How do supply shocks to inflation generalize? Evidence from the pandemic era in Europe*

Viral V. Acharya
NYU Stern, CEPR, ECGI, NBER

Matteo Crosignani
New York Fed, CEPR

Tim Eisert
Nova School of Business and Economics, CEPR

Christian Eufinger
IESE

July 2025

Abstract

We document how the interaction of supply chain pressures, elevated household inflation expectations, and firm pricing power contributed to the pandemic-era surge in consumer price inflation in the euro area. Initially, supply chain disruptions raised inflation, particularly in manufacturing through a cost-push channel, while also elevating inflation expectations. In turn, higher inflation expectations appear to have lowered the price elasticity of consumer demand and strengthened firms' pricing power, enabling even firms in service sectors, that were initially unaffected by supply constraints, to raise markups. Through this expectations mechanism, localized inflation in sectors sensitive to supply-side shocks generalized into broad-based inflation.

JEL: E31, E58, D84, L11.

Keywords: inflation expectations, euro area, firm markups, market power, supply chain.

*We thank Filippo De Marco, Marco del Negro, Michael Weber, Gil Nogueira, Yang Liu, and Lars Norden, as well as seminar and conference participants at Yale, Western Finance Association Annual conference, Catolica Lisbon, the Federal Reserve Bank of New York, the Bank of Italy, the European Central Bank, Norges Bank, NHH Bergen, the Danish Central Bank, University of Padova, IESE, CEPR Luiss Finance Workshop, Banco de Portugal, CEPR Conference on Financial Intermediation, the "Heterogenous Households, Firms and Financial Intermediaries: Theoretical Insights and Validation with Microdata" conference (Norges Bank), and the CEPR Paris Symposium for valuable comments. We thank Lily Gordon and Jasper Yang for excellent research assistance. The views expressed in this paper are those of the authors and do not necessarily represent those of the Federal Reserve Bank of New York, the Federal Reserve System, or any of their staff. Emails: Viral V. Acharya (vva1@stern.nyu.edu); Matteo Crosignani (matteo.crosignani@ny.frb.org); Tim Eisert (tim.eisert@novasbe.pt); Christian Eufinger (ceufinger@iese.edu). First draft: October 2023.

1 Introduction

"Elasticity is a relative thing. Elasticity is lower where there's high levels of price inflation across the market. So we measure a relative price position. We are the price leader. Competition is following in pricing, and we're measuring that."

— Graeme Pitkethly (Unilever CFO), Q4 2021 Earnings Call, 10 February 2022.

In response to the outbreak of the COVID-19 pandemic in March 2020, governments and central banks implemented substantial stimulus measures to avert a deep recession. The global economy and aggregate demand rebounded rapidly, leading to a rise in inflation (see Reis, 2022a). Throughout 2021 and 2022, additional supply-side shocks intensified inflationary pressures. Notably, new pandemic waves and the resultant restrictions on economic activity put severe strain on global value chains, resulting in shortages across various sectors. Moreover, energy prices began to climb in 2021 and surged dramatically in early 2022, following the Russian invasion of Ukraine, causing inflation rates to reach their highest levels in four decades in many countries across the globe, and in particular in the euro area. Initially, these supply-side shocks exerted more inflationary pressure on directly affected sectors such as manufacturing (see Figure 1). However, despite a later easing of these shocks, inflation became increasingly generalized across the entire European economy, extending even to sectors not directly impacted by the supply constraints, such as services.

Using several cross-sectional and time-series tests, we show how supply chain pressures, household inflation expectations, and firm pricing power interacted to fuel the pandemic-era surge, and eventual generalization, of consumer price inflation in the euro area. Our findings are consistent with the sequence of effects illustrated in Figure 2.

First, we document localized cost pass-through effects from supply chain constraints (left panel), which started rising in late 2020/early 2021, on prices—particularly in sectors directly affected by these disruptions (mostly manufacturing). Second, we demonstrate that these localized supply constraints also contributed to a rise in household inflation expectations,

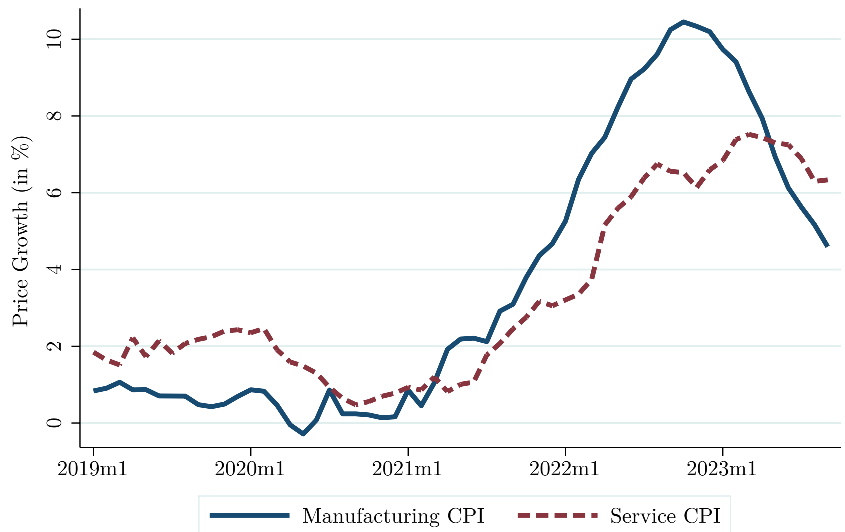

Figure 1: Manufacturing and service consumer price inflation. This figure shows the average CPI growth for manufacturing and service products. Source: Eurostat.

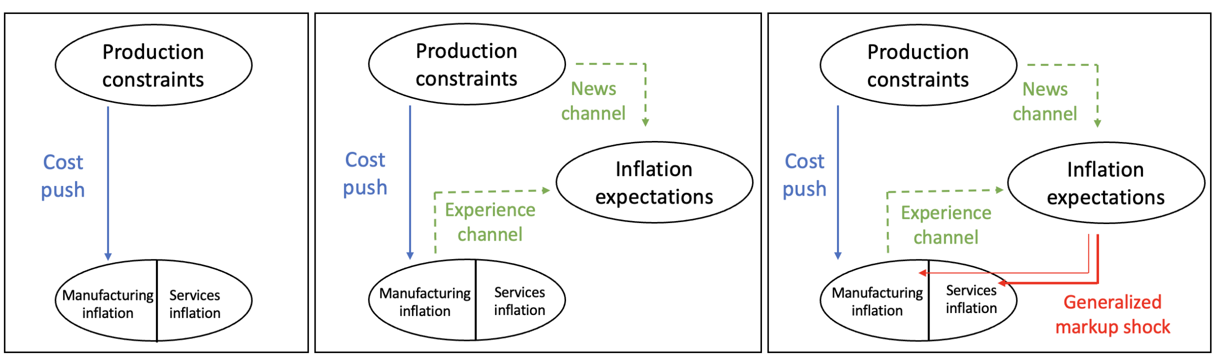

Figure 2: From supply chain constraints and *localized* inflation to high inflation expectations and *generalized* inflation. This figure shows the main channels at the core of our analysis. The left panel shows how production constraints might affect inflation through a cost-push channel. The middle panel shows how production constraints and inflation might increase inflation expectations. The right panel shows how inflation expectations might contribute to the rise in generalized inflation.

which started to increase in early 2021 (middle section). Households, observing higher prices in their own consumption baskets through the *experience channel* (e.g., D'Acunto et al., 2021) and receiving news about supply-side shocks—such as cargo ship delays signaling rising costs—via the *news channel* (e.g., Larsen et al., 2021), revised their inflation expectations in anticipation of broader increases in costs and prices. Ultimately, these elevated inflation expectations appear to have facilitated a pass-through to broad-based inflation, which began to emerge in the second half of 2021; that is, higher inflation even in sectors not initially affected by supply-side cost shocks (mostly services). Taken together, our analysis suggests that elevated household inflation expectations act as the key transmission channel through which localized inflationary shocks evolve into broader-based inflation.

A potential explanation for the mechanism is as follows: Following supply-side disruptions, households face a challenging signal extraction problem, needing to determine whether the shock and the resultant cost and price increases are local or widespread, which influences their price search efforts and consumption choices (Benabou and Gertner, 1993; Fishman, 1996; Gaballo and Paciello, 2022). When these shocks are perceived as common and widespread—aligned with elevated inflation expectations—households tend to search less for better deals, leading to higher reservation prices and lower price elasticity of demand. As noted by Unilever's CFO, "elasticity is lower where there's high levels of price inflation across the market." This behavior allows even firms not materially affected by supply-side disruptions to sustain higher markups without significant losses in sales. Our results can thus be seen as a tangible manifestation of "excuseflation."[1]

To conduct our tests, we combine several data sets at various units of observation. At

[1]This term captures the idea that sellers may exploit unusual, opaque disruptions that appear broad or systemic in the eyes of consumers to raise prices (Bloomberg, *"How 'Excuseflation' Is Keeping Prices—and Corporate Profits—High"*, March 9, 2023).

the industry-country-time level, we observe (i) firms' production constraints from the Joint Harmonised EU Programme of Business and Consumer Surveys (BCS), and (ii) energy consumption data from Eurostat. At the country-time and at the household-time level, we observe inflation expectations from the BCS and the European Central Bank (ECB) Consumer Expectations Survey (CES), respectively. At the product-country-time level, we observe Consumer Price Index (CPI) data from Eurostat. Finally, at the firm-time level, we examine pricing strategies extracted from earnings call transcripts obtained from the LSEG Workspace Transcripts & Briefs database along with financial data from Compustat Global and Bureau van Dijk's Orbis, which we use to estimate firm markups.

Our analysis is structured in five parts. First, using a stringent fixed effects framework with product-country, country-time, and product-time fixed effects, we document the pass-through of supply chain constraints to price levels, particularly in manufacturing sectors, consistent with a cost-push channel: product-country pairs facing greater supply constraints exhibit higher CPI growth during the COVID-19 pandemic period. An instrumental variable (IV) estimation supports a causal interpretation of this finding. Specifically, we instrument a market's degree of supply chain disruptions with its firms' pre-COVID reliance on imports from China paired with Chinese province-time level data on lockdown stringency. We employ granular energy consumption and price data to isolate—and confirm robustness of—the impact of supply chain frictions on inflation from the impact of the contemporaneous surge in energy costs.

Second, we show that supply chain constraints feed into broad-based inflation expectations. Specifically, we find a positive association between the prevalence of supply chain constraints in a country with both (i) the share of households with elevated inflation expectations in that country, and (ii) individual short-term (one-year-ahead) and long-term household inflation (three-year-ahead) expectations. We further substantiate the causal link between supply chain disruptions and rising household inflation expectations using, again, the IV strategy based on the lockdown-induced trade shock. The household-time level estimation further shows that households more aware of realized inflation during the initial cost-push phase expect CPI growth to increase more when reported supply chain constraints tighten—and this relationship is particularly pronounced in countries with greater exposure to salient information about supply chain disruptions. Our results support both the experience and the news channel of household expectation formations.

Third, we find evidence consistent with elevated household inflation expectations facilitating a generalization of inflation to firms in service sectors—that is, markets not directly exposed to supply chain constraints. In particular, using again our stringent fixed effects framework with product-country, country-time, and product-time fixed effects, we document that in countries with elevated household inflation expectations, products with a higher contribution from service sectors exhibit higher relative CPI growth in 2022 compared to similar products in countries with less pronounced inflation expectations. To further ensure this effect is not driven by demand factors, we employ several additional controls: (i) we account for potential pent-up demand by controlling for country-level energy costs and the intensity of lockdown measures during the COVID-19 pandemic; (ii) we include product-country-time fixed effects at the 1-digit COICOP level to absorb the impact of broader demand shocks on product categories; and (iii) we control for demand shifts across different product categories using data on final consumption expenditure of households at the product-country-time level.

We further show that the generalization effect is robust to controlling for potential delays in supply shock transmission along the supply chain, i.e., delayed upstream cost-push spillovers do not drive the generalization. Moreover, based on a sample split between countries with high and low collective bargaining coverage, the effect does not appear to reflect firms anticipating rising labor costs.

We then examine the role of firms' pricing behavior in the generalization of inflationary pressures and how it is shaped by household inflation expectations, firms' pricing power, and their interaction. First, we show that the generalization of inflation is driven by industry-country pairs where firms have significant market power. We then combine firm-level financial data and estimated markups—following Loecker and Warzynski (2012)—with a systematic analysis of company earnings call transcripts using a Large Language Model (OpenAI's GPT-4o) to link elevated household inflation expectations to firms' ability to sustain higher markups through increased pricing power. In line with our proposed mechanism, we find that executives of firms in countries with elevated household inflation expectations more frequently reference pricing power due to resilient demand—an indicator of a low consumer price sensitivity—compared to executives in countries with lower inflation expectations. Moreover, such references are predictive of higher markups in the subsequent quarter, while mentions of pricing power in combination with scarcity-driven factors that also contribute to increased costs (i.e., supply chain disruptions, labor constraints, or energy costs) are less frequent and generally not associated with markup increases.

Next, we examine how this dynamic differs across sectors. In 2022, once supply constraints had eased but inflation expectations were still elevated, service-sector firms citing pricing power associated with resilient demand were able to catch up to manufacturing firms in their price increases. This provides further evidence that pricing power linked to resilient demand played a key role in driving the generalization of inflation across the economy.

In a final step, we further explore how firms' pre-pandemic pricing power interacts with elevated household inflation expectations in shaping firms' markup strategies. Consistent with our findings based on company earnings call transcripts, we find that in countries with elevated household inflation expectations, firms with higher pre-COVID pricing power sustained relatively higher markups and EBITDA margins in 2022 than similar firms in countries with more stable inflation expectations. This pattern holds using firm-level data from both Compustat Global and Bureau van Dijk's Orbis, demonstrating that the result applies not only to large publicly listed firms—used in our LLM-based analysis—but also to a broader, more representative population that includes private and smaller firms. These findings suggest that the interaction between inflation expectations and firm-level pricing power can amplify and propagate inflationary pressures throughout the broader economy.

Overall, our results suggest that opaque cost shocks—such as the one caused by supply-side disruptions during the COVID-19 pandemic—can lead households to anticipate a broad-based increase in input costs and prices. This, in turn, can give pricing power even to firms not directly affected by the initial shock, allowing localized inflationary pressures to spread into broad-based inflation. As inflation began to rise in 2021, central banks initially tolerated the elevated inflation levels under the assumption that the supply shocks were transitory in nature. However, our results highlight that supply-side shocks that lead to a de-anchoring of inflation expectations can trigger a disproportionate, widespread, and persistent surge in actual inflation—operating through a rise in firms' pricing power.

Related literature. The literature on supply-side factors and their connection to inflation and inflation expectations covers several interconnected areas of research, including (i) the effect of supply shocks on prices, (ii) the formation of inflation expectations, and (iii) the relationship between inflation and inflation expectations.

A variety of studies has investigated the impact of supply-side frictions on prices and price expectations. In the theoretical literature, Alessandria et al. (2022) and Kalemli-Ozcan et al. (2022) model the aggregate effects of supply chain shocks during the COVID-19 pandemic. Bilbiie and Känzig (2023) investigates the interplay of corporate profits and income distribution in shaping inflation and aggregate demand. In the empirical literature, Carriere-Swallow et al. (2022) and Jiménez-Rodríguez and Morales-Zumaquero (2022) examine the effects of global shipping costs and commodity prices, respectively, on domestic prices and inflation expectations. Benigno et al. (2022) and Bai et al. (2024) propose new indices to capture global supply chain pressures and their impact on inflation.[2]

[2] There is also a growing body of country-specific research on the effects of supply-side factors on inflation (Isaacson and Rubinton, 2022; Amiti et al., 2022; Ball et al., 2022; Anayi et al., 2022; Bernanke and Blanchard, 2023; Comin et al., 2023; Finck and Tillmann, 2022; Celasun et al., 2022; Binici et al., 2022).

More closely related to our paper, Franzoni et al. (2023) focuses on the role of market power in the propagation of the initial cost-push shock. The authors provide evidence that supply chain constraints can help explain about 19% of the U.S. inflation in industries with more asymmetric firm size distribution, where supply chain shortages are more likely to benefit large firms at the expense of smaller firms. Similarly, Bräuning et al. (2022) investigates the effect of market concentration on the pass-through of cost shocks into prices in the U.S., suggesting that increased industry concentration may amplify local inflationary pressures. We contribute to this literature by showing that supply-side shocks can *interact* with household inflation expectations and firm pricing power, leading to broad-based inflation.

More generally, our paper is also related to the literature on the formation of inflation expectations and their link to household behavior, firm behavior, and inflation. Weber et al. (2022) reviews the literature on inflation expectations, highlighting systematic upward bias, large disagreements, high forecast uncertainty, deviations from professional forecasters, joint short-long term adjustments (suggesting potential "unanchoring"), inattention in stable economies, and varied expectations across countries. Moreover, there is a large body of work on how inflation expectations affect households' economic decisions (Crump et al., 2022; Dräger and Nghiem, 2021; D'Acunto et al., 2022; Ichiue and Nishiguchi, 2015; Duca-Radu et al., 2021; Armantier et al., 2015; Malmendier and Nagel, 2016; Coibion et al., 2023). Our paper adds to this literature by providing evidence that elevated household inflation expectations are a key transmission channel through which inflation generalizes in response to localized inflationary cost shocks.

2 Data and stylized facts

In this section, we outline our data sources (Section 2.1) and highlight key stylized facts that characterize the post-pandemic inflationary environment in the euro area (Section 2.2).

2.1 Data sources

Our analysis is based on several data sets for the euro area from 2019:Q1 to 2022:Q4. We use data about (i) firms' production constraints; (ii) household inflation expectations; (iii) CPI growth, (iv) firm financials; and, (v) corporate earnings call transcripts. In Appendix OA.1, we provide a detailed explanation of our data sources and explain how we process and transform the data. Below, we summarize the key datasets used.

Joint Harmonised EU Programme of Business and Consumer Surveys (BCS). We obtain information about firms' production constraints at the industry-country-time level and household inflation expectations at the country-time level from the BCS conducted by the European Commission's Directorate-General for Economic and Financial Affairs (DG ECFIN). These surveys are conducted on a monthly and quarterly basis, covering 37,990 corporations across the manufacturing, services, retail trade, and construction industries, as well as 31,810 households from the 27 EU member countries.

The use of survey data to gauge constraints to firms' production stemming from supply chain disturbances offers two key advantages: (i) Survey data offers more immediate and direct evidence regarding firms' production constraints compared with raw supply chain data, which may not fully capture their extent due to firms' ability to adapt, either through sourcing alternative material inputs or adjusting their supply chains; (ii) Survey data about constraints to production can serve as a leading indicator for increases in supply-side costs since firms often anticipate the impact of supply shocks, such as container ship congestion, before they translate into a tangible material shortage.

ECB Consumer Expectations Survey (CES). Furthermore, we use newly available anonymized household-time level inflation expectations microdata from the CES launched in 2020. Its sample covers six key euro area countries: Belgium, France, Germany, Italy, Spain, and the Netherlands, and it is representative of the euro area population (Bańkowska et al., 2021). A total of 18,492 distinct respondents participated in the 12 CES waves and households appear repeatedly in the survey, allowing us to compare responses of the same household over time.

Other data sources. We obtain monthly data on consumer prices at the product-country-time level, industry-country-time level data on energy input use, country-time level data on energy prices, and country-time level data on government and household expenditures from Eurostat. For our Large Language Model (LLM) analysis, we use OpenAI's GPT-4o model to analyze earnings call transcripts from the LSEG Workspace Transcripts & Briefs database (see Section 5.2 for more details). Finally, we obtain firm-time level financial data from Compustat Global and Bureau van Dijk's Orbis to estimate firm markups, and leverage Google Trends data as a proxy for households' information acquisition.

2.2 Stylized facts: From localized to generalized inflation

The COVID-19 pandemic triggered a contemporaneous surge in supply chain disruptions, inflation, and inflation expectations across the euro area.

The top panel in Figure 3 shows that firms began reporting significant shortages of material inputs in 2021:Q1, followed by less pronounced labor shortages from 2021:Q2 onward. Both production constraints began easing by 2022:Q1 and 2022:Q3, respectively. Supply chain shocks often prompt producers to raise prices to protect profit margins in response to challenges in sourcing materials and elevated input costs. Consistent with this mechanism, the CPI began to rise in 2021:Q1, peaking in October 2022 (see Figure OA.1). Although price increases may propagate through firm-to-firm linkages, the initial *cost-push* inflationary impulse remained primarily confined to products in sectors directly affected by the supply-side shock, such as manufacturing.

Then, starting in the second half of 2021, localized inflation in supply-sensitive sectors gave way to a more widespread inflationary environment, with even sectors not directly affected by supply chain disruptions, such as services, experiencing high inflation rates (see

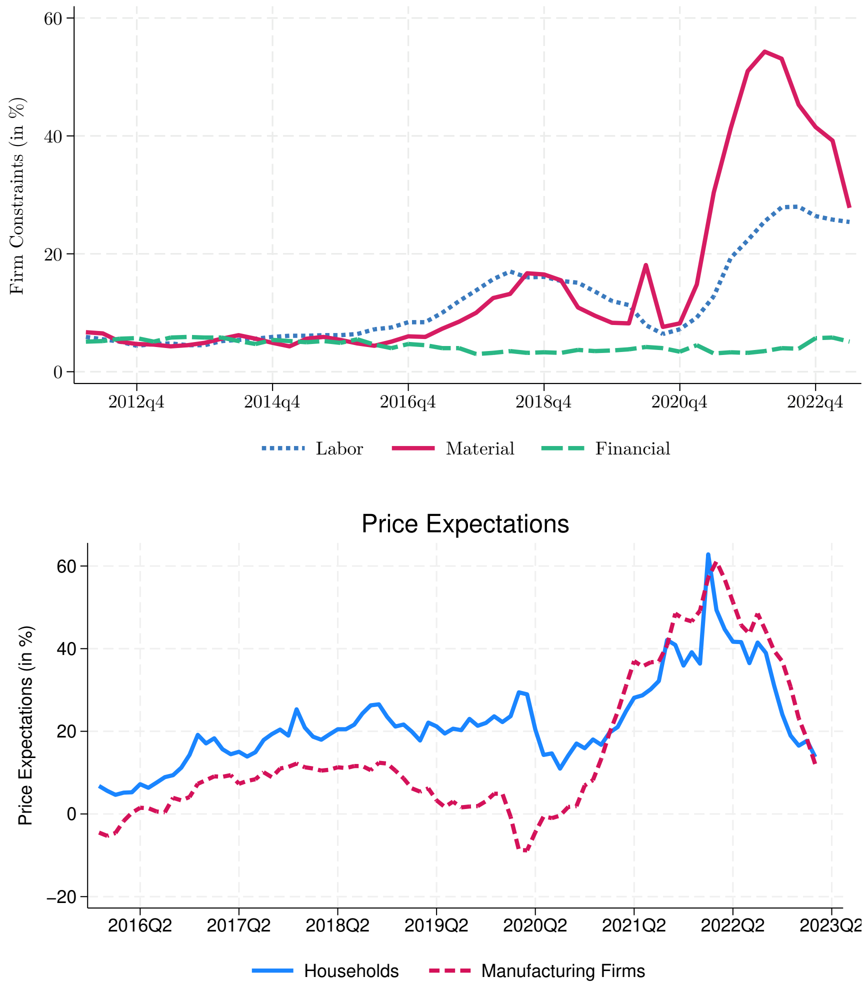

Figure 3: Production constraints and rising inflation expectations. The top panel shows the share of firms answering the following survey question: *"What main factors are currently limiting your production?"* as follows: (i) shortage of labor, (ii) shortage of material/equipment, (iii) financial constraints. The data runs at a monthly frequency from January 2016 to April 2023 and is obtained from the BCS firm survey for 27 EU countries, where the unit of observation is industry-country. The bottom panel shows the evolution of households' and manufacturing firms' inflation expectations over time. These expectations are measured as the share of households/firms expecting prices to increase more rapidly minus share of households/firms expecting inflation to fall over 12 months (for households) and 3 months (for manufacturing firms). The data source is the monthly survey on euro area households' and firms' inflation expectations.

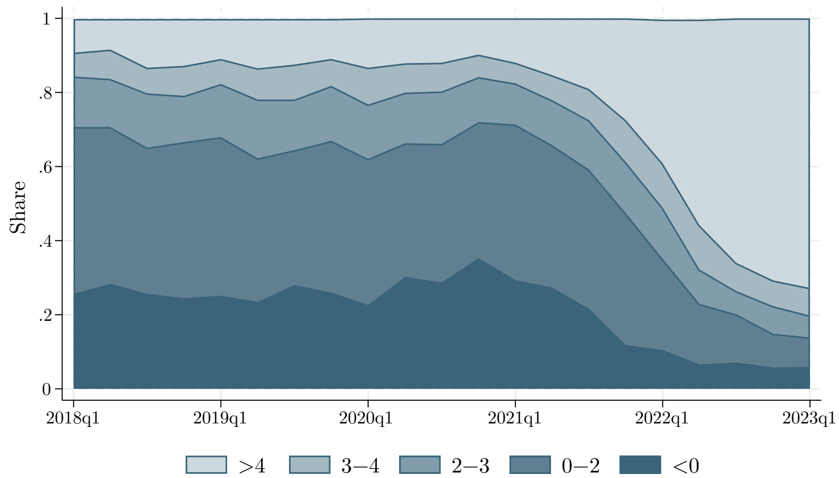

Figure 4: Localized inflation in 2021 becomes broad-based in 2022. The figure provides a visual representation of inflation trends at the product-country-time level in the euro area. Each shaded area shows the share of product-country pairs that, in each quarter, have a specific CPI year-over-year growth as outline in the legend.

Figure 4). While by late 2021, CPI year-over-year growth was 5%, with 27% of products experiencing inflation above 4% and 50% below 2%, by the end of 2022, CPI had risen to 9%, with 70% of products exceeding 4% inflation.[3]

This generalization can plausibly be explained by an interplay between supply-side disruptions, household inflation expectations and purchasing behavior, and firm pricing power. While their immediate cost-push effect is localized, supply-side constraints can increase inflation expectations when households experience higher prices and observe news coverage about the supply shocks (e.g., D'Acunto et al., 2021; Larsen et al., 2021). As supply chain disruptions intensified, both households and firms began to expect higher inflation (see the bottom panel of Figure 3).[4] However, households face a difficult signal extraction problem

[3]Figure OA.2 confirms this transition to generalized inflation, displaying the survey-based measure of supply chain constraints alongside an "inflation diffusion" index, which assigns values of 0, 50, and 100 to product-quarters with annual inflation below 2%, between 2% and 4%, and above 4%, respectively. Despite easing supply chain bottlenecks in 2022, the index continued to rise as inflation became more broad-based.

[4]These expectations are measured as the share of households or firms expecting prices to increase more rapidly minus the share of households or firms expecting inflation to fall over the next 12 months for

in response to supply shocks: they must assess whether the disruptions affect only specific producers or are common across many suppliers, in order to make optimal decisions about how much effort to invest in understanding price distributions across firms and products, which in turn shapes their consumption choices.

Search theory (Benabou and Gertner, 1993; Fishman, 1996; Gaballo and Paciello, 2022) suggests that consumers perceiving a supply-side shock as widespread (i.e., a common shock affecting many suppliers), a perception aligned with generalized inflation expectations (Dietrich, 2024), reduce their effort to seek better deals elsewhere when confronted with high prices. This translates into higher reservation (acceptance) prices and a lower price elasticity of demand; that is, households become less "choosy" and tend to enter into less adequate transactions. Consequently, *all* firms, even those not directly affected by the initial supply chain disruptions, can "hide" behind aggregate cost and inflationary noise to maintain, or even raise, their markups without risking a considerable decline in sales.

Our empirical analysis provides evidence supporting this transition from localized to generalized broad-based inflation via household expectations and firms' pricing power.

3 Pass-through of supply chain constraints

We start by presenting evidence consistent with a post-COVID pass-through of supply chain disruptions to price levels through a cost-push channel (Section 3.1) and to household inflation expectations (Section 3.2).

households and 3 months for firms (see Weber et al., 2022; D'Acunto and Weber, 2024).

3.1 Pass-through to localized inflation

We first document the initial *localized* cost-push inflationary impulse using cross-sectional variation in supply chain disruptions at the product-country level, and confirm this relationship with an IV strategy that isolates exogenous variation in supply shocks.

Baseline analysis. We test the effect of increasing supply chain pressures (as perceived by firms) on CPI growth by estimating the following specification at the product-country-quarter level:

$$\Delta CPI_{pct+1} = \beta_1 Material_{pct} + \mu_{pc} + \nu_{ct} + \xi_{pt} + \epsilon_{pct}, \tag{1}$$

where p is a product, c is a country, and t is a quarter. $Material_{pct}$ measures the share of firms producing product p for the market in country c indicating that their production is constrained by supply chain bottlenecks. The sample period spans 2019:Q1 to 2022:Q4 at a quarterly frequency. We measure the CPI growth in quarter t as the yearly CPI growth from quarter $t-3$ to quarter $t+1$. This approach allows us to gauge the effect of our independent variable of interest ($Material_{pct}$) in quarter t on the one-quarter ahead dependent variable of interest (ΔCPI_{pct+1}), while accounting for seasonality by taking the same quarter in the previous year as base year for the growth calculation.

In our most stringent specification, we include product-country (μ_{pc}), country-quarter (ν_{ct}), and product-quarter (ξ_{pt}) fixed effects, which allows us to isolate the effect of firms' supply constraints while holding constant time-varying demand at both the country and product levels. Specifically, the country-quarter fixed effects absorb all national shocks that might influence prices (e.g., country-level demand shocks, energy shocks, government support packages, changes in tax legislation and national regulations). Product-quarter fixed effects account for shocks common to a given product across all countries in a given period, while product-country fixed effects control for time-invariant characteristics specific to each product-country pair. Identification thus comes from variation across countries within the same product and quarter, net of national-level shocks. Specifications including product-quarter fixed effects are particularly demanding, as supply shocks often exhibit high commonality across producers of the same product, leaving limited identifying variation.

Our analysis includes firms in both manufacturing and services. For manufacturing firms, we observe supply chain constraints ($Material_{pct}$), alongside other supply factors ($Labor_{pct}$, $Financial_{pct}$, and $Other_{pct}$). These variables represent the share of firms that report being constrained by each respective factor. For services, we observe shortages in equipment and space ($Equipment_{pct}$), in addition to the constraints $Labor_{pct}$, $Financial_{pct}$, and $Other_{pct}$. We conservatively measure supply chain constraints solely using the $Material_{pct}$ variable, setting this variable to zero for service firms.[5]

The first column of Table 1 shows that supply chain constraints are positively associated with CPI growth. Specifically, a one standard deviation higher supply chain constraint value is associated with a 1.1pp higher annual CPI growth, which suggests a meaningful pass-through of supply-side frictions to consumer prices.

In Column (2), we further control for the contemporaneous energy cost shock by including the interaction term $Energy\ Use_{pc} \times Energy\ Inflation_{ct}$, which allows us to disentangle the effect of supply chain frictions on inflation from the impact of rising energy costs. $Energy\ Inflation_{ct}$ is the time-varying country-level CPI index for energy, capturing the evolution of a country's overall energy costs over time. $Energy\ Use_{pc}$ is an industry-country pair's energy input before the COVID-19 pandemic, measured in 2019 and scaled by the country's total energy use.[6] The year 2019 provides a pre-COVID baseline for energy usage, reflecting

[5] This approach attenuates the estimated magnitude of an eventual supply chain constraint pass-through in the full sample.

[6] Our results are robust to employing the nonscaled energy input level.

	(1) ΔCPI_{pct+1}	(2) ΔCPI_{pct+1}	(3) ΔCPI_{pct+1}	(4) ΔCPI_{pct+1}
Material_{pct}	0.068***	0.066***	0.066***	0.046**
	(0.013)	(0.013)	(0.013)	(0.018)
$\text{Energy Use}_{pc} \times \text{Energy Inflation}_{ct}$		1.311**	1.315**	-0.042
		(0.481)	(0.483)	(0.231)
Labor_{pct}			0.005	-0.023*
			(0.013)	(0.012)
Financial_{pct}			-0.009	-0.007
			(0.014)	(0.012)
Equipment_{pct}			0.006	0.038*
			(0.025)	(0.021)
Other_{pct}			-0.008	-0.004
			(0.010)	(0.007)
Observations	8,515	8,515	8,515	8,515
R-squared	0.504	0.511	0.512	0.675
Country-time FE	✓	✓	✓	✓
Product-country FE	✓	✓	✓	✓
Product-time FE				✓

Table 1: Supply chain constraint pass-through to CPI. This table presents estimation results from Specification (1) The subscript notation is defined as follows: p is a product, c is a country, and t is a quarter. The dependent variable is the one-quarter ahead annual CPI growth at the product-country-time level. $Material_{pct}$, $Labor_{pct}$, $Financial_{pct}$, $Equipment_{pct}$, and $Other_{pct}$ measure the share of firms that indicate that their production is constrained by the respective constraint. All constraints are transformed from the industry-country-time level to the product-country-time level using an input-output table and the share of consumption that each industry contributes to the final household consumption of a particular product. $Energy\ Inflation_{ct}$ is the country-time level CPI index for energy. $Energy\ Use_{pc}$ is a product-country pair's energy input before the COVID-19 pandemic, measured in 2019 and scaled by the country's total energy use. We exclude the product "Energy" from the regression. Standard errors are double-clustered at the country-product and quarterly level and are reported in parentheses. *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

"normal" economic conditions without pandemic-related distortions. Column (2) shows that accounting for energy costs does not significantly alter the coefficient capturing the impact of supply chain frictions, suggesting that, in terms of pass-through to CPI growth, the shocks from supply chain disruptions are largely orthogonal to those from energy costs.

In Column (3), we add controls for other production constraints ($Labor_{pct}$, $Financial_{pct}$, $Equipment_{pct}$, and $Other_{pct}$), while Column (4) includes product-quarter fixed effects. The estimated coefficients on supply chain constraints are stable across the first three specifications, but decrease modestly in the most stringent specification in Column (4), consistent with a reduction in identifying variation due to the high degree of comovement in supply constraints across countries within the same product and quarter.

IV estimation. Next, we conduct an IV regression approach. This analysis serves two purposes: first, to further validate our survey data; and second, to pinpoint exogenous variations in supply chain frictions. Most importantly, it ensures that the reported material constraints are truly a result of supply chain disruptions, rather than capturing rising consumer demand paired with a lack of scalability in material inputs.

We instrument the degree of supply chain disruptions faced by firms selling a given product in a given country with their pre-pandemic reliance on imports from China and their resulting susceptibility to the disruptions caused by COVID-19 lockdowns in China:

$$\widetilde{B}_{pct} = \text{China Dependence}_{pc,2019} \times \text{Lockdown Stringency}_t,$$

where $\textit{China Dependence}_{pc,2019}$ is the share of material inputs that the respective firms imported from China in 2019 to produce and sell product p in country c (using data from Eurostat Figaro), while $\textit{Lockdown Stringency}_t$ measures the severity of lockdown measures implemented in the top-5 exporting provinces of China (Guangdong, Jiangsu, Shandong, Shanghai, and Zhejiang) using data from the Oxford COVID-19 Government Response Tracker project (OxCGRT).[7] Our instrument thus gets all of the cross-sectional variation in the exposure of a product's supply chain to material imports sourced from China, and all of

[7]OxCGRT provides the COVID-19 Stringency Index, a composite measure based on nine response indicators including school closures, workplace closures, and travel bans, rescaled to a value from 0 to 100 (100 = strictest). We focus on lockdowns in the five leading Chinese provinces in export contributions to more precisely capture supply chain disruptions. Note that export volumes do not significantly correlate with the severity of COVID-19-related government policies at the provincial level. For instance, Guangdong, despite being a top exporter, experienced relatively moderate COVID-19 restrictions. Conversely, Xinjiang, with some of the most stringent lockdown measures, ranks low in export volumes. To create the consolidated top-5 export COVID-19 stringency index, we take the average of the province-time level index for the top-5 export provinces, collectively representing 67% of the national export total. See Figure OA.3 for the time-series evolution of this aggregate lockdown stringency index.

	First stage		Second stage	
	(1)	(2)	(3)	(4)
	Material_{pct}	Material_{pct}	ΔCPI_{pct+1}	ΔCPI_{pct+1}
China $\text{Dependence}_{pc,2019}$ × Lockdown Stringency_t	7.023***	3.717***		
	(0.369)	(0.593)		
$\widehat{Material}_{pct}$			0.081***	0.170**
			(0.016)	(0.086)
F-Test	363.06	39.24		
Observations	8,483	8,483	8,483	8,483
R-squared	0.783	0.957		
Controls	✓	✓	✓	✓
Product-country FE	✓	✓	✓	✓
Country-time FE	✓	✓	✓	✓
Product-time FE		✓		✓

Table 2: Supply chain constraint pass-through to CPI: IV estimation. This table presents the estimation results from the IV specification. The subscript notation is defined as follows: p is a product, c is a country, and t is a quarter. The first stage results are shown in Columns (1) and (2), the second stage results in Columns (3) and (4). The dependent variable in Columns (3) and (4) is the one-quarter ahead annual CPI growth at the product-country-time level. $\textit{China Dependence}_{pc,2019}$ represents the share of inputs to produce product p in country c that are imported from China in 2019. $\textit{Lockdown Stringency}_t$ measures the severity of lockdown measures implemented in China's top-5 exporting provinces. Non-reported controls include the other perceived constraints to production ($Labor_{pct}$, $Financial_{pct}$, $Equipment_{pct}$, and $Other_{pct}$) and, in addition, the interaction of $\textit{Energy Inflation}_{ct}$ and $\textit{Energy Use}_{pc}$. $Material_{pct}$, $Labor_{pct}$, $Financial_{pct}$, $Equipment_{pct}$, and $Other_{pct}$ measure the share of firms that indicate that their production is constrained by the respective constraint. All constraints are transformed from the industry-country-time level to the product-country-time level using input-output tables and the share of consumption that each industry contributes to the final household consumption of a particular product. $\textit{Energy Inflation}_{ct}$ is the country-time level CPI index for energy. $\textit{Energy Use}_{pc}$ is a product-country pair's energy input before the COVID-19 pandemic, measured in 2019 and scaled by the country's total energy use. We exclude the product "Energy" from the regression. Standard errors are double-clustered at the country-product and quarterly level. We report standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

its time-series variation from the lockdown-induced disruptions.

Table 2 presents the results of the IV estimation. Columns (1) and (2) report the first-stage regressions, while Columns (3) and (4) present the second-stage results. In Columns (1) and (3), we control for product-country and country-time fixed effects. Columns (2) and (4) adopt the fully saturated specification that additionally includes product-time fixed effects. The instrument has a positive and statistically significant effect on reported material frictions ($Material_{pct}$), with F-statistics well above the conventional threshold of 10 used to rule out weak instruments (Staiger and Stock, 1997).

In the second-stage estimation, we replace the $Material_{pct}$ frictions with the predicted $\widehat{Material}_{pct}$ frictions from the first stage. The dependent variable is again the one-quarter ahead annual CPI growth at the product-country-time level. The IV estimated coefficients confirm the positive effect of an increase in the reported material frictions on CPI growth, suggesting a causal impact of supply chain disruptions on CPI growth.[8] These results are consistent with recent evidence on supply-side disruptions in Europe (Finck and Tillmann, 2022; Binici et al., 2022; Celasun et al., 2022).

3.2 Pass-through to higher inflation expectations

Despite their localized impact on costs and prices, supply-side constraints can generalize into broad-based inflation expectations.[9] This transmission works through two channels: the *experience* channel and the *news* channel. The experience channel operates through the observable effect of supply-side shocks on prices. Agents experiencing price increases tend to revise their inflation expectations, anticipating similar price movements in the future (Cavallo et al., 2017; D'Acunto et al., 2021). The news channel influences inflation expectations through information about economic developments that are perceived to have an impact on prices (Carroll, 2003; Dräger and Lamla, 2017; Larsen et al., 2021; Mazumder, 2021; Andre et al., 2024). For example, following reports about shipping container backlogs at Chinese ports, consumers may anticipate rising production costs and adjust their inflation

[8]The increase in the IV coefficient in Column (4) relative to Column (3) likely reflects the shift in identifying variation induced by the inclusion of product-time fixed effects, which restricts identification to within-product–within-quarter variation across countries. This change narrows the estimator's focus to more localized differences in supply constraints and price responses. Additionally, by absorbing common product-level shocks, this specification may enhance the signal-to-noise ratio in both the regressor and the outcome, yielding a sharper estimate.

[9]Figure OA.4 shows three snapshots of the distribution of one-year-ahead households' inflation expectations. Inflation expectations by households and firms shift to the right and become more fat-tailed in 2021 and especially 2022—mirroring past episodes where inflation expectations became unanchored (Reis, 2022b). Using a representative sample of the U.S. population, Andre et al. (2024) demonstrates that even in the U.S.—a country less exposed to supply-side shocks than Europe—households overwhelmingly identified supply-side factors as key drivers of the inflation surge in late 2021 and 2022.

expectations even before any observable price changes. The most recent evidence on this pass-through shows that U.S. consumers expect tariff policies to significantly affect the prices of both imported and domestically produced goods (Coibion et al., 2025).

To examine the pass-through from supply chain constraints to household inflation expectations, we run three sets of empirical tests: (i) a baseline analysis at the household-quarter level using data from the ECB's CES; (ii) an extended analysis incorporating measures of households' awareness of past inflation and their exposure to salient information about supply chain disruptions; and (iii) complementary evidence at the country-quarter level using BCS consumer survey data.

Household-quarter level analysis. The *household-quarter level* data from ECB's CES allows us to observe households' short-term (one-year ahead) and longer term (three-year ahead) inflation expectations. Accordingly, we employ the following two dependent variables. First, a dummy variable set to one if household h anticipates a significant price increase over the next 12 months. Second, a dummy variable set to one if household h expects a substantial price rise during the 12-month period starting two years from now and ending three years from now.

To formally gauge the impact of supply chain disruptions on inflation expectations at the household-quarter level, we estimate the following specification:

$$\begin{aligned}\hat{\pi}^e_{hct} =& \beta_1 Material_{ct} + \beta_2 Food\ Inflation_{ct} + \beta_3 Energy\ Inflation_{ct} + \beta_4 Core\ Inflation_{ct} \\ &+ \beta_5 Perceived\ (realized)\ Inflation_{hct} + Controls_{ct} + \mu_{hc} + \nu_t + \epsilon_{hct}, \end{aligned} \tag{2}$$

where h is a household, c is a country, and t is a quarter. We control for realized inflation, decomposed into core, energy, and food inflation, given that the latter two have been highlighted as strong drivers of household inflation expectations (Coibion and Gorodnichenko, 2015; D'Acunto et al., 2021; Cavallo et al., 2017; D'Acunto et al., 2021; Wong, 2015). Alternatively, we directly control for households' perception about inflation in the last 12 months

Panel A: Short-Term Expectations	(1) $\hat{\pi}^{e,ST}_{hct}$	(2) $\hat{\pi}^{e,ST}_{hct}$	(3) $\hat{\pi}^{e,ST}_{hct}$	(4) $\hat{\pi}^{e,ST}_{hct}$	(5) $\hat{\pi}^{e,ST}_{hct}$	(6) $\hat{\pi}^{e,ST}_{hct}$	(7) $\hat{\pi}^{e,ST}_{hct}$
Material_{ct}	0.581***	0.530***	0.438***	0.417***	0.569***	0.547***	0.506***
	(0.045)	(0.044)	(0.045)	(0.045)	(0.041)	(0.057)	(0.054)
$\text{Food Inflation}_{ct}$		1.050***	0.862***	0.471***		0.594***	
		(0.053)	(0.059)	(0.071)		(0.092)	
$\text{Energy Inflation}_{ct}$			0.245***	0.237***		0.240***	
			(0.011)	(0.011)		(0.015)	
$\text{Core Inflation}_{ct}$				1.525***		1.512***	
				(0.199)		(0.212)	
$\text{Perceived (realized) Inflation}_{hct}$					1.089***		1.071***
					(0.030)		(0.029)
Observations	126,080	126,080	126,080	126,080	126,080	126,080	126,080
R-squared	0.526	0.529	0.533	0.533	0.543	0.533	0.544

Panel B: Long-Term Expectations	(1) $\hat{\pi}^{e,LT}_{hct}$	(2) $\hat{\pi}^{e,LT}_{hct}$	(3) $\hat{\pi}^{e,LT}_{hct}$	(4) $\hat{\pi}^{e,LT}_{hct}$	(5) $\hat{\pi}^{e,LT}_{hct}$	(6) $\hat{\pi}^{e,LT}_{hct}$	(7) $\hat{\pi}^{e,LT}_{hct}$
Material_{ct}	0.152***	0.144***	0.127***	0.120***	0.147***	0.194***	0.207***
	(0.024)	(0.025)	(0.025)	(0.025)	(0.024)	(0.040)	(0.038)
$\text{Food Inflation}_{ct}$		0.165***	0.130***	-0.016		0.068	
		(0.044)	(0.045)	(0.064)		(0.075)	
$\text{Energy Inflation}_{ct}$			0.045***	0.042***		0.042***	
			(0.010)	(0.010)		(0.012)	
$\text{Core Inflation}_{ct}$				0.569***		0.542***	
				(0.164)		(0.178)	
$\text{Perceived (realized) Inflation}_{hct}$					0.486***		0.490***
					(0.023)		(0.024)
Observations	126,080	126,080	126,080	126,080	126,080	126,080	126,080
R-squared	0.500	0.500	0.500	0.500	0.504	0.500	0.504

Additional controls						✓	✓
Household FE	✓	✓	✓	✓	✓	✓	✓
Time FE	✓	✓	✓	✓	✓	✓	✓

Table 3: Supply chain constraint pass-through to household inflation expectations: Household-level evidence. This table presents estimation results from Specification (2). The subscript notation is defined as follows: h is a household, c is a country, and t is a quarter. The dependent variables are a household-time level dummy equal to one if household h believes prices will increase a lot over the next 12 month in Panel A and equal to one if household h believes prices will increase a lot over the 12-month period between current year+2 and current year+3 in Panel B. Columns (6)–(7) include non-reported controls for government expenditures as a percentage of GDP, as well as the other perceived constraints to production ($Labor_{ct}$, $Financial_{ct}$, $Equipment_{ct}$, and $Other_{ct}$). $Material_{ct}$, $Labor_{ct}$, $Financial_{ct}$, $Equipment_{ct}$, and $Other_{ct}$ measure the share of firms that indicate that their production is constrained by the respective constraint. All constraints are transformed from the industry-country-time level to the country-time level using the share of consumption that each industry contributes to the final household consumption. *Food Inflation*$_{ct}$, *Energy Inflation*$_{ct}$, and *Core Inflation*$_{ct}$ are the country-time level CPI indices for food, energy, and core, respectively. *Perceived (realized) Inflation*$_{hct}$ is household h's perception about the inflation over the last 12 months. Standard errors are clustered at the country-demographics level and are reported in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

(*Perceived (realized) Inflation*$_{hct}$), since the literature has identified households' beliefs about the inflation over the recent past as strong predictor of their inflation forecast (Ranyard et al., 2008). In our most stringent specifications, we additionally control for government expenditure as a percentage of GDP to account for fiscal stimulus that may independently influence inflation expectations, as well as for the other perceived constraints to production ($Labor_{ct}$, $Financial_{ct}$, $Equipment_{ct}$, and $Other_{ct}$).

The estimation results in Table 3 show that supply chain disruptions are positively associated with households' inflation expectations, both for their short-term (Panel A) and long-term (Panel B) expectations. Even after controlling for the experience channel (by including either realized inflation or households' perceptions of past inflation) the positive correlation between material input constraints and household inflation expectations persists. Both realized inflation and households' perceived inflation are strongly associated with higher short- and long-term inflation expectations, indicating that the experience channel plays an important role in shaping expectations. Importantly, a significant positive association between supply chain constraints and inflation expectations remains even after accounting for the experience channel, suggesting that the news channel also contributes to the formation of household inflation expectations.

The estimated effect is economically meaningful. For instance, the results in Column (5) of Panel A suggest that a one standard deviation increase in the share of firms reporting material frictions leads to a 6.3pp higher probability for a household to believe prices will increase lot in the following year. This corresponds to 21% of the average share of households expecting inflation to increase a lot.

Household-quarter level analysis with interactions. In the second set of tests, we extend our analysis at the *household-quarter level* to explore the mechanisms through which the COVID-induced supply shocks shaped households' inflation expectations. Specifically, we augment Specification (2) with two additional explanatory variables that serve as proxies

	(1) $\hat{\pi}^{e,ST}_{hct}$	(2) $\hat{\pi}^{e,ST}_{hct}$	(3) $\hat{\pi}^{e,ST}_{hct}$	(4) $\hat{\pi}^{e,ST}_{hct}$
Material_{ct}	-0.228***		0.552***	
	(0.052)		(0.112)	
$\text{Material}_{ct} \times \text{Awareness}_{hc}$	1.517***	1.209***	0.687***	0.503***
	(0.048)	(0.047)	(0.153)	(0.120)
$\text{Material}_{ct} \times \text{Awareness}_{hc} \times \text{Google}_{ct}$			1.383***	1.308***
			(0.275)	(0.220)
Google_{ct}			-0.273***	
			(0.038)	
Food Inflation_{ct}	0.599***		0.721***	
	(0.089)		(0.096)	
Energy Inflation_{ct}	0.224***		0.153***	
	(0.015)		(0.018)	
Core Inflation_{ct}	1.772***		2.194***	
	(0.206)		(0.236)	
Perceived (realized) Inflation_{hct}		0.849***		0.841***
		(0.028)		(0.026)
Observations	122,096	122,096	102,551	103,088
R-squared	0.536	0.554	0.543	0.556
Other constraints	✓		✓	
Household FE	✓	✓	✓	✓
Time FE	✓		✓	
Country-time FE		✓		✓

Table 4: Supply chain constraint pass-through to household inflation expectations: Interactions with household characteristics. This table presents estimation results from Specification (2). The subscript notation is defined as follows: h is a household, c is a country, and t is a quarter. The dependent variable is a household-time level dummy equal to one if household h believes prices will increase a lot over the next 12 month. Columns (1) and (3) include non-reported controls for the other perceived constraints to production ($Labor_{ct}$, $Financial_{ct}$, $Equipment_{ct}$, and $Other_{ct}$). $Material_{ct}$, $Labor_{ct}$, $Financial_{ct}$, $Equipment_{ct}$, and $Other_{ct}$ measure the share of firms that indicate that their production is constrained by the respective constraint. All constraints are transformed from the industry-country-time level to the country-time level using the share of consumption that each industry contributes to the final household consumption. $Awareness_{hc}$ is a dummy equal to one for households with an above median within household correlation between realized inflation over the last 12 months and the household's inflation estimate for the last 12 months. $Google_{ct}$ is a country-time level variable measuring the intensity of Google searches for "delays in shipping" (in the respective country's language). *Food* $Inflation_{ct}$, *Energy* $Inflation_{ct}$, and *Core* $Inflation_{ct}$ are the country-time level CPI indices for food, energy, and core, respectively. *Perceived (realized)* $Inflation_{hct}$ is household h's perception about the inflation over the last 12 months. Standard errors are clustered at the country-demographics level and are reported in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

for (i) households' awareness of realized inflation during the initial cost-push phase, and (ii) households' exposure to salient information about supply chain disruptions, conveyed through news media, peer discussions, interactions with employers, and similar channels.

Households with greater awareness of inflationary pressures caused by supply-side frictions are more likely to incorporate these perceptions into their inflation expectations (Link et al., 2024). To capture this awareness, we calculate the *within-household* correlation between households' reported point estimates of headline inflation over the previous 12 months and actual inflation rates for the period 2020:Q2–2022:Q4. Using this metric, we construct a binary variable, $Awareness_{hc}$, which equals one for households whose correlation exceeds the sample median.

The news channel suggests that households' exposure to salient information about supply chain shocks influences their inflation expectations. To assess this exposure, we leverage Google Trends data—a widely used proxy for information acquisition in the social sciences (Choi and Varian, 2012; Korenok et al., 2022; Link et al., 2024; Fetzer et al., 2021).[10] Specifically, we construct the variable $Google_{ct}$, which measures the intensity of Google searches for "delays in shipping" at the country-level, serving as a proxy for households' exposure to and engagement with salient information about supply-side shocks.[11] For this analysis, we focus on Germany, Italy, France, and Spain—the European countries with a sufficient volume of relevant searches.[12]

The coefficient for $Material_{ct} \times Awareness_{hc}$ in Columns (1) of Table 4 show that households more aware of realized inflation during the initial cost-push phase of the COVID-19 supply shock expect a more significant increase in CPI growth in response to escalating supply chain constraints. Column (2) confirms this result for a specification in which we additionally control for country-quarter fixed effects, which account for other country-specific factors influencing household inflation expectations, including realized inflation.

Finally, Columns (3) and (4) report results for specifications including interaction terms of

[10] Google Trends quantifies the search intensity for specific terms as a relative measure of search interest, where a value of 100 represents the peak popularity of the term for the specified region and time.

[11] This variable reflects heightened awareness and concern that drive the demand for additional information. Unlike metrics based on news article counts, it captures a wider range of information channels, including informal interactions with coworkers, peers, and social networks.

[12] We search for "Lieferschwierigkeiten" and "Lieferengpasse" for Germany, "tempi consegna" for Italy, "tiempo entrega" for Spain, and "delai de livraison" for France. These words maximize the number of searches available.

$Material_{ct}$ jointly with both $Awareness_{hc}$ and $Google_{ct}$. The coefficients show that households with high awareness about realized inflation during the initial cost-push phase expect even higher future inflation rates in response to supply chain shocks in countries with greater exposure to salient information about supply chain disruptions.[13] These findings align with recent research showing an increase in the degree of attention and awareness about the aggregate price level for higher levels of inflation (Cavallo et al., 2017; Bracha and Tang, 2022; Korenok et al., 2022; Pfäuti, 2022; Weber et al., 2023). They are also consistent with Link et al. (2024), which shows that consumers more attentive to and informed about realized inflation tend to have inflation expectations that deviate more strongly upward from professional forecasts than those of less attentive individuals.

Taken together, our findings indicate that the supply chain pressures in the period after the outbreak of the COVID-19 pandemic influenced household inflation expectations upwards through *both* the experience and the news channel.

Country-quarter level analysis. In the final set of tests, we confirm the positive association between supply chain constraints and household inflation expectations using BCS consumer survey data, which covers all EU member countries, and estimate the following *country-quarter level* specification:

$$\begin{aligned}\hat{\pi}^e_{ct} &= \beta_1 Material_{ct} + \beta_2 Food\ Inflation_{ct} + \beta_3 Energy\ Inflation_{ct} + \beta_4 Core\ Inflation_{ct} \\ &\quad + Other\ Constraints_{ct} + \mu_c + \nu_t + \epsilon_{ct}. \qquad (3)\end{aligned}$$

Here, the dependent variable is the share of households in country c that believe consumer

[13] Table OA.1 shows that the results from Table 4 are robust to including interaction terms between the variable $Awareness_{hc}$ and the different inflation categories—namely, food, energy, and core inflation—as well as perceived inflation.

prices will increase more rapidly. As in the previous tests, we control for the other perceived constraints to production as well as for realized inflation components—or, alternatively, for households' perceptions of past inflation.

Columns (1) and (2) of Table OA.2 confirm the positive association between supply chain disruptions and household inflation expectations. Columns (3) and (4) present IV estimates using again the interaction of $\textit{China Dependence}_{pc}$ and $\textit{Lockdown Stringency}_{t}$ as the instrument, confirming a positive and plausibly causal effect.

4 Generalization into broad-based inflation

In this section, we examine whether higher household inflation expectations are associated with a lower price elasticity of demand, enabling firms to hide behind aggregate cost and price uncertainty and, in turn, sustain higher markups without risking substantial sales losses. This dynamic may allow even firms not directly affected by supply-side constraints to raise prices, thereby contributing to the broader generalization of inflation.

Baseline spillover analysis. To isolate and test this mechanism, we compare the CPI growth in product-country pairs (hereafter termed "markets") not materially affected by supply chain disruptions, across countries with varying degrees of aggregate (country-time level) growth in inflation expectations. Specifically, we isolate the impact on the CPI growth of service-based products, which were largely unaffected by supply chain constraints during the pandemic, across countries that exhibit varying increases in inflation expectations. To this end, we estimate the following "spillover specification":

$$\Delta CPI_{pct+1} = \beta_1 Service_{pc} \times High\ Infl\ Exp_c + \sum_{\tau=20,21,22} \beta_{2\tau} Service_{pc} \times Year_\tau$$
$$+ \sum_{\tau=20,21,22} \beta_{3\tau} Service_{pc} \times High\ Infl\ Exp_c \times Year_\tau$$
$$+ Controls + \mu_{pc} + \nu_{ct} + \xi_{pt} + \epsilon_{cpt}, \quad (4)$$

where p is a product, c is a country, and t is a quarter. The dependent variable is again the one-quarter ahead annual CPI growth for a product-country pair and *Year* is a set of dummy variables equal to one in 2020, 2021, and 2022, respectively—where the year dummy for 2020 equals one for Q2–Q4 only (i.e., only after the COVID-19 outbreak). We use 2019 as our "base year."

$Service_{pc}$ is the time-invariant contribution of service sectors to the consumption of product p in country c.[14] $High\ Infl\ Exp_c$ is an indicator equal to one if the increase in the share of households expecting prices to rise more rapidly is above the median in a country between 2021:Q1 and 2022:Q1—the period during which household inflation expectations rose substantially in Europe (see Figure 3). Figure OA.5 shows that in countries with high inflation expectations, the distribution of the growth in the share of households expecting prices to rise more rapidly has a notably thicker right tail, indicating a larger share anticipating steep price increases.

We again also include product-country, country-time, and product-time fixed effects, as well as the following set of control variables: the other constraints to production ($Labor_{ct}$, $Financial_{ct}$, $Equipment_{ct}$, and $Other_{ct}$) interacted with the three year dummies, and *Energy*

[14] We use the BCS classification to identify service sectors and obtain the service sector contribution to consumption from the COICOP-CPA matrix from Cai and Vandyck (2020).

$Inflation_{ct}$ interacted with the $Service_{pc}$ variable and the three year dummies. Finally, we exclude the product "Energy" from the sample. Controlling for the $Energy\ Inflation_{ct}$ interactions and excluding the product "Energy" alleviates concerns about bias coming from the rise in energy inflation during our sample period—due to manifestation of pent-up demand in 2021 and notably after the Russian invasion of Ukraine in March 2022, which severely affected energy supply to several European countries.

The estimation results in Table 5 present evidence consistent with a generalization of inflation going from markets directly affected by supply-side constraints to more service-oriented markets, which are less affected, or not affected at all, by these constraints. In line with supply chain constraints being passed through to higher consumer prices in the manufacturing sector, the first three rows of Column (1) show that more service-oriented markets have a lower CPI growth than more manufacturing-based markets in the same country. However, the coefficient for the interaction of $Service_{pc} \times High\ Infl\ Exp_{c}$ with the year 2022 confirms that the CPI growth of service-oriented markets tends to be higher in 2022 when inflation expectations significantly increased in the respective country, relative to similar markets in countries that experienced a less pronounced increase in inflation expectations. Consistent with this catch-up in price increases among service-sector firms relative to manufacturing firms, Figure OA.6 shows that while the gap between service and manufacturing inflation initially widened after 2020, it narrowed more toward 2022 in high-inflation-expectation countries than in countries with more anchored expectations.

Moreover, the coefficients for $Service_{pc} \times Energy\ Inflation_{ct}$ interacted with the three post-COVID years in Column (1) of Table 5 indicate that energy prices do not seem to substantially affect the differential CPI growth rates between service- and manufacturing-oriented markets. This observation implies that energy prices are unlikely to be the driver of the spillover and generalization of inflation that we are documenting.

In Columns (2)–(4), we conduct three tests to rule out that the generalization of inflation is merely a result of demand shocks. In Column (2), we include product-country-time

	(1) ΔCPI_{pct+1}	(2) ΔCPI_{pct+1}	(3) ΔCPI_{pct+1}	(4) ΔCPI_{pct+1}	(5) ΔCPI_{pct+1}	(6) ΔCPI_{pct+1}
Specification	Full Sample Baseline	Demand 1-Digit	Lockdown Intensity	Household Expenditure	Supply Spillovers	Lagged Supply Spillovers
$\text{Service}_{pc} \times 2020_t$	0.680	-0.728	0.825	0.643	-0.192	0.532
	(1.338)	(0.539)	(1.363)	(1.348)	(1.597)	(1.430)
$\text{Service}_{pc} \times 2021_t$	-4.308**	-3.515***	-4.266**	-4.297**	-3.847**	-3.852**
	(1.791)	(0.744)	(1.813)	(1.797)	(1.503)	(1.531)
$\text{Service}_{pc} \times 2022_t$	-4.773**	-4.564***	-4.645**	-4.714**	-4.819**	-4.965**
	(2.056)	(0.999)	(2.098)	(2.037)	(2.354)	(2.415)
$\text{Service}_{pc} \times \text{High Infl Exp}_c \times 2020_t$	-0.935	-0.804	-0.724	-0.915	-0.745	-0.841
	(0.655)	(0.880)	(0.631)	(0.652)	(0.695)	(0.700)
$\text{Service}_{pc} \times \text{High Infl Exp}_c \times 2021_t$	0.336	-0.239	0.284	0.373	0.258	0.281
	(0.646)	(0.930)	(0.614)	(0.647)	(0.616)	(0.621)
$\text{Service}_{pc} \times \text{High Infl Exp}_c \times 2022_t$	1.777**	2.957**	1.931**	1.842**	1.812**	1.842**
	(0.804)	(1.157)	(0.790)	(0.807)	(0.863)	(0.861)
$\text{Service}_{pc} \times \text{Energy Inflation}_{ct} \times 2020_t$	0.088	0.128**	0.057	0.090	0.141	0.141*
	(0.057)	(0.057)	(0.061)	(0.057)	(0.078)	(0.079)
$\text{Service}_{pc} \times \text{Energy Inflation}_{ct} \times 2021_t$	-0.015	0.068	-0.041	-0.017	0.023	0.020
	(0.045)	(0.040)	(0.044)	(0.044)	(0.049)	(0.049)
$\text{Service}_{pc} \times \text{Energy Inflation}_{ct} \times 2022_t$	-0.017	0.011	-0.036	-0.018	0.023	0.021
	(0.045)	(0.032)	(0.045)	(0.044)	(0.042)	(0.042)
$\text{Service}_{pc} \times \text{Energy Inflation}_{ct}$	0.042	0.022	0.060	0.043	0.001	0.002
	(0.042)	(0.029)	(0.044)	(0.041)	(0.040)	(0.041)
$\text{Energy Use}_{pc} \times \text{Energy Inflation}_{ct}$	0.068	1.186***	0.070	0.073	0.083	0.082
	(0.228)	(0.234)	(0.230)	(0.229)	(0.450)	(0.451)
Observations	8,515	7,678	8,515	8,515	8,515	8,515
R-squared	0.678	0.768	0.678	0.678	0.679	0.678
Constraints	✓	✓	✓	✓	✓	✓
Lockdown intensity control			✓			
Household expenditure control				✓		
Supply chain spillover control					✓	✓
Country-time FE	✓		✓	✓	✓	✓
Product-country FE	✓	✓	✓	✓	✓	✓
Product-time FE	✓		✓	✓	✓	✓
1-digit product-country-time FE		✓				

Table 5: Pass-through of supply chain constraints to generalized inflation. This table presents estimation results from Specification (4). The subscript notation is defined as follows: p is a product, c is a country, and t is a quarter. The dependent variable is the one-quarter ahead annual CPI growth at the product-country level. Non-reported controls include the other perceived constraints to production ($Labor_{pct}$, $Financial_{pct}$, $Equipment_{pct}$, and $Other_{pct}$) uninteracted and, in addition, these other constraints interacted with the three year dummies. $Labor_{pct}$, $Financial_{pct}$, $Equipment_{pct}$, and $Other_{pct}$ measure the share of firms that indicate that their production is constrained by the respective constraint. All constraints are transformed from the industry-country-time level to the product-country-time level using the share of consumption that each industry contributes to the final household consumption. $Service_{pc}$ is the time-invariant contribution of service sectors to the consumption of product p in country c. $High\ Infl\ Exp_c$ is an indicator equal to one if the increase in the share of households expecting that prices will rise more rapidly is above the median in a country between 2021:Q1 and 2022:Q1. In Column (2), we include product-country-time fixed effects using the 1-digit COICOP as the product category. In Column (3), we additionally control for the country-level severity of lockdown measures in 2021, as well as for its double and triple interactions with $Service_{pc}$ and the different year dummies. In Column (4), we additionally control for the final consumption expenditure of households at the product-country-time level. Columns (5) and (6) introduce interactions with $Material\ Supply_{pcx}$, which measures the share of firms that indicate that their production is constrained by material input constraints in year $x = t$ among the suppliers that provide input goods to firms that sell product p in country c in year t. Both columns also include include controls for the energy cost exposure in year x of the suppliers that provide input goods to firms that sell product p in country c in year t. We set $x = t$ in Column (5) to capture contemporaneous spillovers, and $x = t - 1$ in Column (6) to allow for lagged transmission along the supply chain. $Energy\ Inflation_{ct}$ is the country-time level CPI index for energy. $Energy\ Use_{pc}$ is an industry-country pair's energy input before the COVID-19 pandemic, measured in 2019 and scaled by the country's total energy use. We exclude the product "Energy" from the regression. Standard errors are double-clustered at the country-product and quarterly level and are reported in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

fixed effects, using the 1-digit COICOP as product category. These fixed effects control for the impact of demand shocks affecting broad product categories. In Column (3), we further control for the country-level severity of lockdown measures in 2021 (using OxCGRT's COVID-19 Stringency Index) as a proxy for pent-up demand for services. Finally, in Column (4), we control for the final consumption expenditure of households at the product-country-time level, employing data from Eurostat at the 2-digit COICOP level. This variable helps control for shifts in demand across different product categories. The spillover of inflation to services sectors in high inflation expectation countries is not materially affected when we control for these proxies of demand.

Controlling for spillovers along the supply chain. Another potential concern is that the observed generalization of inflation from markets directly affected by supply-side constraints to those less impacted is, at least partially, driven by spillover effects along the supply chain. Specifically, disruptions in upstream production could cascade downstream, influencing the prices of final goods sold to consumers. This dynamic might bias our results if more service-oriented product-country pairs tend to be initially less impacted by supply-side shocks in the early post-COVID period, yet are indirectly affected later due to their reliance on upstream suppliers that experience these shocks.

To assess the relevance of this mechanism, we include two additional controls for upstream shocks related to material and energy inputs: $\textit{Material Supply}_{pcx}$, which captures the share of suppliers facing material shortages in year x among those supplying firms that sell product p in country c in year t; and $\textit{Energy Use Supply}_{pc} \times \textit{Energy Inflation}_{cx}$, which captures the impact of rising energy costs on suppliers, defined as the product of their pre-shock energy usage and the growth in energy prices. Specifically, we calculate these controls as:

$$\begin{aligned}&\textit{Supplier Constraint}_{pcx} = \\ &\sum_{\overline{j},\overline{c}} \left[\textit{COICOP Share}_{p c \overline{j}} \times \textit{Consumption Share}_{c \overline{j} \overline{c}} \times \left(\sum_{\underline{j},\underline{c}} \textit{Supply Share}_{\overline{j}\overline{c}\underline{j}\underline{c}} \times \textit{Constraint}_{\underline{j}\underline{c}x} \right) \right],\end{aligned}$$

where *Constraint* is either $\textit{Material}_{\underline{j}\underline{c}x}$ or $\textit{Energy Use Supply}_{\underline{j}\underline{c}} \times \textit{Energy Inflation}_{\underline{c}x}$. Indices $\overline{j}$ and $\overline{c}$ denote the customer industry and country, while $\underline{j}$ and $\underline{c}$ denote the supplier industry and country. $\textit{COICOP Share}_{pc\overline{j}}$ refers to the weight of CPA categories linked to a given COICOP category, and $\textit{Consumption Share}_{c\overline{j}\overline{c}}$ reflects the contribution of these CPA categories to final consumption.

Columns (5) and (6) present the results of this robustness test: Column (5) includes contemporaneous controls ($x = t$), while Column (6) incorporates one-quarter-lagged values to account for potential delays in the transmission of supply shocks through the supply chain ($x = t - 1$). The results show that the inflation generalization effect to the services sector remains robust even after controlling for supply chain spillovers.

Testing for the influence of labor costs. Another potential concern is that the higher price levels in service-oriented markets in countries with rapidly rising inflation expectations might stem from firms anticipating a steeper rise in labor costs, driven by heightened household inflation expectations and subsequent wage hike demands (e.g., see Reis, 2023). To address this concern, we employ the OECD/AIAS ICTWSS database, which includes an adjusted collective bargaining coverage rate, defined as the number of employees covered by a collective agreement in force as a proportion of the total number of employees minus the number of employees legally excluded from the right to bargain.

We then re-estimate Specification (4) separately in the subsample of high collective bargaining countries (collective bargaining coverage rate above 75%) and low collective bar-

	(1) ΔCPI_{pct+1}	(2) ΔCPI_{pct+1}	(3) ΔCPI_{pct+1}	(4) ΔCPI_{pct+1}
Sample	High Bargaining Countries	Low Bargaining Countries	High Mkt Power Markets	Low Mkt Power Markets
$Service_{pc} \times$ High Infl $Exp_c \times 2020_t$	-0.238	-1.426	1.136	-1.202
	(0.529)	(1.723)	(0.955)	(1.227)
$Service_{pc} \times$ High Infl $Exp_c \times 2021_t$	-0.765	0.187	2.391**	-0.749
	(0.680)	(1.070)	(1.085)	(0.981)
$Service_{pc} \times$ High Infl $Exp_c \times 2022_t$	1.347	2.808**	3.355**	0.478
	(0.886)	(1.317)	(1.605)	(1.536)
Observations	5,046	2,973	3,563	3,926
R-squared	0.720	0.794	0.729	0.800
Other constraints	✓	✓	✓	✓
Country-time FE	✓	✓	✓	✓
Product-time FE	✓	✓	✓	✓
Product-country FE	✓	✓	✓	✓

Table 6: Pass-through of supply chain constraints to generalized inflation: Sample splits. This table presents estimation results from Specification (4), estimating Column (1) of Table 5 in subsamples. The subscript notation is defined as follows: p is a product, c is a country, and t is a quarter. The dependent variable is the one-quarter ahead annual CPI growth at the product-country level. Non-reported controls include the other perceived constraints to production ($Labor_{pct}$, $Financial_{pct}$, $Equipment_{pct}$, and $Other_{pct}$) uninteracted and, in addition, these other constraints interacted with the three year dummies. $Labor_{pct}$, $Financial_{pct}$, $Equipment_{pct}$, and $Other_{pct}$ measure the share of firms that indicate that their production is constrained by the respective constraint. All constraints are transformed from the industry-country-time level to the product-country-time level using the share of consumption that each industry contributes to the final household consumption. $Service_{pc}$ is the time-invariant contribution of service sectors to the consumption of product p in country c. *High Infl* Exp_c is an indicator equal to one if the increase in the share of households expecting that prices will rise more rapidly is above the median in a country between 2021:Q1 and 2022:Q1. *High Collective Bargaining* countries are countries with a share of employees covered by a collective agreement as a proportion of the number of eligible employees above 75%. *High Market Power* markets are defined as industry-country pairs with an above median average markup. *Energy* $Inflation_{ct}$ is the country-time level CPI index for energy. *Energy* Use_{pc} is an industry-country pair's energy input before the COVID-19 pandemic, measured in 2019 and scaled by the country's total energy use. We exclude the product "Energy" from the regression. Standard errors are double-clustered at the country-product and quarterly level and are reported in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

gaining countries (collective bargaining coverage rate below 75%).[15] Columns (1) and (2) of Table 6 show that the effect is statistically significant only in countries with low coverage. This pattern is inconsistent with a wage-cost channel: if firms were raising prices in anticipation of higher labor costs, the effect should be stronger in countries with higher collective

[15]We set the threshold for the sample split to 75% since the distribution of the collective bargaining coverage rate across countries is clustered into two distinct groups as shown in Figure OA.7: countries that all have a coverage ratio below 57% and countries that all have a coverage ratio above 77%.

bargaining coverage, where coordinated wage increases are more likely.

Influence of market power. Finally, we examine whether the generalization of inflation is linked to firms' pricing power. Columns (3) and (4) of Table 6 show estimation results in the subsamples of *High Market Power* and *Low Market Power* markets, which consist of industry-country pairs with an above and below median average markup in 2018, respectively.[16] The results show that the generalization into broad-based inflation is driven by markets with high market power, consistent with service firms using their pricing power to extract higher markups in an environment of elevated household inflation expectations—thereby enabling inflation to spread more broadly.

Taken together, our evidence is consistent with inflation initially driven by supply-side shocks becoming increasingly broad-based over time—shifting from manufacturing to services—as firms leverage their pricing power in response to elevated household inflation expectations.

5 The role of firms' pricing behavior

In this section, we employ two sets of tests to further examine the role of firms' pricing behavior in the generalization of inflationary pressures and how such generalization is shaped by household inflation expectations, firms' pricing power, and their interaction.

In Section 5.1, we use firm-level financial data for publicly listed firms from Compustat Global and earnings call transcripts analyzed with a LLM to link elevated household inflation expectations to firms' ability to sustain higher markups through increased pricing power. As outlined in Section 2.2, elevated household inflation expectations can result in lower price

[16] We obtain average markups at the industry-country level from the 9th vintage of the CompNet database.

elasticity of demand, as evidenced by references to increased pricing power and resilient demand in company earnings call transcripts. In Section 5.2, we analyze how firms' pre-COVID pricing power interacts with elevated household inflation expectations during the pandemic to shape their pricing and markup behavior, using data from Compustat Global and Bureau van Dijk's Orbis, which provides extensive coverage of both publicly listed and privately held firms.

5.1 Drivers of firms' pricing behavior and pricing power

To assess firms' pricing behavior in the post-COVID inflationary environment, we leverage data from Compustat Global and estimate firm markups following Loecker and Warzynski (2012) (see Section OA.1 for details). Their approach relies on the insight that the output elasticity of a variable production factor is only equal to its expenditure share in total revenue when price equals marginal cost of production. Under any form of imperfect competition, however, the relevant markup drives a wedge between the input's revenue share and its output elasticity.

To explore the factors influencing firms' pricing behavior, we analyze transcripts of companies' earnings calls, which are key events where executives provide insights into a firm's financial health, future outlook, and—most importantly for our analysis—strategic decisions, including pricing policies. We obtain earnings call transcripts from the LSEG Workspace Transcripts & Briefs database. Our sample includes 27,163 transcripts from 2,414 European firms, covering all quarters from 2019:Q1 to 2023:Q4. Each transcript consists of a presentation by company executives, followed by a Q&A session with analysts. To ensure consistency, we retain only the presentation portion, as it follows a standardized format across firms and focuses on comparable company-specific topics. We further segment each transcript by speaker to reduce the LLM input length and analyze patterns within a call. The total number of speaker sections across all transcripts is 120,305, resulting in an average of 4.43 speaker sections per transcript.

We employ an LLM to identify whether firms discuss price increases and the factors driving them, leveraging the model's ability to process large volumes of textual data while preserving context and capturing relationships within the text (Vaswani et al., 2017).[17] Specifically, we use OpenAI's GPT-4o model and interact with it through the ChatCompletion API endpoint.[18] To ensure consistent formatting of the model's output, we specify a structured JavaScript Object Notation (JSON) output schema.[19] Each API request includes the following prompt, along with a speaker section of an earnings call transcript:

> *You are an economic analyst specializing in extracting nuanced insights from textual data. Your specialization is in understanding firms' pricing power, input costs and frictions, and customer demand in an inflationary environment. You will be given a section of an earnings call transcript where the dialogue is segmented by speaker. Based only on the text provided, you must assign two scores: score one and score two.*
>
> ***Score one**:*
> - *'1' if the company experiences or expects rising pricing power.*
> - *'0' if the company does not experience or expect rising pricing power.*
> - *'na' if the company does not discuss its pricing power.*
>
> ***Score two** (one or more values):*
> - *'1' if the company experiences or expects resilient demand.*
> - *'2' if the company experiences or expects supply-chain disruptions.*
> - *'3' if the company experiences or expects rising labor costs.*
> - *'4' if the company experiences or expects rising energy costs.*
> - *'na' only if none of the other options are assigned.*
>
> *The values should only include the score and no additional text.*

[17] Traditional text analysis techniques—such as keyword extraction, word counting, and rule-based sentiment analysis—often struggle to preserve context over long sequences and to capture complex relationships between words.

[18] We set the temperature to 0 to ensure deterministic behavior, meaning the model will always select the most probable next token in its output. This behavior is preferred for a classification task such as ours.

[19] The structured output feature enables users to define the expected format of the model's response.

Based on the LLM output, we construct a set of variables to investigate the mechanisms linking firms' pricing behavior to elevated household inflation expectations and firms' pricing power.

To capture firms' general perception of their ability to raise prices, we define the baseline variable $\textit{Pricing Power Overall}_{ijct}$ as the number of transcript sections in which executives of firm i in industry j in country c during quarter t report experiencing or expecting rising pricing power (i.e., score one equals 1), irrespective of the underlying justification. In line with our hypothesized transmission mechanism that elevated household inflation expectations are associated with lower consumer price sensitivity, mentions of pricing power are significantly more common in countries characterized by higher household inflation expectations.[20] Firms in high-expectation countries report a size-adjusted average of 1.04 mentions of pricing power, compared to 0.97 in low-expectation countries, with the difference being statistically significant ($t = 2.66$).

To more directly assess whether firms are able to maintain higher prices without significant losses in sales—indicative of lower demand elasticity—we construct the variable $\textit{Pricing Power \& Resilient Demand}_{ijct}$, which counts the number of transcript sections in which executives explicitly link their pricing power to resilient consumer demand, as identified by our LLM classification (i.e., score one equals 1 and score two includes value 1). Consistent with the baseline results, firms in high-expectation countries are significantly more likely to cite resilient demand when discussing pricing power (1.02 vs. 0.92; $t = 3.41$). This pattern reinforces the idea that elevated inflation expectations can support stronger firm pricing power by altering consumer behavior.

Next, we parametrically confirm that pricing power and resilient demand, associated with

[20] Recall that high inflation expectation countries are those where the increase in the share of households expecting prices to rise more rapidly between 2021:Q1 and 2022:Q1 is above the median.

elevated household inflation expectations and indicative of lower price elasticity of demand, allow firms to charge relatively higher markups. For this analysis, we regress the estimated markup of firm i in industry j and country c in quarter $t + 1$ on our LLM-based pricing power measures in quarter t, controlling for country-quarter fixed effects:

$$Markup_{ijct+1} = \alpha + \beta LLM_{ijct} + \psi_{ct} + \epsilon_{ijct}, \quad (5)$$

where i is a firm, j is an industry, c is a country, and t is a quarter.

Panel A of Table 7 presents the results. Column (1) shows that executives' explicit discussions of pricing power during earnings calls are predictive of increased firm-level markups in the following quarter, thus validating our LLM-based classification. Importantly, in a context where costs are increasing, even simply maintaining the same markup suggests that these firms were able to enhance their gross margins in absolute terms—and consequently, their absolute profits—per unit sold.[21] Column (2) shows that firms specifically highlighting resilient demand as a basis for their pricing power are able to charge relatively higher markups, supporting the idea that once elevated household inflation expectations reduce consumers' price sensitivity, firms can leverage this environment to sustain higher markups.

In addition to demand-side drivers, an alternative source of firms' pricing power in the post-COVID period could stem from scarcity-driven factors. Specifically, supply chain bottlenecks—while simultaneously raising input costs—may enhance firms' ability to set higher prices, either directly due to reduced competitive pressures from limited product availability, or indirectly by elevating consumers' inflation expectations, which firms could exploit more broadly as justification for price increases. To investigate this potential mech-

[21] Markups are defined as the ratio of price to marginal costs. Take, for instance, an initial markup of 1.5. If marginal costs rise from 1 to 2 due to supply-side shocks, the per-unit gross margin in absolute terms then grows from 0.5 ($= 1.5 \times 1 - 1$) to 1 ($= 1.5 \times 2 - 2$).

anism, we construct the variable *Pricing Power & Supply Chain*$_{ijct}$ analogously to *Pricing Power & Resilient Demand*$_{ijct}$. This variable counts the number of transcript sections in which executives explicitly link their pricing power to supply chain disruptions. The results in Column (3) indicate that firms citing supply chain frictions alongside pricing power do not exhibit significantly higher markups, suggesting that supply-side scarcity alone may be a weaker basis for firms to raise prices.

Similarly, we examine whether labor and energy constraints influence firms' pricing power in the post-COVID inflationary environment. To this end, we construct the measures *Pricing Power & Labor*$_{ijct}$ and *Pricing Power & Energy*$_{ijct}$, which count instances in earnings call transcripts where executives link their pricing power to rising labor costs or elevated energy prices, respectively. Columns (4) and (5) show that references to labor have no significant effect, while energy costs are associated with relatively lower markups, suggesting that rising energy costs pose particular challenges for firms in passing through price increases to consumers.

Finally, we parametrically analyze how firms in the service and manufacturing sectors differ in their ability to sustain higher markups, and whether these differences change over time. For this analysis, we augment Specification (5) by introducing interaction terms with the dummy variable *Service*$_{ijc}$—which equals one if a firm i operates in a service industry—and the three post-COVID year dummies.

The results in Panel B are consistent with the evidence on the generalization of inflation in Section 4. Specifically, in 2022, among firms citing pricing power associated with resilient demand, service-sector firms were able to sustain relatively higher markups compared to manufacturing firms. This evidence indicates that once supply chain constraints subsided but household inflation expectations nevertheless remained elevated, service firms possessing pricing power leveraged resilient demand effectively, allowing them to catch up to manufacturing firms in terms of price increases.

Overall, this analysis supports the idea that elevated household inflation expectations,

Panel A: Baseline	(1) Markup$_{ijct+1}$	(2) Markup$_{ijct+1}$	(3) Markup$_{ijct+1}$	(4) Markup$_{ijct+1}$	(5) Markup$_{ijct+1}$
Specification	Overall (X=1)	X=Resilient Demand$_{ijct}$	X=Supply Chain$_{ijct}$	X=Labor	X=Energy$_{ijct}$
Pricing Power$_{ijct}$ & X	0.029*	0.034**	−0.007	−0.015	−0.070***
	(0.016)	(0.017)	(0.020)	(0.030)	(0.027)
Observations	5,992	5,992	5,992	5,992	5,992
R-squared	0.067	0.067	0.065	0.065	0.067

Panel B: Service vs. Manufacturing	(1) Markup$_{ijct+1}$	(2) Markup$_{ijct+1}$	(3) Markup$_{ijct+1}$	(4) Markup$_{ijct+1}$	(5) Markup$_{ijct+1}$
Specification	Overall (X=1)	X=Resilient Demand$_{ijct}$	X=Supply Chain$_{ijct}$	X=Labor	X=Energy$_{ijct}$
Pricing Power$_{ijct}$ & X	0.054*	0.065**	−0.004	−0.037	−0.186**
	(0.032)	(0.025)	(0.041)	(0.069)	(0.078)
Pricing Power$_{ijct}$ & X × Service$_{ijc}$ × 2020$_t$	−0.049	−0.047	−0.037	−0.037	−0.035
	(0.067)	(0.039)	(0.059)	(0.192)	(0.211)
Pricing Power$_{ijct}$ & X × Service$_{ijc}$ × 2021$_t$	0.048	0.059	0.039	0.174	−0.091
	(0.052)	(0.042)	(0.053)	(0.138)	(0.125)
Pricing Power$_{ijct}$ & X × Service$_{ijc}$ × 2022$_t$	0.096*	0.088***	0.086	0.005	−0.041
	(0.050)	(0.026)	(0.059)	(0.114)	(0.117)
Observations	5,992	5,992	5,992	5,992	5,992
R-squared	0.082	0.082	0.083	0.078	0.084
Country-time FE	✓	✓	✓	✓	✓

Table 7: Drivers of firms' pricing behavior and pricing power. This table presents estimation results from Specification (5). Panel A reports the baseline specification, while Panel B augments it by introducing interaction terms between the dummy variable $Service_{ijc}$ and the three post-COVID year dummies. The subscript notation is defined as follows: i is a firm, j is an industry, c is a country, and t is a quarter. The dependent variable is a firm's one-quarter-ahead markup. In Column (1), $Pricing\ Power_{ijct}$ is measured as the total number of instances in which a firm discusses having pricing power. In Columns (2) to (5), $Pricing\ Power_{ijct}$ & X is measured based on the number of instances attributed to each specific driver listed in the respective column. $Service_{ijc}$ is an indicator variable equal to one if a firm is incorporated in a service sector, and zero otherwise. Standard errors are clustered at the industry-level and are reported in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

and the resulting increase in firms' pricing power and reduced consumer price sensitivity, serve as a key transmission channel in facilitating the transition from localized to generalized inflationary pressures. These dynamics allow even firms initially unaffected by supply-side shocks to sustain higher markups.

5.2 Firms' pricing behavior and pre-COVID pricing power

To further evaluate how firms' pricing power interacts with elevated household inflation expectations in shaping firms' markup strategies, we estimate the following triple-interaction specification at the firm-quarter level:

$$\begin{aligned} Markup_{ijct+1} = &\sum_{\tau=20,21,22} \beta_{1\tau} Markup_{ijc}^{2018} \times Constraint_{jct} \times Year_{\tau} \\ &+ \sum_{\tau=20,21,22} \beta_{2\tau} Markup_{ijc}^{2018} \times High\ Infl\ Exp_c \times Year_{\tau} \\ &+ \beta_3 Markup_{ijc}^{2018} \times Constraint_{jct} + \beta_4 Markup_{ijc}^{2018} \times High\ Infl\ Exp_c \\ &+ \sum_{\tau=20,21,22} \beta_{5\tau} Markup_{ijc}^{2018} \times Year_{\tau} + \beta_6 Markup_{ijc}^{2018} + \xi_{jct} + \epsilon_{ijct}, \end{aligned} \tag{6}$$

where i is a firm, j is an industry, c is a country, and t is a quarter. The main coefficient of interest is $\beta_{2\tau}$, which captures the influence of pre-pandemic pricing power—proxied by $Markup_{ijc}^{2018}$, the firm-level markup measured at the end of 2018—on the generalization of inflationary pressures through the rise in household inflation expectations. $High\ Infl\ Exp_c$ is again an indicator equal to one if the increase in the share of households expecting that prices will rise more rapidly is above the median in a country between 2021:Q1 and 2022:Q1. Moreover, $Constraint_{jct}$ is a vector encompassing the two supply-side constraints, $Material_{jct}$ and $Labor_{jct}$, both measured at the industry-country-time level. *Year* is a set of dummy variables for 2020 (from Q2 onwards), 2021, and 2022, with 2019 again being the base year.

To isolate the firm-level impact of pricing power on markup dynamics, we include industry-country-time fixed effects to absorb time-varying shocks that simultaneously impact all firms within a given industry and country, such as policy interventions or demand fluctuations. These fixed effects also account for sector-specific differences in markup levels, which arise due to variations in cost structures, particularly the balance between fixed and variable costs across industries.

Panel A: Compustat data	(1) Markup_{ijct+1}	(2) Markup_{ijct+1}	(3) Margin_{ijct+1}	(4) Margin_{ijct+1}
Sample	Full	Services	Full	Services
High Infl $\text{Exp}_c \times \text{Markup}^{2018}_{ijc} \times 2020_t$	0.066	0.023	0.012	-0.059
	(0.062)	(0.123)	(0.042)	(0.058)
High Infl $\text{Exp}_c \times \text{Markup}^{2018}_{ijc} \times 2021_t$	0.068	0.158	0.055	0.033
	(0.064)	(0.113)	(0.040)	(0.049)
High Infl $\text{Exp}_c \times \text{Markup}^{2018}_{ijc} \times 2022_t$	0.140**	0.289**	0.110**	0.159**
	(0.066)	(0.109)	(0.047)	(0.075)
Observations	19,538	6,448	19,538	6,448
R-squared	0.804	0.708	0.748	0.739

Panel B: Orbis data	(1) Markup_{ijct+1}	(2) Markup_{ijct+1}	(3) Margin_{ijct+1}	(4) Margin_{ijct+1}
Sample	Full	Services	Full	Services
High Infl $\text{Exp}_c \times \text{Markup}^{2018}_{ijc} \times 2020_t$	0.011	0.012	0.018	0.021
	(0.012)	(0.013)	(0.011)	(0.013)
High Infl $\text{Exp}_c \times \text{Markup}^{2018}_{ijc} \times 2021_t$	0.020	0.023	0.026*	0.032*
	(0.014)	(0.016)	(0.014)	(0.018)
High Infl $\text{Exp}_c \times \text{Markup}^{2018}_{ijc} \times 2022_t$	0.039***	0.039***	0.032***	0.035***
	(0.013)	(0.015)	(0.011)	(0.013)
Observations	2,791,201	1,951,760	2,791,201	1,951,760
R-squared	0.680	0.686	0.481	0.485
Industry-country-time FE	✓	✓	✓	✓

Table 8: Firms' pricing behavior and pre-COVID pricing power. This table presents estimation results from Specification (6). Panel A presents results using quarterly firm-level data from Compustat Global, focusing on publicly listed firms, while Panel B reports results using the broader Orbis sample, which includes both public and private firms at annual frequency. Columns (1) and (3) are estimated in the full sample. Columns (2) and (4) are estimated in the sample of firms operating in service sectors. The subscript notation is defined as follows: i is a firm, j is an industry, c is a country, and t is a quarter. The dependent variable in Columns (1) and (2) is a firm's one-period-ahead markup, estimated following Loecker and Warzynski (2012), while the dependent variable in Columns (3) and (4) is a firm's one-period-ahead EBITDA margin (EBITDA/Sales). $Markup^{2018}$ measures a firm's markup in the fiscal year 2018. *High Infl* Exp_c is an indicator equal to one if the increase in the share of households expecting that prices will rise more rapidly is above the median in a country between 2021:Q1 and 2022:Q1. Standard errors are clustered at the industry-country level and reported in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Column (1) of Panel A in Table 8 presents the estimation results for the full Compustat sample, allowing for direct comparability with the analysis in Table 7. The estimated coefficient on the triple interaction between *High Infl* Exp_c, $Markup^{2018}_{ijc}$, and the *2022* dummy indicates that firms with greater pre-pandemic pricing power particularly benefited from elevated household inflation expectations, enabling them to sustain relatively higher markups. Specifically, the estimates suggest that the markup difference between firms (scaled by the average markup) at the 90th and 10th percentile of $Markup_{ijc}^{2018}$ increased by 13% more in countries where household inflation expectations rose sharply, relative to countries with more stable expectations.[22]

Column (2) focuses on service sector firms and shows that, even among firms without direct exposure to cost shocks, those with greater pre-pandemic pricing power were able to sustain relatively higher markups in countries with elevated household inflation expectations. Columns (3) and (4) confirm the robustness of these findings using EBITDA margins as a less model-dependent alternative to estimated markups, showing that firms with greater pre-COVID pricing power were able to sustain relatively higher profitability in environments with elevated inflation expectations.

Panel B of Table 8 further confirms that these results extend to the broader Orbis sample, which includes both public and private firms, showing that the observed pattern generalizes to a more heterogeneous and representative firm population. Here, the markup gap between firms at the 90th and 10th percentile of $Markup_{ijc}^{2018}$ widened by 6% more (relative to the average markup) in countries where inflation expectations rose sharply compared to those with more stable expectations.[23]

Taken together, the interaction between high inflation expectations and firms' pricing power thus appears to contribute to the emergence of generalized inflation, spreading inflationary pressures across the broader economy.

[22]These results align with Konczal et al. (2022), which finds that 2021 recorded the highest markups and the largest annual increase in the U.S. since 1955, particularly among firms with already elevabted pre-pandemic markups.

[23]The differences in the estimated effect magnitudes between Panels A and B are likely driven by the fact that average firm size, and thus pricing power, is significantly higher in the Compustat sample than in the Orbis sample.

6 Mechanisms driving the generalization of inflation

Our key empirical finding is that localized supply-side inflation can generalize into broad-based markups and inflation. What are the potential driving mechanisms?

Building on the search model from Benabou and Gertner (1993), we show in Appendix OA.4 how the perception of a common cost shock, potentially associated with generalized inflation expectations, can drive higher markups and prices, particularly in sectors not directly impacted by the initial localized supply-side shock. In response to a supply shock, consumers must evaluate the extent to which individual firms are affected in order to make optimal decisions about their search efforts and subsequent consumption choices. If a supply shock is perceived as widespread—a common shock affecting many firms—consumers are less inclined to engage in costly search efforts for better deals because they anticipate uniformly higher prices across the market (see also Fishman, 1996 and Gaballo and Paciello, 2022). This shift in behavior translates into higher reservation (acceptance) prices, particularly in sectors that are not materially affected by the initial supply-side shocks. In effect, consumers become less selective and are more likely to enter into less adequate transactions. This dynamic reduces competitive pressure on firms, enhancing their pricing power.[24]

The ability of supply-side shocks to generalize into broad-based inflation expectations, characterized by a perception of uniformly higher costs and prices, stems from how these expectations are formed. As explored in the diagnostic expectations literature (Bordalo et al., 2018, 2019, 2012, 2021), individuals tend to infer broader economic trends from specific,

[24]In our model, we show that this effect can be amplified by fairness concerns in consumer behavior. Empirical evidence suggests that consumers tend to view price increases driven by rising costs as more acceptable than those driven by demand shocks (see Eyster et al., 2021 for a detailed discussion). The overestimation of a supply-side shock as a common shock driven by elevated generalized inflation expectations causes consumers to perceive firms' prices as more fair. This perception reduces their price elasticity of demand, allowing firms—particularly those less directly affected by the initial supply-side shock—to charge higher markups and prices without significantly affecting demand.

salient incidents, and often overweight recent events when predicting future outcomes. Consistent with this framework, Link et al. (2024) shows that consumers particularly attentive and informed about realized inflation rates have inflation expectations that deviate more significantly upward from professional forecasts compared to less attentive individuals. This finding suggests that consumers rely on their own—potentially misspecified—models when processing inflation-relevant information (see also Andrade et al., 2016; Andre et al., 2022; Laudenbach et al., 2024).

In the case of the experience channel, salient events include extreme price increases due to supply disruptions (De Bruin et al., 2011) and spikes in the cost of everyday goods such as food or gasoline (Cavallo et al., 2017; D'Acunto et al., 2021; Dietrich, 2024). These salient price increases lead consumers to place significant weight on them when forming their expectations about *overall* price trends. In the case of the news channel, salient events include reports about supply chain disruptions and their effects on costs and prices, especially when the media emphasizes potential economy-wide implications.[25]

Besides diagnostic expectations, rational inattention (Sims, 2003) and sparsity (Gabaix, 2014) can also lead to generalized inflation expectations. Due to cognitive limitations, individuals face a trade-off between the benefits of acquiring additional information and the costs (time, effort, or cognitive resources) of processing it. Individuals thus tend to focus on the most relevant information while ignoring less critical details. In the context of inflation, individuals thus typically base their expectations on easily observable price signals (D'Acunto and Weber, 2024), such as rising prices of frequently purchased goods or news about in-

[25]Since reports of supply-side constraints are often more salient and newsworthy, while their resolution receives little attention, this asymmetry can contribute to the persistence of elevated inflation expectations. Supporting this notion, Ascari et al. (2023) finds that increases in inflation expectations have a stronger impact than shocks that lower them, and Blanco et al. (2022) finds that inflation surges elevate long-term inflation expectations, which remain persistent throughout the disinflation process.

creases in headline inflation, while selectively ignoring complex or technical information, such as disaggregated inflation data.[26] If these easily observable signals indicate higher inflation, individuals may generalize this perception to the broader economy. If a supply shock elevates generalized inflation expectations, it is likely perceived as widespread—a common cost shock affecting many firms.[27]

7 Conclusion

The post-pandemic era witnessed supply-side shocks that, combined with a swift economic recovery, resulted in a dramatic rise in inflation rates, levels which had not been observed in many decades. In this paper, we document the complex interactions between supply chain pressures, firm pricing power, and household inflation expectations that contributed to the surge, generalization, and persistence of post-pandemic inflation in the euro area.

We find that supply chain disruptions not only contributed to localized inflation in sectors directly affected by the cost shock—such as manufacturing—through a cost-push mechanism, but also led to an increase in household inflation expectations. These elevated expectations appear to have facilitated a transmission of initially localized shocks into broad-based consumer price inflation, which began to emerge in the second half of 2021; that is, higher inflation even in sectors not initially impacted by supply-side disruptions, such as services. Overall, our findings suggest that supply-side inflationary impulses can generalize and intensify through household inflation expectations, lower consumer price sensitivity, and the

[26]Relatedly, the theory proposed by Mei and Wu (2024) suggests that longer causal chains exert diminishing influence on beliefs, resulting in an overreaction of inflation expectations to cost-push news shocks.

[27]Acharya et al. (2023) demonstrates that in a regime-switching model with parameter uncertainty, a *negative duration dependence* can take hold: if the economy remains in a regime for an extended period, even fully rational agents may begin to assign via learning a higher likelihood to the possibility of being in the regime with persistence, potentially indefinitely.

resulting increase in firms' pricing power.

From a policy perspective, three main implications emerge. First, "see through the shock" policy approaches may need to take into account the possibility of persistent and intertwined inflationary pressures. Policymakers may need to be prepared to act decisively to adjust the monetary policy stance if inflation expectations show the first signs of becoming unanchored. Second, elevated consumer inflation expectations can enhance firms' pricing power, even for those not directly affected by the initial shock, which can be considered as an empirically tangible version of "excuseflation." This implication provides support for measures that promote competition, thereby curbing the inflationary tendencies of dominant market players. Third, transparent communication by policymakers regarding the nature—such as the specific magnitude and duration—of relatively opaque cost shocks, along with a clear commitment to price stability, can help prevent a self-fulfilling prophecy in which unanchored inflation expectations translate into actual inflation.

References

Acharya, V. V., T. Johnson, S. Sundaresan, and S. Zheng (2023): "Disasters with unobservable duration and frequency: Intensified responses and diminished preparedness," Tech. rep., National Bureau of Economic Research.

Ackerberg, D., K. Caves, and G. Frazer (2015): "Identification Properties of Recent Production Function Estimators," *Econometrica*, 83, 2411–2451.

Alessandria, G., S. Khan, A. Khederlarian, C. Mix, and K. Ruhl (2022): "The aggregate effects of global and local supply chain disruptions: 2020–2022," *Working Paper*.

Amiti, M., S. Heise, F. Karahan, and A. Şahin (2022): "Inflation strikes back: The return of wage to price pass-through," *Working Paper*.

Anayi, L. S., N. Bloom, P. Bunn, P. Mizen, G. Thwaites, and I. Yotzov (2022): "Firming up price inflation," *Working Paper*.

Andrade, P., R. K. Crump, S. Eusepi, and E. Moench (2016): "Fundamental disagreement," *Journal of Monetary Economics*, 83, 106–128.

Andre, P., I. Haaland, C. Roth, M. Wiederholt, and J. Wohlfart (2024): "Narratives about the macroeconomy," *Working Paper*.

Andre, P., C. Pizzinelli, C. Roth, and J. Wohlfart (2022): "Subjective models of the macroeconomy: Evidence from experts and representative samples," *The Review of Economic Studies*, 89, 2958–2991.

Armantier, O., W. Bruine de Bruin, G. Topa, W. Van Der Klaauw, and B. Zafar (2015): "Inflation expectations and behavior: Do survey respondents act on their beliefs?" *International Economic Review*, 56, 505–536.

Ascari, G., S. Fasani, J. Grazzini, and L. Rossi (2023): "Endogenous uncertainty and the macroeconomic impact of shocks to inflation expectations," *Journal of Monetary Economics*.

Bai, X., J. Fernández-Villaverde, Y. Li, and F. Zanetti (2024): "The causal effects of global supply chain disruptions on macroeconomic outcomes: Evidence and theory," .

Ball, L. M., D. Leigh, and P. Mishra (2022): "Understanding U.S. inflation during the COVID era," *Working Paper*.

Bańkowska, K., A. Borlescu, E. Charalambakis, A. Dias da Silva, D. Di Laurea, M. Dossche, D. Georgarakos, J. Honkkila, N. Kennedy, G. Kenny, et al. (2021): "ECB consumer expectations survey: An overview and first evaluation," *ECB Occasional Paper*.

Benabou, R. and R. Gertner (1993): "Search with learning from prices: Does increased inflationary uncertainty lead to higher markups?" *The Review of Economic Studies*, 60, 69–93.

Benigno, G., J. di Giovanni, J. J. Groen, and A. I. Noble (2022): "The GSCPI: A new barometer of global supply chain pressures," *Working Paper*.

Bernanke, B. and O. Blanchard (2023): "What caused the U.S. pandemic-era inflation?" *Hutchins Center Working Papers*.

Bilbiie, F. O. and D. R. Känzig (2023): "Greed? Profits, inflation, and aggregate demand," *Working Paper*.

Binici, M., S. Centorrino, S. Cevik, and G. Gwon (2022): "Here comes the change: The role of global and domestic factors in post-pandemic inflation in Europe," *Working Papers*.

Blanco, A., P. Ottonello, and T. Ranosova (2022): "The dynamics of large inflation surges," Tech. rep., National Bureau of Economic Research.

Blinder, A., E. R. Canetti, D. E. Lebow, and J. B. Rudd (1998): *Asking about prices: A new approach to understanding price stickiness*, Russell Sage Foundation.

Bordalo, P., N. Gennaioli, S. Y. Kwon, and A. Shleifer (2021): "Diagnostic bubbles," *Journal of Financial Economics*, 141, 1060–1077.

Bordalo, P., N. Gennaioli, R. L. Porta, and A. Shleifer (2019): "Diagnostic expectations and stock returns," *The Journal of Finance*, 74, 2839–2874.

Bordalo, P., N. Gennaioli, and A. Shleifer (2012): "Salience theory of choice under risk," *The Quarterly Journal of Economics*, 127, 1243–1285.

——— (2018): "Diagnostic expectations and credit cycles," *The Journal of Finance*, 73, 199–227.

Bracha, A. and J. Tang (2022): "Inflation levels and (in) attention," .

Bräuning, F., J. L. Fillat, and G. Joaquim (2022): "Cost-price relationships in a concentrated economy," *Working Paper*.

Cai, M. and T. Vandyck (2020): "Bridging between economy-wide activity and household-level consumption data: Matrices for European countries," *Data in brief*, 30, 105395.

Carriere-Swallow, Y., P. Deb, D. Furceri, D. Jimenez, and J. D. Ostry (2022): "Shipping costs and inflation," *Working Paper*.

Carroll, C. D. (2003): "Macroeconomic expectations of households and professional forecasters," *Quarterly Journal of Economics*, 118, 269–298.

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

Celasun, O., N.-J. Hansen, A. Mineshima, M. Spector, and J. Zhou (2022): "Supply bottlenecks: Where, why, how much, and what next?" *IMF Working Paper*.

Choi, H. and H. Varian (2012): "Predicting the present with Google Trends," *Economic Record*, 88, 2–9.

Coibion, O., D. Georgarakos, Y. Gorodnichenko, and M. Van Rooij (2023): "How does consumption respond to news about inflation? Field evidence from a randomized control trial," *American Economic Journal: Macroeconomics*, 15, 109–152.

Coibion, O. and Y. Gorodnichenko (2015): "Is the Phillips curve alive and well after all? Inflation expectations and the missing disinflation," *American Economic Journal: Macroeconomics*, 7, 197–232.

Coibion, O., Y. Gorodnichenko, and M. Weber (2025): "The Upcoming Trump Tariffs: What Americans Expect and How They Are Responding," *Working Paper*.

Comin, D., R. C. Johnson, and C. Jones (2023): "Supply chain constraints and inflation," *Working Paper*.

Crump, R. K., S. Eusepi, A. Tambalotti, and G. Topa (2022): "Subjective intertemporal substitution," *Journal of Monetary Economics*, 126, 118–133.

De Bruin, W. B., W. Van der Klaauw, and G. Topa (2011): "Expectations of inflation: The biasing effect of thoughts about specific prices," *Journal of Economic Psychology*, 32, 834–845.

De Loecker, J., J. Eeckout, and G. Unger (2020): "The rise of market power and the macroeconomic implications," *Quarterly Journal of Economics*, 135, 561–644.

Dietrich, A. M. (2024): "Consumption categories, household attention, and inflation expectations: Implications for optimal monetary policy," *Journal of Monetary Economics*, 103594.

Dräger, L. and M. J. Lamla (2017): "Imperfect information and consumer inflation expectations: Evidence from microdata," *Oxford Bulletin of Economics and Statistics*, 79, 933–968.

Dräger, L. and G. Nghiem (2021): "Are consumers' spending decisions in line with a Euler equation?" *Review of Economics and Statistics*, 103, 580–596.

Duca-Radu, I., G. Kenny, and A. Reuter (2021): "Inflation expectations, consumption and the lower bound: Micro evidence from a large multi-country survey," *Journal of Monetary Economics*, 118, 120–134.

D'Acunto, F., D. Hoang, and M. Weber (2022): "Managing households' expectations with unconventional policies," *The Review of Financial Studies*, 35, 1597–1642.

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

D'Acunto, F. and M. Weber (2024): "Why survey-based subjective expectations are meaningful and important," *Annual Review of Economics*, 16.

Eyster, E., K. Madarász, and P. Michaillat (2021): "Pricing under fairness concerns," *Journal of the European Economic Association*, 19, 1853–1898.

Fetzer, T., L. Hensel, J. Hermle, and C. Roth (2021): "Coronavirus perceptions and economic anxiety," *Review of Economics and Statistics*, 103, 968–978.

Finck, D. and P. Tillmann (2022): "The macroeconomic effects of global supply chain disruptions," *Working Paper*.

Fishman, A. (1996): "Search with learning and price adjustment dynamics," *The Quarterly Journal of Economics*, 111, 253–268.

Franzoni, F., M. Giannetti, and R. Tubaldi (2023): "Supply chain shortages, large firms' market power, and inflation," *Working Paper*.

Frey, B. S. and W. W. Pommerehne (1993): "On the fairness of pricing—an empirical survey among the general population," *Journal of Economic Behavior & Organization*, 20, 295–307.

Gabaix, X. (2014): "A sparsity-based model of bounded rationality," *The Quarterly Journal of Economics*, 129, 1661–1710.

Gaballo, G. and L. Paciello (2022): "Spending allocation under nominal uncertainty: A model of effective price rigidity," *Working Paper.*

Gielissen, R., C. E. Dutilh, and J. J. Graafland (2008): "Perceptions of price fairness: An empirical research," *Business & Society*, 47, 370–389.

Ichiue, H. and S. Nishiguchi (2015): "Inflation expectations and consumer spending at the zero bound: Micro evidence," *Economic Inquiry*, 53, 1086–1107.

Isaacson, M. and H. Rubinton (2022): "Shipping prices and import price inflation," *Working Paper.*

Jiménez-Rodríguez, R. and A. Morales-Zumaquero (2022): "Commodity price pass-through along the pricing chain," *Review of World Economics*, 158, 109–125.

Kahneman, D., J. L. Knetsch, R. Thaler, et al. (1986): "Fairness as a constraint on profit seeking: Entitlements in the market," *American Economic Review*, 76, 728–741.

Kalemli-Ozcan, S., A. Silva, M. A. Yildirim, and J. di Giovanni (2022): "Global supply chain pressures, international trade, and inflation," *Working Paper.*

Konczal, M., N. Lusiani, and R. Institute (2022): "Prices, Profits, and Power: An analysis of 2021 firm-level markups," *Working Paper.*

Korenok, O., D. Munro, and J. Chen (2022): "Inflation and attention thresholds," *Working Paper.*

Larsen, V. H., L. A. Thorsrud, and J. Zhulanova (2021): "News-driven inflation expectations and information rigidities," *Journal of Monetary Economics*, 117, 507–520.

Laudenbach, C., A. Weber, R. Weber, and J. Wohlfart (2024): "Beliefs about the stock market and investment choices: Evidence from a survey and a field experiment," *The Review of Financial Studies*, hhae063.

Levinsohn, J. and A. Petrin (2003): "Estimating Production Functions Using Inputs to Control for Unobservables," *Review of Economic Studies*, 70, 317–341.

Link, S., A. Peichl, C. Roth, and J. Wohlfart (2024): "Attention to the macroeconomy," *Available at SSRN 4697814.*

Loecker, J. D. and F. Warzynski (2012): "Markups and firm-level export status," *American Economic Review*, 102, 2437–2471.

Malmendier, U. and S. Nagel (2016): "Learning from inflation experiences," *The Quarterly Journal of Economics*, 131, 53–87.

Mazumder, S. (2021): "The reaction of inflation forecasts to news about the fed," *Economic Modelling*, 94, 256–264.

Mei, P. and L. Wu (2024): "Thinking about the economy, deep or shallow?" *Working Paper*.

Olley, G. S. and A. Pakes (1996): "The Dynamics of Productivity in the Telecommunications Equipment Industry," *Econometrica: Journal of the Econometric Society*, 1263–1297.

Pfäuti, O. (2022): "Inflation–who cares? Monetary policy in times of ow attention," *Working Paper*.

Piron, R. and L. Fernandez (1995): "Are fairness constraints on profit-seeking important?" *Journal of Economic Psychology*, 16, 73–96.

Ranyard, R., F. Del Missier, N. Bonini, D. Duxbury, and B. Summers (2008): "Perceptions and expectations of price changes and inflation: A review and conceptual framework," *Journal of Economic Psychology*, 29, 378–400.

Reis, R. (2022a): "The burst of high inflation in 2021-22: How and why did we get here?" *Working Paper*.

——— (2022b): "Losing the inflation anchor," *Brookings Papers on Economic Activity*, 2021, 307–379.

——— (2023): "Four mistakes in the use of measures of expected inflation," *AEA Papers and Proceedings*, 113, 47–51.

Rotemberg, J. J. (2008): "Behavioral aspects of price setting, and their policy implications," Tech. rep., National Bureau of Economic Research.

Shiller, R. J., M. Boycko, and V. Korobov (1991): "Popular attitudes toward free markets: The Soviet Union and the United States compared," *The American Economic Review*, 81, 385–400.

Sims, C. A. (2003): "Implications of rational inattention," *Journal of monetary Economics*, 50, 665–690.

Staiger, D. and J. Stock (1997): "Instrumental variables regression with weak instruments," *Econometrica*, 65, 557–586.

Urbany, J. E., T. J. Madden, and P. R. Dickson (1989): "All's not fair in pricing: An initial look at the dual entitlement principle," *Marketing Letters*, 1, 17–25.

Vaswani, A., N. Shazeer, N. Parmar, J. Uszkoreit, L. Jones, A. N. Gomez, Ł. Kaiser, and I. Polosukhin (2017): "Attention is all you need," *Advances in Neural Information Processing Systems*, 30.

Weber, M., B. Candia, T. Ropele, R. Lluberas, S. Frache, B. Meyer, S. Kumar, Y. Gorodnichenko, D. Georgarakos, O. Coibion, et al. (2023): "Tell me something I don't already know: Learning in low-and high-inflation settings," *Working Paper*.

Weber, M., F. D'Acunto, Y. Gorodnichenko, and O. Coibion (2022): "The subjective inflation expectations of households and firms: Measurement, determinants, and implications," *Journal of Economic Perspectives*, 36, 157–184.

Wong, B. (2015): "Do inflation expectations propagate the inflationary impact of real oil price shocks?: Evidence from the Michigan survey," *Journal of Money, Credit and Banking*, 47, 1673–1689.

Online Appendix

OA.1 Detailed data description

Our analysis is based on various data sets for the euro area from 2019:Q1 to 2022:Q4. We use data about (i) firms' production constraints and price expectations, all at the *industry-country-time level*; (ii) household inflation expectations at the *country-time level* and *household-time level*; (iii) CPI growth at the *product-country-time level*; and, (iv) *firm-time level* financials.

Joint Harmonised EU Programme of Business and Consumer Surveys. We obtain information about firms' production constraints and household inflation expectations from the Joint Harmonised EU Programme of Business and Consumer Surveys (BCS) conducted by the European Commission's Directorate-General for Economic and Financial Affairs (DG ECFIN). These surveys (harmonized across countries) are administered to a total of 37,990 corporations from manufacturing, services, retail trade, and construction industries and 31,810 households across the 27 EU member countries, on a monthly and quarterly basis.

Manufacturing firms are asked about firm-specific factors, such as production capacity, competitive position, price expectations, and factors constraining production. Consumers are questioned on both objective variables (e.g., inflation and the country's general economic situation) and subjective assessments (e.g., major purchases and savings).

From the BCS firm survey, we use responses to the following two questions. First, we employ responses to the quarterly Question 8, which asks firms: *"What main factors are currently limiting your production?"* Firms can respond with (only) one of the following factors: (i) none, (ii) insufficient demand, (iii) shortage of labour force, (iv) shortage of material and/or equipment, (v) financial constraints, or (vi) other factors. The BCS then reports, at the industry-country-time level, the share of firms that respond that their production is constrained by the respective factor.

Second, we obtain inflation expectations at the country-time level from Question 6 that asks households: *"By comparison with the past 12 months, how do you expect that consumer prices will develop in the next 12 months?"* Respondents can reply: (i) increase more rapidly,

(ii) increase at the same rate, (iii) increase at a slower rate, (iv) stay about the same, or (v) fall. Following D'Acunto et al. (2022), we use the share of households expecting prices to increase more rapidly to measure high inflation expectations.

ECB Consumer Expectations Survey. Furthermore, we use newly available anonymized household-time level inflation expectations microdata from the ECB Consumer Expectations Survey (CES) launched in 2020. Its sample covers six key euro area countries: Belgium, France, Germany, Italy, Spain, and the Netherlands, and it is representative of the euro area population (Bańkowska et al., 2021). The CES comprises monthly *core*, *background*, and *recruitment* questionnaires, along with a quarterly questionnaire. The core questionnaire addresses households' expectations in areas such as macroeconomic conditions, housing markets, and their financial situation. The quarterly and background modules contain additional questions on household expenditures, savings, employment, borrowing, risk attitudes, financial knowledge, and income. A total of 18,492 distinct respondents participated in the 12 CES waves and households appear repeatedly in the survey, allowing us to compare responses of the same household over time.

To measure inflation expectations at the country-time and household-time level consistently across the two surveys (BCS and CES), we use the responses to CES' Question C1110 that asks households: *"Looking ahead to 12 months from now, what do you think will happen to prices in general?"* Similar to the BCS, households can answer: (i) prices will increase a lot, (ii) prices will decrease a lot, (iii) prices will increase a little, (iv) prices will decrease a little, or (v) prices will be exactly the same (that is 0% change). We again classify a household as having high inflation expectations if the household responds that prices will increase a lot.

Additionally, the CES provides insight into households' long-term inflation expectations. Specifically, Question C1210 asks: *"Please think further ahead to <survey month year+2 >. What do you think will happen to prices in general in the country you currently live in over the 12-month period between <survey month year+2 and survey month year+3 >?"* Again, we classify a household as having high inflation expectations if it indicates that prices will increase a lot.

Other data sources. We also use monthly data on consumer prices from Eurostat, which provides information for various producer and consumer price indices for all European countries. In this granular data, we observe prices at the product-country-time level. Products are grouped in COICOP categories.[28] From Eurostat, we also obtain an industry-country level input-output table as well as data about industry-country-time level energy input use and energy prices at the country-time level. Finally, we obtain firm-time level financial data from Compustat Global and Bureau van Dijk's Orbis, and leverage Google Trends data as a proxy for households' information acquisition.

Markup estimation. To obtain firm-level markups, we follow the procedure proposed in Loecker and Warzynski (2012), which relies on the insight that the output elasticity of a variable production factor is only equal to its expenditure share in total revenue when price equals marginal cost of production. Under any form of imperfect competition, however, the relevant markup drives a wedge between the input's revenue share and its output elasticity.

In particular, this approach relies on standard cost minimization conditions for variable input factors free of adjustment costs. To obtain output elasticities, a production function has to be estimated. A major challenge is a potential simultaneity bias since the output may be determined by productivity shocks, which might be correlated with a firm's input choice.

To correct the markup estimates for unobserved productivity shocks, Loecker and Warzynski (2012) follows the control function or proxy approach, developed by Ackerberg, Caves, and Frazer (2015), based on Olley and Pakes (1996) and Levinsohn and Petrin (2003). This approach requires a production function with a scalar Hicks-neutral productivity term (i.e., changes in productivity do not affect the proportion of factor inputs) and that firms can be pooled together by time-invariant common production technology at the industry-country level.

Hence, we consider the case where in each period t, firm i minimizes the contemporaneous production costs given the following production function:

$$Q_{ijt} = Q_{ijt}(\Omega_{ijt}, V_{ijt}, K_{ijt}), \tag{OA.1}$$

where Q_{ijt} is the output quantity produced by technology $Q_{ijt}(\cdot)$, V_{ijt} the variable input

[28]The Classification of Individual Consumption According to Purpose (COICOP) is the international reference classification of household expenditure. It provides homogeneous categories of goods and services.

factor, K_{ijt} the capital stock (treated as a dynamic input in production), and Ω_{ijt} the firm-specific Hicks-neutral productivity term. Following De Loecker, Eeckout, and Unger (2020), we assume that within a year the variable input can be adjusted without frictions, while adjusting the capital stock involves frictions.

As we assume that producers are cost minimizing, we have the following Lagrangian:

$$\mathcal{L}(V_{ijt}, K_{ijt}, \lambda_{ijt}) = P^V_{ijt} V_{ijt} + r_{ijt} K_{ijt} + F_{ijt} - \lambda_{ijt}(Q(\cdot) - \overline{Q}_{ijt}), \tag{OA.2}$$

where P^V is the price of the variable input, r is the user cost of capital, F_{ijt} is the fixed cost, and λ_{ijt} is the Lagrange multiplier. The first order condition with respect to the variable input V is thus given by:

$$\frac{\partial \mathcal{L}_{ijt}}{\partial V_{ijt}} = P^V_{ijt} - \lambda_{ijt} \frac{\partial Q(\cdot)}{\partial V_{ijt}} = 0. \tag{OA.3}$$

Multiplying by V_{ijt}/Q_{ijt}, and rearranging terms yields an expression for input V's output elasticity:

$$\theta^v_{ijt} \equiv \frac{\partial Q(\cdot)}{\partial V_{ijt}} \frac{V_{ijt}}{Q_{ijt}} = \frac{1}{\lambda_{ijt}} \frac{P^V_{ijt} V_{ijt}}{Q_{ijt}}. \tag{OA.4}$$

As the Lagrange multiplier λ is the value of the objective function as we relax the output constraints, it is a direct measure of the marginal costs. We thus define the markup as $\mu = P/\lambda$, where P is the price for the output good, which depends on the extent of market power. Substituting marginal costs for the markup/price ratio, we obtain a simple expression for the markup:

$$\mu_{ijt} = \theta^v_{ijt} \frac{P_{ijt} Q_{ijt}}{P^V_{ijt} V_{ijt}}. \tag{OA.5}$$

Hence, there are two ingredients needed to estimate the markup of firm i: its expenditure share of the variable input, $P_{ijt}Q_{ijt}/P^V_{ijt}V_{ijt}$, which is readily observable in the date, and its output elasticity of the variable input, θ^v_{ijt}.

To obtain an estimate of the output elasticity of the variable input of production, we estimate a parametric production function for each industry (at the 2-digits NACE level).

For a given industry h in country j, we consider the translog production function (TLPF):[29]

$$q_{ijt} = \beta_{v1} v_{ijt} + \beta_{k1} k_{ijt} + \beta_{v2} v_{ijt}^2 + \beta_{k2} k_{ijt}^2 + \omega_{ijt} + \epsilon_{ijt}. \tag{OA.6}$$

where lower cases denote logs.[30] In particular, q_{ijt} is the log of the realized firm's output (i.e., deflated turnover), v_{ijt} the log of the variable input factor (i.e., cost of goods sold for the Compustat sample, and cost of goods sold plus other operational expenditures for the Orbis sample, as COGS is not reported separately), k_{ijt} the log of the capital stock (i.e., tangible assets), $\omega_{ijt} = ln(\Omega_{ijt})$, and ϵ_{ijt} is the unanticipated shock to output.[31] Moreover, we follow best practice and deflate these variables with the relevant industry-country specific deflator.

We follow the literature and control for the simultaneity and selection bias, inherently present in the estimation of Eq. (OA.6), and rely on a control function approach, paired with a law of motion for productivity, to estimate the output elasticity of the variable input.

This method relies on a so-called two-stage approach. In the first stage, the estimates of the expected output ($\widehat{\phi}_{ijt}$) and the unanticipated shocks to output (ϵ_{ijt}) are purged using a non-parametric projection of output on the inputs and the control variable:

$$q_{ijt} = \phi_{ijt}(v_{ijt}, k_{ijt}) + \epsilon_{ijt}. \tag{OA.7}$$

The second stage provides estimates for all production function coefficients by relying on the

[29] The TLPF is a common technology specification that includes higher order terms that is more flexible than, e.g., a Cobb-Douglas production function. The departure from the standard Cobb-Douglas production function is important for our purpose. If we were to restrict the output elasticities to be independent of input use intensity when analyzing how markup differs across firms, we would be attributing variation in technology to variation in markups, and potentially bias our results.

[30] Following De Loecker, Eeckout, and Unger (2020), we do not consider the interaction term between v and k to minimize the potential impact of measurement error in capital to contaminate the parameter of most interest, i.e., the output elasticity.

[31] Loecker and Warzynski (2012) shows that when relying on revenue data (instead of physical output), only the markup level is potentially affected but not the estimate of the correlation between markups and firm-level characteristics or how markups change over time.

law of motion for productivity:

$$\omega_{ijt} = g_t(\omega_{ijt-1}) + \varepsilon_{ijt}. \tag{OA.8}$$

We can compute productivity for any value of β, where $\beta = (\beta_{v1}, \beta_{k1}, \beta_{v2}, \beta_{k2})$, using $\omega_{ijt}(\beta) = \widehat{\phi}(\beta_{v1}v_{ijt} + \beta_{k1}k_{ijt} + \beta_{v2}v_{ijt}^2 + \beta_{k2}k_{ijt}^2)$. By nonparametrically regressing $\omega_{ijt}(\beta)$ on its lag, $\omega_{ijt-1}(\beta)$, we recover the innovation to productivity given β, $\varepsilon_{ijt}(\beta)$.

This gives rise to the following moment conditions, which allow us to obtain estimates of the production function parameters:

$$E\left(\varepsilon_{ijt}(\beta)\begin{pmatrix} v_{ijt-1} \\ k_{ijt} \\ v_{ijt-1}^2 \\ k_{ijt}^2 \end{pmatrix}\right) = 0, \tag{OA.9}$$

where we use standard GMM techniques to obtain the estimates of the production function and rely on block bootstrapping for the standard errors. These moment conditions exploit the fact that the capital stock is assumed to be decided a period ahead and thus should not be correlated with the innovation in productivity. We rely on the lagged variable input to identify the coefficients on the current variable input since the current variable input is expected to react to shocks to productivity.

The output elasticities are computed using the estimated coefficients of the production function:

$$\theta_{ijt}^v = \widehat{\beta}_{v1} + 2\widehat{\beta}_{v2}v_{ijt}, \tag{OA.10}$$

which allows us to calculate the markup of firm i.

OA.2 Additional figures

Figure OA.1: Inflation in euro area. This figure shows the CPI growth in the euro area at a monthly frequency from January 2016 to April 2023. Source: Eurostat.

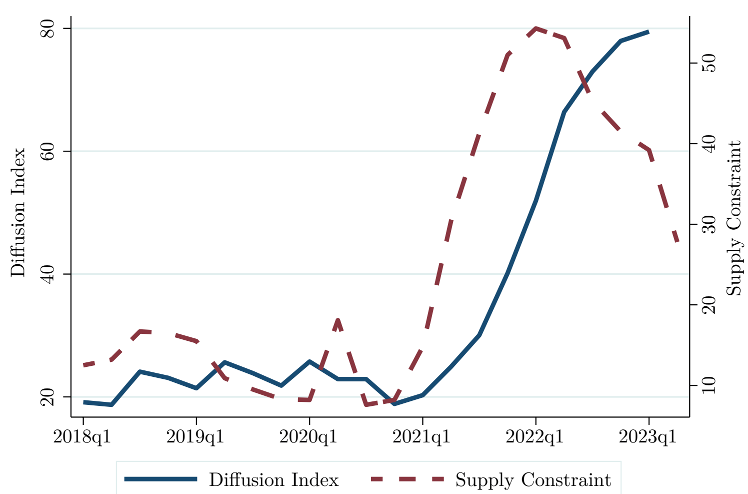

Figure OA.2: Inflation diffusion index. The figure shows the time-series evolution of an inflation diffusion index (blue line) and the time-series evolution of the supply chain constraint (red dashed line). The diffusion index is defined by assigning a value of 0 to product-quarters that have an annual inflation of less than 2%, a value of 50 to product-quarters with an annual inflation between 2% and 4%, and a value of 100 to product-quarters with an annual inflation of more than 4%.

Figure OA.3: Chinese lockdown stringency index. This figure shows the time-series evolution of the aggregate stringency index of the top-5 exporting provinces in China. Source: OxCGRT.

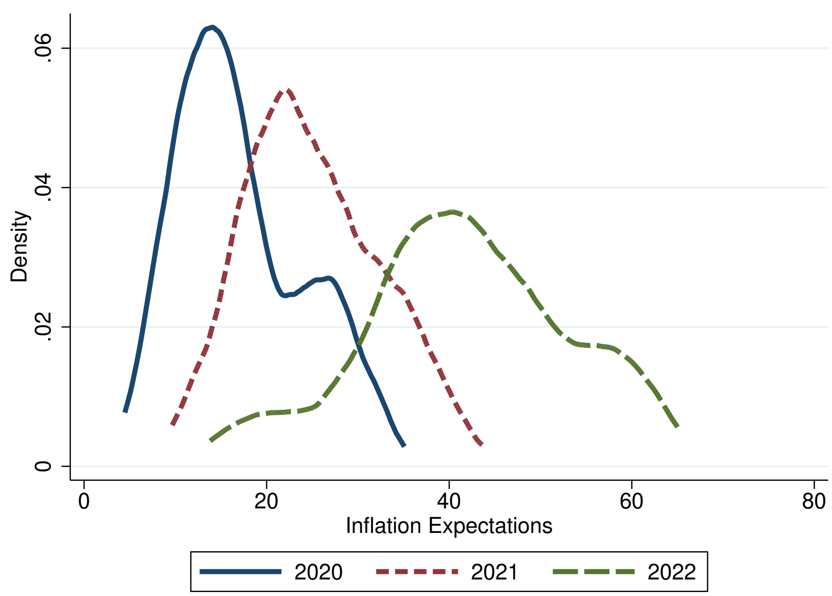

Figure OA.4: Distribution of inflation expectations over time. The figure shows three snapshots of the distribution of one-year ahead household inflation expectations.

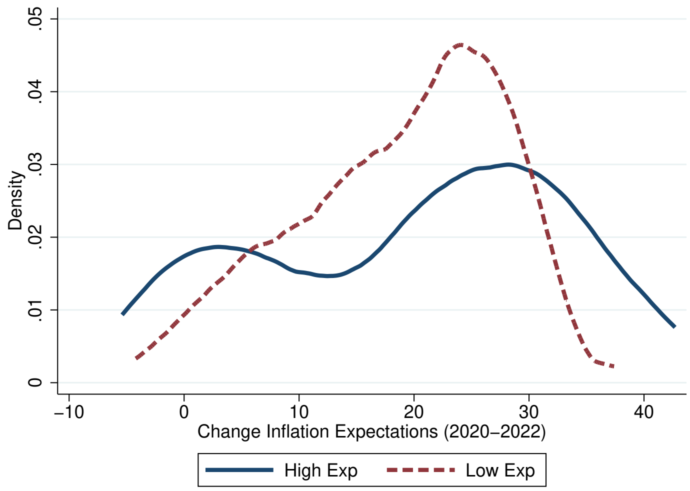

Figure OA.5: Growth in the share of households with high inflation expectations (growth between 2020 and 2022). The figure plots the growth in the share of households who believe prices will increase more rapidly, separately for high and low inflation expectation countries.

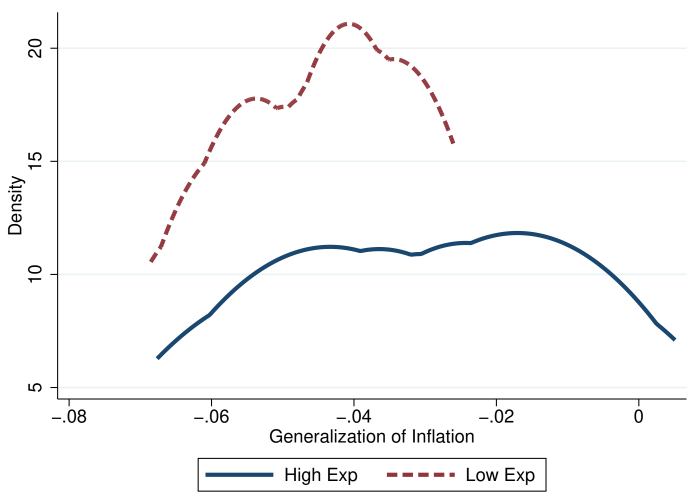

Figure OA.6: Difference service − manufacturing inflation in high vs. low inflation expectation countries (growth between 2020 and 2022). The figure plots the density (across countries, with countries bracketed by high vs. low inflation expectations) of the difference in service vs. manufacturing inflation from 2020 to 2022.

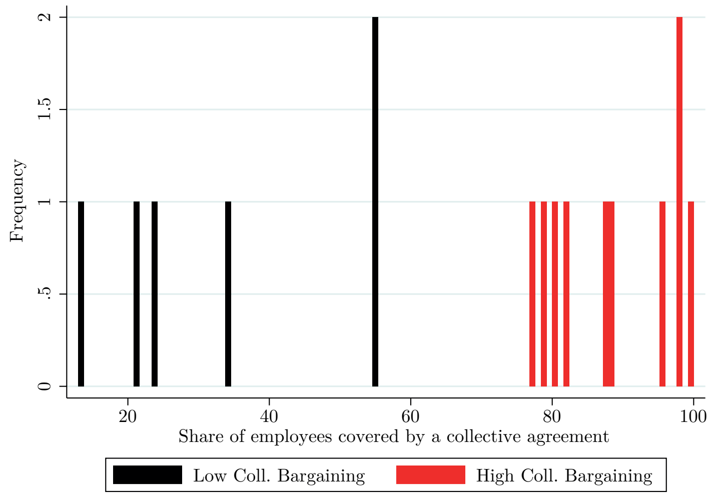

Figure OA.7: Share of employees covered by a collective agreement. This figure shows the distribution of the adjusted collective bargaining coverage rate from the OECD/AIAS ICTWSS database for our sample countries. This coverage rate is defined as the number of employees covered by a collective agreement in force as a proportion of the number of eligible employees equipped (i.e., the total number of employees minus the number of employees legally excluded from the right to bargain).

OA.3 Additional tables

	(1) $\hat{\pi}^{e,ST}_{hct}$	(2) $\hat{\pi}^{e,ST}_{hct}$	(3) $\hat{\pi}^{e,ST}_{hct}$	(4) $\hat{\pi}^{e,ST}_{hct}$
$\text{Awareness}_{hc} \times \text{Google}_{ct} \times \text{Material}_{ct}$	1.341***	1.308***	2.227***	1.493***
	(0.225)	(0.220)	(0.295)	(0.222)
$\text{Material}_{ct} \times \text{Awareness}_{hc}$	0.140	0.514***	−0.497***	0.368***
	(0.119)	(0.120)	(0.173)	(0.121)
$\text{Awareness}_{hc} \times \text{Google}_{ct}$	−0.293***	−0.163***	−0.089*	−0.147***
	(0.047)	(0.042)	(0.054)	(0.044)
$\text{Awareness}_{hc} \times \text{Food Inflation}_{ct}$	0.542***		1.963***	
	(0.115)		(0.673)	
$\text{Awareness}_{hc} \times \text{Food Inflation}_{ct} \times \text{Google}_{ct}$			−2.096*	
			(1.191)	
$\text{Awareness}_{hc} \times \text{Energy Inflation}_{ct}$	0.186***		0.262**	
	(0.022)		(0.133)	
$\text{Awareness}_{hc} \times \text{Energy Inflation}_{ct} \times \text{Google}_{ct}$			−0.085	
			(0.228)	
$\text{Awareness}_{hc} \times \text{Core Inflation}_{ct}$	2.560***		8.960***	
	(0.365)		(1.752)	
$\text{Awareness}_{hc} \times \text{Core Inflation}_{ct} \times \text{Google}_{ct}$			−11.845***	
			(3.156)	
$\text{Perceived (realized) inflation}_{hct}$		0.900***		1.555***
		(0.035)		(0.151)
$\text{Awareness}_{hc} \times \text{Perceived (realized) inflation}_{hct}$		−0.126**		0.516**
		(0.052)		(0.250)
$\text{Perceived (realized) inflation}_{hct} \times \text{Google}_{ct}$				−1.179***
				(0.262)
$\text{Awareness}_{hc} \times \text{Perceived (realized) inflation}_{hct} \times \text{Google}_{ct}$				−0.957**
				(0.415)
Observations	103,088	103,088	103,088	103,088
R-squared	0.549	0.556	0.549	0.556
Country-time FE	✓	✓	✓	✓
Household FE	✓	✓	✓	✓

Table OA.1: Supply chain constraint pass-through to household inflation expectations: Interactions with household characteristics. This table presents estimation results from an adjusted version of Specification (2). The subscript notation is defined as follows: h is a household, c is a country, and t is a quarter. The dependent variable is a household-time level dummy equal to one if household h believes prices will increase a lot over the next 12 month. $Material_{ct}$ measures the share of firms that indicate that their production is constrained by the respective constraint. The constraint is transformed from the industry-country-time level to the country-time level using the share of consumption that each industry contributes to the final household consumption. $Awareness_{hc}$ is a dummy equal to one for households with an above median within household correlation between realized inflation over the last 12 months and the household's inflation estimate for the last 12 months. $Google_{ct}$ is a country-time level variable measuring the intensity of Google searches for "delays in shipping" (in the respective country's language). $Food\ Inflation_{ct}$, $Energy\ Inflation_{ct}$, and $Core\ Inflation_{ct}$ are the country-time level CPI indices for food, energy, and core, respectively. $Perceived\ (realized)\ Inflation_{hct}$ is household h's perception about the inflation over the last 12 months. Standard errors are clustered at the country-demographics level and are reported in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

	OLS		IV	
	(1)	(2)	(3)	(4)
	$\hat{\pi}^e_{ct}$	$\hat{\pi}^e_{ct}$	Material_{ct}	$\hat{\pi}^e_{ct}$
Material_{ct}	0.804***	0.822***		
	(0.231)	(0.210)		
$\sum_p \text{China Dependence}_{pc,2019} \times \text{Lockdown Stringency}_t$			3.519***	
			(0.800)	
$\widehat{Material}_{ct}$				2.558***
				(0.505)
$\text{Food Inflation}_{ct}$	-0.260			
	(0.248)			
$\text{Energy Inflation}_{ct}$	0.109**			
	(0.045)			
$\text{Core Inflation}_{ct}$	0.729			
	(0.542)			
$\text{High Perception}_{ct}$		0.122*	0.088***	0.421*
		(0.066)	(0.018)	(0.246)
F-Test			20.6	
Observations	288	288	288	288
R-squared	0.550	0.549	0.779	
Country FE	✓	✓	✓	✓
Year FE	✓	✓		

Table OA.2: Supply chain constraint pass-through to household inflation expectations: Country-level evidence. This table presents estimation results from Specification (3) in Columns (1) and (2), where the dependent variable is the share of households that believe consumer prices will increase more rapidly at the country-time level. Columns (3) and (4) report results from the IV specification: Column (3) shows the first-stage regression, and Column (4) presents the corresponding second-stage estimates. The subscript notation is defined as follows: p is a product, c is a country, and t is a quarter. Non-reported controls include the other perceived constraints to production ($Labor_{ct}$, $Financial_{ct}$, $Equipment_{ct}$, and $Other_{ct}$). $Material_{ct}$, $Labor_{ct}$, $Financial_{ct}$, $Equipment_{ct}$, and $Other_{ct}$ measure the share of firms that indicate that their production is constrained by the respective constraint. All constraints are transformed from the industry-country-time level to the country-time level using the share of consumption that each industry contributes to the final household consumption. *Food Inflation*$_{ct}$, *Energy Inflation*$_{ct}$, and *Core Inflation*$_{ct}$ are the country-time level CPI indices for food, energy, and core, respectively. *High Perception*$_{ct}$ is the share of households at the country-time level that believe prices have risen a lot over the last 12 months. *China Dependence*$_{pc,2019}$ represents the share of inputs to produce product p in country c that are imported from China in 2019. *Lockdown Stringency*$_t$ measures the severity of lockdown measures implemented in China's top-5 exporting provinces. Standard errors are double-clustered at the country and quarterly level and are reported in parentheses. We report standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

OA.4 Theoretical framework

To examine how consumers' generalized inflation expectations influence firms' pricing behavior, we employ a duopolistic search market equilibrium model, drawing on the search model from Benabou and Gertner (1993) and the fairness concern framework from Eyster et al. (2021).

OA.4.1 Setup

There are two firms with index $i \in \{1, 2\}$, which have constant marginal costs C_i:

$$C_i = e^{\bar{c}+\theta+\gamma_i}, \tag{OA.11}$$

where $\bar{c}$ is the lower bound of the marginal costs, $\theta \sim \mathcal{N}(0, \psi_\theta)$ is a common cost shock affecting both firms equally, while $\gamma_i \sim \mathcal{N}(Z_i, \psi_\gamma)$ are independent firm-specific shocks, with Z_i characterizing the extent of a firm-specific supply-side shock. The firms cannot price-discriminate, implying that each unit of their good sells at the same price, P_i.

Influence of generalized inflation expectations. Customers cannot directly observe firms' marginal production costs. Instead, they infer these costs based on the observed price and their understanding of the broader economic environment, which is shaped by their perceptions of supply-side cost shocks and the resulting inflation expectations.

To formalize this belief formation process (as outlined in Section 3) and examine its implications for firms' pricing strategies in response to supply-side shocks during the pandemic, we introduce a biased belief function $C_i^B(P_i)$. This function maps the price that a monopoly with marginal costs C_i would set to consumers' biased perception of these costs as follows:

$$C_i^B(P_i) = e^{\bar{c}+\widehat{\theta}+\widehat{\gamma}_i}, \tag{OA.12}$$

where $\widehat{\theta} \sim \mathcal{N}(b_Z, \psi_\theta)$, and $\widehat{\gamma}_i \sim \mathcal{N}(\max(0, Z_i - b_Z), \psi_\gamma)$ with $b_Z > 0$. This belief function captures that elevated generalized inflation expectations are associated with a tendency to misinterpret a supply-side shock affecting only certain firms as a broader shock impacting a wider range of firms. Consequently, the supply-side cost shock is at least partially attributed to a common shock, rather than being recognized as firm-specific.

OA.4.2 Effect of generalized inflation expectations on firm pricing through search

First, to build intuition about the effect of generalized inflation expectations on firm pricing via consumer search behavior, we draw on the comparative statics (Section 4, Case 1) of Benabou and Gertner (1993), focusing on a partial equilibrium mechanism rather than full equilibrium. There is a continuum of identical consumers, with measure normalized to one, and their demand function in absence of search is given by:

$$Y_i^d(P_i) = P_i^{-\eta}. \tag{OA.13}$$

Hence, the profit function of a monopolist with cost C_i is $(P_i - C_i)Y_i^d(P_i)$, and its maximum value is given by

$$P_i^m(C_i) = \frac{\eta}{\eta - 1} \cdot C_i. \tag{OA.14}$$

To study the effect of search on firm pricing, we assume that, initially, half the consumers observe firm 1's price, and the other half observe firm 2's price, at no cost. Given the observed price, each consumer decides whether to purchase at that price or search further to learn the price from the other firm. Searching entails a cost $\sigma > 0$, but it allows consumers to buy at the lower of the two prices.

Without loss of generality, let us consider consumers who first observe the price P_1. Upon observing P_1, they infer firm 1's underlying marginal cost structure. Using this information, they then form a posterior belief about the distribution of firm 2's price, denoted $G(P_2 \mid P_1)$ with density $g(P_2 \mid P_1)$. Based on these beliefs, the consumers then decide whether it is worthwhile to search and discover P_2. Specifically, upon observing P_1, consumers map this price to the biased marginal cost C_1^B and form a biased Bayesian posterior for C_2^B. This posterior is subsequently mapped to the monopoly price P_2^m that a firm with costs C_2^B would charge. For convenience, we define $c \equiv \log C$ and $p_i^m(c) \equiv \log(P_i^m(C))$.

The conditional distribution of c_2^B, given $c_1^B = c$, is normal with mean,

$$E[c_2^B|c] = \rho c + (1-\rho)\left(\bar{c} + \max(b_Z, Z_2)\right),$$

where

$$\rho = \frac{\psi_\theta}{\psi_\theta + \psi_\gamma}, \tag{OA.15}$$

and variance:

$$\text{Var}(c_2^B | c) = (1 - \rho^2)(\psi_\theta + \psi_\gamma).$$

The unconditional distribution of p_2^m is normal, with mean

$$\bar{p} \equiv \bar{c} + (\bar{c} + \max(b_Z, Z_2)) + \log\left(\frac{\eta}{\eta - 1}\right). \tag{OA.16}$$

Moreover, the conditional distribution of $p_2^m(c_2^B)$, given $c_1^B = c$, is normal with mean,

$$\mu(p) \equiv \rho p + (1 - \rho)\bar{p},$$

and variance:

$$s^2 \equiv (1 - \rho^2)(\psi_\theta + \psi_\gamma).$$

The expected gain from search. Let $S(p) \equiv \int_p^\infty Y_i^d(r)\, dr$ be the surplus that consumers derive from buying at price p; thus:

$$S(p) = \frac{1}{\eta - 1} e^{(1-\eta)p}. \tag{OA.17}$$

Therefore, after observing p_1, consumers' expected gain from search is given by:

$$\begin{aligned} W(p_1) &= \int_{-\infty}^{p_1} [S(p_2) - S(p_1)]\, g(p_2 \mid p_1)\, dp_2 \\ &= \frac{1}{\eta - 1} \int_{-\infty}^{p_1} \frac{1}{\sqrt{2\pi s}} \{\exp[(1-\eta)p_2] - \exp[(1-\eta)p_1]\} \exp\left[-\frac{(p_2 - \mu(p_1))^2}{2s^2}\right] dp_2. \end{aligned}$$

If $W(p_1) > \sigma$, a consumer chooses to search; otherwise, the consumer buys immediately at price p_1. Moreover, define consumers' reservation price p_1^* as the smallest solution to:

$$W(p_1^*) = \sigma.$$

Accordingly, consumers are thus indifferent between searching and purchasing from firm 1 when it charges p_1^*. Let c_1^* denote the cost level such that $p_1^m(c_1^*) = p_1^*$. Consequently, if firm 1's cost level is $c_1 > c_1^*$ and it charges its monopoly price, it will induce search. Rather than incur the first-order loss in customers (who may search and potentially find a lower price), the firm opts to charge p_1^*, avoiding customer loss and experiencing only a second-order effect on profits per customer.

Rewriting the consumers' expected gain from search, $W(p_1)$, in terms of the distribution Φ of a standard normal gives:

$$\begin{aligned} W(p_1) =& \frac{1}{\eta-1}\exp\left[-\frac{(\eta-1)}{2}\left[2\bar{p}+2\rho(p_1-\bar{p})-s^2(\eta-1)\right]\right] \\ &\cdot \Phi\left[\frac{(1-\rho)(p_1-\bar{p})+s^2(\eta-1)}{s}\right] \\ &-\frac{1}{\eta-1}\exp\left[-(\eta-1)p_1\right]\cdot\Phi\left[\frac{(1-\rho)(p_1-\bar{p})}{s}\right]. \end{aligned} \tag{OA.18}$$

Generalized inflation expectations and the perceived search value. Taking the derivative of $W(p_1)$ with respect to the extent of common shock bias b_Z yields:

$$\frac{\partial W(p_1)}{\partial b_Z} = \begin{cases} -(1-\rho)\exp\left(-\frac{(\eta-1)}{2}\left[2\bar{p}+2\rho(p_1-\bar{p})-s^2(\eta-1)\right]\right) & \\ \quad \cdot\Phi\left(\frac{(1-\rho)(p_1-\bar{p})+s^2(\eta-1)}{s}\right) < 0 & \text{if } b_Z > Z_2, \\ 0 & \text{if } b_Z \leq Z_2. \end{cases}$$

Hence, the effect of an increase in b_Z on the search value of consumers depends on the sector and its exposure to supply-side shocks.

For less affected sectors—where $b_Z > Z_2$ (e.g., service sectors)—an increase in the mean of the conditional distribution of $p_2^m(c_2^B)$ conditional on $p_1 = p$, driven by a higher b_Z (i.e., attributing the supply-side cost shock to a common shock across both firms), reduces the perceived option value of search. This effect arises because consumers in these sectors are effectively overestimating the average price level in the market. This dynamic reduces competitive pressure on firm 1, raising its market power. As a result, the reservation price p_1^* shifts upward, allowing firm 1 to charge higher prices without inducing consumers to search for alternatives. Correspondingly, the threshold cost level c_1^* increases, extending the range of cost levels over which firm 1 can charge monopoly markups.

In contrast, in sectors more directly impacted by the supply-side shock—where $b_Z \leq Z_2$ (e.g., manufacturing)—this effect does not arise. The greater actual commonality in costs across firms means that consumers' attribution of elevated costs to a shared shock is accurate. As a result, their posterior beliefs about firm 2's prices reflect the true cost structure, leaving the reservation price p_1^* unchanged. Consequently, there is no distortion in market power, and firm 1's pricing behavior remains unaffected by the attribution of the shock.

While we study a single product market, our findings are also applicable to multiple product markets where the consumption of different products is interconnected through a positive cross-elasticity of demand. A lower perceived option value of search the cross-price elasticity of demand. This reduction, in turn, causes an upward shift in the demand curve for individual firms.

OA.4.3 Effect of generalized inflation expectations on firm pricing through fairness concerns

Next, we explore how the overestimation of the magnitude of the common shock (i.e., bias $b_Z > 0$) impacts firm pricing through consumers' fairness concerns. To study this effect, we consider a case without search, and where customers assess transactional fairness by evaluating the perceived markup charged by firms.

Consumers' fairness concerns. There is microevidence supporting the idea that consumers care about fairness (see Eyster et al., 2021 for a detailed discussion). Customers typically perceive price hikes driven by increased demand as unfair, whereas those resulting from rising costs are viewed more acceptably (e.g., Kahneman et al., 1986; Frey and Pommerehne, 1993; Gielissen et al., 2008; and Shiller et al., 1991). Perceived unfair pricing can reduce customers' willingness to pay (e.g., Piron and Fernandez, 1995; Rotemberg, 2008; and Urbany et al., 1989). Firms also recognize that customers respond negatively to markups perceived as unfair (e.g., Blinder et al., 1998 and Eyster et al., 2021).

To capture consumers' fairness concerns, we assume that the perceived markup (over perceived costs) determines a transaction's perceived fairness, represented by a twice differentiable fairness function $F(M^B)$, which is positive, strictly decreasing, and weakly concave over $[0, M^h]$, where $F(M^h) = 0$ and $M^h > \eta/(\eta - 1)$. The decreasing nature of F reflects customers' aversion to higher markups, while its weak concavity implies that increases in perceived markup lead to a utility loss at least as large as the utility gain from an equal-sized decrease in the perceived markup.

Generalized inflation expectations are associated with consumers' overestimation of the magnitude of the common shock, which influences their fairness assessments. Specifically, consumers form biased beliefs about firms' marginal costs and infer the firms' markup accordingly. Given these biased perceptions, consumers infer that the markup is as follows:

$$M^B(P_i) = \frac{P_i}{E\left[C^B(P_i)\right]}. \tag{OA.19}$$

A customer who purchases quantity Y_i of the good at price P_i thus experiences the following fairness-adjusted consumption:

$$A = F(M^B(P_i)) \cdot Y_i.$$

Customers also face a budget constraint:

$$P_i \cdot Y_i + B = I,$$

where $I > 0$ represents initial wealth, and B denotes remaining money balances. Fairness-adjusted consumption and money balances are incorporated into a quasilinear utility function:

$$\frac{\eta}{\eta - 1} \cdot A^{(\eta-1)/\eta} + B,$$

where the parameter $\eta > 1$ governs the concavity of the utility function. Given the fairness factor F and price P_i, customers choose their purchases Y_i and money balances B to maximize utility, subject to the budget constraint:

$$\frac{\eta}{\eta - 1} \left(F \cdot Y_i\right)^{(\eta-1)/\eta} + I - P_i \cdot Y_i.$$

The maximum of the customers' utility function is determined by the following first-order condition (FOC):

$$F^{(\eta-1)/\eta} \cdot Y_i^{-1/\eta} = P_i,$$

which yields the following demand function:

$$Y_i^d(P_i) = P_i^{-\eta} \cdot F(M^B(P_i))^{\eta-1}. \tag{OA.20}$$

The price affects demand through two channels: the typical substitution effect, represented by $P_i^{-\eta}$, and the fairness channel, captured by $F(M^B(P_i))^{\eta-1}$. The fairness channel arises because the price influences the perceived markup, and thus the perceived fairness of the transaction; this, in turn, impacts the marginal utility of consumption and, consequently, demand.

Firm pricing under fairness concerns. When firms set prices under fairness concerns, they need to account for how the perceived fairness of their markups influences customers' willingness to pay. Consequently, firms must balance the direct impact of the price on profit margins with the indirect effect of perceived fairness on the demand elasticity.

Specifically, in the absence of search, the two firms set price P_i and output Y_i to maximize profits $(P_i - C_i) \cdot Y_i^d(P_i)$, subject to customers' demand for their good. The resulting FOC is:

$$Y_i^d(P_i) + (P_i - C_i)\frac{dY_i^d}{dP_i} = 0. \tag{OA.21}$$

We introduce the price elasticity of demand, normalized to be positive:

$$E_i = -\frac{d\ln(Y_i^d)}{d\ln(P_i)} = -\frac{P_i}{Y_i^d} \cdot \frac{dY_i^d}{dP_i},$$

which implies together with the FOC from Eq. (OA.21) for the monopoly price that

$$P_i^m(C_i) = \frac{E_i}{E_i - 1} \cdot C_i. \tag{OA.22}$$

From Eq. (OA.20), we find the elasticity E:

$$E_i = \eta + (\eta - 1) \cdot \phi(M^B) > \eta, \tag{OA.23}$$

where

$$\phi(M^B) = -\frac{d\ln(F)}{d\ln(M^B)}$$

is the elasticity of the fairness function with respect to the perceived markup. The properties of the fairness function F imply the following lemma (for the proof, please refer to Online Appendix A of Eyster et al., 2021).

Lemma 1. *The elasticity of the fairness function* $\phi(M^B)$ *is strictly positive and strictly increasing on* $(0, M^h)$*, with* $\lim_{M^B \to 0} \phi(M^B) = 0$ *and* $\lim_{M^B \to M^h} \phi(M^B) = +\infty$*. As an implication, the superelasticity of the fairness function*

$$\kappa = \frac{d\ln(\phi)}{d\ln(M^B)}$$

is strictly positive on $(0, M^h)$*.*

The second term in Eq. (OA.23), $(\eta - 1) \cdot \phi$, represents the fairness channel, which implies that higher perceived marginal costs and a lower price reduce the perceived markup, thereby increasing the perceived fairness and lowering the price elasticity of demand.

From Eq. (OA.22) and Eq. (OA.23) it follows that the firms' monopoly price is given by

$$P_i^m = \left(\frac{\eta + (\eta - 1)\phi}{(\eta - 1)(1 + \phi)} \right) \cdot C_i. \tag{OA.24}$$

Generalized inflation expectations and price elasticity of demand. Next, we investigate the effect of consumers' overestimation of the common cost shock, b_Z, on optimal firm pricing. To this end, we calculate the derivative of P_i^m with respect to b_Z using the chain rule, as ϕ depends on the perceived markup M^B, which in turn is influenced by b_Z:

$$\frac{dP_i^m}{db_Z} = \frac{dP_i^m}{d\phi} \cdot \frac{d\phi}{db_Z}, \tag{OA.25}$$

where the derivative of P_i^m with respect to ϕ is given by:

$$\frac{dP_i^m}{d\phi} = -\frac{C_i}{(\eta - 1)(1 + \phi)^2} < 0. \tag{OA.26}$$

Plugging Eq. (OA.26) into Eq. (OA.25) yields:

$$\frac{dP_i^m}{db_Z} = -\frac{C_i}{(\eta - 1)(1 + \phi)^2} \cdot \frac{d\phi}{db_Z}. \tag{OA.27}$$

Hence, to determine the sign of dP_i^m/db_Z, we next need to establish the sign of $d\phi/db_Z$. Since ϕ depends on b_Z via the perceived markup given in Eq. (OA.19), we have:

$$\frac{d\phi}{db_Z} = \frac{d\phi}{dM^B(P_i)} \cdot \frac{dM^B(P_i)}{db_Z}, \tag{OA.28}$$

for which we know that $d\phi/dM^B(P_i) > 0$ from Lemma 1. To determine $dM^B(P_i)/db_Z$, we first substitute the actual and perceived marginal costs into Eq. (OA.19), which, after simplification, yields:

$$M^B(P_i) = \left(\frac{\eta + (\eta-1)\phi}{(\eta-1)(1+\phi)}\right) \cdot e^{-b_Z}. \tag{OA.29}$$

The derivative of $M^B(P_i)$ with respect to b_Z is given by:

$$\frac{dM^B(P_i)}{db_Z} = \begin{cases} = -\left(\frac{1}{(\eta-1)(1+\phi)^2} \cdot \frac{d\phi}{db_Z} + \frac{\eta+(\eta-1)\phi}{(\eta-1)(1+\phi)}\right) \cdot e^{-b_Z} & \text{if } b_Z > Z_1, \\ 0 & \text{if } b_Z \leq Z_1. \end{cases} \tag{OA.30}$$

Substituting Eq. (OA.28) into Eq. (OA.30) and solving for $dM^B(P_i)/db_Z$ yields

$$\frac{dM^B(P_i)}{db_Z} = \begin{cases} = -\frac{\left(\frac{\eta+(\eta-1)\phi}{(\eta-1)(1+\phi)}\right)\cdot e^{-b_Z}}{1+\frac{e^{-b_Z}}{(\eta-1)(1+\phi)^2}\cdot\frac{d\phi}{dM^B(P_i)}} < 0 & \text{if } b_Z > Z_1, \\ 0 & \text{if } b_Z \leq Z_1. \end{cases} \tag{OA.31}$$

Eq. (OA.31) together with Eq. (OA.28) imply that $d\phi/db_Z < 0$ if $b_Z > Z_1$, which in turn implies that $dE/db_Z < 0$ (see Eq. OA.23) and that $dP_i^m/db_Z > 0$ (see Eq. OA.27). Therefore, the overestimation of the common cost shock magnitude, b_Z, reduces the price elasticity of demand E whenever $b_Z > Z_1$ due to consumers' fairness concerns, prompting firms to set higher prices.

Finally, we determine the derivative of the actual markup with respect to b_z. Plugging the price P_i^m from Eq. (OA.24) into the actual markup (P_i/C_i) yields:

$$M_i = \frac{P_i}{C_i} = \left(\frac{\eta + (\eta-1)\phi}{(\eta-1)(1+\phi)}\right); \tag{OA.32}$$

thus, the derivative of M_i with respect to b_Z is given by:

$$\frac{dM_i}{db_Z} = \frac{dM_i}{d\phi} \cdot \frac{d\phi}{db_Z},$$

since ϕ again depends on the perceived markup, which depends on b_Z. Taking the derivative of M_i with respect to ϕ yields:

$$\frac{dM_i}{d\phi} = -\frac{1}{(\eta - 1)(1 + \phi)^2} < 0. \tag{OA.33}$$

Hence, the derivative of M_i with respect to b_Z is:

$$\frac{dM_i}{db_Z} = \begin{cases} = -\frac{1}{(\eta-1)(1+\phi)^2} \cdot \frac{d\phi}{db_Z} > 0 & \text{if } b_Z > Z_1, \\ \\ 0 & \text{if } b_Z \leq Z_1. \end{cases} \tag{OA.34}$$

Therefore, the overestimation of the size of the common cost shock, b_Z, also increases the actual markup charged by firms in the absence of search if $b_Z > Z_1$.

In summary, when consumers have elevated generalized inflation expectations, they attribute higher prices to broader market-wide cost increases, which reduces their perception of unfairness in pricing. This shift lowers the price elasticity of demand, as consumers become less responsive to price hikes. Firms capitalize on this reduced elasticity by increasing their markups and prices. These effects are again more pronounced in sectors less affected by supply-side shocks.