflation expectations passthrough to nominal wage growth across our respondents by choosing a wage contract duration of about 8 quarters ($\gamma = 0.875$) with indexation to past inflation of 0.675.[24] To construct a

[22]While there are many parameter combinations that can match the model-implied passthrough in (14) with the empirical one, we interpret a less than unity passthrough as evidence of significant nominal wage rigidity and thus remain focused on calibrating this parameter together with the wage indexation to past inflation.

[23]Recall that our posterior question about income growth expectations infers $\widetilde{\mathbb{E}}_t(\hat{W}_{t+7} - \hat{W}_{t+3})$.

[24]Duration of a wage contract is given by $1/(1 - \gamma)$.

counterfactual scenario of unity passthrough from inflation expectations to nominal wage growth expectations, we set $\gamma = 0.65$, which implies an average wage contract duration of about 3 quarters. The wage indexation to past inflation in this case is set to $\zeta_w = 0.306$.

Second, to match **Fact 3**, we set the elasticity of the wage-push factor with respect to inflation expectations so that we match the evidence shown in Tables 3-5. Parameter $\bar{e}_\pi$ is the elasticity between inflation and nominal wage growth expectations *conditional* on having applied for another job due to higher inflation expectations. Hence, we parameterize $\bar{e}_\pi$ as follows:

$$\bar{e}_\pi = \underbrace{\text{passthrough}}_{\text{Tables 3, 4}} \times \underbrace{\text{elasticity of job applications w.r.t. inflation expectations}}_{=0.114\text{, Table 5}} \tag{15}$$

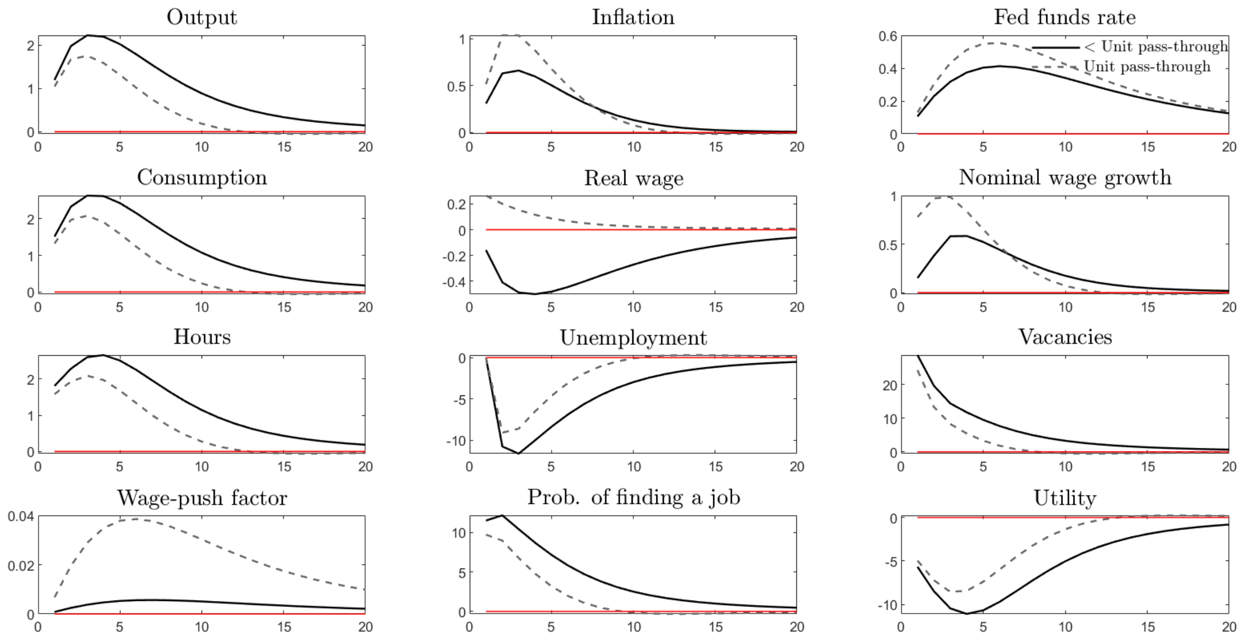
5.3 Impulse Response Functions: Lessons

Next, we analyze the dynamics of our model subject to a positive demand shock and a positive (adverse) cost-push shock, the two predominant disturbances that we judge were affecting the US economy around our survey period. Two lessons emerge that help us understand the mechanism behind households' association of higher inflation with worse economic outcomes, consistent with our empirical findings and the work of Shiller (1997) and Candia et al. (2020).

Lesson 1: Negative or dampened responses of real wages to shocks due to nominal wage rigidity translate into greater fluctuations and volatility in output and consumption.

Regardless of whether the model is subjected to a demand- or supply-side inflationary disturbance, an economy calibrated to quantitatively match our empirical passthrough of inflation expectations to income growth expectations has large ramifications for real wage dynamics relative to a counterfactual scenario of a unit passthrough. As we subsequently explain, severe nominal wage rigidity is the driving source for consumers' dislike of inflation in the model.

Figure 2: Response to a Positive Demand Shock



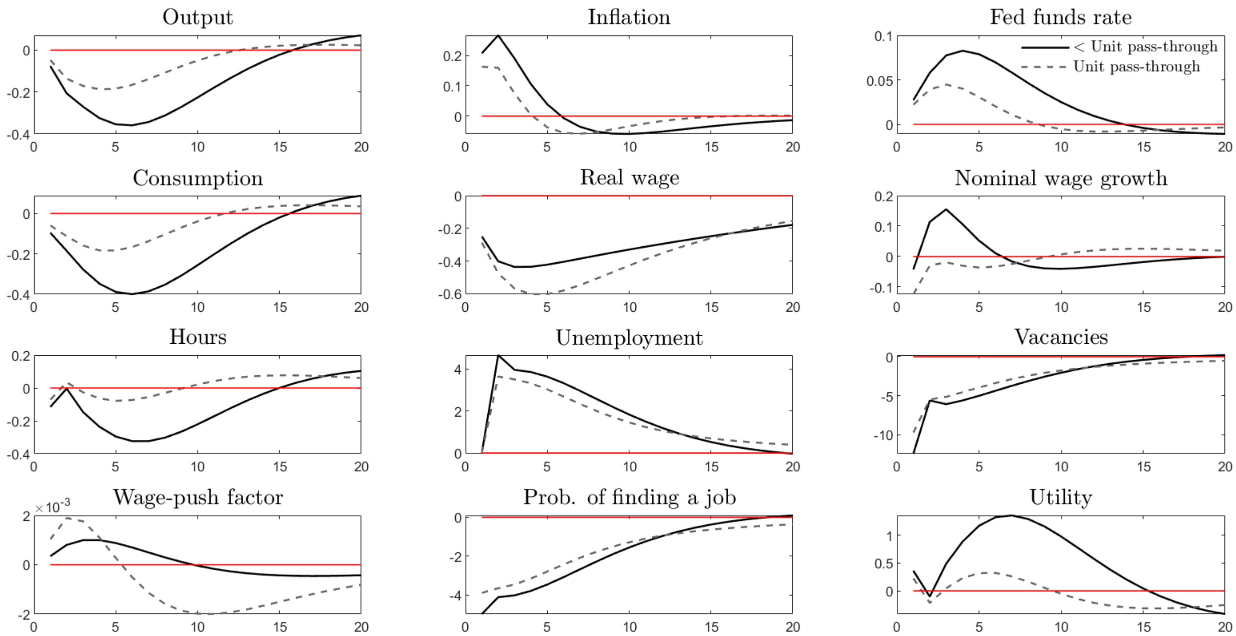
Notes: In black: calibration matching our empirical passthrough from inflation to nominal wage growth expectations ($\gamma = 0.875, \zeta_w = 0.675$). In dashed gray: calibration matching counterfactual of unity passthrough from inflation to nominal wage growth expectations ($\gamma = 0.65, \zeta_w = 0.306$). In red: x axis.

Consider Figure 2, where the economy is subject to a one standard deviation positive demand shock.[25] Relative to the counterfactual of unit passthrough, real wages decline, which results in a larger increase in labor hours that amplifies the responses of output and consumption. Consumers' utility is affected by two opposing forces: It declines in response to working more along both the extensive and the intensive margins, but it increases in response to higher consumption.[26] The former channel is considerably larger in the case of 20 percent passthrough compared with full passthrough, yielding a larger decline in utility even though inflation has risen by less.

[25]The standard deviation of the demand shock is set equal to 1.

[26]It is worth noting that hours in the model fluctuate in response to both the demand and the supply shocks that drive inflation up, while the survey respondents indicated that they did not expect to change their hours in response to higher inflation, indicating some tension between the theoretical model and the empirical data. We leave the resolution of this conundrum for future work.

Figure 3: Response to a Positive Cost-Push Shock



Notes: In black: calibration matching our empirical passthrough from inflation to nominal wage growth expectations ($\gamma = 0.875, \zeta_w = 0.675$). In dashed gray: calibration matching counterfactual of unity passthrough from inflation to nominal wage growth expectations ($\gamma = 0.65, \zeta_w = 0.306$). In red: x axis.

Figure 3 considers the case where the economy is shocked by a one standard deviation cost-push supply disturbance.[27] Relative to the counterfactual of a unit passthrough economy, the decline in real wages is smaller, putting more downward pressure on labor hours. The large decline in hours worked translates into large declines in output and consumption. Under a supply shock, greater nominal wage frictions cause larger increases in inflation and larger decreases in consumption/output, strengthening the consumers' negative association between the two. As was the case for a positive demand shock, a positive cost-push supply shock initially causes an increase in utility, followed by a decline a few periods later, and then a subsequent increase as consumers receive higher utility from working less and enjoying more leisure.[28]

The comparative analysis pertaining to Figures 2 and 3 is similar when the model is calibrated

[27] The standard deviation of the cost-push shock is set equal to 1.

[28] As with the demand shock, we note that the fluctuations along the hours margin run counter to our survey results in which respondents believe they will not adjust their hours worked in response to a change in expected inflation, providing fertile ground to explore alternative models that can capture this dimension of the data.

to match the passthrough from inflation expectations to income growth expectations associated with high- versus low-income respondents. To avoid repetition, we report those IRFs in Appendix I.

We next show how the correlation between expected period-utility and inflation expectations varies with the degree of nominal wage stickiness and wage indexation to past inflation. A representative family's period utility in deviation from its steady-state value is given by:

$$\mathcal{U}_t = (c(1-\varrho))^{1-\sigma}(\hat{c}_t - \varrho\hat{c}_{t-1}) - \frac{\kappa_h n h^{1+\varphi}}{1+\varphi}\left(\hat{n}_t + (1+\varphi)\hat{h}_t\right) \tag{16}$$

where $\hat{c}_t$ and $\hat{h}_t$ denote consumption and labor hours, respectively, in deviation from their steady-state values; ϱ is the degree of external habit in consumption; φ is the inverse of labor supply elasticity; and κ_h is a scaling factor to labor disutility.[29]

We simulate 50 periods of expected period-utility and inflation expectations data when shocking the model with demand and cost-push innovations, for a given pair j of (γ, ζ_w), and consider the following regression of simulated data:[30]

$$\mathbb{E}_t\mathcal{U}_{j,t+1} = \alpha_j + \gamma_t + \beta\widetilde{\mathbb{E}}_t\hat{\pi}_{t+1} + \theta\left(\gamma_j \times \widetilde{\mathbb{E}}_t\hat{\pi}_{t+1}\right) + \phi\left(\zeta_{w,j} \times \widetilde{\mathbb{E}}_t\hat{\pi}_{t+1}\right) + \varepsilon_{j,t} \tag{17}$$

where α_j is an IRF fixed effect, with an IRF being the series of expected period-utility and expected inflation for a given combination of γ and ζ_w; and γ_{t+1} is a period after the shock fixed effect. In the regression we drop the coefficient for each specific value γ and ζ_w as it will be absorbed by the IRF fixed effect. Table 8 shows the results for a demand and a supply shock.

[29] See Tables 17 and 18 for their calibration.

[30] For each shock, we consider a total of $10 \times 11 = 110$ pairs of (γ, ζ_w), where $\gamma \in \{0, 0.1, ..., 0.9\}$ and $\zeta_w \in \{0, 0.1, ..., 0.9, 1\}$

Table 8: Relationship between Expected Inflation and Utility for Different Levels of Wage Rigidity

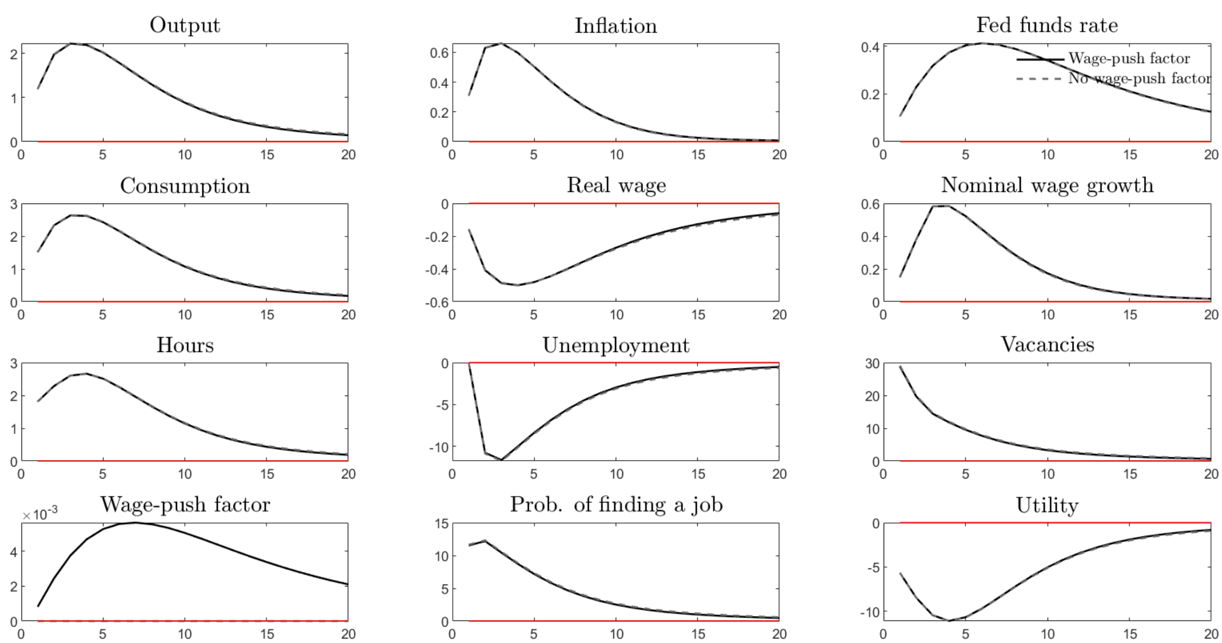
	Cost-push Shock				Demand Shock			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$E_t\pi_{t+1}$	8.842***	1.232**	9.906***	9.897***	1.187***	-1.034**	0.236	-0.285
	(1.438)	(0.561)	(1.756)	(1.669)	(0.223)	(0.482)	(0.227)	(0.183)
γ	0.119***		0.121***		-1.501***		-1.464***	
	(0.016)		(0.016)		(0.071)		(0.067)	
$\gamma \times E_t\pi_{t+1}$	-9.961***		-10.115***	-10.187***	-12.939***		-13.470***	-14.486***
	(1.807)		(1.861)	(1.800)	(0.356)		(0.388)	(0.347)
ζ_w		0.050***	0.051***			0.756***	0.736***	
		(0.011)	(0.011)			(0.059)	(0.046)	
$\zeta_w \times E_t\pi_{t+1}$		-0.830	-1.321	-1.305		0.040	1.509***	1.791***
		(0.816)	(0.897)	(0.842)		(0.394)	(0.255)	(0.227)
Period FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
IRF FE	No	No	No	Yes	No	No	No	Yes
Observations	5,500	5,500	5,500	5,500	5,500	5,500	5,500	5,500
R-squared	0.185	0.150	0.190	0.204	0.743	0.530	0.762	0.844

Notes: This table shows results for regression (17). Columns (1) to (4) show results conditional on a positive cost-push shock and columns (5) to (8) show results conditional on a positive demand shock. Period FE denotes a fixed effect of every period after the shock. IRF FE is a series constant fixed effect. Robust standard errors in parenthesis.

As shown in Table 8, the correlation between expected period utility and inflation expectations in the model is strongly dependent on the extent of wage rigidity: the higher is the share of workers whose wages are rigid, γ, the greater is the negative correlation between expected inflation and expected period utility, as captured by the coefficients on the interacted $\gamma \times E_t\pi_{t+1}$. Consistent with our empirical findings, the model exhibits a sticky wage channel to explain consumers' dislike of inflation. These findings hold whether the inflationary shock originates on the supply side or the demand side. Meanwhile, period utility is increasing in the degree of nominal wage indexation to past inflation, ζ_w, once again regardless of whether the shock originates on the supply or demand side, because this mechanism helps to generally insulate consumers from high inflation. The interaction between indexation and expected inflation is only positive and statistically significant under a demand shock, but it is statistically insignificant when the inflationary shock is from the supply-side. Similarly, the impact of other parameters on expected utility depends on the source of the shock. On its own, a higher probability of having a fixed wage tends to lower utility under a demand shock, but it raises utility modestly under a cost-push shock. In Appendix H we explore in more detail the implied correlation between expected utility and inflation when the economy is shocked with a demand and cost-push innovations. We find that the correlation between the two can be non-linear in the two parameters governing nominal wage rigidity, but the full implications of the non-linearities are beyond the scope of the present paper.

Lesson 2: No macroeconomic effects from inflation expectations operating through the wage-push factor.

Figure 4: Response to a Positive Demand Shock

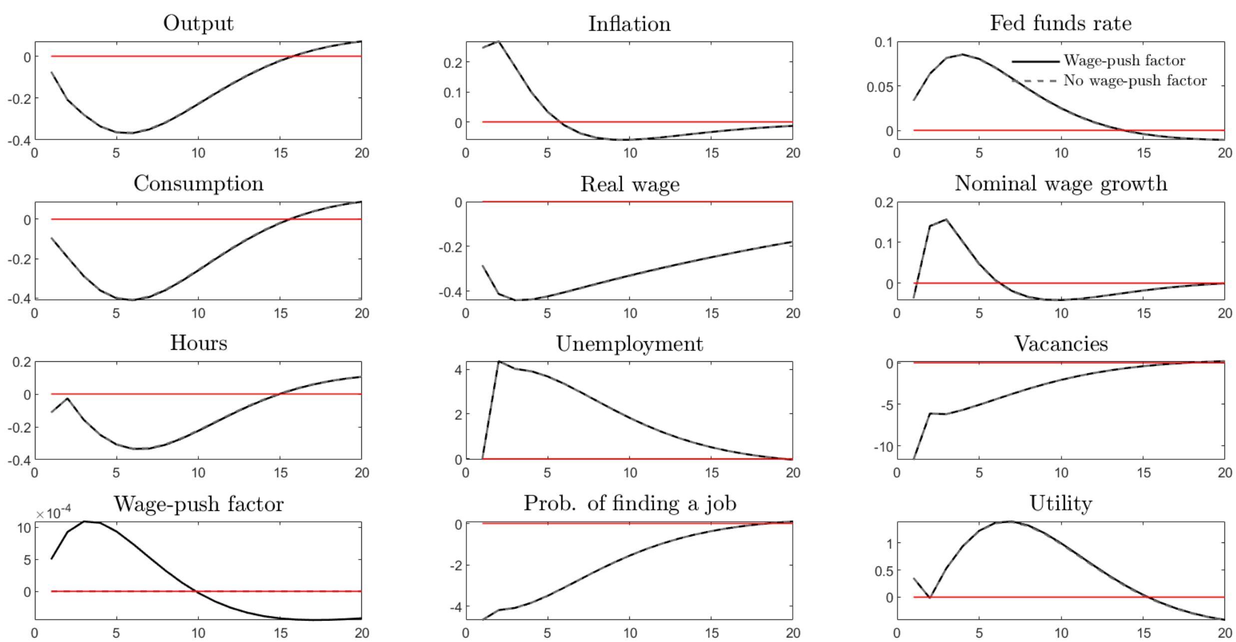


Notes: In black: calibration matching our empirical passthrough from inflation expectations to wage-push factor ($\bar{e}_\pi = 0.0228$). In dashed gray: counterfactual calibration of no passthrough from inflation expectations to wage-push factor ($\bar{e}_\pi = 0$). In red: x axis.

The second macroeconomic implication of our empirical facts is that the positive relationship between expected inflation and nominal wages running through the wage-push factor as we have captured it appears to generate no discernible effects on the macroeconomy in the context of this benchmark model. To show this, we repeat the same IRF exercises when the wage-push factor responds to inflation expectations with an elasticity that matches the passthrough across all respondents, that is, $\bar{e}_w = 0.0228$, compared to a case when $\bar{e}_w = 0$ and we have shut down this channel. Figures 4 and 5 plot the responses of key macroeconomic variables under both scenarios.

The competing results are virtually indistinguishable. The low passthrough from inflation expectations to nominal wage growth expectations results in a low elasticity of the wage-push factor with respect to expected inflation. On average then, consumers' efforts to raise their wages due to higher inflation expectations do not generate visible changes in their utility, real wage, or consumption.

Figure 5: Response to a positive Cost-Push Shock



Notes: In black: calibration matching our empirical passthrough from inflation expectations to wage-push factor ($\bar{e}_\pi = 0.0228$). In dashed gray: counterfactual calibration of no passthrough from inflation expectations to wage-push factor ($\bar{e}_\pi = 0$). In red: x axis.

6 Concluding Remarks

This paper relies on a novel experimental setup to study the direction of causality between consumers' inflation expectations and their income growth expectations. Based on the results from a large, nationally representative survey, we find that the rate of passthrough from consumers' inflation expectations to income growth expectations is incomplete, on the order of only 20 percent. We do not find a statistically significant effect in the other direction. Moreover, the degree of passthrough varies systematically with our respondents' socioeconomic and demographic characteristics. Specifically, we find a higher passthrough for higher-income individuals and for male consumers. The passthrough for lower-income and for female consumers is not statistically different from zero.

In a general equilibrium model with search-and-matching in labor markets, we calibrate the degree of nominal wage rigidity and wage indexation to past inflation to match the empirical passthrough of inflation expectations to income growth expectations in our survey data. We show that regardless of whether an inflationary shock originates from the demand or supply side, the matched (less than unity) passthrough generates amplifications and additional volatility in the output and consumption responses, relative to a counterfactual scenario of unit passthrough. As wage rigidity rises, higher rates of expected inflation tend to depress expected utility in the model.

In a seminal paper, Shiller (1997) argued that consumers associate higher inflation with a reduction in their purchasing power. We find that this negative relationship between inflation and consumers' earning prospects holds causally based on our experimental setup. We also explore the consequences of these results. Respondents appear to perceive that their nominal incomes are very rigid with their current employers, as higher inflation expectations only make them more willing to look for another job in order to improve their wages rather than asking for a raise. The implication from these results is that consumers associate inflationary shocks with a reduction in welfare, which can explain why consumers more generally associate higher inflation expectations with worse economic outcomes, as shown by Candia et al. (2020)). Overall, our empirical findings and our theoretical model provide evidence of a labor market channel that can explain why people dislike inflation.

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Appendix (For Online Publication)

A Survey Details and Questions

The experiment was put into the field by Morning Consult during the first week of March 2022. The goal was to sample a total of 6,600 adult respondents. The number of collected responses was 6,629. The survey starts with demographic questions. These are the ones we include in the paper:

- What is your five-digit ZIP Code?
- What is your gender?
  - Male
  - Female
- What is your age?
  - 18-34
  - 35-44
  - 45-64
  - 65+
- Which category represents the total combined income of all members of your HOUSEHOLD during the past 12 months? This includes money from jobs, net income from business, farm or rent, pensions, dividends, interest, social security payments and any other money income received by members of your family who are 15 years of age or older.
  - Under 50k
  - 50k-100k
  - 100k+

  Then, we have the prior questions for the experiment:

  - Next we are asking you to think about changes in prices during the next 12 months in relation to your income. Given your expectations about developments in prices of goods and services during the next 12 months, how would your income have to change to make you equally well-off relative to your current situation, such that you can buy the same amount of goods and services as today? (For example, if you consider prices will fall by 2% over the next 12 months, you may still be able to buy the same goods and services if your income also decreases by 2%.) To make me equally well off, my income would have to"

    * Increase by __%;
    * Stay about the same; and
    * Decrease by __%.
- Do you expect your income to increase, decrease, or stay about the same over the next 12 months?
    * Increase by __%;
    * Stay about the same; and
    * Decrease by __%.

At this point, respondents were randomly assigned to receive either a single treatment or be part of the control group respondents (with the number of respondents in parentheses):

- Control (N=1,075)
- The Federal Reserve targets an inflation rate of 2% per year in the long run. (1,155)
- A recent survey from the Conference Board found that wages were expected to rise 3.9% in 2022. (1,093)
- Between January 2021 and January 2022, the Consumer Price Index (CPI), which measures the average change in prices over time that consumers pay for goods and services, showed the inflation rate in the US was 7.5%. (1,112)
- According to the Survey of Professional Forecasters, the Consumer Price Index (CPI), which measures the average change in prices over time that consumers pay for goods and services, showed the inflation rate will be 3.7% by the end of 2022. (1,074)
- According to the US Census Bureau, the United States population was 332,402,978 as of December 31, 2021. (1,120)

After being designated to the control group or receiving a treatment, we asked everybody for their posteriors in the following questions:

- In the next year, do you think prices in general will increase, decrease, or stay about the same?
    * Increase by __%;
    * Stay about the same; and
    * Decrease by __%.
- Between December 2022 and December 2023, do you expect your income to increase, decrease, or stay about the same over the next 12 months?

    * Increase by __%;
    * Stay about the same; and
    * Decrease by __%.

After the posteriors, individuals were asked about their likely labor market actions to increase their income over in next three months.

- How likely are you to do the following to increase your income over the next three months?
    * Apply for a job(s) that pays more
        · Very likely
        · Somewhat likely
        · Somewhat unlikely
        · Very unlikely
        · Don't know / No opinion
    * Work longer hours
        · Very likely
        · Somewhat likely
        · Somewhat unlikely
        · Very unlikely
        · Don't know / No opinion
    * Ask for a raise
        · Very likely
        · Somewhat likely
        · Somewhat unlikely
        · Very unlikely
        · Don't know / No opinion
    * Other (in this case, respondent are asked to provide a description of labor market actions)

B Additional Tables

Table 9: Robustness First Stage Exercise with Trimmed and Quantile Regressions

	(1)	(2)	(3)	(4)
	$E\left[\pi_i^{Prices}\right]$	$E\left[\pi_i^{Prices}\right]$	$E\left[\pi_i^{Income2y}\right]$	$E\left[\pi_i^{Income2y}\right]$
$E\left[\pi_i^{ICIE}\right]$	0.490***	0.467***		
	(0.020)	(0.016)		
$E\left[\pi_i^{Income1y}\right]$			0.960***	1.000
			(0.010)	-
T2: Target	-0.382	0.558	-0.081	-
	(0.395)	(0.583)	(0.104)	-
T3: Wages	-0.540	1.333**	0.146	-
	(0.385)	(0.592)	(0.108)	-
T4: CPI	-0.547	0.533	-0.048	-
	(0.395)	(0.587)	(0.112)	-
T5: SPF	-0.429	1.556***	-0.049	-
	(0.409)	(0.596)	(0.106)	-
T6: Placebo	0.482	1.333**	-0.182*	-
	(0.403)	(0.590)	(0.106)	-
T2 x prior	-0.053*	-0.079***	-0.003	-
	(0.028)	(0.022)	(0.015)	-
T3 x prior	-0.036	-0.107***	-0.029*	-
	(0.028)	(0.022)	(0.017)	-
T4 x prior	-0.065**	-0.107***	0.013	-
	(0.027)	(0.022)	(0.013)	-
T5 x prior	-0.084***	-0.189***	0.005	-
	(0.030)	(0.023)	(0.016)	-
T6 x prior	-0.026	0.013	0.006	-
	(0.026)	(0.022)	(0.015)	-
Constant	4.223***	0.667	0.274***	-
	(0.291)	(0.419)	(0.075)	-
Sample	Trimmed	Quantile	Trimmed	Quantile
Observations	6,373	6,620	6,355	6,622
R-squared	0.432		0.922	

Notes: The table shows estimates of equations 3 and 4 that gauge the effect of treatments and their interaction with prior beliefs. Columns (1) and (3) show results that, exclude responses in the tails of the distribution (less than the 5th percentile or greater than the 95th percentile) of changes between priors and posteriors, using robust standard errors. Columns (2) and (4) use quantile regressions at the median.

Table 10: Effect of Inflation Expectations on Apply for a job(s) by demographics

	Apply for a Job(s) that Pays More					
	All	Male	Female	<50k	50k-100k	100k+
	(1)	(2)	(3)	(4)	(5)	(6)
$E\left[\pi^{Prices}\right]$	0.029***	0.021***	0.042***	0.019**	0.048***	0.025***
	(0.006)	(0.007)	(0.010)	(0.010)	(0.011)	(0.007)
Constant	2.015***	2.172***	1.802***	2.173***	1.801***	2.033***
	(0.054)	(0.060)	(0.102)	(0.095)	(0.096)	(0.074)
Regression	IV	IV	IV	IV	IV	IV
F-Test	143.328	82.591	59.017	59.277	36.924	137.812
$\frac{dy}{dx}\frac{\bar{x}}{\bar{y}}$	0.114	0.072	0.184	0.076	0.182	0.094
Observations	4,651	2,371	2,280	1,984	1,662	1,005

Table 11: Effect of Inflation Expectations on Work Longer Hours by demographics

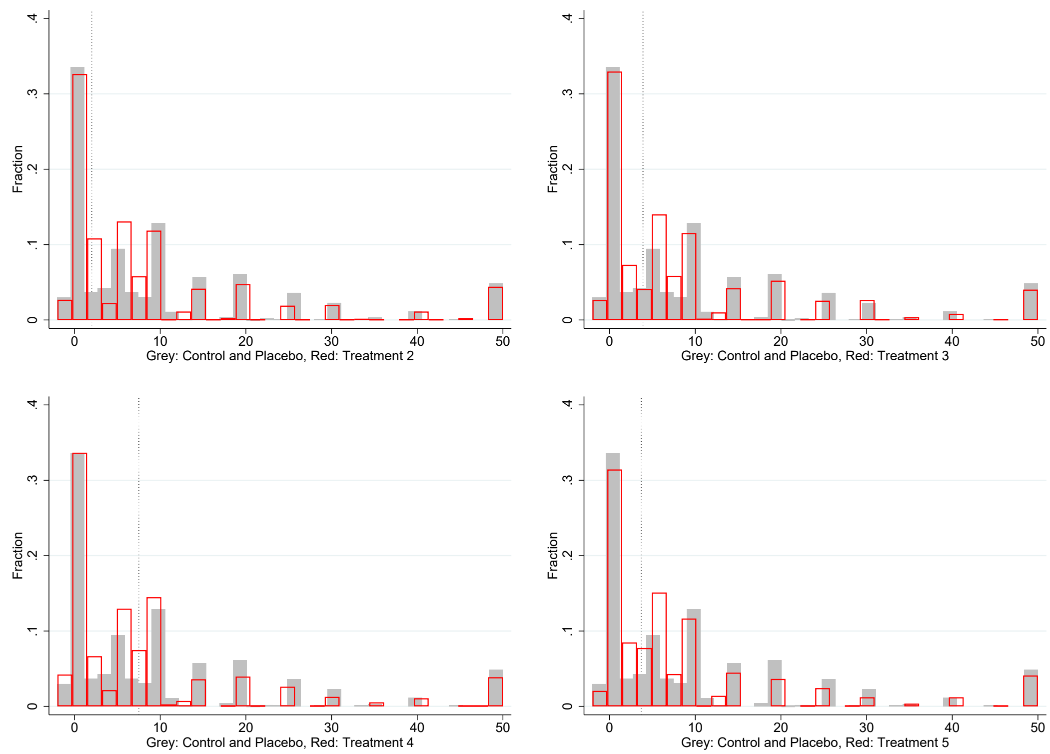
	Work Longer Hours					
	All	Male	Female	<50k	50k-100k	100k+
	(1)	(2)	(3)	(4)	(5)	(6)
$E\left[\pi^{Prices}\right]$	0.009	0.004	0.018**	0.001	0.024**	0.012
	(0.005)	(0.007)	(0.009)	(0.009)	(0.011)	(0.008)
Constant	2.219***	2.372***	2.008***	2.263***	2.067***	2.296***
	(0.051)	(0.060)	(0.091)	(0.088)	(0.093)	(0.078)
Regression	IV	IV	IV	IV	IV	IV
F-Test	149.752	88.642	60.033	61.735	39.939	138.630
$\frac{dy}{dx}\frac{\bar{x}}{\bar{y}}$	0.034	0.014	0.080	0.003	0.088	0.043
Observations	4,573	2,339	2,234	1,942	1,630	1,001

Table 12: Effect of Inflation Expectations on Ask for a Raise by demographics

	Ask for a Raise					
	All	Male	Female	<50k	50k-100k	100k+
	(1)	(2)	(3)	(4)	(5)	(6)
$E\left[\pi^{Prices}\right]$	0.003	0.007	0.000	-0.011	0.016*	0.018**
	(0.006)	(0.007)	(0.010)	(0.010)	(0.009)	(0.008)
Constant	2.068***	2.205***	1.910***	2.100***	1.962***	2.112***
	(0.052)	(0.058)	(0.092)	(0.094)	(0.083)	(0.076)
Regression	IV	IV	IV	IV	IV	IV
F-Test	143.25	88.667	53.836	49.857	50.938	194.820
$\frac{dy}{dx}\frac{\bar{x}}{\bar{y}}$	0.011	0.023	0.002	-0.051	0.064	0.066
Observations	4,406	2,283	2,126	1,847	1,593	969

C Additional Figures

Figure 6: Distribution of Price Posterior by Treatment Group



Notes: The figures show the distribution of the posterior for the control and placebo group (grey) and the treatment groups (red). The upper-left panel shows results for treatment 2 related to the Fed target. The upper-right panel shows results for treatment 3 related to the wage growth expectations. The lower-left panel shows results for treatment 4 related to CPI inflation. The lower-right panel shows results for treatment 5 related to the inflation forecast. The black vertical dots indicate the numerical information provided in the treatment

D Follow-Up Exercise

In the second week of September 2022, we ran a follow-up exercise. This exercise consisted of the same questions used in the first run, with the same phrasing and ordering. Then, we updated the wage, CPI, and SPF treatments with the most up-to-date information. This time we targeted a sample of 1500 respondents per treatment. The target and placebo treatments remained the same. The wage treatment changed its reference to a forecast from the CBO, as there was no update available on the Conference Board forecast used before and the old forecast was quite dated at that point. The new wage treatment was the following *"A recent forecast from the Congressional Budget Office projected that wages and salaries among non-government workers would rise 4.1% on average in 2023."*. In the case of the CPI treatment, we used the CPI inflation rate as of July 2022 (8.5%) and moved forward the corresponding dates. In terms of the SPF projection, we used the forecast for the CPI inflation rate to the end of 2023 (3.2%). We then run:

$$E\left[\pi_i^{Prices}\right] = \alpha_t + \beta\pi_{it}^{ICIE} + \sum_{j=2}^{6}\gamma_\pi^j \times T_i^j + \sum_{j=2}^{6}\theta_\pi^i \times T_i^j \times E\left[\pi_i^{ICIE}\right] + \varepsilon_i \tag{D.1}$$

and we estimate the following specification for income growth expectations:

$$E\left[\pi_{it}^{Income2y}\right] = \alpha_t + \beta\pi_{it}^{Income1y} + \sum_{j=2}^{6}\gamma_I^j \times T_{it}^j + \sum_{i=2}^{6}\theta_I^i \times T_{it}^j \times E\left[\pi_{it}^{Income1y}\right] + \varepsilon_{it} \tag{D.2}$$

where α_t is a time or survey round fixed effect. In this case the treatment information is multiplied by its numerical value which is why T_{it} varies by individual and time, as we use data from March and September. This is similar to the instrument used by Coibion et al. (2020a). The results are presented in Table 13.

Table 13: Follow up Treatment Effect

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	$E\left[\pi^{Prices}\right]$	$E\left[\pi^{Prices}\right]$	$E\left[\pi^{Prices}\right]$	$E\left[\pi^{Prices}\right]$	$E\left[\pi^{Income2y}\right]$	$E\left[\pi^{Income2y}\right]$	$E\left[\pi^{Income2y}\right]$	$E\left[\pi^{Income2y}\right]$
$E\left[\pi^{ICIE}\right]$	0.199***	0.209***	0.300***	0.450***	0.658***	0.648***	0.570***	0.533***
	(0.015)	(0.018)	(0.038)	(0.005)	(0.036)	(0.046)	(0.042)	(0.060)
$E\left[\pi^{Income1y}\right]$	0.199***	0.209***	0.300***	0.450***	0.658***	0.648***	0.570***	0.533***
	(0.015)	(0.018)	(0.038)	(0.005)	(0.036)	(0.046)	(0.042)	(0.060)
$Target_{it}$	-0.638**	-0.634**	0.442*	1.247***	-0.382**	-0.530***	0.093	0.133
	(0.274)	(0.318)	(0.268)	(0.104)	(0.156)	(0.204)	(0.074)	(0.091)
$Wages_{it}$	-0.603**	-0.510	0.000	1.179***	-0.188	-0.318	0.052	0.084
	(0.269)	(0.313)	(0.251)	(0.106)	(0.160)	(0.210)	(0.072)	(0.088)
CPI_{it}	-0.751***	-0.819***	0.000	1.010***	-0.047	-0.191	0.150*	0.137
	(0.274)	(0.313)	(0.246)	(0.106)	(0.172)	(0.214)	(0.078)	(0.089)
SPF_{it}	-0.696**	-0.710**	0.585**	1.322***	-0.104	-0.207	0.119	0.083
	(0.276)	(0.313)	(0.268)	(0.105)	(0.173)	(0.232)	(0.074)	(0.087)
$Placebo_{it}$	0.207	0.327	0.000	0.335***	-0.305*	-0.341	-0.013	-0.061
	(0.289)	(0.334)	(0.256)	(0.099)	(0.164)	(0.217)	(0.073)	(0.082)
$Target_{it} \times Prior_{it}$	-0.005	-0.008	-0.040*	-0.188***	-0.030	-0.008	-0.041	-0.040
	(0.010)	(0.013)	(0.022)	(0.004)	(0.026)	(0.031)	(0.030)	(0.040)
$Wages_{it} \times Prior_{it}$	0.001	-0.004	-0.012	-0.083***	-0.001	-0.001	-0.012	-0.020
	(0.005)	(0.006)	(0.011)	(0.002)	(0.013)	(0.016)	(0.014)	(0.021)
$CPI_{it} \times Prior_{it}$	-0.001	-0.001	-0.010*	-0.042***	-0.006	-0.007	0.000	0.001
	(0.002)	(0.003)	(0.005)	(0.001)	(0.007)	(0.008)	(0.007)	(0.010)
$SPF_{it} \times Prior_{it}$	-0.005	-0.006	-0.029**	-0.115***	0.004	0.008	-0.022	-0.015
	(0.006)	(0.008)	(0.012)	(0.002)	(0.015)	(0.018)	(0.017)	(0.022)
$Placebo_{it} \times Prior_{it}$	0.038*	0.019	0.057	0.004	-0.021	-0.008	-0.068	-0.045
	(0.021)	(0.025)	(0.047)	(0.007)	(0.052)	(0.062)	(0.055)	(0.072)
Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sample	All	All	All	All	All	All	Trimmed	Trimmed
Regression	OLS	Weights	Quantile	Huber	OLS	Weights	OLS	Weights
Observations	15,463	15,463	15,463	14,276	15,465	15,465	13,324	13,324
R-squared	0.212	0.216		0.580	0.487	0.488	0.333	0.314

We can see from Column (4) that we obtain similar effects for the treatments in terms of their effects on inflation expectations, with the exception of the placebo; that is, our treatments are effective in moving people's posterior inflation expectations. Thus, we can once again use our treatments to instrument for inflation expectations. By contrast, columns (5) to (8) show that the information treatments do not seem to affect consumers' posterior income growth expectations, conditional on the prior, meaning that the treated and control groups are effectively the same, and preventing us from doing the same to instrument for income growth expectations. As a result, we run

$$E\left[\widehat{\pi^{Prices}_{\pi,i}}\right] = \begin{cases} \sum_{j=2,4,5} \gamma^j_\pi \times T^j_{it} + \sum_{j=2,4,5} \theta^j_\pi \times T^j_{it} \times E\left[\pi^{ICIE}_i\right] & if \quad T_{it} = Target, CPI, SPF \\ 0 & if \quad T_{it} = Control, Placebo \end{cases}$$

where we use the numerical information provided within each treatment T^j_{it} that varies over time as above. Table 14 shows the results for the average and by demographics

Table 14: Passthrough from Inflation Expectations to Income Growth Expectations, by Demographics Follow Up

	$E\left[\pi^{Income2y}\right]$					
	All	Male	Female	<50k	50k-100k	>100k
$E\left[\pi^{Prices}\right]$	0.174***	0.243***	0.135**	0.148***	0.210**	0.253**
	(0.043)	(0.068)	(0.056)	(0.056)	(0.087)	(0.107)
$E\left[\pi^{Income1y}\right]$	0.594***	0.597***	0.582***	0.597***	0.567***	0.603***
	(0.019)	(0.030)	(0.026)	(0.025)	(0.037)	(0.062)
Time FE	Yes	Yes	Yes	Yes	Yes	Yes
F-test	314.429	123.973	185.655	185.638	76.927	61.875
Observations	12,882	6,039	6,843	6,029	4,452	2,401
R-squared	0.486	0.541	0.441	0.477	0.459	0.559

Notes: This table shows results from IV regressions from different demographics. The regression used is the same in Column (2) in Table 3. Regressions have robust standard errors.

We see a similar pattern to the one in the baseline exercise. The estimated passthrough is a little bit smaller, but still close to 20 percent. We find the same pattern for the results by demographics as before. Finally, we run the regressions on the labor market actions using the same strategies, meaning that we use the same controls and time fixed effect. The results are presented in Table 15.

Table 15: Effect of Inflation Expectations on Wage Increase Actions, Follow Up

	Apply for a job(s) that pays more		Work longer hours		Ask for a raise	
	(1)	(2)	(3)	(4)	(5)	(6)
$E\left[\pi_i^{Prices}\right]$	0.006***	0.036***	0.005***	0.015***	-0.002	0.002
(0.001)	(0.004)	(0.001)	(0.004)	(0.001)	(0.004)	
Time FE	Yes	Yes	Yes	Yes	Yes	Yes
Regression	OLS	IV	OLS	IV	OLS	IV
F-Test		372.1		377.8		359.9
$\frac{dy}{dx}\frac{\bar{x}}{\bar{y}}$	0.020	0.121	0.016	0.049	-0.007	0.007
Observations	4,651	4,651	4,573	4,573	4,409	4,409

Notes: This table shows OLS and IV regressions from equation 5. y_i^j is a value that ranges from 1 to 4, where 1 is "Very unlikely, " 2 is "Somewhat unlikely," 3 is "Somewhat likely" and 4 is "Very Likely." For columns (1) and (2) y_i^j is the answer to the question about "apply for a job that pays more," columns (3) and (4) are the answers to the question about "work longer hours," and columns (5) and (6) are the answers about "ask for a raise." Regressions have robust standard errors.

We find very similar results in terms of point estimates and elasticities. Overall, the follow-up exercise confirms the robustness of the baseline results, suggesting that they are not driven solely by a particular time period in early 2022. In addition, it is worth noting that this exercise from September 2022 shows that our baseline results are robust to varying the precise timeframe used in the priors and posteriors. In particular, in this exercise we used a timeframe for the posterior income growth expectation question that had greater temporal overlap with the prior than was the case in our baseline exercise conducted in February 2022. Given that our results are essentially unchanged, we are comfortable that different timing assumptions were not driving the results documented in the body of the paper.[31]

In addition to this exercise, we use the variation on the same information treatment to learn

[31] As a reminder, in the baseline survey results from February 2022, the inflation prior asked about income needed to offset price changes "over the next 12 months," while the inflation posterior asked about the growth in prices "in the next year." Meanwhile, the income growth prior asked about expected income changes "over the next 12 months" while the income growth posterior asked about expected income growth "between December 2022 and December 2023." In the survey results from September 2022, the wording of the prior and posterior questions was unchanged, meaning that there was now more overlap in the timeframes for the income prior and posterior questions, whereas there had been little overlap in the February wave. The fact that our results are essentially the same implies that the lack of overlap in the baseline results was not important for our findings.

about the effect of each treatment on the passthrough result. In order to do so, we use the "control" groups (placebo and control) and only one treatment group individually at a time. Table 16 describes the results for each treatment group.

Table 16: IV Results for Each Individual Treatment

	$E\left[\pi^{Income2y}\right]$			
	(1)	(2)	(3)	(4)
$E\left[\pi^{Prices}\right]$	0.174***	0.151*	0.148*	0.207**
	(0.043)	(0.078)	(0.079)	(0.090)
$E\left[\pi^{Income1y}\right]$	0.594***	0.598***	0.602***	0.606***
	(0.019)	(0.028)	(0.028)	(0.030)
Time FE	Yes	Yes	Yes	Yes
Treatment	All	Target	CPI	SPF
F-Test	314.429	86.127	96.273	82.905
Observations	12,882	7,792	7,735	7,673
R-squared	0.486	0.494	0.478	0.491

Table 16 shows that the effect changes slightly depending on the treatment. The estimated passthrough is slightly stronger when consumers are treated with information about future inflation, and slightly lower for the other treatments, but they are all comparable. The table shows that our main findings are highly robust: passthrough is on the order of roughly 20 percent. Because each inflation treatment is generating a similar passthrough estimate, we do not believe that the imbalance of having three inflation treatments and one wage treatment is a primary driver of our main result.

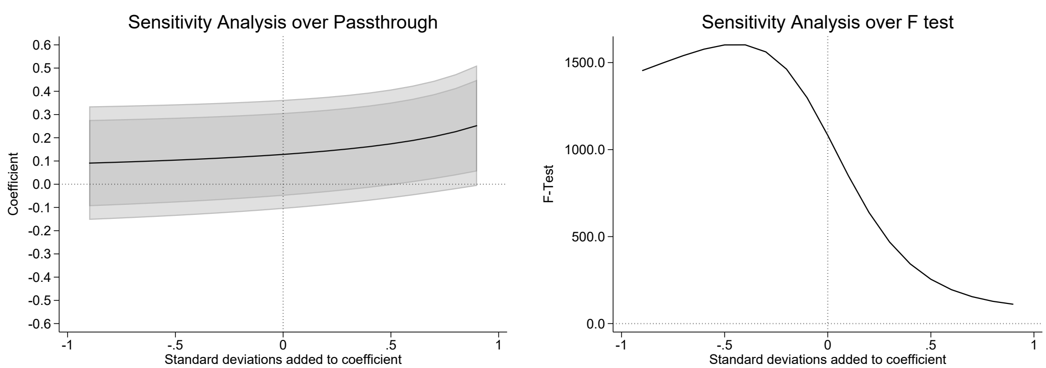
E Sensitivity Analysis

In this section, we more deeply explore the wage passthrough exercise, given that the effect of the wage treatment in the income posterior in 2 column (8) is not as precisely estimated as in the case of the effect of the inflation treatments on inflation expectations in column (4). As explained in the main text, we construct the instrument with

$$E\left[\widehat{\pi_i^{Income2y}}\right] = \begin{cases} \gamma_I^3 \times T_i^3 + \theta_I^3 \times T_i^3 \times E\left[\pi_i^{Income1y}\right] & if \quad T_i = 3 \\ 0 & if \quad T_i = 1,6 \end{cases}$$

Where γ_I^3 and θ_I^3 are the point estimates of the effect of the wage treatment. In order to measure the uncertainty in those coefficients, we create new coefficients $\gamma_{I\omega}^3 = \gamma_{I\,alt}^3 + \omega \times \sigma(\gamma_{I\,alt}^3)$ and $\theta_{I\omega}^3 = \theta_I^3 + \omega \times \sigma(\theta_I^3)$, with $\sigma(X)$ the standard deviation associated with the estimation of the coefficient X and ω a constant that we vary between -1 and 1. With those estimates, we run our second-stage regressions using the new instruments to estimate the passthrough regression. The left panel of Figure 7 shows the passthrough estimates and the 95 percent confidence interval for each value of ω, and the right panel shows the F tests of the IV regression using each instrument.

Figure 7: Sensitivity Analysis for Wage IV regression



Notes: The figures show the result for the sensitivity analysis of the passthrough from income to price expectations. In that exercise, we run the IV regression over an instrument that has a value that is a number of standard deviation of the point estimate from 2, column (8). The x axis shows how many standard deviation are added or subtracted to the intercept and interaction coefficient. The left panel shows the estimated passthrough. The darker shaded area indicates 95 percent confidence intervals and the light shaded area indicates 99 percent confidence intervals. We use robust standard errors. The right panel plots the F test of each IV regression.

The figure shows that as we move over one standard deviation higher or lower, the exercise finds that there is not much change in the estimated passthrough. When we subtract values, while the instrument is strong in terms of the F-test, the passthrough is stable at numbers close to 0.1. When we increase the coefficient, the passthrough increases modestly except at big numbers close to one standard deviation. More importantly, we usually cannot reject the null of zero passthrough at the 95 or 99 percent confidence level. In addition, as the coefficients become larger, the value of the F test declines dramatically, suggesting that the instrument is becoming weaker.

Overall, these results indicate that the passthrough from income growth expectations to inflation expectations is most likely small and insignificantly different from zero, mainly because of its low value. Noise that is affecting the treatment doesn't seem to explain the result.

F Model

The model has been largely adapted from Christoffel and Kuester (2008) and Christoffel et al. (2009).

Households. There is a large number of identical families with unit measure. Each family consists of a measure n_t of employed members and $u_t = 1 - n_t$ of unemployed members. Each family member has the following utility function:

$$\widetilde{\mathbb{E}}_0 \sum_{t=0}^{\infty} \left(\frac{(c_{it} - \varrho c_{t-1})^{1-\sigma}}{1-\sigma} - \kappa_h \frac{h_{it}^{1+\varphi}}{1+\varphi} \right) \tag{F.1}$$

where c_{it} denotes the consumption of consumer i; c_{t-1} is the family's aggregate real consumption in period $(t-1)$; h_{it} is the working hours of employed consumer i; $\kappa_h > 0$ is a parameter of work disutility; and $\varrho \in [0,1)$ captures the degree of external habit in consumption. Each family faces the following constraint:

$$c_t + \tau_t + \kappa_t v_t = \int_0^{1-u_t} w_{it} h_{it} di + u_t b + e_t^d d_{t-1} \frac{R_{t-1}}{\pi_t} - d_t + \Psi_t + n_t \Phi^K \tag{F.2}$$

where $\widetilde{\mathbb{E}}_t$ is a generic expectations operator; τ_t is lump-sum taxes per capita in real terms; κ_t denotes real cost per vacancy posting v_t; w_{it} is the real wage of employed consumer i; d_t denotes the risk-free one-period real bond holdings with return $e_t^d R_t$ and e_t^d being a shock to the risk premium; b is real unemployment benefits. Variable Ψ_t denotes the real dividends of the family from firms in the economy, such that $\Psi_t = \Psi_t^C + \int_0^{1-u_t} \Psi_{it}^h di$, where Ψ_t^C and Ψ_{it}^h are dividends arising from the differentiated goods and labor goods firms, respectively, to be described in what follows. The model does not account for capital income, so we assume that the family receives a fixed share $n_t \Phi^K$, $\Phi^K \geq 0$, out of current revenue of labor firms as "capital income." The family makes optimal decisions on behalf of its members by maximizing the aggregate utility function in (F.1) with respect to consumption and real bond holdings, subject to the budget constraint in (F.2).

Firms. There are three types of firms: i) firms that produce a homogeneous intermediate good, "labor good"; ii) wholesale firms that purchase labor goods in a perfectly competitive market, and use them as inputs to produce differentiated goods; and iii) retail firms that purchase differentiated goods from the wholesalers and bundle those goods into a homogeneous consumption basket sold to consumers and the government.

Retailers' demand for differentiated good j is given by:

$$y_{jt} = \left(\frac{P_{jt}}{P_t}\right)^{-\varepsilon} y_t \tag{F.3}$$

where P_{jt} is the j^{th} good price; $\varepsilon > 1$ is the own-price elasticity of demand; P_t is the aggregate price level; and y_t denotes the final good/economy's aggregate output.

The wholesale sector has a unit mass with firms indexed by $j \in [0,1]$. Each firm produces variety j according to $y_{jt} = l^d_{jt}$, where l^d_{jt} denotes firm j's demand for the intermediate labor good which it can acquire in a perfectly competitive market at real price x^h_t. Wholesalers face Calvo-type price stickiness such that in every period, a fraction $\omega \in (0,1)$ of them cannot reset the price. Similar to Christiano et al. (2005), we assume that the firms that cannot reoptimize can adjust prices by the index factor $\pi^{\zeta_p}_{t-1}\bar{\pi}^{1-\zeta_p}$, where $\zeta_p \in [0,1]$ denotes the degree of inflation indexation. The problem of wholesalers then is expressed as follows:

$$\max_{P_{jt}} \widetilde{\mathbb{E}}_t \sum_{h=0}^{\infty} \left[\omega^h \Gamma_{t,t+h} \left(\frac{P_{jt}\pi^{\zeta_p}_{t-1,t-1+h}(\bar{\pi}^{1-\zeta_p})^h}{P_{t+h}} - mc_{t+h}\right) y_{j,t+h}\right] \tag{F.4}$$

where $\Gamma_{t,t+h} = \beta^h \frac{\lambda_{t+h}}{\lambda_t}$, with λ_t being households' marginal utility of consumption; $\pi_{t-1,t-1+h} = P_{t-1+h}/P_{t-1}$; and $mc_t = x^h_t e^C_t$ is the marginal cost, with e^C_t being a cost-push shock. Total profits of the wholesale sector in period t are given by

$$\Psi^C_t = \int_{j=0}^{1} \left(\frac{P_{jt}}{P_t} - mc_t\right) y_{jt} dj \tag{F.5}$$

Finally, the labor good firms are homogeneous and they need exactly one worker to operate. So, there is a mass of $n_t = (1 - u_t)$ of such firms at any given time. Match i can produce l_{it}

labor good units via $l_{it} = z_t h_{it}^{\alpha}$, where z_t is a productivity shock and $\alpha \in (0,1)$.

Labor markets. The matching process between workers and labor firms is governed by a Cobb-Douglas function,

$$m_t = \sigma_m u_t^{\xi} v_t^{1-\xi} \tag{F.6}$$

where m_t is matches formed in period t; u_t is unemployment; v_t is vacancies; $\xi \in [0,1]$ is the elasticity of matching with respect to unemployment; and $\sigma_m > 0$ is a scaling factor. Labor market tightness is defined as:

$$\theta_t = \frac{v_t}{u_t} \tag{F.7}$$

Then, the probabilities that a vacancy is filled and that an unemployed worker matches with a firm are, respectively,

$$q_t = \frac{m_t}{v_t}, \quad s_t = \frac{m_t}{u_t} \tag{F.8}$$

New matches become productive in $(t+1)$. Employment then evolves according to

$$n_t = (1-\mu) n_{t-1} + m_{t-1} \tag{F.9}$$

If a worker is not separated from employment, she can bargain her nominal wage to W_{t+1}^* in period $(t+1)$ with probability $(1-\gamma) \in [0,1]$. The nominal wage of the γ share of workers who cannot bargain partially adjusts for past inflation such that $W_{t+1} = W_t(e_t^w \pi_t^{\zeta_w} \bar{\pi}^{1-\zeta_w})$, where e_t^w is the wage-push factor as defined in the main text and $\zeta_w \in [0,1]$. In this framework, we define the value of employment as follows:

$$\begin{aligned} \mathcal{V}_t^E(W_{it}) = {} & w_{it} h_{it} - \kappa_h \frac{h_{it}^{1+\varphi}}{(1+\varphi)\lambda_t} + (1-\mu)\widetilde{\mathbb{E}}_t \left[\Gamma_{t,t+1} \left(\gamma \mathcal{V}_{t+1}^E (W_{it}(e_t^w \pi_t^{\zeta_w} \bar{\pi}^{1-\zeta_w})) + (1-\gamma) \mathcal{V}_{t+1}^E (W_{t+1}^*) \right) \right] \\ & + \mu \widetilde{\mathbb{E}}_t \left[\Gamma_{t,t+1} \mathcal{V}_{t+1}^U \right] \end{aligned} \tag{F.10}$$

The value of an employed worker depends on her labor nominal income and her utility loss from working. An employed worker retains her job with probability $(1-\mu)$. In the next period, if she stays employed, she will not be able to renegotiate her nominal wage with probability γ, in which case her employment value is $\mathcal{V}_{t+1}^E(W_{it}(e_t^w \pi_t^{\zeta_w} \bar{\pi}^{1-\zeta_w}))$; in the case of rebargaining, the employment value is given by $V_{t+1}^E(W_{t+1}^*)$. With probability μ the worker will be unemployed next period.

The value of unemployment is described as follows:

$$\mathcal{V}_t^U = b + s_t \widetilde{\mathbb{E}}_t \left[\Gamma_{t,t+1} \left(\gamma \mathcal{V}_{t+1}^E (W_t (e_t^w \pi_t^{\zeta_w} \bar{\pi}^{1-\zeta_w})) + (1-\gamma) \mathcal{V}_{t+1}^E (W_{t+1}^*) \right) \right] + (1-s_t) \widetilde{\mathbb{E}}_t \left[\Gamma_{t,t+1} \mathcal{V}_{t+1}^U \right] \tag{F.11}$$

An unemployed worker finds a new job with probability s_t. In that case, she enters the same Calvo scheme as the average currently employed worker.[32]

Labor good firms are worthless unless they are matched with a worker. Therefore, the market value of a labor firm matched to a worker is

$$J_t(W_{it}) = \Psi_t^h(W_{it}) + (1-\mu) \widetilde{\mathbb{E}}_t \left[\Gamma_{t,t+1} \left(\gamma J_{t+1} (W_{it} (e_t^w \pi_t^{\zeta_w} \bar{\pi}^{1-\zeta_w})) + (1-\gamma) J_{t+1} (W_{t+1}^*) \right) \right] \tag{F.12}$$

where $\Psi_t^h(W_{it}) = x_t^h z_t h_{it}^\alpha - w_{it} h_{it} - \Phi$ with $\Phi \geq 0$ denoting a per-period fixed cost of production. For firms that bargain in a given period, the nominal wage is set according to Nash bargaining,

$$W_{it}^* = argmax_{W_{it}} (\mathcal{V}_{it}^E - \mathcal{V}_t^U)^{\eta_t} (J_{it})^{1-\eta_t} \tag{F.13}$$

where η_t is the time-varying bargaining power of workers.[33]

Free entry into the vacancy posting market implies that the ex ante value of vacancy posting is 0, yieldiing the following relationship:

$$\kappa_t = q_t \widetilde{\mathbb{E}}_t \left[\Gamma_{t,t+1} \left(\gamma J_{t+1} (W_t (e_t^w \pi_t^{\zeta_w} \bar{\pi}^{1-\zeta_w})) + (1-\gamma) J_{t+1} (W_{t+1}^*) \right) \right] \tag{F.14}$$

Expectations. We assume that expectations about any variable, except inflation, are based on full-information and are rational. We introduce some degree of information stickiness, $\lambda \in [0,1]$, in the inflation expectations formation process, such that

$$\widetilde{\mathbb{E}}_t \hat{\pi}_{t+1} = (1-\lambda) \mathbb{E}_t \hat{\pi}_{t+1} + \lambda \widetilde{\mathbb{E}}_{t-1} \hat{\pi}_{t+1} \tag{F.15}$$

where $\mathbb{E}_t$ is the full-information rational expectations operator.

Policy. We assume that the monetary authority sets nominal interest rates R_t by responding

[32] The Calvo scheme of wages is imposed on both new matches and existing matches to preserve some degree of homogeneity in the model for tractability reasons.

[33] Differently from efficient Nash bargaining, we employ the right-to-manage framework of Trigari (2006). The difference between the two is that under the former, firms and workers bargain over both hours and wages, whereas under the latter, they bargain over wages only. Optimal hours and wages in the former case yield $\eta_t J_t = (1-\eta_t)(\mathcal{V}_t^E - \mathcal{V}_t^U)$. In our case, the optimality condition satisfies $\eta_t \delta_t^W J_t = (1-\eta_t) \delta_t^F (\mathcal{V}_t^E - \mathcal{V}_t^U)$, where δ_t^W and δ_t^F denote, respectively, the net marginal benefits from an increase in the wage to worker and firm. See Christoffel and Kuester (2008) for more details.

to inflation deviations from a fixed target $\bar{\pi}$ and output growth.

$$log\left(\frac{R_t}{\bar{R}}\right) = \phi_R log\left(\frac{R_{t-1}}{\bar{R}}\right) + (1-\phi_R)\left[\phi_\pi log\left(\frac{\pi_t}{\bar{\pi}}\right) + \phi_{\Delta y} log\left(\frac{y_t}{y_{t-1}}\right)\right] + e_t^R \tag{F.16}$$

where $\rho_R \in [0,1)$ denotes the interest rate smoothing and e_t^R is a monetary shock. On the fiscal front, we assume that government spending, g_t is exogenous. Overall, there is a total of 7 shocks in the economy, e_t^d, e_t^R, e_t^C, g_t, κ_t, z_t, and η_t. Let $sh\hat{o}ck_t = log(shock_t/sh\bar{o}ck)$; then, each one of the shocks in log-linear deviation from the steady state is given by

$$sh\hat{o}ck_t = \rho_{shock} sh\hat{o}ck_{t-1} + \epsilon_t^{shock}, \epsilon_t^{shock} \sim \mathcal{N}(0, \sigma^2_{shock}) \tag{F.17}$$

Tables 17 and 18 show, respectively, values for the steady state of a number of variables and model parameters.

Table 17: Steady State

Variable	Value	Description
y	1	Ouput
c	0.79	Consumption
whn/y	0.6	Labor income share
J	0.1582	Value of a labor firm
$\mathcal{V}^E - \mathcal{V}^U$	0.1582	Worker's surplus from working

Table 18: Parameter Calibration

Parameter	Value	Description; Reference
$\bar{e}_\pi$	0.0148	Elasticity of wage-push w.r.t. inflation expectations for low income; Tables 4, 5
$\bar{e}_\pi$	0.0388	Elasticity of wage-push w.r.t. inflation expectations for high income; Tables 4, 5
γ	0.895	Nominal wage stickiness; low income passthrough in Table 4
γ	0.8515	Nominal wage stickiness; high income passthrough in Table 4
ζ_w	0.6	Wage indexation to past inflation; low income passthrough in Table 4
ζ_w	0.35	Wage indexation to past inflation; high income passthrough in Table 4
β	0.99	Discount factor; corresponds to a quarterly real rate of 1.01%
φ	10	Labor supply elasticity of 0.1; as in Trigari (2006)
σ	1.38	Risk aversion; posterior mean found in Smets and Wouters (2007)
ϱ	0.71	Degree of external habit; posterior mean found in Smets and Wouters (2007)
κ_h	107.2023	Scaling factor to labor disutility; targets $h = 1/3$
α	0.66	Labor elasticity of production; matches labor share of about 60%
κ	0.0004	Vacancy posting costs; reconciles m with $u = 0.042$ and $v = 0.07$
z	2.1554	Steady-state technology; matches with $y = 1$
Φ^K	0.3042	Imputed share of capital in revenue; matches with capital income share
Φ^h	0.0104	Fixed costs linked to labor; matches with y and h
ε	11	Price markup; conventional markup of 10%
ω	0.65	Calvo price stickiness; posterior mean found in Smets and Wouters (2007)
ζ_p	0.3	Price indexation to past inflation
ϕ_π	1.5	Response to inflation; conventional Taylor rule
$\phi_{\Delta y}$	0.5	Response to output growth; conventional Taylor rule
ϕ_R	0.8	Interest rate rule smoothness; conventional Taylor rule
$\bar{\pi}$	1	Inflation target
$\bar{g}$	0.2	Steady-state government spending; US government spending as share of GDP
b	0.2505	Unemployment benefits; matches replacement rate of 0.4
ρ_{shock}	0.9	Autocorrelation of every shock
σ_{shock}	1	Standard deviation of every shock

G Calibration Strategy for Nominal Wage Stickiness

Solving the model under full information rational expectations, the minimum state variable solution is given by

$$\hat{X}_t = A\hat{X}_{t-1} + B\mathcal{E}_t \text{ , } \mathcal{E}_t \sim MN(0,\Sigma) \tag{G.1}$$

where $\hat{X}_t$ is a vector of size $n_x \times 1$ containing the model's endogenous variables in deviations from their steady-state values; $\mathcal{E}_t$ is a vector of size $n_e \times 1$ containing the exogenous shock innovations; and Σ is the covariance (diagonal) matrix of $\mathcal{E}_t$.

In the presence of one-time innovations occurring in period $t = 0$, $\mathbb{E}_t\hat{x}_{t+h} = \hat{x}_{t+h}$ for any $t \geq 0$. Following a one-time shock innovation in period t, inflation expectations are described by:

$$\widetilde{\mathbb{E}}_t\hat{\pi}_{t+h} = (1-\lambda)\hat{\pi}_{t+h} \tag{G.2}$$

Let $A_{w:}$ denote the row in matrix A located in the same position as the real wage in $\hat{X}_t$, $A_{:\pi}$ denote the column in matrix A located in the same position as inflation in $\hat{X}_t$, $A_{x_k x_j}$ be the element in A whose row is the same x_k's and column the same as x_j's in $\hat{X}_t$. Then, expectations about nominal wage growth, $(\hat{W}_{t+7} - \hat{W}_{t+3})$, are given by:

$$\begin{aligned}
\widetilde{\mathbb{E}}_t(\hat{W}_{t+7} - \hat{W}_{t+3}) &= \widetilde{\mathbb{E}}_t\left(\hat{w}_{t+7} - \hat{w}_{t+3} + \hat{P}_{t+7} - \hat{P}_{t+3}\right) = \mathbb{E}_t\left(\hat{w}_{t+7} - \hat{w}_{t+3}\right) + \widetilde{\mathbb{E}}_t\sum_{j=4}^{7}\hat{\pi}_{t+j} \\
&= \left(\hat{w}_{t+7} - \hat{w}_{t+3}\right) + (1-\lambda)\sum_{j=4}^{7}\hat{\pi}_{t+j} \\
&= A_{w:}A\hat{X}_{t+5} - \hat{w}_{t+3} + (1-\lambda)(\hat{\pi}_{t+4} + \hat{\pi}_{t+5}) + (1-\lambda)\left(A_{\pi:} + A_{\pi:}A\right)\hat{X}_{t+5}
\end{aligned} \tag{G.3}$$

Note that

$$\frac{\partial\hat{X}_{t+5}}{\partial\hat{\pi}_{t+4}} = A_{:\pi}$$

Therefore,

$$\frac{\partial\widetilde{\mathbb{E}}_t(\hat{W}_{t+7} - \hat{W}_{t+3})}{\partial\widetilde{\mathbb{E}}_t\hat{\pi}_{t+4}} = \frac{a_1 - a_2}{1-\lambda} + 1 + a_3$$

where $a_1 = A_{w:}AA_{:\pi}$, $a_2 = A_{w\pi}(A_{\pi:}A_{:\pi})^{-1}$, and $a_3 = A_{\pi\pi} + A_{\pi:}(I + A)A_{:\pi}$.

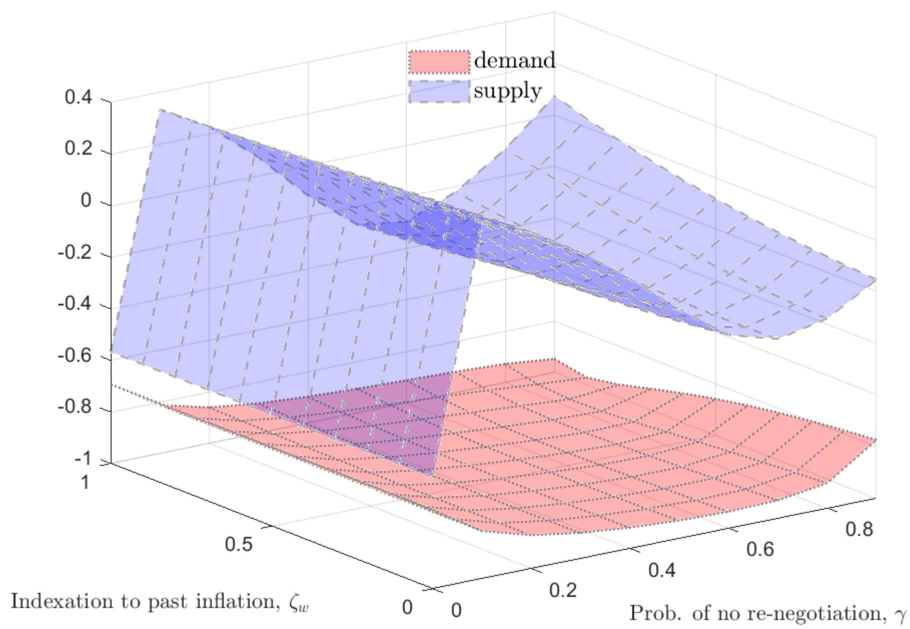
H Correlation between Inflation and Utility Expectations

For a set of (γ, ζ_w) pairs, we compute the model-implied correlation between expected period-utility and inflation expectations, conditional on the economy being shocked by only demand innovations or cost-push innovations, that is:

$$C_x = \frac{\mathbb{E}\left[\mathbb{E}_t(\mathcal{U}_{t+1})\widetilde{\mathbb{E}}_t(\hat{\pi}_{t+1})|\epsilon_t^x\right]}{\sqrt{\mathbb{E}\left[\mathbb{E}_t(\mathcal{U}_{t+1}|\epsilon_t^x)^2\right]\mathbb{E}\left[\widetilde{\mathbb{E}}_t(\hat{\pi}_{t+1}|\epsilon_t^x)^2\right]}} \tag{H.1}$$

where ϵ_t^x denotes the innovation to shock x. Figure 8 shows the surfaces of the computed correlation in (H.1) for various pairs of (γ, ζ_w). The surfaces seem to vary substantially more with nominal wage rigidity in the extensive margin (γ) than the intensive margin (ζ_w).

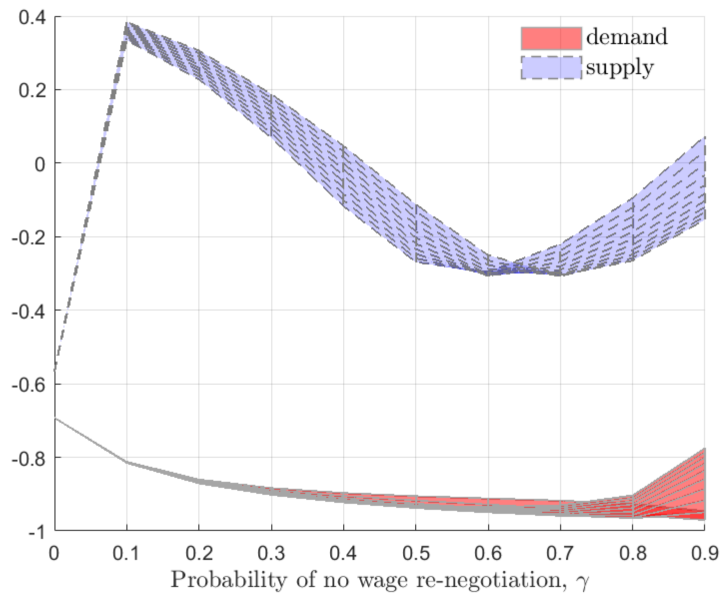
Figure 8: Correlation between $\mathbb{E}_t\mathcal{U}_{t+1}$ and $\widetilde{\mathbb{E}}_t\hat{\pi}_{t+1}$



Notes: In blue: cost-push shock; in red: demand shock.

To better understand the relationship between C_x and nominal wage rigidity, we project the 3-dimensional figure on the (γ, C_x) plane in Figure 8. Subject to cost-push shocks, the relationship between expected utility and inflation is clearly non-monotonic in γ, and it takes negative as well as positive values. On the other hand, conditional on demand innovations, the relationship between expected utility and inflation remains always negative, and it tends to decline with γ.

Figure 9: Correlation between $\mathbb{E}_t \mathcal{U}_{t+1}$ and $\widetilde{\mathbb{E}}_t \hat{\pi}_{t+1}$

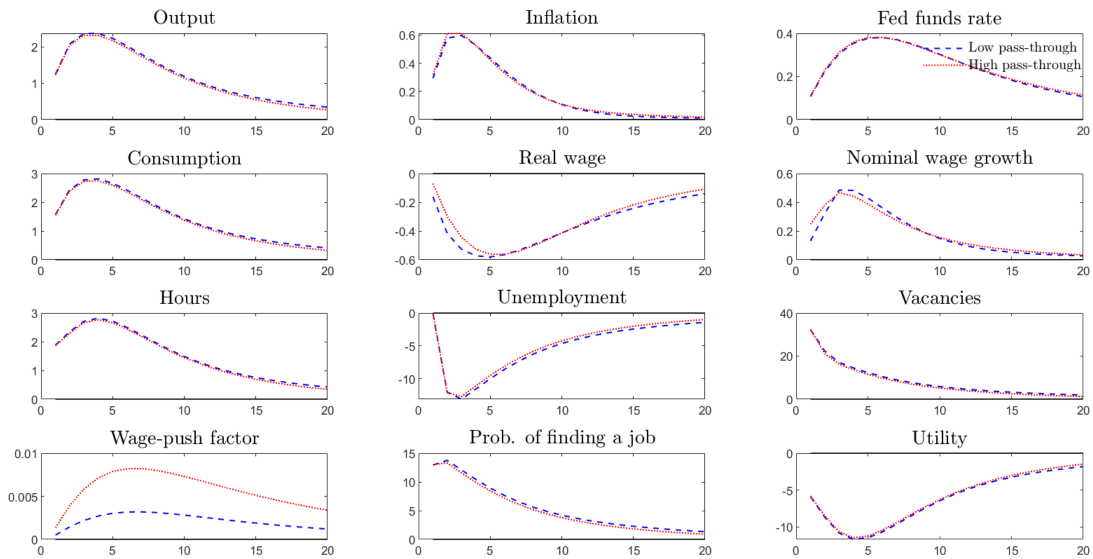


Notes: In blue: cost-push shock; in red: demand shock.

I Additional Impulse Response Functions

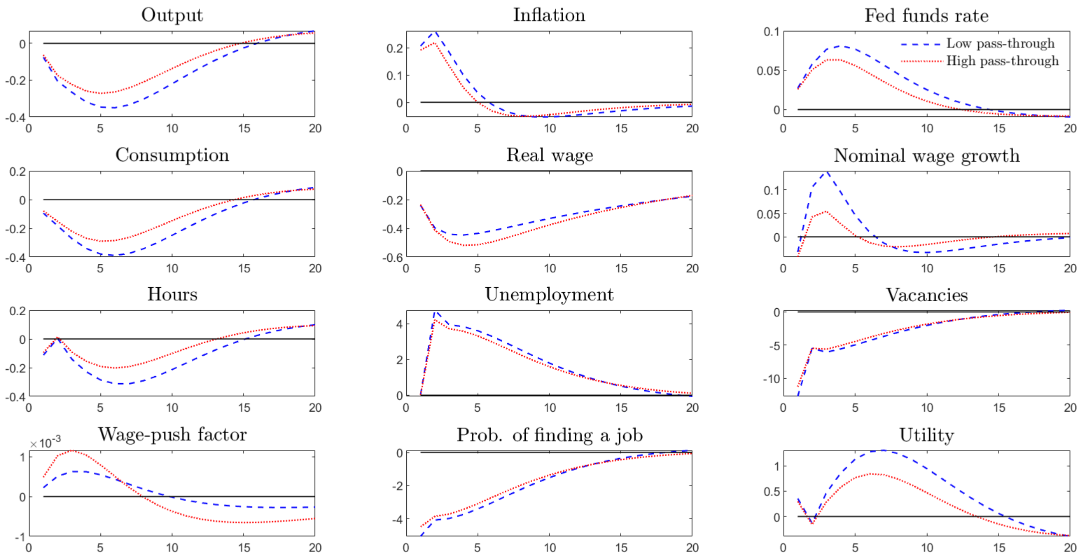
We present here the IRFs of key macroeconomic variables to a one standard deviation positive demand shock and a one standard deviation positive cost-push shock for calibrations that match the passthrough of inflation expectations to income growth expectations for high- and low-income respondents. We note that the gap between the IRFs with low versus high passthrough is siginificantly more noticeable when the economy is shocked with a demand innovation relative to a supply innovation.

Figure 10: Response to a Positive Demand Shock



Notes: In dotted red: calibration matching our empirical passthrough from inflation to nominal wage growth expectations for high-income consumers ($\gamma = 0.8515, \zeta_w = 0.35$). In dashed blue: calibration matching our empirical passthrough from inflation to nominal wage growth expectations for low-income consumers ($\gamma = 0.895, \zeta_w = 0.6$). In black: x axis.

Figure 11: Response to a Positive Cost-Push Shock



Notes: In dotted red: calibration matching our empirical passthrough from inflation to nominal wage growth expectations for high-income consumers ($\gamma = 0.8515, \zeta_w = 0.35$). In dashed blue: calibration matching our empirical passthrough from inflation to nominal wage growth expectations for low-income consumers ($\gamma = 0.895, \zeta_w = 0.6$). In black: x axis.