Beyond Costs: The Dominant Role of Strategic Complementarities in Pricing*

Elias Albagli
Central Bank of Chile

Francesco Grigoli
Georgetown University

Emiliano Luttini
World Bank

Dagoberto Quevedo
Central Bank of Chile

Marco Rojas
Central Bank of Chile

February 18, 2026

Abstract

This paper documents five empirical facts about the role of strategic complementarities in firms' price-setting behavior, using administrative data on Chilean firms. (1) Strategic complementarities play a dominant role in price setting, exerting a stronger influence than changes in marginal costs. (2) While the strength of strategic complementarities varies across sectors, it consistently outweighs the role of cost changes. (3) In high-inflation environments, firms become more responsive to changes in their competitors' prices. (4) Firms respond more strongly to competitors' price increases than to price decreases, mirroring the 'rockets and feathers' phenomenon of costs. (5) Strategic complementarities are stronger among firms with fewer competitors, larger market shares, and broader customer bases. These findings suggest that strategic complementarities—a source of real rigidities—are quantitatively important, state-dependent, asymmetric, and shaped by market structure.

Keywords: Pass-through, price setting, strategic complementarities, state dependency, market structure
JEL Codes: D22, E31

*Elias Albagli, ealbagli@bcentral.cl; Francesco Grigoli, francesco.grigoli@georgetown.edu; Emiliano Luttini, eluttini@worldbank.org; Dagoberto Quevedo, dquevedo@bcentral.cl; Marco Rojas, mrojaso@bcentral.cl. The views expressed in this paper are those of the authors and do not necessarily represent those of the Central Bank of Chile, the IMF, the World Bank, their Executive Boards, or their management. We thank Camila Casas, Lucyna Gornicka, Rodolfo Rigato, Carlos Viana de Carvalho, Pierre-Olivier Gourinchas, Damiano Sandri, Antonio Spilimbergo, Shengxing Zhang, and seminar participants at the Central Bank of Chile, the Central Bank of Brazil, the World Bank, Universidad de los Andes, and participants to the ASSA 2026 Annual Meeting, and the BanRep-FLAR-IMF-IMFER conference for comments and suggestions. No conflict of interest to declare.

1 Introduction

A central tenet of New-Keynesian macroeconomic models is that prices adjust sluggishly in response to changes in marginal costs. This nominal rigidity gives rise to monetary non-neutrality and is reflected in a flatter Phillips curve. If instead prices are flexible, the sacrifice ratio is lower and monetary policy effectiveness is diminished and can become even neutral (Golosov and Lucas, 2007). However, price rigidity is not only determined by the pass-through of marginal costs. A firm's pricing decisions are also shaped by the pricing behavior of its competitors (Cooper and John, 1988), and these interdependencies—referred to as strategic complementarities—have a direct effect on the slope of the Phillips curve (Gopinath and Itskhoki, 2011; Gagliardone et al., 2023). In this respect, some studies argue that monetary non-neutrality arises only when real rigidities are coupled with nominal rigidities (Klenow and Willis, 2016).

But how do strategic complementarities originate? When a firm considers raising its price in response to an increase in marginal costs, it also takes into account how competitors would react. If strategic complementarities are strong, the pass-through of marginal cost increases is reduced, as firms fear losing market share if they raise prices unilaterally. Thus, strategic complementarities can lead to a coordination problem, where firms are reluctant to be the first to change prices, contributing to price stickiness. From a theoretical standpoint, strategic complementarities arise in oligopolistic settings in which the elasticity of demand and markups are a function of the firms' market shares (Kimball, 1995; Atkeson and Burstein, 2008; Wang and Werning, 2022). In these frameworks an increase in competitors' prices lowers a firm's relative prices, boosting its demand and resulting in a market share that exceeds the optimal level. Thus, the firm reacts by increasing its prices, bringing the market share back to its optimal level. The empirical evidence on the importance of strategic pricing suggests that these interdependences are important determinants of firms' prices, albeit less so than changes in firms' marginal costs (Amiti, Itskhoki and Konings, 2019; Gagliardone et al., 2023).

In this paper, we use unique confidential administrative data on input and sales prices for firms in Chile to document key empirical facts about strategic complementarities in price setting. We employ an accounting framework in which prices can be expressed as a weighted average of firms' marginal costs and the prices of their competitors, with the weight on the latter providing a measure of the strength of strategic complementarities (Gopinath and Itskhoki, 2011). Using this framework, we examine the dynamic responses of firms' prices to changes in their competitors' prices and compare them to the responses to changes in their marginal costs, along both the extensive margin of price

adjustments (the frequency of price changes) and the intensive margin (the magnitude of price changes).

Examining strategic complementarities requires a careful identification of each firm's competitors. The literature usually assumes that firms in the same sector are competitors. However, firms do not typically compete with all other firms in the same industry, and may in fact compete only on a subset of their products, and only in certain locations. Leveraging the granularity of our data, we construct a significantly narrower measure of competitors' prices that accounts for the industry in which firms operate, the products they sell, and the geographical area where they compete. With respect to marginal costs, we directly measure the prices of intermediate inputs using data from electronic invoices. Our sample period—from January 2014 to December 2023—is characterized by large inflation fluctuations in Chile, which allows us to explore whether firms' strategic pricing is state dependent and asymmetric. At the same time, the large cross-sectional dimension of the data—covering the universe of firms in the manufacturing, wholesale, and retail sectors (henceforth referred to as retailers)—enables us to explore the sectoral heterogeneity and examine how the intensity of competition, firms' market shares, and their customer bases shape strategic behavior in pricing.

The first fact we document is that strategic complementarities are overwhelmingly important for firms' price setting, relatively more than changes in marginal costs. We estimate that firms pass-through 66 percent of the changes in competitors' prices to their own sales prices over the one-year horizon. In comparison, the response of sales prices to changes in marginal costs is considerably smaller and slower, with the degree of pass-through estimated at 18 percent one year after the shock. That is, the pass-through of changes in competitors' prices is about 3.7 times larger than the pass-through of changes in firms' own costs. Compared to recent studies estimating these elasticities for manufacturing firms, we find a much more prominent role of strategic complementarities relative to changes in marginal costs for firms' pricing.[1] We attribute these differences to smaller measurement error—as we benefit from a rich administrative dataset that allows for a more precise computation of competitors´ prices and firms' marginal costs—as well as a broader coverage of firms in the economy—including retail and wholesale industries beyond manufacturing.

We also find that firms adjust their prices in response to competitors' prices along both the extensive and the intensive margins. One year after a one percentage point increase

[1] Using data on Belgian manufacturing firms, Amiti et al. (2022) and Gagliardone et al. (2023) find an elasticity of about 0.4 in response to its competitors' price changes and an elasticity of about 0.6 in response to its own cost shocks.

in competitors' prices, the frequency of price changes rises by 2.2 percentage points—1.5 times the response to an equivalent increase in marginal costs. This implies that a 27 percent increase in competitors' prices is sufficient to prompt the average firm to adjust the prices of all its products, whereas marginal costs would need to surge by 60 percent to achieve the same result. At the intensive margin, firms react swiftly, incorporating a large share of competitor price changes into their sales prices. By the end of the year, firms have passed through nearly 70 percent of the competitor price increase. In contrast, the adjustment to changes in marginal costs is more gradual and only 24 percent of the initial increase is reflected in sales prices.

The second fact is that the strength of strategic complementarities varies across sectors, but usually remains of first-order importance. We show that manufacturing firms pass through about 40 percent of the changes in competitors' prices. This is considerably less than for retail firms, whose pass-through is about 70 percent. These estimates, however, are still substantially larger than the cost pass-through rates: 26 percent for manufacturing firms and 13 percent for retail firms. That is, strategic complementarities remain dominant even when focusing on the manufacturing sector, the usual focus of the literature. Further analysis of cross-industry heterogeneity corroborates that strategic complementarities are of first-order importance. Turning to the magnitude of price adjustments, we find that retailers pass on a much larger share of the changes in competitors' prices within the first couple of months after the shock, while it takes the entire year for manufacturers to pass on the same share. The frequency of price adjustments in response to changes in competitors' prices is also significantly higher for retailers than for manufacturers at the one-year horizon. These results align with the evidence of higher repricing costs for manufacturers, which face longer production cycles and less frequent sales (Goldberg and Hellerstein, 2007).

The third fact is that strategic complementarities are state dependent. State dependent models predict that, in an environment of heightened nominal volatility firms are more likely to experience large cost shocks, which diminish their profits, triggering more frequent price adjustments compared to periods of greater stability (Klenow and Kryvtsov, 2008). If firms' optimal prices depend on competitors' prices, the increased frequency of price adjustments may also affect the extent to which firms engage in strategic pricing. Thus, we examine whether firms react more strongly to changes in their input prices and competitors' prices when aggregate inflation is high. We indeed find that, in high-inflation environments, firms disproportionately respond to changes in marginal costs and competitors' prices. From a policy perspective, this means that in such settings monetary policy has less traction on real outcomes. Mapping the pass-through esti-

mates to the underlying structural markup elasticities reveals that this pattern is related to firms' tendency to stabilize markups in response to changes in their prices, which leads them to respond more aggressively to variations in both input and competitors' prices. To our knowledge, this is the first study documenting empirically how markup stabilization affects both cost and competitor price pass-through coefficients. In addition, we show that while firms respond to changes in costs primarily by adjusting prices more frequently, changes in competitors' prices trigger both more frequent and larger price adjustments.

The fourth fact is that firms' prices react more strongly when competitors raise prices than when they cut them. The literature has shown that firms are more sensitive to cost increases than cost decreases, a pattern often referred to as the 'rockets and feathers' phenomenon (Bacon, 1991; Peltzman, 2000). However, asymmetries in strategic pricing have remained unexplored. We provide evidence that the pass-through from competitors' price changes is greater when these prices increase than when they decrease, extending the 'rockets and feathers' phenomenon of marginal cost changes to strategic complementarities. In the latter case, increases in competitors' prices result in lower relative prices, prompting a more aggressive upward price adjustment than the downward adjustment following declines in competitors' prices. This larger pass-through of competitors' price increases reflects a larger increase in the frequency of price adjustments, while there are no statistically significant differences in the magnitude of price changes.

The fifth fact is that firms exhibit stronger strategic complementarities when they have fewer competitors, hold larger market shares, and serve broader customer bases. Firms are more willing to engage in strategic pricing when they operate in concentrated markets (Atkeson and Burstein, 2008). In such settings, firms with market power can influence prices more effectively to maximize their profits. Also, concentrated markets often have high barriers to entry, enabling existing firms to engage in strategic pricing without the immediate risk of losing market share to new competitors. Finally, firms with fewer competitors can more easily coordinate their pricing strategies. Slicing the data for firms in the manufacturing sector along different dimensions of market concentration—the number of competing firms, the firms' market shares, or the size of their customer bases—we find support for the prediction that firms in more concentrated markets engage more aggressively in strategic pricing.

We conduct a range of robustness checks to validate the empirical facts documented in the paper. First, our results remain virtually unchanged when including sector-time fixed effects to account for sector-specific demand shocks and coordinated wage adjustments. Second, leveraging the granularity of our data, we construct instrumental variables (IVs)

to address two sources of endogeneity. To mitigate the potential reverse causality of changes in marginal costs due to the monopsonic power of some firms, we exclude purchases of firms from suppliers that have only a few buyers. Also, to tackle the simultaneity in price setting between firms and their competitors, we instrument competitors' prices using input cost changes faced by their suppliers, excluding inputs sold to both the firm and its competitors. The IV results corroborate our finding that strategic complementarities play a dominant role in price setting—if anything, our OLS estimates appear to be conservative. Additional robustness checks—including extended response horizons and alternative estimation methods—further confirm the strength and consistency of our results.

These results underscore the importance of incorporating strategic complementarities, a source of real rigidities, in macroeconomic models. By showing that firms' pricing decisions respond strongly to competitors' prices, our findings point to a mechanism through which nominal shocks can generate amplified and persistent real effects. For example, our findings imply that monetary policy can have relatively larger effects on real variables than standard models predict. However, the magnitude of these effects depends on broader macroeconomic conditions, the direction of cost and competitor price changes, and the structural characteristics of the markets in which firms operate. By precisely estimating the elasticity of firms' prices with respect to both their own costs and competitors' prices, and by documenting how these elasticities vary across different settings, our findings provide empirically grounded inputs for quantitative macroeconomic models that aim to assess monetary policy transmission under realistic market structures. More broadly, our results suggest that evaluating the effectiveness of monetary policy requires accounting not only for price stickiness at the firm level, but also for the network of strategic interactions across firms that shapes how prices adjust at the aggregate level.

Related literature. Our paper is primarily related to the studies quantifying the strength of strategic complementarities.[2] Two key studies in this area are Amiti, Itskhoki and Konings (2019) and Gagliardone et al. (2023), who use Belgian micro data for manufacturing firms to show that the prices of the competitors matter when firms decide how to adjust their own prices. We complement the evidence in these papers by shifting the focus to an emerging market with larger inflation swings, broadening the sample of firms to those in the retail and wholesale sectors, narrowing the identification of competitors based on geographical and product information, exploring firms' price adjustments along the ex-

[2]Other papers study the importance of properly accounting for the role of strategic complementarities. For international trade see Jaravel and Sager (2019). For posted wages see Droste (2024).

tensive and the intensive margins, and examining pass-through dynamics.[3]

The paper is also more generally related to the literature on cost pass-through. Data limitations forced much of the work in this area using micro data to focus on a few small sectors, such as cars, beer, and coffee (Feenstra, Gagnon and Knetter, 1996; Nakamura and Zerom, 2010; Goldberg and Hellerstein, 2013). Moreover, as it is challenging to obtain reliable information about the cost of firms' intermediate inputs, many studies solely consider selected products like energy (Fontagné, Martin and Orefice, 2018; Ganapati, Shapiro and Walker, 2020; Lafrogne-Joussier, Martin and Mejean, 2023) or rely on movements in the exchange rate or import prices (Gopinath and Itskhoki, 2010; Auer and Schoenle, 2016; Pennings, 2017; Amiti, Itskhoki and Konings, 2019) to identify exogenous variation in costs. By leveraging the richness of administrative price information from firm-to-firm invoices, we extend this evidence to a broader set of products and markets across different industries. Moreover, we depart from admittedly noisy accounting measures of firms' average variable costs by measuring directly the price changes of intermediate inputs.

Our analysis of state dependency in strategic pricing is related to the growing evidence on firms' optimizing behavior. Earlier contributions showed that pricing is indeed state dependent, both in advanced economies (Klenow and Kryvtsov, 2008; Nakamura and Steinsson, 2008; Eichenbaum, Jaimovich and Rebelo, 2011; Campbell and Eden, 2014; Lafrogne-Joussier, Martin and Mejean, 2023) and emerging markets (Gagnon, 2009; Alvarez et al., 2019). We extend these findings that largely focus on firms' own costs by examining whether the scope to engage in strategic pricing is also state dependent. Similarly, we contribute to the literature on asymmetric pricing (Bacon, 1991; Peltzman, 2000), extending it to strategic complementarities. Studies in this area are typically limited to firms' own costs and specific markets, such as fuel, food, and retail goods (Karrenbrock et al., 1991; Neumark and Sharpe, 1992). We broaden the focus to the universe of firms in the manufacturing and retail sectors, and examine both the asymmetric price response of firms to changes in marginal costs and competitors' prices.

Finally, our study contributes to the literature on how market concentration shapes firms' pricing behavior. In the model of Atkeson and Burstein (2008), strategic complementarities are stronger among firms facing lower competition and holding higher market shares. Amiti, Itskhoki and Konings (2019) document that strategic complementarities differ between large and small firms, as well as between firms with high and low

[3]Pass-through dynamics to changes in competitors' prices received little attention in the literature. An exception is Gagliardone et al. (2023), who characterize the dynamic pass-through via an error-correction equation.

market shares. Alexander et al. (2024) using Canadian wholesale trade data to show that firms' market shares affect the pass-through of common shocks and the degree of strategic pricing. Consistent with these findings, we show that firms with higher market shares exhibit stronger strategic complementarities—particularly when they face less competition and maintain a larger customer base. Our results can inform quantitative models, such as Wang and Werning (2022), that rely on estimates of strategic complementarities to gauge the effects of monetary policy under varying degrees of market concentration.

The rest of the paper is organized as follows. In Section 2, we describe the sources of our data and the cleaning procedure, and provide a descriptive analysis of price adjustments along the extensive and the intensive margins. We then discuss the empirical framework in Section 3. Section 4 establishes five key facts about firms' price setting in relation to their competitors' prices. We present the results of a series of robustness tests in Section 5. Section 6 concludes.

2 Data

Our empirical setting is Chile over the period January 2014 to December 2023. Unlike advanced economies, where inflation remained low and stable until the pandemic, Chile experienced substantial inflation fluctuations throughout the sample. On a year-on-year basis, CPI inflation declined to 1.4 percent in late 2017 after peaking at 5.9 percent at the end of 2014, and it remained above the central bank's 3 percent target during the so-called 'commodity supercycle'. After a period of relative stability around the central bank's target, inflation began rising in mid-2020 and reached a peak of 14 percent in August 2022, before gradually declining to 3.8 percent by the end of 2023. PPI inflation followed a similar trajectory but with markedly higher volatility. It turned negative in 2016, 2019, and 2023, reaching a trough of –8.7 percent in July 2023. In 2014 it approached 10 percent, and surged to 27.9 percent in July 2022. These pronounced fluctuations in both consumer and producer prices provide a rich environment for studying firms' price-setting behavior.

To construct our dataset, we draw from the detailed price information of the administrative firm-to-firm invoice records maintained by Chile's Internal Revenue Service (IRS). Since 2014, Chilean firms have been required to issue electronic invoices, which report prices and quantities for each product variety sold. From these records, we extract information on the buyer, the seller, their economic sectors, the product varieties sold (identified by text descriptors), and the prices at which transactions were settled for the uni-

verse of domestic transactions.[4] We also leverage the transaction-level information from the Chilean Customs Service to obtain prices and quantities for each product that firms purchase from abroad.

We aggregate the transaction-level data at the selling firm–product variety–month level by computing the median price at which each product variety is sold in a given month. Then, we apply a series of cleaning criteria to exclude erroneous or invalid records. If the month-to-month price change is smaller than 10 Chilean pesos (less than 2 U.S. cents), we treat the observation as a non-change and carry forward the previous month's price. If a price change in one month is fully reversed in the following month, we also replace it with the prior month's price. In addition, we drop records for which the price change lies outside the bottom and top 5th percentiles of the distribution, corresponding to instances in which prices decline by more than half or increase by more than double. Finally, to ensure that we are analyzing genuine firms—rather than entities created for tax purposes—we further restrict the sample based on firm characteristics. First, we exclude firms with fewer than five employees on average over the year.[5] Second, we retain only firms that are listed in the Chilean National Accounts registry. Third, we drop within-firm transactions, which may not reflect market pricing. Fourth, we exclude transactions that were subject to invoice corrections via credit notes. [6]

2.1 Firms' prices

We compute a measure of firm-level inflation for all firms in the manufacturing and retail sectors. To do so, we first calculate the median price of each product sold by a firm in each month. Then, for each firm i selling product variety v at time t, we construct its inflation

[4] Eichenbaum et al. (2014) shows that unit value based pricing induces a leftward shift in the distribution of price changes, overstating the frequency of small price adjustments and understating the frequency of large ones. It also leads to infer that the median size of price changes is smaller than in reality. Because we directly observe actual transaction prices rather than inferred unit values, our data are not subject to these distortions.

[5] Chilean employers are required to report wage information to calculate social security contributions and withholding taxes. From these administrative records, we retrieve both the number of employees and the firms' wage bill.

[6] This study was developed within the scope of the research agenda conducted by the Central Bank of Chile (CBC) in economic and financial affairs of its competence. The CBC has access to anonymized information from various public and private entities, by virtue of collaboration agreements signed with these institutions. To secure the privacy of workers and firms, the CBC mandates that the development, extraction and publication of the results should not allow the identification, directly or indirectly, of natural or legal persons. Officials of the CBC processed the disaggregated data. All the analysis was implemented by the authors and did not involve or compromise the Chilean IRS. The information contained in the databases of the Chilean IRS is of a tax nature originating in self-declarations of taxpayers presented to the IRS; therefore, the veracity of the data is not the responsibility of the latter.

rate as the sales-weighted average of product-level price changes

$$\Delta p_{i,t} = \sum_{v \in i} \omega_{i,v,t} \Delta p_{i,v,t}, \tag{1}$$

where $\omega_{i,v,t}$ denotes the one-year rolling average of the sales share of product variety v in firm i's total sales at time t.[7] Our sample consists of 21,722 firms.

Following Klenow and Kryvtsov (2008), we decompose the firm's inflation rate into the product of the extensive margin——the frequency of price changes, $f_{i,t}$—and the intensive margin——the average size of non-zero price changes, $s_{i,t}$—as follows

$$\Delta p_{i,t} = f_{i,t} s_{i,t}, \tag{2}$$

and explore how firms set prices along these margins. The firm-level measure of the frequency of price changes is computed as the share of product varieties sold by the firm that changed prices per unit of time

$$f_{i,t} = \sum_{v \in i} \omega_{i,v,t} D_{v,i,t}, \tag{3}$$

where $D_{v,i,t}$ is an indicator equal to one if the price of product variety v sold by firm i changes in month t, and $O_{v,i,t}$ indicates whether the price of product variety v is observed in that month. The firm-level measure of the average size of price changes, conditional on observing a non-zero price change, is

$$s_{i,t} = \sum_{v \in i} \omega^{\neq 0}_{i,v,t} \Delta p^{\neq 0}_{v,i,t}, \tag{4}$$

where $\Delta p^{\neq 0}_{v,i,t}$ denotes the price change for product variety v when the price differs from the previous month, and $\omega^{\neq 0}_{i,v,t}$ are the corresponding sales weights, normalized over the subset of varieties with non-zero price changes.

As we also want to examine whether price increases or decreases are more frequent and different in size, we repeat the frequency and size calculations separately for price increases and decreases such that

$$\Delta p_{i,t} = f_{i,t} s_{i,t} \approx f^{+}_{i,t} s^{+}_{i,t} + f^{-}_{i,t} s^{-}_{i,t}, \tag{5}$$

where superscripts + and − denote positive and negative price changes, respectively. To

[7] As alternative weighting schemes, we use simple averages and the contemporaneous sales shares.

avoid the risk of large fluctuations affecting the results, we drop observations outside of the bottom and top 5 percentiles of the distribution, which approximately corresponds to monthly price declines and increases of over 20 percent.

The literature has pointed out that assessing price rigidity using observed prices can be problematic due to temporary sales and stockouts. Price variations associated with these events have little to do with the price changes analyzed in price-setting models and are unlikely to be related to macroeconomic conditions. Another issue is product substitution. A price change associated with the end of a product's life cycle and the introduction of a new one is motivated by factors unrelated to the firm's desire to change the product's price. To deal with temporary sales, we follow Nakamura and Steinsson (2008) and compute regular prices from observed prices.[8] As for product substitution, we get around the issue by working with data at the product variety level. In the Chilean system, whenever a firm introduces a new product substituting an old one, the new product gets assigned a different text descriptor corresponding to a unique variety. Thus, any product substitution gets classified as a new product variety.

Table 1 reports the frequency and size of price changes at the firm level, as defined in Equation 3 and Equation 4.[9] To aggregate across firms, we employ two alternative weighting schemes—based on sales and on employment—and report the corresponding time averages. Using sales-based weights, the weighted median frequency of observed price changes is 40.5 percent. With employment-based weights, the frequency is somewhat lower at 37.3 percent. Both estimates imply that, on average, firms adjust prices approximately every two months. When we focus on regular prices, the frequency declines: the weighted median falls to 31.6 percent using sales weights and to 27.7 percent using employment weights. This indicates that regular prices persist, on average, nearly one month longer than observed prices.

Price increases occur more frequently than price decreases. For observed prices, the difference in frequency is approximately 6 percentage points, while for regular prices the gap narrows to about 4 percentage points. Comparing observed and regular prices also reveals that the reduction in frequency is largely driven by fewer price increases,

[8] This methodology assumes that the regular price is usually the same after sales and stockouts as before, which indicates that the old regular price should be viewed as a latent state variable in the firm's pricing problem. Appendix A provides details about the implementation of this approach.

[9] Most of the literature on price rigidity focuses on CPI or PPI products rather than firm-level measures. To relate our estimates to those in the literature, Appendix B presents analogous calculations of the frequency and size of price adjustments at the product level for varieties included in the CPI and PPI indexes. While direct comparisons across studies are challenging due to differences in methodology, sample periods, and data sources, the available evidence for emerging markets suggests that our firm-level estimates of price adjustment frequency fall broadly within the range reported for other countries.

consistent with the notion that regular prices filter out temporary price declines, such as those associated with promotional sales. Moreover, weighted averages exceed weighted medians, indicating that a subset of products experiences price changes more frequently than the typical product.

We now turn to the intensive margin of firms' price adjustments. Over the sample period, the average magnitude of monthly price changes ranges between 0.7 and 0.8 percent, depending on whether we use median or average prices. Price increases range from 11.1 to 13.4 percent, depending on the weighting scheme and whether the median or average is used. Price decreases tend to be even larger, approximately 2.5 percentage points higher than price increases. This implies that while firms reduce prices less frequently, they do so by a larger magnitude. When comparing regular prices to observed prices, the overall size of price changes is similar. However, both regular price increases and decreases are somewhat smaller, suggesting that price adjustments associated with temporary sales tend to be larger.

3 Empirical framework

Strategic complementarities arise in models where the elasticity of demand and markups are a function of the firms' market shares (Kimball, 1995; Atkeson and Burstein, 2008). When a firm's market share depends inversely on its relative price, then its price should react positively to an increase in competitors' prices. For instance, an increase in the competitors' price translates into a firm's lower relative price, increasing its demand and market share, which results in a market share and markup that exceed their optimal levels. Because of that, the firm reacts by increasing its own prices and reducing its market share, bringing markups back to their optimal levels. Thus, the firm's optimal pricing strategy responds positively to changes in competitors' prices, generating strategic complementarities in price setting.

This strategic motive in pricing dampens the response of firms' prices to changes in their marginal costs. To illustrate, consider a firm facing a cost shock while competitors' prices remain unchanged. The firm can then aim either at maintaining its markup by increasing its prices and losing market share, or at lowering its markup by maintaining its prices and market share. However, when a firm considers raising its prices in response to an increase in marginal costs, it also considers how competitors would react. If strategic complementarities are strong, the pass-through of marginal cost changes is reduced because firms are concerned about losing market share. Hence, strategic complementarities can lead to a coordination problem where firms become hesitant to be the first to change

Table 1: Frequency and size of price changes of firms
(Percent)

	Sales weights		Employment weights	
	Median prices	Average prices	Median prices	Average prices
Frequency				
Observed prices				
All changes	40.5	45.7	37.3	43.5
Duration (months)	2.0	1.6	2.2	1.8
Increases	20.2	25.9	17.0	24.4
Decreases	14.8	19.9	11.8	19.1
Regular prices				
All changes	31.6	34.8	27.7	33.3
Duration (months)	2.7	2.4	3.1	2.5
Increases	15.7	19.1	13.4	18.3
Decreases	11.5	15.6	8.9	15.0
Size				
Observed prices				
All changes	0.8	0.7	0.8	0.7
Increases	11.1	12.3	12.0	13.4
Decreases	-13.4	-14.6	-14.4	-15.9
Regular prices				
All changes	0.7	0.6	0.9	0.7
Increases	10.4	11.6	11.1	12.6
Decreases	-12.5	-13.8	-13.5	-15.0

Notes: The table reports the frequency and size of firms' price changes. Regular prices (i.e., excluding sales) are identified using the filter of Nakamura and Steinsson (2008), which removes asymmetric V-shaped sales, defined as temporary price reductions followed by a return to the regular price. The filter applies a return window of five months. Implied duration is expressed in months and calculated as the inverse of the frequency of price changes.

prices, which in turn leads to price stickiness.

To examine the strength of strategic complementarities in relation to firms' own cost pass-through, we borrow the setup of Amiti, Itskhoki and Konings (2019), in which firms maximize profits by setting prices according to

$$p_{i,t} = mc_{i,t} + \mathcal{M}_i(p_{i,t}, \boldsymbol{p}_{-\boldsymbol{i},\boldsymbol{t}}, \boldsymbol{\xi}_{\boldsymbol{t}}), \tag{6}$$

where variables are in logs. $mc_{i,t}$ denotes the firm i's marginal cost at time t and $\mathcal{M}$ is the markup, which is a function of the firm's own prices, a vector of its competitors' prices $\boldsymbol{p}_{-\boldsymbol{i},\boldsymbol{t}}$, and a vector of demand shifters $\boldsymbol{\xi}_{\boldsymbol{t}}$.

The markup function is defined as

$$\mathcal{M}_i(p_{i,t}, \boldsymbol{p_{-i,t}}, \boldsymbol{\xi_t}) = \log\left(\frac{\epsilon\left(p_{i,t} - p_{-i,t}, \boldsymbol{\xi_t}\right)}{\epsilon\left(p_{i,t} - p_{-i,t}, \boldsymbol{\xi_t}\right) - 1}\right), \tag{7}$$

where ϵ is the elasticity of demand. The intuition behind this formulation is that a change in any firm's prices affects the demand of other competing firms, which in turn alters their demand elasticities such that the optimal markups change for all firms. A key advantage of this framework lies in its generality. Specifically, the markup function holds for any invertible demand system and competition structure, and any vector $p_{-i,t}$, such that $p_{i,t}$ is the firm's optimal reaction function.

We then estimate

$$\Delta p_{i,t} = \alpha_i + \tau_t + \sum_{r=0}^{R} \beta^r \Delta mc_{i,t-r} + \sum_{r=0}^{R} \gamma^r \Delta p_{-i,t-r} + \varepsilon_{i,t}, \tag{8}$$

which is the distributed lag version of the generalized accounting framework of price changes of Gopinath, Itskhoki and Rigobon (2010) and Burstein and Gopinath (2014). The equation indicates that firms adjust prices according to the degree of pass-through of changes in their own marginal cost β^r and the strength of strategic complementarities γ^r, with the two coefficients being functions of the underlying own and competitor markup elasticities

$$\sum_{r=0}^{T} \beta_i^r \equiv \frac{1}{1 + \Gamma_{i,T}}, \quad \sum_{r=0}^{T} \gamma_i^r \equiv \frac{\Gamma_{-i,T}}{1 + \Gamma_{i,T}}, \tag{9}$$

where $\Gamma_{i,T} \equiv -\frac{\partial \mathcal{M}_i(p_T;\xi_T)}{\partial p_{i,T}}$ is the elasticity of the markup with respect to the firms' own prices and $\Gamma_{-i,T} \equiv \sum_{j \neq i} \frac{\partial \mathcal{M}_i(p_T;\xi_T)}{\partial p_{j,T}}$ is the elasticity with respect to competitors' prices.

These elasticities influence the reduced form coefficients differently. The own price markup elasticity affects both β_i^r and γ_i^r, since firms must adjust their prices in response to both cost and competitor shocks to stabilize their markups. In contrast, the competitor price markup elasticity influences only the response to competitor prices γ_i^r. Thus, the magnitude of strategic complementarities is directly embedded in the pass-through to competitors' prices. The distributed lag specification allows us to capture the dynamics in response to changes in marginal costs and competitors' prices. In our baseline specification, $T = 12$ captures the long-term reduced form elasticities. To our knowledge, this is the first paper to characterize the dynamics of these coefficients.[10]

[10] One could alternatively obtain the dynamics by estimating local projections. However, there are two

We also examine how firms adjust prices along the extensive and intensive margins. Specifically, we re-estimate the specification in Equation 8, replacing the dependent variable with the frequency of price changes and the size of price changes, as defined in Equation 3 and Equation 4 respectively. The former is useful for gauging the extent to which nominal rigidities are state dependent, and the latter provides a measure of pass-through conditional on price changes.

3.1 Marginal costs

We assume that firms produce with constant returns to scale in material and labor, so that the log change in marginal costs is

$$\Delta mc_{i,t} = -\Delta a_{i,t} + (1-\rho_i)\Delta w_{i,t} + \rho_i \Delta ip_{i,t}, \tag{10}$$

where $\Delta a_{i,t}$ denotes productivity changes, $\Delta w_{i,t}$ represents wage growth, and $\Delta ip_{i,t}$ is the change in the firm's unit cost of intermediate inputs, aggregated via a Cobb-Douglas technology. The parameter ρ_i denotes the share of intermediate input costs in total costs.[11] In our baseline, we assume that wages are predetermined at the frequency of the firm's pricing decisions. We further assume that firm productivity evolves around a firm-specific trend plus an idiosyncratic white noise disturbance, yielding

$$\Delta mc_{i,t} = -\mu_i + \rho_i \Delta ip_{i,t} + \epsilon_{i,t}. \tag{11}$$

In the empirical specification, the firm-specific productivity trend, μ_i, is absorbed by firm fixed effects, while the idiosyncratic productivity shock, $\epsilon_{i,t}$, is part of the error term. Thus, the only component required to measure the firm's marginal costs is the intermediate input price change weighted by the intermediate input cost share.

We leverage the granularity and comprehensiveness of the price information in the electronic invoice data to construct firm-level measures of changes in input prices. For each intermediate input k purchased by firm i in month t, we calculate the change in the

downsides to this approach. First, the first year of data would be lost because the independent variables have 12 lags, and this is particularly costly with already short series (moreover, specifications for farther horizons would be estimated on fewer observations because of the long difference in the dependent variable). Second, local projections are computationally more intensive as they require the estimation of one regression per horizon compared to a single regression in the distributed lag framework. In the robustness section of the paper, we present results using local projections.

[11] We compute ρ_i as the firm's time series average of the intermediate input cost share in total costs, $\frac{1}{T_i}\sum_{t\in T_i} \frac{\text{inputs}_{it}}{(\text{inputs}_{it}+\text{wagebill}_{it})}$.

within-month median price, $\Delta ip_{k,i,t}$, weighted by the firm's expenditure share $\omega_{i,k,t}$

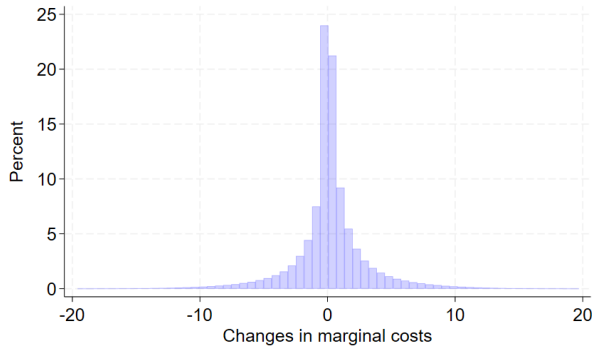
$$\Delta mc_{i,t} = \rho_i \sum_k \omega_{k,i,t} \Delta ip_{k,i,t}, \tag{12}$$

where the expenditure shares are computed as one-year rolling averages.[12]

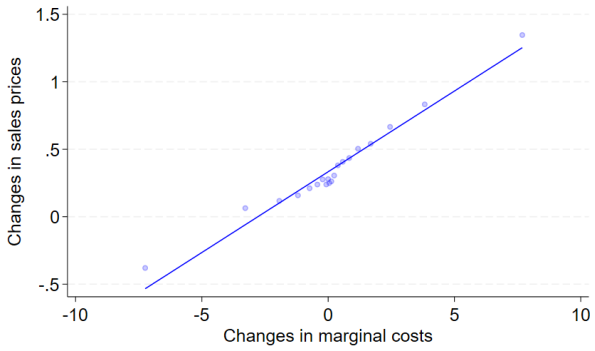
The left panel of Figure 1 displays the distribution of changes in marginal costs, which is skewed to the right, indicating that cost increases are more frequent and larger than cost decreases. The right panel plots the unconditional relationship between changes in marginal costs and changes in firms' sales prices. The slope of the regression line is 0.17, statistically significant at the 1 percent level, providing *prima facie* evidence of a positive pass-through from input cost changes to output prices.

Figure 1: Changes in marginal costs
(Percent)

(a) Distribution



(b) Relationship with sales prices



Notes: The figure shows the distribution of changes in marginal costs and the relationship between changes in marginal costs and changes in sales prices.

Compared to Amiti, Itskhoki and Konings (2019) and Gagliardone et al. (2023), who proxy marginal costs using (admittedly noisy) accounting-based measures of firms' average variable costs, we improve upon existing approaches by precisely tracking the price changes in the intermediate inputs purchased by each firm. One limitation of our measure is that we lack a precise measure of variable labor costs. From Social Security records, we observe workers' wages over the months they worked in the year, from which we can compute workers' average wages and then aggregate them at the firm level to obtain a measure of total labor costs. On average, total labor costs account for only 23 percent of

[12]To address concerns about potential recording mistakes, we restrict each firm's set of intermediate inputs to those it is expected to purchase based on the input-output matrix.

the combined value of intermediate inputs and labor costs, suggesting that input costs dominate firms' cost structure.

3.2 Competitors' prices

The literature typically assumes that a firm's competitors are all the other firms operating within the same sector.[13] However, Rossi-Hansberg, Sarte and Trachter (2021) note that product markets are generally local because transportation of goods and people is expensive, so firms set up production plants, distribution centers, and stores close to buyers; and customers may locate in areas where they can obtain the goods they desire. Beyond geography, the product dimension also plays a critical role in identifying competitors. Firms may sell a variety of products and thus face different sets of competitors depending on the specific product, even if they are classified within the same sector and operate in the same geographical area. In sum, competition is also shaped by both spatial proximity and product specialization, challenging the conventional sector-based definitions.

We depart from the existing literature by leveraging the granularity of our data to construct a significantly narrower measure of competitors' prices. Specifically, for each firm, we define competitors' price changes as the sales-weighted average of price changes for the same products, sold by other firms operating in the same sector and province. Formally, competitors' price changes are computed as

$$\Delta p_{-i,t} = \sum_{r \in R_i} \omega_{i,r,t} \sum_{d \in D_{i,r}} \sum_{j \in J_{s(i),d,r}} \omega_{j,s,d,r,t} \Delta p_{j,s,d,r,t}, \tag{13}$$

where R_i denotes the set of provinces where firm i sells, $D_{i,r}$ the set of products sold by firm i in province r, and $J_{s,d,r}$ is the set of firms, excluding firm i, that sell product d in province r and operate in the same sector s as firm i.[14] And the firm-province-product price change rate is defined as

$$\Delta p_{j,s,d,r,t} = \sum_{v \in V_{j,s,d,r,t}} \omega_{j,v,t} \Delta p_{j,v,t}, \tag{14}$$

where $V_{j,s,d,r,t}$ is the set of varieties of product d that firm j sells in province r at time t.

This measure exploits the granularity of the electronic invoice data. In particular,

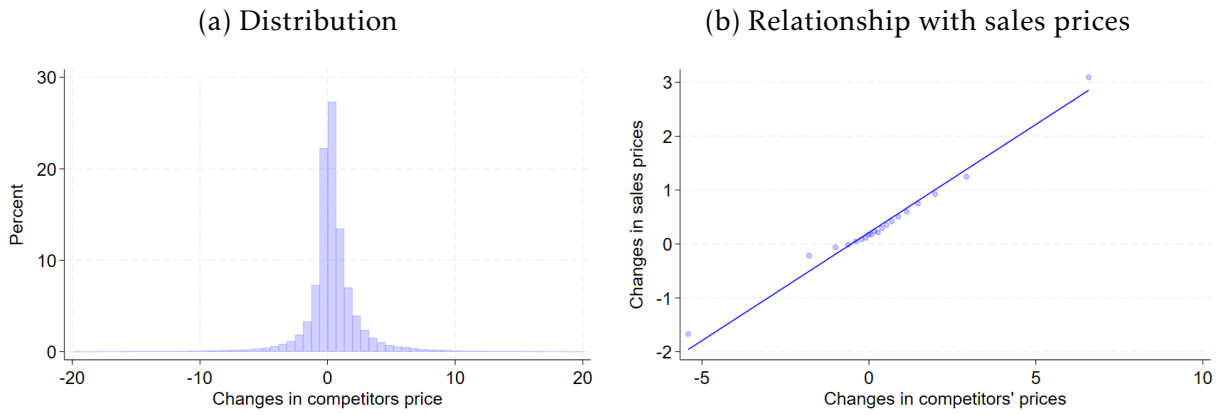
[13] See Amiti, Itskhoki and Konings (2019) and Gagliardone et al. (2023) for empirical examples and Wang and Werning (2022) for a theoretical model.

[14] According to the 3-digit ISIC rev. 4 classification, firms are sorted into 54 manufacturing sectors, 5 wholesale sectors, and 11 retail sectors. As for the other dimensions, there are 56 provinces and about 290 products.

the province is defined based on the location of the buyer, consistent with the notion that product markets are geographically localized.[15] For the product dimension, we follow Acevedo et al. (2025), who apply natural language processing techniques to classify product varieties—identified through text descriptors—into 290 standardized product categories of the *Clasificador Único de Productos* (CUP), consistent with the Central Product Classification (CPC) and an adapted version of the Classification of Individual Consumption by Purpose (COICOP).[16]

The distribution of changes in competitors' prices in Figure 2 appears leptokurtic, with a larger mass on the positive side of the distribution. For nearly half of the firm-time observations, competitors' prices remain unchanged; when changes occur, they are more likely to be price increases. The unconditional correlation between changes in competitors' prices and changes in firms' own sales prices is about 0.38, which is suggestive of sizable strategic complementarities. Importantly, the correlation between the two variables is low, at 0.15, easing the identification of the β^r and γ^r coefficients in Equation 8.

Figure 2: Competitors' price inflation
(Percent)



Notes: The figure shows the distribution of changes in competitors' prices and the relationship between changes in competitors' prices and changes in sales prices.

[15]The calculation of changes in competitors' prices excludes price changes of foreign firms selling into the Chilean market. While customs records identify the importing firm, they do not report the geographic location of the buyer. Since many importing firms operate across multiple provinces, it is not possible to accurately assign foreign price changes to specific local markets, so including them is more likely to induce measurement error instead of improving the estimator. To the extent that imports are varieties of products that are not widely produced in Chile, this is unlikely to affect the competitors price measures. It is important to highlight that imports are considered in the construction of firm's marginal costs.

[16]See Appendix C for a detailed description of the mapping algorithm.

3.3 Identification challenges

Estimating Equation 8 poses three key identification challenges. First, sectoral demand shocks or coordinated wage adjustments may correlate with changes in firms' sales prices and either marginal costs or competitors' prices, leading to omitted variable bias. To address this concern, we re-estimate Equation 8, replacing time fixed effects with sector-time fixed effects. This purges our baseline estimates of factors potentially correlated with both marginal costs and competitors' prices.

The second challenge is that firms with monopsony power may influence or even set prices charged by their suppliers. For these firms, reverse causality may introduce a positive bias in the OLS estimates. To mitigate this concern, we leverage the granularity of our data to construct an instrument for changes in marginal costs that excludes purchases from suppliers with a limited number of buyers

$$\Delta mc^{*}_{i,t} = \rho^{*}_{i} \sum_{k} \omega_{k,i,t} \Delta ip^{90}_{k,i,t}, \tag{15}$$

where $\Delta ip^{90}_{k,i,t}$ denotes changes in the prices of intermediate inputs sold by suppliers whose number of buyers exceeds the 90th percentile of the distribution, and ρ^{*}_{i} is the intermediate input cost share constructed using exclusively those inputs.

Relevance follows from the fact that intermediate inputs account for a substantial share of firms' total costs, and price changes charged by large suppliers translate mechanically into variation in firms' marginal costs. The exclusion restriction requires that price changes charged by these suppliers affect firms' pricing decisions only through marginal costs. This assumption is plausible in our setting for two reasons. First, suppliers with many buyers are unlikely to tailor prices to any individual firm, mitigating concerns about reverse causality arising from monopsonic power. Second, the instrument excludes transactions with suppliers that have a small buyer base, precisely where firm-level bargaining power is most likely to distort input prices. Under these conditions, variation in input prices faced by large suppliers provides plausibly exogenous shifts in firms' marginal costs.

The third identification challenge is the potential simultaneity in price setting between firms and their competitors. In oligopolistic settings with strategic competition, individual firms directly affect competitors and market-level prices, making simultaneity a first-order concern requiring instrumental variables. In this case, the bias could go in either direction: competitors may adjust their prices in response to the firm's pricing decisions, or firms may strategically lower prices to undercut competitors and gain market

share. By contrast, in models with strategic complementarities à la Kimball (1995), where there is a continuum of monopolistically competitive firms, individual firms do not affect aggregate or industry price indices.

To address this concern, we construct an instrument for competitors' price changes by exploiting differences in firms' supply chain network. Specifically, for each firm i we first identify the subset of suppliers $\mathcal{S}$ that sell both to firm i and its competitors. Then, we compute the sales-weighted changes in the costs of inputs K that competitors J operating in sector s use to produce product d sold in province r in month t.[17] Crucially, we exclude from the set K any inputs purchased from suppliers $\mathcal{S}$ that sell to both firm i and its competitors, thus isolating variation in competitors' input costs that is unlikely to be influenced by firm i's pricing decisions. Considering the geographical and product-level granularity used to define competitors' prices in Equation 13, the instrument is calculated as

$$\Delta p^*_{-i,t} = \sum_{r \in R_i} \omega_{i,r,t} \sum_{d \in D_{i,r}} \sum_{j \in J_{s(i),d,r}} \omega_{j,s,d,r,t} \rho_j \sum_{k \notin K_{\mathcal{S}}} \omega_{k,j,t} \Delta i p_{k,j,t}. \tag{16}$$

In this case, relevance arises because input cost shocks faced by competitors pass through to competitors' prices. The exclusion restriction requires that these supplier-level cost shocks affect the firm's pricing decisions only through their impact on competitors' prices. By construction, the instrument removes direct linkages between the firm and its competitors, thereby ruling out mechanical transmission of input price shocks to the firm's marginal costs. Moreover, since the variation originates from upstream suppliers of competitors, it is orthogonal to firm-specific demand shocks and local pricing decisions of the firm. This design mitigates simultaneity and reflection concerns that could otherwise contaminate estimates of strategic complementarities.

4 Five facts about strategic complementarities

In this section we document five key facts about firms' pricing behavior with respect to their competitors' prices.

4.1 Fact 1: strategic complementarities are overwhelmingly important

Our first key result is that strategic complementarities are overwhelmingly important for firms' price setting, relatively more than changes in marginal costs. Figure 3 presents the

[17] Input k is defined at the same level of product variety v.

results from estimating Equation 8, with standard errors clustered at the firm and month level. We find that firms react quickly and strongly to changes in competitors' prices. Firms pass through just over half of the changes in competitors' prices to their own sales prices within the same month and 65 percent over the one-year horizon. By contrast, about 10 percent of the increase in marginal costs is passed through to sales prices on impact, reaching only 16 percent after one year. In other words, firms' pricing decisions are heavily influenced by competitors' prices, with the pass-through of competitors' prices changes being 4 times larger than the pass-through of changes in input prices.

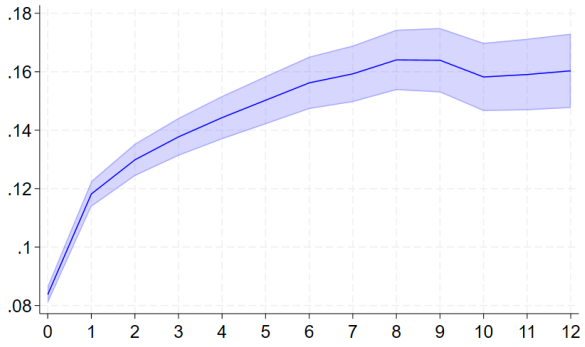
The cross-competitor interdependence in firms' pricing behavior points to substantial real rigidities. Considering the mapping between the reduced form coefficients and the structural markup elasticities in Equation 9, our results indicate that firms exhibit a stronger tendency to stabilize their markups in response to competitors' prices—with an implied elasticity of 4.1—than to their own input prices—for which the implied elasticity is 5.3. These findings stand in contrast to the predictions of complete pass-through and no strategic complementarities of canonical models with constant markups, constant elasticity of substitution demand functions, and monopolistic competition. Instead, they lend support to models allowing for strategic complementarities, such as Kimball (1995), Atkeson and Burstein (2008), and Amiti, Itskhoki and Konings (2019).

Compared to the results of Amiti, Itskhoki and Konings (2019) and Gagliardone et al. (2023) for manufacturing firms in Belgium, we find lower pass-through of firms' own marginal costs and higher pass-through of competitors' prices, which imply stronger strategic complementarities. This finding is important because, as emphasized by Ball and Romer (1990) and Klenow and Willis (2016), monetary non-neutrality arises when nominal rigidities are coupled with real rigidities. Moreover, relative to studies that do not account for strategic complementarities, our estimates of marginal cost pass-through are lower. If changes in marginal costs and competitors' prices are positively correlated, omitting competitors' prices from the regression would bias the coefficient on marginal costs upward. As a benchmark, estimating Equation 8 without controlling for competitors' prices yields a higher marginal cost pass-through of 35 percent, closer to the estimates reported in the existing literature, e.g. Nakamura and Zerom (2010).

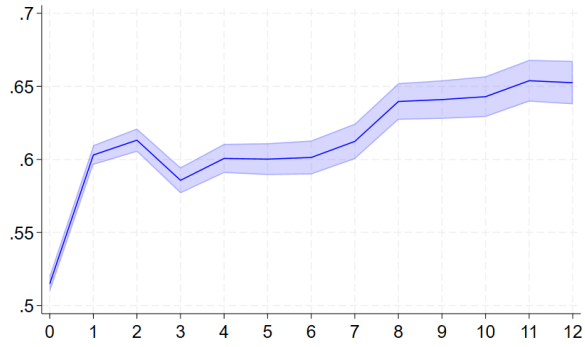
As noted in Section 2, accounting for the geographical and product dimensions is critical to accurately identifying firms' competitors. We now provide evidence of how neglecting these dimensions affects the estimates of the coefficients of interest. Specifically, we replace the definition of competitors' prices in Equation 13 with the measure typically used in the literature, which identifies competitors based solely on their industry. The results in Figure 4 show that excluding the geographical and product dimensions leads to

Figure 3: Cost pass-through and strategic complementarities
(Percentage points)

(a) Change in marginal costs



(b) Change in competitors' prices



Notes: The figure shows the percent change in firms' sales prices in response to a one percentage point change in their marginal costs and a one percentage point change in competitors' prices, along with the 90 percent confidence intervals. The specification includes firm and time fixed effects. Standard errors are clustered at the firm and time level.

substantial biases in the estimated elasticities. In particular, the estimated marginal cost pass-through would be 62 percent higher, while the pass-through to competitors' prices would be 58 percent lower compared to our baseline estimates, consistent with the notion that a less granular measure of competitors is likely including firms that are not actually competitors.

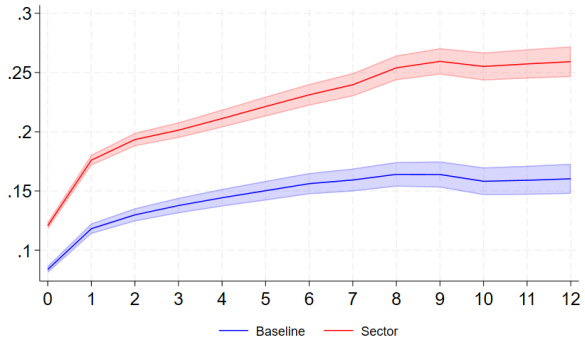
4.1.1 Extensive and intensive margins of price adjustments

We first examine the response of prices along the extensive margin——that is, the share of a firm's product varieties that change prices in a given month in response to changes in marginal costs or competitors' prices. The top-left panel of Figure 5 shows that a one percentage point increase in a firm's marginal costs is associated with a 0.8 percentage point increase in the share of products changing prices over a 12-month horizon. Based on the sales-weighted median frequency of price changes reported in Table 1, this implies that for the average firm, it takes a 10-percentage point increase in marginal costs to raise the share of products changing prices to nearly 50 percent.

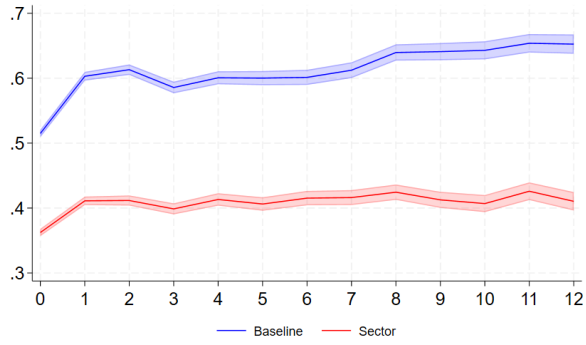
Consistent with our earlier findings, the top-right panel indicates that the frequency of price changes responds more strongly to changes in competitors' prices. In response to a one percentage point increase in competitors' prices, the share of products adjusting prices rises by 2.3 percentage points after one year. These estimates suggest that for the average firm to adjust prices across all products, marginal costs would need to increase

Figure 4: Pass-through estimates with alternative measures of competitors' prices (Percentage points)

(a) Change in marginal costs



(b) Change in competitors' prices



Notes: The figure shows the percent change in firms' sales prices in response to a one percentage point change in their marginal costs and a one percentage point change in competitors' prices, along with the 90 percent confidence intervals. It compares the pass-through estimates based on two definitions of competitors: (i) the baseline definition (i.e., firms operating in the same sector, selling the same product, and located in the same province); and (ii) a broader definition based solely on the sector of operation. The specification includes firm and time fixed effects. Standard errors are clustered at the firm and time level.

by approximately 75 percent, whereas only a 26 percent increase in competitors' prices would achieve the same effect.

We complete the characterization of firms' price adjustments by examining the response of the intensive margin—that is, the magnitude by which firms adjust their prices, pass-through conditional on price changes. The results show that, on impact, approximately 12 percent of a marginal cost increase is passed through to firms' sales prices. Firms continue to adjust over time, and after one year about 22 percent of the initial cost increase is reflected in sales prices.

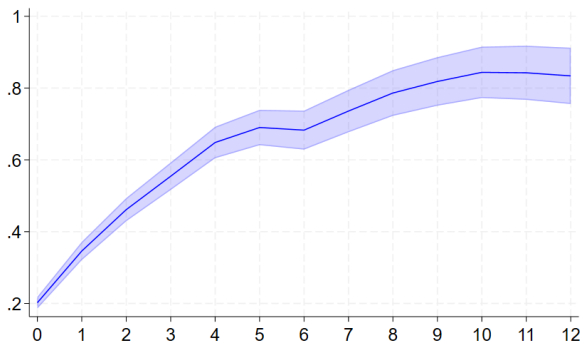
Changes in competitors' prices generate different estimates and dynamics compared to changes in marginal costs. When competitors raise prices, firms respond by passing through a much larger share of the increase to their own prices. On impact, 61 percent of the increase in competitors' prices is reflected in firms' sales prices. This pass-through rises to 76 percent within the first quarter, before gradually declining to around 72 percent over the subsequent months.

All in all, the substantial pass-through of competitors' prices reflects strong adjustments on both the extensive and the intensive margins. The initial increase in pass-through is driven by a short-run rise in the size of price adjustments, while the longer-run decline reflects a reduction in the size of adjustments, offset by a steady increase in the frequency of price changes. This pattern is consistent with models featuring state-

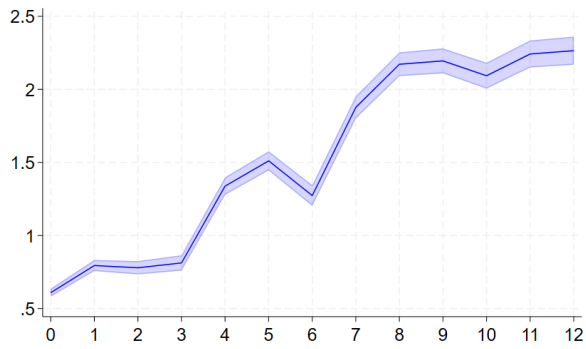
dependent pricing and strategic complementarities, where firms adjust both the timing and the size of price changes in response to competitors' actions.

Figure 5: Frequency and size of price adjustments
(Percentage points)

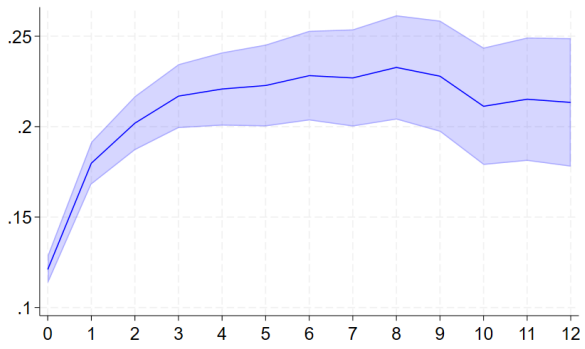
(a) Frequency, change in marginal costs



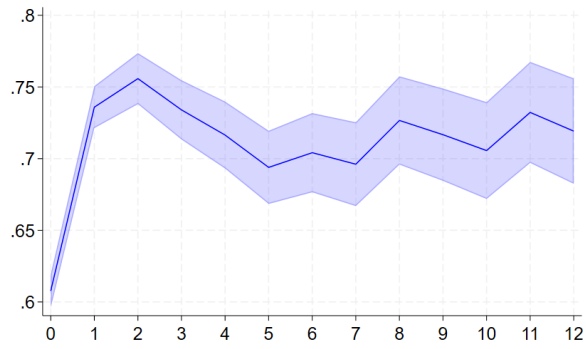
(b) Frequency, change in competitors' prices



(c) Size, change in marginal costs



(d) Size, change in competitors' prices



Notes: The figure shows the percent change in the frequency of firms' sales price adjustments and the percent change in size of non-zero sales price adjustments in response to a one percentage point change in their marginal costs and a one percentage point change in competitors' prices, along with the 90 percent confidence intervals. The specification includes firm and time fixed effects. Standard errors are clustered at the firm and time level.

4.2 Fact 2: strategic complementarities are of first order importance across sectors

The second fact is that the strength of strategic complementarities varies across sectors, but remains of first-order importance relative to changes in marginal costs. As noted in Section 2, our sample covers the universe of both manufacturing and retail firms, with retail firms accounting for about two-thirds of the total. Hence, the results presented in subsection 4.1 reflect a sample composition skewed towards the retail sector. To examine

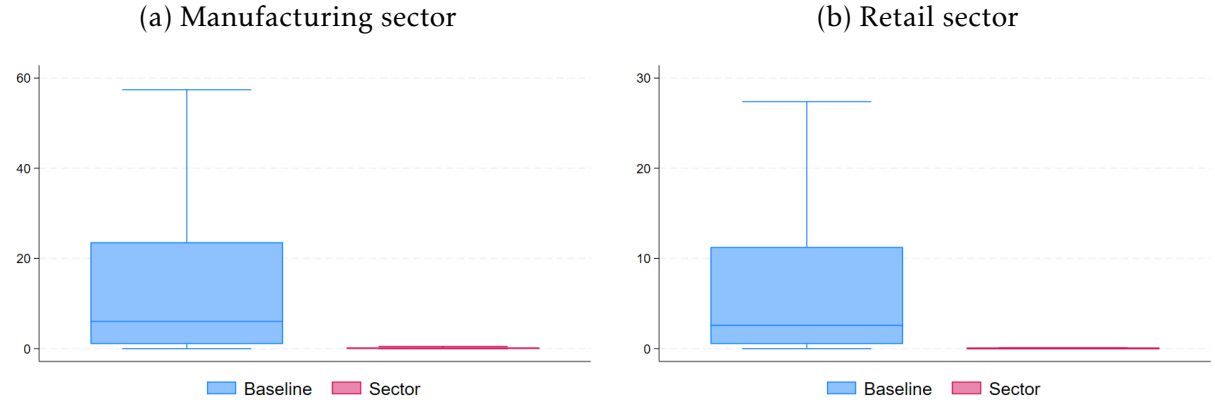
sectoral heterogeneity in the strength of strategic complementarities, we estimate a variant of Equation 8 that allows the coefficients to vary between the manufacturing and the retail sectors

$$\Delta p_{i,t} = \alpha_i + \tau_t + \sum_{r=0}^{R} \Delta mc_{i,t-r}(\beta^r + \delta^r M_i) + \sum_{r=0}^{R} \Delta p_{-i,t-r}(\gamma^r + \xi^r M_i) + \varepsilon_{i,t}, \tag{17}$$

where M_i is a variable equal to one if firm i is in the manufacturing sector, and zero otherwise.

Our empirical strategy assumes that firms internalize the effect of their pricing decisions on the market in which they compete (defined as the firms of the same sector selling the same product in the same province) and react strategically to their competitors. For strategic complementarities to happen, some firms need to have some degree of power to influence decisions in their markets. As shown in Figure 6, this appears to be the case: firms hold relatively large market shares within narrowly defined markets (i.e., 3-digit ISIC sector–province–product combinations), compared to much smaller shares when competition is measured at a broader level (i.e., 3-digit ISIC sector). As a reference, for the level of disaggregation we work with, the average market share is 10.7 percent for retail firms and 17.3 percent for manufacturing firms.

Figure 6: Market shares distributions
(Percent)



Notes: The figure shows the distribution of firms' market shares under two alternative market definitions: (i) the baseline definition (i.e., firms operating in the same sector, selling the same product, and located in the same province); and (ii) a broader definition based solely on the sector of operation.

Figure 7 shows that, on impact, the pass-through of changes in marginal costs is similar for manufacturing firms and retail firms, at about 8 percent. However, a wedge emerges over time: for manufacturing firms, the pass-through rises to 24 percent one year

after the shock, about double that of retail firms. Sectoral heterogeneity is even more pronounced in the response to changes in competitors' prices. Among manufacturing firms, less than 20 percent of competitors' price changes are passed through to sales prices on impact. By contrast, retail firms immediately pass through more than 60 percent of competitors' price changes. Over time, both sectors continue to adjust prices, but the gap persists: by the end of the year, manufacturing firms have passed through approximately 40 percent of competitors' price changes, compared to about 75 percent for retail firms.[18] These sectoral differences are consistent with the notion that retail markets, characterized by lower menu costs and more flexible pricing strategies, exhibit stronger strategic complementarities. In contrast, manufacturing firms, facing higher adjustment costs and longer production cycles, respond more sluggishly to competitive pressures.[19]

These heterogeneous reduced-form coefficients reflect substantial structural differences in the determinants of pricing behavior between the manufacturing and retail sectors. In particular, markup elasticities are significantly larger in the retail sector compared to the full sample. For input prices, the estimated elasticity is 6.7 in retail versus 4.7 in the full sample; for competitors' prices, the elasticity is 5.3 compared to 3.7, respectively. In contrast, manufacturing firms display much lower elasticities: 3 with respect to competitors' prices and only 1.6 with respect to their own input prices. These differences in structural elasticities across sectors help explain the variation in estimated pass-through coefficients. Despite these differences, the evidence supports our general conclusion that firms in both sectors tend to stabilize markups in response to changes in competitors prices to a larger extent than in response to input prices.

We now turn to the sectoral differences in the extensive and intensive margins of price adjustments. Our results indicate that in response to a marginal cost increase, firms in the manufacturing sector adjust prices more frequently and by a larger magnitude than firms in the retail sector. A one percentage point increase in marginal costs leads manufacturing firms to increase the share of product varieties changing prices by 1.5 percentage points at the end of the year, compared to 0.7 percentage points for retail firms. Similarly, on the intensive margin, manufacturing firms pass through 42 percent of the increase in marginal costs to sales prices, compared to 15 percent for retail firms.

A one percentage point increase in competitors' prices is associated with a similar immediate increase in the share of product varieties changing prices for both manufacturing and retail firms. However, by the end of the year manufacturing firms increase the share

[18] Appendix Table D.1 reports the cumulative coefficients on the interaction terms and their statistical significance for both marginal cost changes and competitors' price changes.

[19] Bils and Klenow (2004) show that durable good sectors, which are usually sold by manufacturing industries, have stickier prices than non-durable goods.

of products adjusting prices by 1.5 percentage points, while retail firms show a larger increase of 2.5 percentage points. Notably, the dynamics differ across sectors: the frequency of price adjustments among retail firms continues to rise steadily even 12 months after the shock, whereas for manufacturing firms the adjustment peaks at 1.8 percentage points after six months and then marginally declines. The intensive margin response also shows distinct dynamics. Among manufacturing firms, the size of price adjustments rises from 28 percent on impact to 66 percent after 12 months. In contrast, retail firms pass through approximately 75 percent of competitors' price changes immediately, peaking at 82 percent just two months after the shock. Retail firms thus respond more quickly and aggressively to changes in competitors' prices, likely reflecting the higher degree of competition in retail markets. However, their adjustment subsequently retrenches, and by 12 months after the shock, the size of the price change is not statistically different from that observed among manufacturing firms.

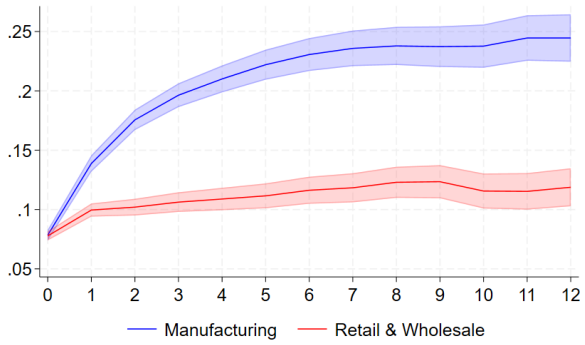
We now delve deeper into sector heterogeneity. We run the baseline specification in Equation 8 separately for each industry (at the 2- or 3-digit ISIC Rev. 4 level) within the manufacturing and retail sectors, restricting the sample to industries with at least 100 firms. For each industry, we compute the difference between the estimated one-year pass-through coefficient for competitors' prices and the corresponding one for marginal costs. Figure 8 shows that for the majority of industries, the positive difference between the two estimates is statistically significant. For the few industries where the difference is negative, the estimates are statistically indistinguishable from zero. We interpret these findings as further evidence of the dominant role of strategic complementarities relative to firms' own marginal costs in shaping pricing decisions.

4.3 Fact 3: state-dependent strategic pricing

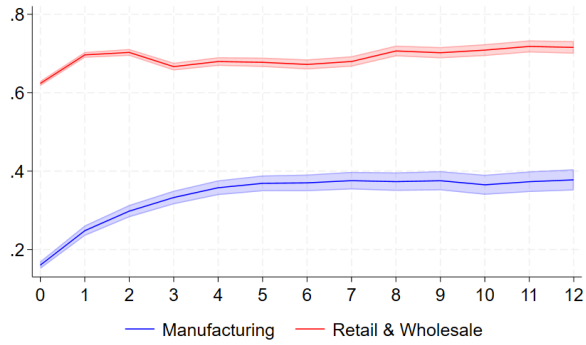
The third fact is that when inflation runs high, firms become more sensitive to the actions of their competitors. In a high inflation environment, firms are more likely to face large and persistent cost shocks, which squeeze their profit margins (Taylor, 2000). According to state dependent pricing theories, these shocks increase the likelihood that firms pass through changes in their own costs, thereby reducing nominal rigidities. This is central to policy debates, because when pricing is state-dependent, monetary policy becomes approximately neutral (Golosov and Lucas, 2007) and the Phillips curve is nonlinear, reducing the sacrifice ratio (Karadi et al., 2024). If firms' optimal prices depend on competitors' prices, when inflation runs high and the frequency of price adjustment increases, firms may become more likely to seize opportunities to stabilize their prices

Figure 7: Manufacturing versus retail firms
(Percentage points)

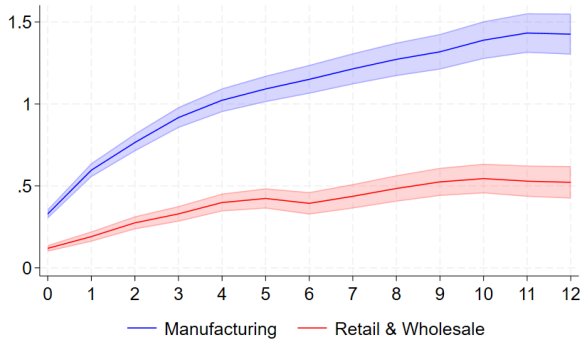
(a) Pass-through, change in marginal costs



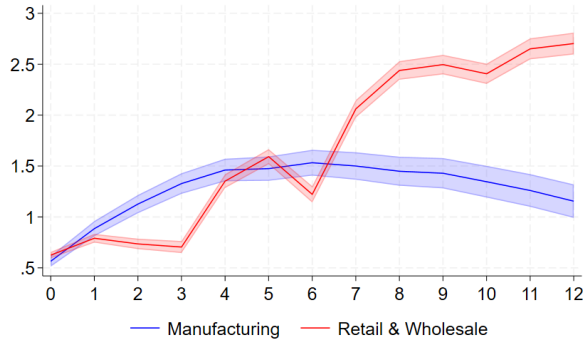
(b) Pass-through, change in competitors' prices



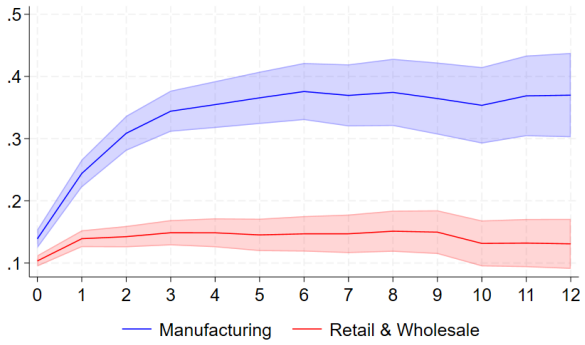
(c) Frequency, change in marginal costs



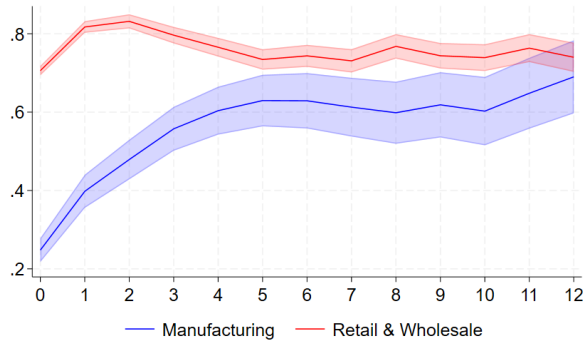
(d) Frequency, change in competitors' prices



(e) Size, change in marginal costs

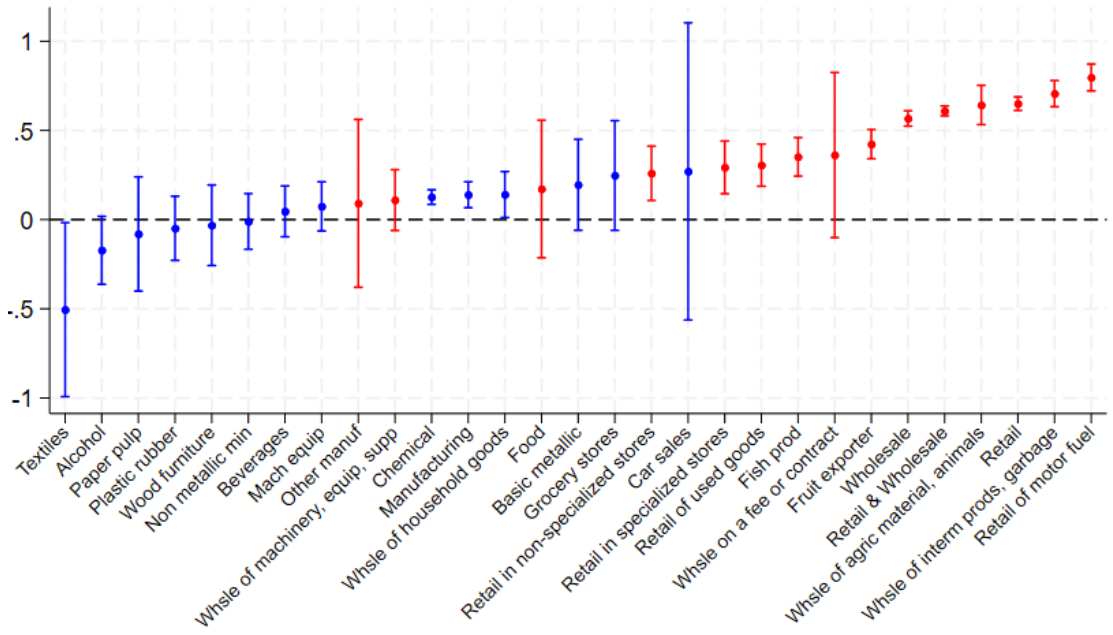


(f) Size, change in competitors' prices



Notes: The figure shows the percent change in firms' sales prices, the percent change in the frequency of sales price adjustments, and the percent change in the size of non-zero sales price adjustments in response to a one percentage point change in marginal costs and a one percentage point change in competitors' prices, along with the 90 percent confidence intervals. It compares the responses of manufacturing and retail firms. The specification includes firm and time fixed effects. Standard errors are clustered at the firm and time level.

Figure 8: Elasticity differential
(Percentage points)



Notes: The figure shows the difference between the competitors' price pass-through estimate and the marginal cost pass-through estimates at the one-year horizon, along with the 90 percent confidence intervals. For manufacturing sectors, the 2-digit ISIC Rev. 4 classification is used, while for retail and wholesale sectors, the 3-digit ISIC Rev. 4 classification is used. The figure also reports the estimates for the 1-digit Rev. 1 classifications (i.e., manufacturing, wholesale, and retail).

relative to their competitors.

We study whether firms' pricing behavior changes in a high inflation environment by conditioning their responses to changes in marginal costs and competitors' prices on these happening in a period of high inflation

$$\Delta p_{i,t} = \alpha_i + \tau_t + \sum_{r=0}^{R} \Delta mc_{i,t-r}(\beta^r + \delta^r \pi_{t-r}) + \sum_{r=0}^{R} \Delta p_{-i,t-r}(\gamma^r + \xi^r \pi_{t-r}) + \varepsilon_{i,t}, \tag{18}$$

where π_{t-r} equals one when (monthly) inflation is above the median plus one standard deviation, and zero otherwise.[20] This section focuses on manufacturing firms, for which nominal rigidities appear more important.[21] In this conditional specification, coefficients β^r and γ^r describe the responses to changes in marginal costs and competitors' prices, respectively, in a low inflation environment, while δ^r and ξ^r capture the differential effects in a high inflation environment.

Figure 9 compares the estimated pass-through of changes in marginal costs and competitors' prices between periods of low and high inflation. We find that in a high-inflation environment, firms become more responsive to their own cost shocks, passing through a larger share to sales prices. On impact, manufacturing firms pass through approximately 10 percent of marginal cost changes when inflation is high, compared to 6 percent when inflation is low. Over time, this gap widens considerably, with firms passing through about 26 percent of their cost changes in a high inflation environment and only 18 percent in a low inflation environment.

The wedge in the cost pass-through between periods of low and high inflation is primarily driven by more frequent price adjustments when inflation is high. A one percentage point increase in marginal costs is associated with a 1.7 percentage point increase in the frequency of price adjustments during high-inflation periods, compared to a 0.6 percentage point increase when inflation is low. In contrast, the size of price adjustments remains broadly similar across inflation regimes. The finding that firms adjust a significantly larger share of their products per unit of time when aggregate inflation is high is consistent with previous evidence in the literature (Nakamura et al., 2018; Alvarez et al., 2019; Karadi and Reiff, 2019; Blanco et al., 2024).

We now turn to whether inflation alters the scope for strategic behavior in price setting. We find that firms become more sensitive to competitors' pricing decisions in

[20] The mean and standard deviation are computed within each calendar month to account for seasonal patterns. We obtain similar results when constructing the dummy based on monthly inflation without seasonality adjustment or using annual inflation, as shown in Appendix E.

[21] Appendix F reports the results for retail firms.

high inflation environments. Specifically, a one percentage point increase in competitors' prices is associated with a 0.5 percent increase in a firm's sales prices when inflation is high, compared to approximately half that magnitude when inflation is low.

In contrast to the adjustment to changes in marginal costs, the differential effect of high inflation on firms' responses to competitors' prices occurs at both the extensive and intensive margins. A one percentage point increase in competitors' prices is associated with a 1.8 percentage point increase in the frequency of price adjustments one year after the shock when inflation is high. In contrast, when inflation is low, the increase in frequency is transitory and modest, peaking at 0.8 percentage point three months after the shock and declining to about zero after one year. In addition, when inflation is high, firms fully reflect competitors' price changes in the prices they adjust, whereas the size effect is only 0.5 percent when inflation is low.[22] In sum, our results suggest that high inflation weakens nominal rigidities and amplifies firms' responsiveness to competitors' prices.

A striking pattern emerges when mapping the reduced-form coefficients to the underlying structural markup elasticities. The larger pass-through estimates observed during high-inflation periods, compared to low-inflation periods, can be largely attributed to a decline in the markup elasticity in response to changes in firm's own prices. Specifically, this elasticity declines from 4.9 during low-inflation periods to 2.3 in high-inflation periods, reflecting firms' stronger tendency to stabilize markups in more volatile environments. According to the structural relationships in Equation 9, the reduction in the markup elasticity with respect to firms' own prices accounts for approximately 90 percent of the overall increase in the reduced-form pass-through coefficients, with the remaining 10 percent attributable to changes in the markup elasticity with respect to competitors' prices.

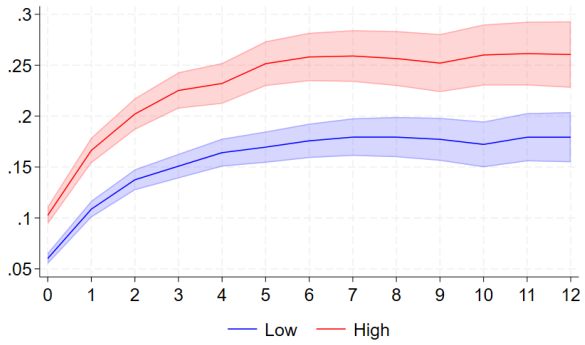
4.4 Fact 4: strategic complementarities as 'rockets and feathers'

The fourth fact is that firms' prices react more strongly when competitors raise prices (like 'rockets') than when they cut them (like 'feathers'). Earlier work on cost pass-through has shown that firms are more sensitive to cost increases than cost decreases (Bacon, 1991; Peltzman, 2000). The underlying mechanism is that when costs rise, firms have an incentive to increase prices to maintain profit margins, leading to a high pass-

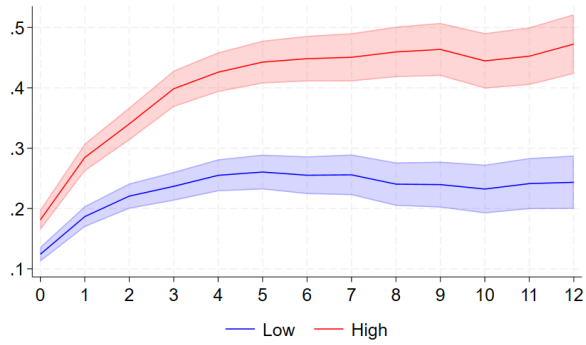
[22] Appendix Figure F.1 reports the corresponding pass-through estimates for retail firms. For retail firms, the pass-through of marginal costs is statistically indistinguishable between high- and low-inflation environments, but, similar to manufacturing firms, the pass-through of competitors' prices is higher when inflation runs high.

Figure 9: Firms' pricing during high vs low inflation
(Percentage points)

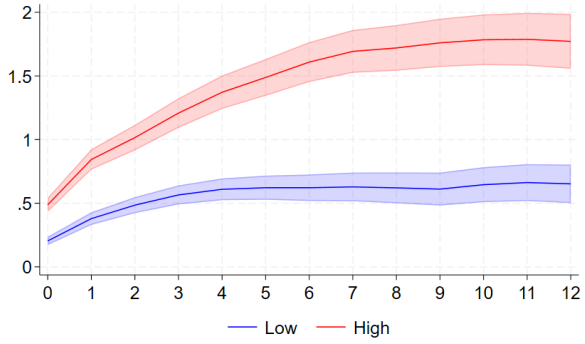
(a) Pass-through, change in marginal costs



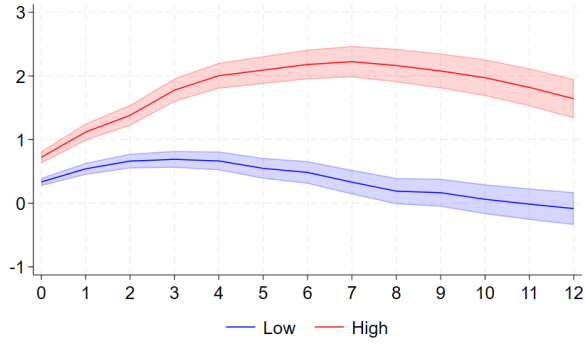
(b) Pass-through, change in competitors' prices



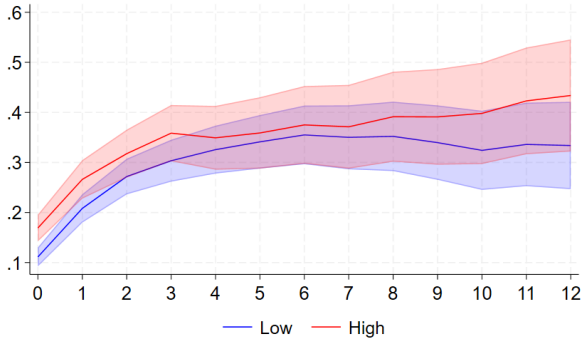
(c) Frequency, change in marginal costs



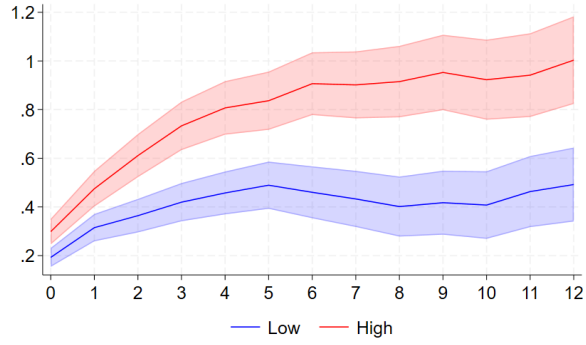
(d) Frequency, change in competitors' prices



(e) Size, change in marginal costs



(f) Size, change in competitors' prices



Notes: The figure shows the percent change in firms' sales prices, the percent change in the frequency of sales price adjustments, and the percent change in the size of non-zero sales price adjustments in response to a one percentage point change in marginal costs and a one percentage point change in competitors' prices, along with the 90 percent confidence intervals. It compares the responses of manufacturing firms during high inflation periods to those during low inflation periods. The specification includes firm and time fixed effects. Standard errors are clustered at the firm and time level.

through of cost increases. In contrast, when costs fall, firms facing favorable demand conditions may prefer to keep prices unchanged to avoid inducing buyers to re-optimize their purchasing decisions, resulting in a lower pass-through of cost decreases.

In the case of strategic complementarities, the mechanism operates through the elasticity of markups in response to changes in competitors' prices. An increase in competitors' prices lowers the firm's relative prices, leading to an expansion in the firms' demand. The firm's optimal response is to raise its prices to restore the desired markup. Conversely, a reduction in competitors' prices raises the firm's relative prices, reducing its demand and prompting a downward adjustment in its own prices. In the presence of downward nominal rigidities, this mechanism can generate asymmetric responses, whereby the reaction to increases in competitors' prices is larger than the response to competitors' prices declines.

To examine the potential asymmetry in firms' pricing behavior in response to changes in competitors' prices (as well as changes in marginal costs), we estimate the following specification

$$\Delta p_{i,t} = \alpha_i + \tau_t + \sum_{r=0}^{R} \Delta mc_{i,t-r}(\beta^r + \delta^r I_{i,t-r}^{\Delta mc}) + \sum_{r=0}^{R} \Delta p_{-i,t-r}(\gamma^r + \xi^r I_{i,t-r}^{\Delta p_{-i}}) + \varepsilon_{i,t}, \tag{19}$$

where $I_{i,t-r}^{\Delta mc}$ and $I_{i,t-r}^{\Delta p_{-i}}$ are two indicators equal to one if changes in marginal costs and competitors' prices are positive, respectively, and zero otherwise. In this setup, β^r and γ^r capture the responses to negative changes, while δ^r and ξ^r measure the differential effect for positive changes. Thus, a statistically significant positive estimate of the latter two coefficients would indicate that firms respond more strongly to marginal cost or competitor price increases than to decreases, consistent with asymmetric price adjustment.

In Figure 10, we present the results for manufacturing firms. Consistent with earlier findings in the literature, we find that marginal cost pass-through is higher for cost increases than for cost decreases. This asymmetry is particularly pronounced during the first quarter after the cost shock, with a gap as large as 8 percentage points. However, the gap narrows over time and becomes statistically insignificant by the end of the year. Examining the margins of price adjustment, we find that firms catch up with cost increases by adjusting sales prices more frequently compared to when marginal costs decline. One year after a one percentage point increase in marginal costs, the share of products changing prices rises by 1.5 percentage points, compared to a statistically non-significant effect following a one percentage point decrease.[23] This is consistent with the notion that firms

[23]Note that, by construction, the regression estimates represent the response of the frequency of price

delay price reductions to avoid triggering buyer re-optimization and associated cognitive costs. We also find that the initial size of price changes is larger in response to cost increases than to decreases, although this difference quickly fades and becomes negligible within a quarter after the cost shock.

The evidence of asymmetric pricing points to a 'rockets and feathers' phenomenon for competitors' prices as well, but with distinct dynamics. The pass-through is significantly larger for competitors' price increases than for decreases, and the gap is more persistent. On impact, the pass-through to a price increase is 8 percentage points higher than for a price cut (18 percent versus 10 percent). Over time, the gap widens: by the end of the year, firms have passed through 40 percent of competitors' price increases, compared to 23 percent of price decreases.

These dynamics reflect a larger increase in both the frequency and the magnitude of price adjustments in response to competitors' price hikes. A one percentage point increase in competitors' prices leads to a gradual rise in the share of products changing prices, reaching 3 percentage points higher after one year. For competitors' price cuts, the frequency of price changes declines by about 1.6 percentage points. By contrast, the size of price changes in response to competitors' price increases and decreases is statistically indistinguishable. Overall, these results suggest the presence of strong downward nominal rigidities.[24]

4.5 Fact 5: market structure shapes firms' strategic pricing responses

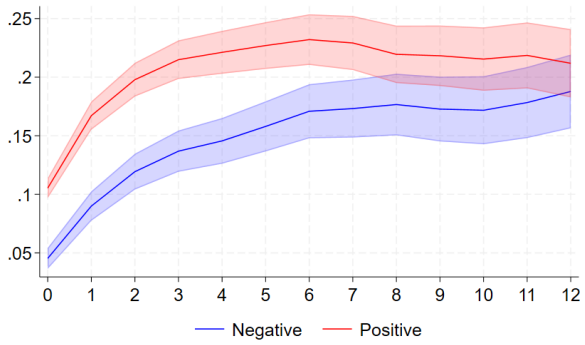
The fifth fact is that firms exhibit stronger strategic complementarities when they face less competition, enjoy higher market shares, and serve larger customer bases. In models of oligopolistic competition, firms operating in less competitive sectors exhibit stronger strategic complementarities relative to those in more competitive markets. For example, in the framework of Atkeson and Burstein (2008), a larger number of competing firms reduces the degree of strategic complementarities, and in Alexander et al. (2024), the degree of strategic complementarity is increasing in a firm's market share. As competition intensifies, firms' market shares shrink and demand elasticity increases, dampening strategic complementarities. Other studies focusing on firms' own costs, including Genesove and

adjustments to increases in marginal costs or competitors' prices. Thus, for declines in marginal costs or competitors' prices, negative estimates correspond to a positive change in the frequency of price adjustments.

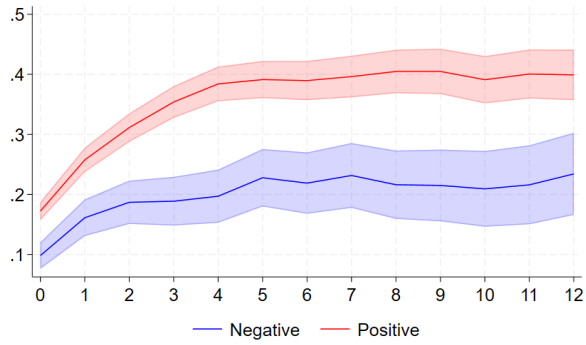
[24] Appendix Figure F.2 reports the corresponding estimates for retail firms. In contrast to manufacturing firms, the marginal cost pass-through for retail firms is generally statistically indistinguishable between cost increases and decreases. For changes in competitors' prices, the asymmetry is also limited; if anything, retail firms appear somewhat more sensitive to competitors' price declines.

Figure 10: Asymmetric pricing
(Percentage points)

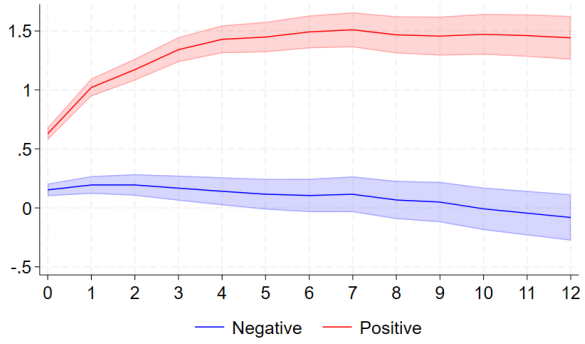
(a) Pass-through, change in marginal costs



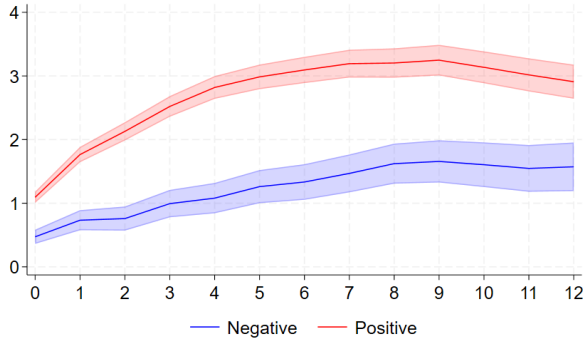
(b) Pass-through, change in competitors' prices



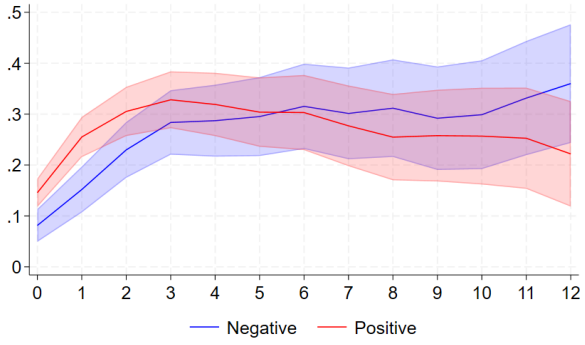
(c) Frequency, change in marginal costs



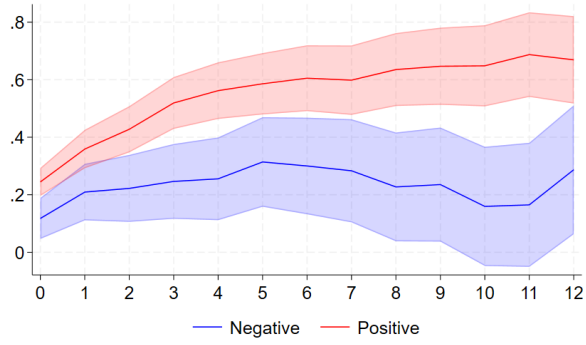
(d) Frequency, change in competitors' prices



(e) Size, change in marginal costs



(f) Size, change in competitors' prices



Notes: The figure shows the percent change in firms' sales prices, the percent change in the frequency of sales price adjustments, and the percent change in the size of non-zero sales price adjustments in response to a one percentage point change in marginal costs and a one percentage point change in competitors' prices, along with the 90 percent confidence intervals. It compares the responses of manufacturing firms to positive and negative changes in marginal costs and competitors' prices. The specification includes firm and time fixed effects. Standard errors are clustered at the firm and time level.

Mullin (1998), Campbell and Hopenhayn (2005), and Genakos and Pagliero (2022) lend support to this view, documenting that markups are inversely related to the number of competitors, which in turn raises the pass-through of firms' own cost changes into prices.

We empirically test these predictions. To do that, we first construct a proxy for the degree of competition as the sales-weighted sum of the number of firms operating in the same sector of firm i, selling the same products, and selling them in the provinces where they operate. In particular, we measure

$$C_{i,t} = \sum_{r \in R_i} \sum_{d \in D_{i,r}} \omega_{i,r,d,t} F_{i,r,d,t}, \tag{20}$$

where $\omega_{i,r,d,t}$ is the share of firm i's sales in province-product r,d, and $F_{i,r,d,t}$ denotes the number of firms selling product d in province r. Then, we examine whether firms respond differently to changes in their own costs and competitors' prices by estimating the following specification for manufacturing firms

$$\Delta p_{i,t} = \alpha_i + \tau_t + \sum_{r=0}^{12} \Delta mc_{i,t-r}(\beta^r + \beta_C^r I_i^C) + \sum_{r=0}^{12} \Delta p_{-i,t-r}(\gamma^r + \gamma_C^r I_i^C) + \varepsilon_{i,t}, \tag{21}$$

where I_i^C takes value one if the median of $C_{i,t}$ for the firm is above the overall median, and zero otherwise.

Figure 11 presents the pass-through estimates of changes in input costs and competitors' prices, comparing firms operating in high competition versus low competition environments. Since we are interested in differences in the long-run response, we focus on the impact after one year. We find that firms with a lower number of competitors respond more strongly to changes in their competitors' prices. Specifically, a one percentage point increase in competitors' prices is associated with a 0.34 percentage point increase in prices for firms operating in less competitive markets, compared to a 0.25 percentage point increase for firms in more competitive environments. In contrast, we find no statistically significant difference in the pass-through of firms' own input cost changes across competition levels.

We further explore the role of competition by replacing the variable I_i^C in Equation 21 with a dummy variable that takes the value of one if firm i's median market share is above the overall median. We compute each firm's market share at the sector-province-product level, and then aggregate these market shares to the firm level using the firm's

sales weights across markets as follows,

$$\text{market share}_{i,t} = \sum_{r \in R_i} \sum_{d \in D_{i,r}} \omega_{i,r,d,t} \frac{\text{sales}_{i,d,r,t}}{\sum_j \text{sales}_{j,d,r,t}}. \tag{22}$$

Our results indicate that firms with higher market shares respond more strongly to changes in competitors' prices than those with lower market shares. This finding aligns with the intuition that strategic complementarities become more pronounced as market shares increase, given that larger firms exhibit greater markup sensitivity to competitors' price changes (Atkeson and Burstein, 2008; Burstein and Gopinath, 2014). The magnitudes of these effects are similar to those obtained when using the number of competing firms as a proxy for competition. The evidence on the pass-through of marginal costs indicates that this is higher when the market share is lower compared to when it is higher.

Another approach to examining the role of market structure is to focus on firms' customer bases. Since a higher market share is associated with a larger residual demand, a relationship between the number of buyers and the strength of strategic complementarities should emerge. Firms with a large customer base are likely to be more concerned with maintaining their market share, leading them to pass through a smaller fraction of marginal cost increases to avoid losing customers. Conversely, when competitors raise prices, these firms can expand their market share by adjusting their own prices upward to restore optimal markups. As before, we test this prediction by constructing a dummy variable that equals one if a firm's median number of buyers is the overall median, and zero otherwise.

We find that firms with larger customer bases respond more strongly to competitors' price changes and less to marginal cost changes relative to firms with fewer buyers, although the differences in marginal cost pass-through are not statistically significant. Specifically, a one percentage point increase in competitors' prices is associated with a 0.37 percentage point increase in prices for firms with a large customer base, compared to 0.20 percentage points for firms with a smaller one.[25]

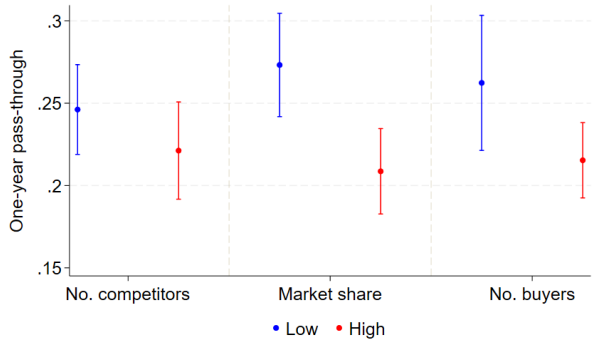
5 Robustness

In this section, we present the results of a series of exercises designed to address the potential identification concerns outlined in Section 3, to take into account incomplete price adjustment dynamics, as well as to test the sensitivity of our findings to the estimation

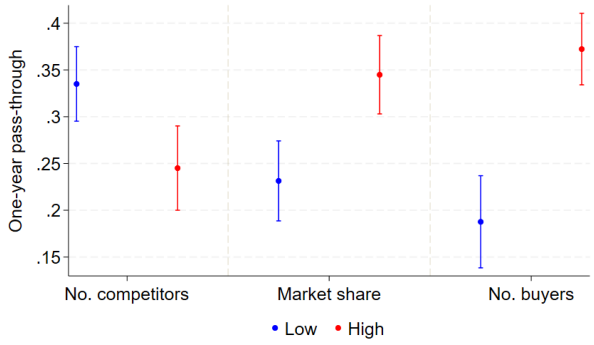
[25] Appendix Figure F.3 reports the evidence for retail firms. Except for the case of the number of competitors, the patterns are broadly consistent with those observed for manufacturing firms.

Figure 11: The role of market structure
(Percentage points)

(a) Pass-through, change in marginal costs



(b) Pass-through, change in competitors' prices



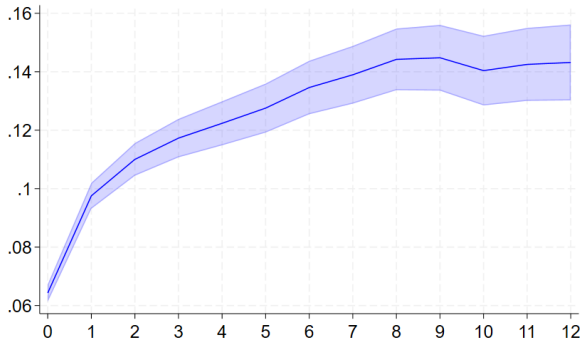
Notes: The figure shows the percent change in manufacturing firms' sales prices one year after a one percentage point change in their marginal costs and a one percentage point change in competitors' prices, conditional on the firm's number of competitors, market share, and number of buyers, along with the 90 percent confidence interval. The specification includes firm and time fixed effects. Standard errors are clustered at the firm and time level.

technique. One identification concern is the possibility that common sectoral factors——such as sector-wide demand shocks or coordinated wage adjustments stemming from collective bargaining agreements——may simultaneously influence firms' pricing decisions, thereby biasing our estimates. To mitigate this issue, we augment our baseline specification (Equation 8) by incorporating sector-time fixed effects. These fixed effects control for unobserved, time-varying sectoral shocks that could affect all firms within a sector simultaneously. As illustrated in Figure 12, the inclusion of sector-time fixed effects yields results that are consistent with our baseline estimates, suggesting that our findings are robust to sector-level confounding factors.

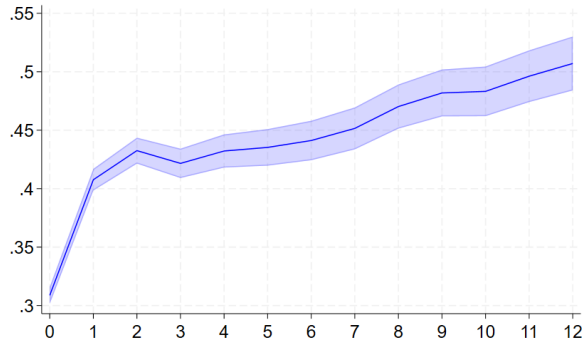
We also perform a placebo test to show that our results are not an artifact of the empirical approach. This test consists of constructing a placebo variable for firms' competitors' prices. Specifically, we generate 200 arbitrary groups of firms of approximately 100 firms each. Then, using a uniform random assignment, we allocate firms to these groups and we compute the price variation of all other firms within its assigned artificial competitor group. Finally, we re-estimate our baseline specification after replacing the actual changes in competitors' prices with the placebo variable. Alternatively, we add the placebo variable to the baseline specification and obtain coefficients on both the actual changes in competitors' prices and the placebo variable. The results in Figure 13 show that in both cases the coefficient on changes in placebo competitors' prices is close to zero in magnitude and not statistically significant for most of the horizons, while the coef-

Figure 12: Sector-time fixed effects
(Percentage points)

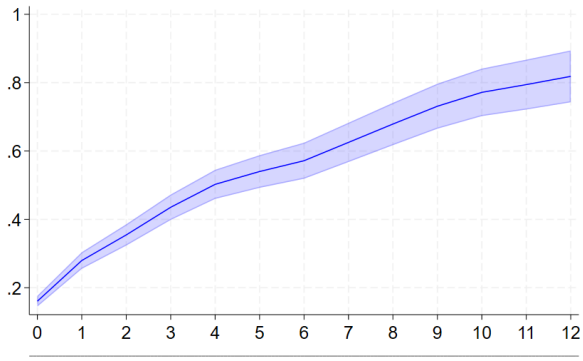
(a) Pass-through, change in marginal costs



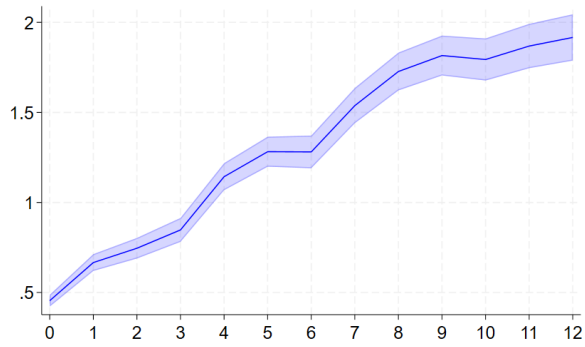
(b) Pass-through, change in competitors' prices



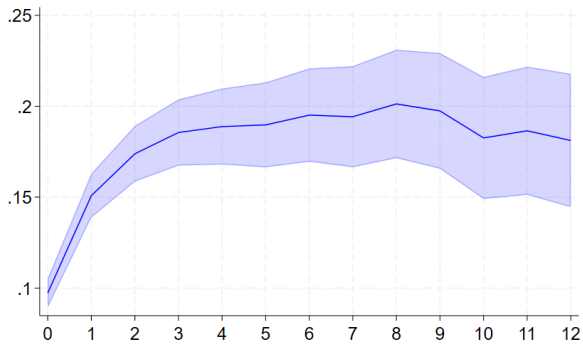
(c) Frequency, change in marginal costs



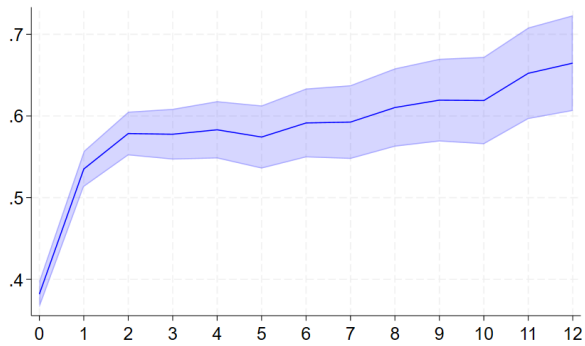
(d) Frequency, change in competitors' prices



(e) Size, change in marginal costs



(f) Size, change in competitors' prices

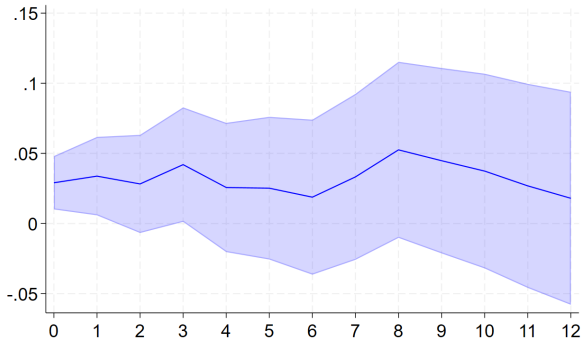


Notes: The figure shows the percent change in firms' sales prices, the percent change in the frequency of sales price adjustments, and the percent change in the size of non-zero sales price adjustments in response to a one percentage point change in marginal costs and a one percentage point change in competitors' prices, along with the 90 percent confidence intervals. The specification includes firm and sector-time fixed effects. Standard errors are clustered at the firm and time level.

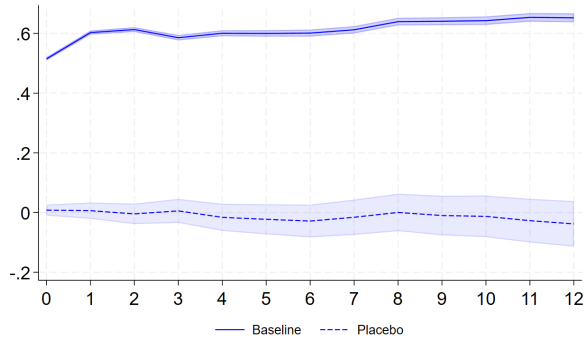
ficient on the actual changes in competitors' prices remains statistically significant and virtually unchanged in magnitude.

Figure 13: Placebo test
(Percentage points)

(a) Replacing baseline with placebo prices



(b) Adding placebo prices



Notes: The figure shows the percent change in manufacturing firms' sales prices one year after a one percentage point change in their marginal costs and a one percentage point change in competitors' prices, conditional on the firm's number of competitors, market share, and number of buyers, along with the 90 percent confidence interval. The specification includes firm and time fixed effects. Standard errors are clustered at the firm and time level.

Another identification concern relates to the potential reverse causality of marginal costs and the simultaneity of competitors' price-setting decisions. Reverse causality in marginal costs arises when a firm, by purchasing a large share or even all of a supplier's output, can influence the prices it pays for intermediate inputs. To address this, we instrument marginal costs using a measure that excludes purchases from suppliers with a limited number of buyers, as described in Equation 15. Competitors' prices may also be endogenous due to simultaneous price-setting decisions between firms and their competitors. To mitigate this issue, we instrument changes competitors' prices with changes in input costs faced by competitors' suppliers, which exclude inputs sourced from suppliers that trade with both the firm and its competitors, as detailed in Equation 16. Figure 14 reports the IV estimates where both marginal costs and competitors' prices are instrumented. The first-stage Kleibergen-Paap Wald F-statistic consistently exceeds 160, addressing concerns about weak instruments. The IV estimates reveal an even larger pass-through of competitors' prices—80 percent over the one-year horizon—relative to the OLS results. In contrast, the pass-through of marginal costs declines to 12 percent, reinforcing the predominant role of strategic complementarities over cost factors in firms' pricing behavior. Notably, the sum of the two estimated elasticities is now statistically indistinguishable from one, consistent with the class of models from which our empirical

specification is derived.[26]

We now turn to potentially incomplete price adjustment dynamics. The longitudinal dimension of our data is limited to the period from January 2014 to December 2023, constraining the horizon over which we can study the elasticities of interest. This is because, in the distributed lag framework, extending the horizon requires including additional lags of changes in marginal costs and competitors' prices, thereby reducing the sample size of price changes. In our baseline specification, we assume that the adjustment dynamics are completed within 12 months. To test the validity of this assumption, we re-estimate the baseline model over a 24-month horizon.

Appendix Figure G.4 reports the results. The responses to changes in marginal costs confirm that the bulk of the adjustment occurs within the first 12 months following the shock. If anything, the magnitude of price adjustments declines during the second year, although the estimates become less precise. For changes in competitors' prices, we find that the pass-through elasticity after 24 months is approximately 55 percent, about 10 percentage points lower than in the baseline specification. Nevertheless, the pass-through remains considerably larger than that associate with changes in marginal costs. The decline is primarily explained by a continued reduction in the size of price adjustments during the second year, which is only partially offset by a modest increase in the frequency of price adjustments.

Finally, we examine the robustness of our results to the choice of the estimation technique. Our preferred estimation approach is the distributed lag model, as it allows us to exploit the full time dimension of the data and efficiently trace adjustment dynamics. However, to test the robustness of our results, we also estimate the elasticities of interest using long-differences, which comes at the cost of losing the first year of observations due to the lags in the independent variables and not isolating the effect of a single shock. Specifically, we estimate horizon-specific elasticities using the following specification:[27]

$$p_{i,t+h} - p_{i,t-1} = \alpha_i + \tau_t + \beta^h \left(mc_{i,t+h} - mc_{i,t-1} \right) + \gamma^h \left(p_{-i,t+h} - p_{-i,t-1} \right) + \varepsilon^h_{i,t}, \tag{23}$$

where changes in marginal costs and competitors' prices are cumulated over the same horizon h as the dependent variable.

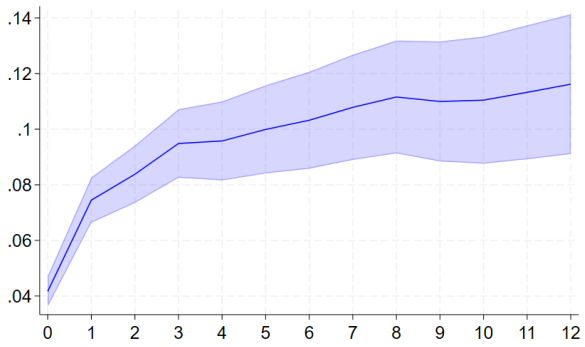
This approach accounts for the possibility that changes in marginal costs and competitors' prices are serially correlated, meaning that initial changes are often followed by

[26] Appendix Figure G.1 and Appendix Figure G.2 show the results when instrumenting each variable separately, and Appendix Figure G.3 reports the IV estimates for the manufacturing sector.

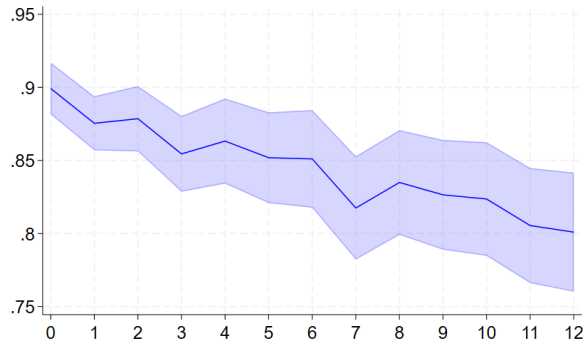
[27] Amiti, Itskhoki and Konings (2022) and Boehm, Levchenko and Pandalai-Nayar (2023) use a similar approach to estimate exchange rate pass-through and trade elasticities, respectively.

Figure 14: IV regressions
(Percentage points)

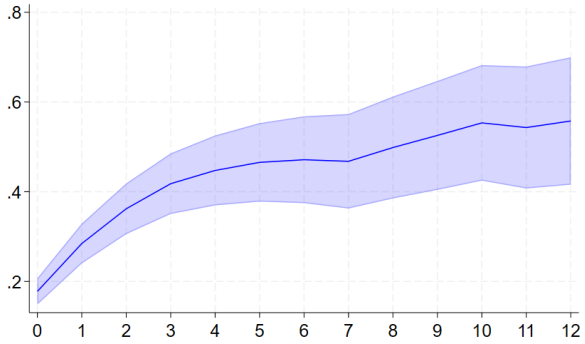
(a) Pass-through, change in marginal costs



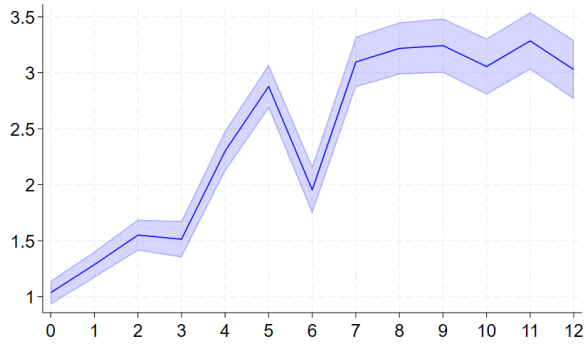
(b) Pass-through, change in competitors' prices



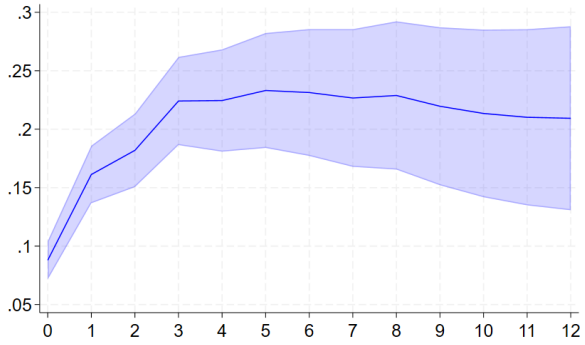
(c) Frequency, change in marginal costs



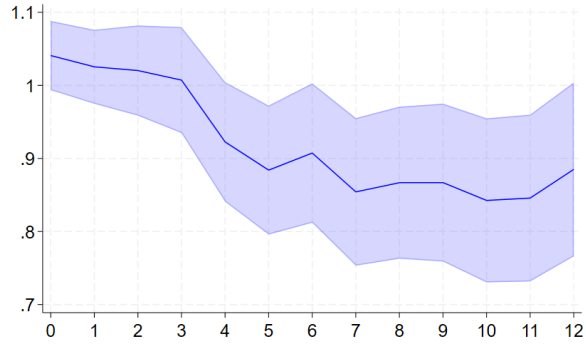
(d) Frequency, change in competitors' prices



(e) Size, change in marginal costs



(f) Size, change in competitors' prices



Notes: The figure shows the percent change in firms' sales prices, the percent change in the frequency of sales price adjustments, and the percent change in the size of non-zero sales price adjustments in response to a one percentage point change in marginal costs and a one percentage point change in competitors' prices, along with the 90 percent confidence intervals. It reports the results from IV regressions, in which both changes in marginal costs and competitors' prices are instrumented. The specification includes firm and time fixed effects. Standard errors are clustered at the firm and time level.

further adjustments over subsequent periods. If autocorrelation is present, conventional local projections—based only on contemporaneous changes—could overestimate the coefficients for horizons $h > 0$, as they would omit subsequent cost or competitor price changes. Conversely, if these changes are mean-reverting, conventional long-differences would underestimate the true parameters. By cumulating changes over the horizon, our specification mitigates both concerns.

We report the results of long-differences regressions in Appendix Figure G.5. The findings are broadly consistent with our baseline estimates, though the pass-through coefficients are slightly smaller. Specifically, the one-year-ahead marginal cost pass-through is estimated at 17 percent, compared to 18 percent in the baseline, while the pass-through of competitors' prices is 59 percent, down from 66 percent. These differences are primarily attributed to variations in the estimated responses of the frequency of price adjustments. In response to an increase in marginal costs, the frequency of price changes rises by 1.2 percentage points, slightly higher than the 1 percentage point increase observed in our baseline estimates. The magnitude of individual price adjustments remains virtually unchanged at 0.2 percent. Similarly, following a change in competitors' prices, the frequency of price adjustments increases by 2.8 percentage points, compared to 2.2 percentage points in the baseline, with the size of adjustments remaining comparable at 0.7 percent. Overall, the long-differences estimates confirm our central result that firms' pricing decisions are substantially more responsive to competitors' prices than to their own marginal costs.

6 Conclusions

In this paper, we examine the role of strategic complementarities in firms' price setting. Using granular administrative data on Chilean firms, we make progress on accurately measuring changes in marginal costs and competitors' prices, and use them to document five key facts about firm's strategic pricing behavior.

The first fact is that firms set prices strategically, with the pass-through from competitors' prices substantially exceeding that from their own costs. Specifically, firms pass through approximately two-thirds of changes in competitors' prices—about 4 times larger than the pass-through of marginal cost changes. The second fact is that the strength of strategic complementarities varies across sectors but remains of first-order importance throughout. For manufacturing firms, the pass-through of competitors' prices is estimated at 40 percent. This is considerably less than for retail firms, whose pass-through is as high as 75 percent. However, it is still significantly larger than the cost pass-

through, confirming that strategic complementarities dominate cost-based pricing even in the manufacturing sector traditionally studied in the literature.

The willingness of firms to engage in strategic pricing, however, changes depending on a number of factors. The third fact is that strategic complementarities are state dependent. Focusing on manufacturing firms, we find that during periods of high inflation, firms not only become more sensitive to changes in their own costs, but also twice as responsive to competitors' price changes. High inflation thus weakens nominal rigidities while amplifying the role of strategic complementarities in price setting. The fourth fact is that the pass-through of changes in competitors' prices is asymmetric: it is larger for competitors' price increases than for decreases. This 'rockets and feathers' phenomenon extends to beyond cost pass-through to strategic pricing interactions. Finally, the fifth fact is that strategic complementarities are stronger when firms face lower competition, have larger customer bases, and enjoy higher market shares. These findings highlight the importance of market structure in shaping firms' strategic pricing behavior. Taken together, the evidence supports the view that strategic complementarities are a key source of real rigidities in pricing, leading firms to adjust their prices less than one-for-one with changes in marginal costs.

The pass-through of competitors' prices to firms' prices——along with the elasticity of markups to competitors' prices——provides disciplined, micro-founded moments for macroeconomic models in which market structure shapes monetary transmission. By showing that strategic complementarities vary systematically with inflation regimes and market concentration, our results imply that the real effects of monetary policy depend not only on nominal rigidities, but also on the competitive environment in which firms operate. Exploring the implications of these findings for quantitative models and optimal monetary policy design offers a promising direction for future research.

References

Acevedo, Pablo, Emiliano Luttini, Matías Pizarro, Dagoberto Quevedo, and Marco Rojas. 2025. "Invoices rather than surveys: Using ML to monitor the economy." mimeo.

Alexander, Patrick, Lu Han, Oleksiy Kryvtsov, and Ben Tomlin. 2024. "Markups and Inflation in Oligopolistic Markets: Evidence from Wholesale Price Data." C.E.P.R. Discussion Papers CEPR Discussion Papers 19419.

Alvarez, Fernando, Martin Beraja, Martin Gonzalez-Rozada, and Pablo Andrés Neumeyer. 2019. "From hyperinflation to stable prices: Argentina's evidence on menu cost models." *Quarterly Journal of Economics*, 134(1): 451–505.

Amiti, Mary, Oleg Itskhoki, and Jozef Konings. 2019. "International shocks, variable markups, and domestic prices." *Review of Economic Studies*, 86(6): 2356–2402.

Amiti, Mary, Oleg Itskhoki, and Jozef Konings. 2022. "Dominant currencies: How firms choose currency invoicing and why it matters." *Quarterly Journal of Economics*, 137(3): 1435–1493.

Amiti, Mary, Sebastian Heise, Fatih Karahan, and Aysegul Sahin. 2022. "Pass-through of wages and import prices has increased in the post-COVID period." Federal Reserve Bank of New York Liberty Street Economics.

Atkeson, Andrew, and Ariel Burstein. 2008. "Pricing-to-market, trade costs, and international relative prices." *American Economic Review*, 98(5): 1998–2031.

Auer, Raphael A, and Raphael S Schoenle. 2016. "Market structure and exchange rate pass-through." *Journal of International Economics*, 98: 60–77.

Bacon, Robert W. 1991. "Rockets and feathers: The asymmetric speed of adjustment of UK retail gasoline prices to cost changes." *Energy Economics*, 13(3): 211–218.

Ball, Laurence, and David Romer. 1990. "Real rigidities and the non-neutrality of money." *Review of Economic Studies*, 57(2): 183–203.

Barros, Rebecca, Marco Bonomo, Carlos Carvalho, and Silvia Matos. 2009. "Price setting in a variable macroeconomic environment: Evidence from Brazilian CPI." unpublished paper.

Bils, Mark, and Peter J Klenow. 2004. "Some evidence on the importance of sticky prices." *Journal of political economy*, 112(5): 947–985.

Blanco, Andres, Corina Boar, Callum J Jones, and Virgiliu Midrigan. 2024. "Non-linear inflation dynamics in menu cost economies." NBER Working Paper No. 32094.

Boehm, Christoph E, Andrei A Levchenko, and Nitya Pandalai-Nayar. 2023. "The long and short (run) of trade elasticities." *American Economic Review*, 113(4): 861–905.

Burstein, Ariel, and Gita Gopinath. 2014. "International prices and exchange rates." In *Handbook of international economics*. Vol. 4, 391–451. Elsevier.

Campbell, Jeffrey R, and Benjamin Eden. 2014. "Rigid prices: Evidence from us scanner data." *International Economic Review*, 55(2): 423–442.

Campbell, Jeffrey R., and Hugo A. Hopenhayn. 2005. "Market size matters." *Journal of Industrial Economics*, 53(1): 1–25.

Cooper, Russell, and Andrew John. 1988. "Coordinating coordination failures in Keynesian models." *Quarterly Journal of Economics*, 103(3): 441–463.

Creamer, Kenneth, and Neil Rankin. 2008. "Price setting in South Africa 2001 to 2007 stylised facts using consumer price micro data." *Journal of Development Perspectives*, 4(1): 93–118.

Droste, Michael. 2024. "Strategic Complementarities in Posted Wages." Working Paper.

Eichenbaum, Martin, Nir Jaimovich, and Sergio Rebelo. 2011. "Reference prices, costs, and nominal rigidities." *American Economic Review*, 101(1): 234–262.

Eichenbaum, Martin, Nir Jaimovich, Sergio Rebelo, and Josephine Smith. 2014. "How frequent are small price changes?" *American Economic Journal: Macroeconomics*, 6(2): 137–155.

Feenstra, Robert C, Joseph E Gagnon, and Michael M Knetter. 1996. "Market share and exchange rate pass-through in world automobile trade." *Journal of International Economics*, 40(1-2): 187–207.

Fontagné, Lionel, Philippe Martin, and Gianluca Orefice. 2018. "The international elasticity puzzle is worse than you think." *Journal of International Economics*, 115: 115–129.

Gagliardone, Luca, Mark Gertler, Simone Lenzu, and Joris Tielens. 2023. "Anatomy of the Phillips curve: Micro evidence and macro implications." NBER Working Paper No. 31382.

Gagnon, Etienne. 2009. "Price setting during low and high inflation: Evidence from Mexico." *Quarterly Journal of Economics*, 124(3): 1221–1263.

Ganapati, Sharat, Joseph S Shapiro, and Reed Walker. 2020. "Energy cost pass-through in US manufacturing: Estimates and implications for carbon taxes." *American Economic Journal: Applied Economics*, 12(2): 303–342.

Genakos, Christos, and Mario Pagliero. 2022. "Competition and pass-through: Evidence from isolated markets." *American Economic Journal: Applied Economics*, 14(4): 35–57.

Genesove, David, and Wallace P. Mullin. 1998. "Testing static oligopoly models: Conduct and cost in the sugar industry, 1890–1914." *The RAND Journal of Economics*, 29(2): 355–377.

Gentzkow, Matthew, Bryan Kelly, and Matt Taddy. 2019. "Text as data." *Journal of Economic Literature*, 57(3): 535–574.

Goldberg, Pinelopi, and Rebecca Hellerstein. 2007. "A Structural approach to identifying the sources of local currency price stability." Federal Reserve Bank of New York, Staff Report no. 287.

Goldberg, Pinelopi, and Rebecca Hellerstein. 2013. "A structural approach to identifying the sources of local currency price stability." *Review of Economic Studies*, 80(1): 175–210.

Golosov, Mikhail, and Robert E Lucas. 2007. "Menu costs and Phillips curves." *Journal of Political Economy*, 115(2): 171–199.

Gopinath, Gita, and Oleg Itskhoki. 2010. "Frequency of price adjustment and pass-through." *Quarterly Journal of Economics*, 125(2): 675–727.

Gopinath, Gita, and Oleg Itskhoki. 2011. "In search of real rigidities." *NBER Macroeconomics Annual*, 25(1): 261–310.

Gopinath, Gita, Oleg Itskhoki, and Roberto Rigobon. 2010. "Currency choice and exchange rate pass-through." *American Economic Review*, 100(1): 304–336.

Gouvea, Solange. 2007. "Price rigidity in Brazil: Evidence from CPI micro data." Banco Central do Brasil, Working Paper N. 143.

Jaravel, Xavier, and Erick Sager. 2019. "What are the Price Effects of Trade? Evidence from the U.S. and Implications for Quantitative Trade Models." Board of Governors of the Federal Reserve System (U.S.) Finance and Economics Discussion Series 2019-068.

Joulin, Armand, Edouard Grave, Piotr Bojanowski, and Tomas Mikolov. 2016. "Bag of tricks for efficient text classification." *arXiv preprint arXiv:1607.01759*.

Julio, Juan Manuel, Héctor Manuel Zárate, and Manuel Dario Hernández. 2009. "The stickiness of Colombian consumer prices." Borradores de Economía, Banco de la Republica N. 578.

Karadi, Peter, and Adam Reiff. 2019. "Menu costs, aggregate fluctuations, and large shocks." *American Economic Journal: Macroeconomics*, 11(3): 111–146.

Karadi, Peter, Anton Nakov, Galo Nuno, Ernesto Pastén, and Dominik Thaler. 2024. "Strike while the iron is hot: Optimal monetary policy with a nonlinear Phillips curve." BIS Working Paper No. 1203.

Karrenbrock, Jeffrey D, et al. 1991. "The behavior of retail gasoline prices: symmetric or not?" Federal Reserve Bank of St. Louis Review Vol. 73(4): 19–29.

Kimball, Miles S. 1995. "The Quantitative Analytics of the Basic Neomonetarist Model." *Journal of Money, Credit and Banking*, 27(4): 1241–1277.

Klenow, Peter J, and Jonathan L Willis. 2016. "Real rigidities and nominal price changes." *Economica*, 83(331): 443–472.

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

Lafrogne-Joussier, Raphaël, Julien Martin, and Isabelle Mejean. 2023. "Cost pass-through and the rise of inflation." Institut national de la statistique et des études économiques No. 94.

Medina, Juan, David Rappoport, and Claudio Soto. 2007. "Dynamics of price adjustments: Evidence from micro level data for Chile." Central Bank of Chile, Working Paper N. 432.

Nakamura, Emi, and Dawit Zerom. 2010. "Accounting for incomplete pass-through." *Review of Economic Studies*, 77(3): 1192–1230.

Nakamura, Emi, and Jón Steinsson. 2008. "Five facts about prices: A reevaluation of menu cost models." *Quarterly Journal of Economics*, 123(4): 1415–1464.

Nakamura, Emi, Jón Steinsson, Patrick Sun, and Daniel Villar. 2018. "The elusive costs of inflation: Price dispersion during the US great inflation." *Quarterly Journal of Economics*, 133(4): 1933–1980.

Neumark, David, and Steven A Sharpe. 1992. "Market structure and the nature of price rigidity: evidence from the market for consumer deposits." *Quarterly Journal of Economics*, 107(2): 657–680.

Peltzman, Sam. 2000. "Prices rise faster than they fall." *Journal of Political Economy*, 108(3): 466–502.

Pennings, Steven. 2017. "Pass-through of competitors' exchange rates to US import and producer prices." *Journal of International Economics*, 105: 41–56.

Rossi-Hansberg, Esteban, Pierre-Daniel Sarte, and Nicholas Trachter. 2021. "Diverging trends in national and local concentration." *NBER Macroeconomics Annual*, 35(1): 115–150.

Taylor, John B. 2000. "Low inflation, pass-through, and the pricing power of firms." *European Economic Review*, 44(7): 1389–1408.

Wang, Olivier, and Iván Werning. 2022. "Dynamic oligopoly and price stickiness." *American Economic Review*, 112(8): 2815–2849.

Online appendix

A Regular prices

For any product, we compute the regular prices r_t from observed prices p_t following the procedure of Nakamura and Steinsson (2008). This essentially filters out changes in observed prices due to sales and stockouts by assuming that the regular price of the product comes back to its level after sales and stockouts events. Specifically, the algorithm consists of the following steps

1. If $p_t = r_{t-1}$, then $r_t = r_{t-1}$
2. If $p_t > r_{t-1}$, then $r_t = p_t$
3. If $r_{t-1} \in \{p_{t+1}, \ldots, p_{t+J}\}$ and $p_t \leq r_{t-1}$ before returning to r_{t-1}, then $r_t = r_{t-1}$
4. If $\{p_t, p_{t+1}, \ldots, p_{t+L}\}$ has K or more different elements, then $r_t = p_t$
5. Define $p_{max} = \max\{p_{t+1}, \ldots, p_{t+L}\}$ and $t_{max} =$ first-time $\max\{p_{t+1}, \ldots, p_{t+L}\}$; if $p_{max} \in \{p_{t_{max}+1}, \ldots, p_{t_{max}+L}\}$, then $r_t = p_{max}$
6. $r_t = p_t$

In our calculations, we parametrize the filter with $L = 3$, $K = 3$, and $J = 5$.

B Price rigidity of CPI and PPI products

We provide descriptive evidence about price rigidity based on a sample product varieties that enter the CPI and PPI baskets, and compare it with that available for other countries.[28] The frequency of price changes is defined the number of price changes per unit of time. Thus, for each product variety v entering the CPI or PPI product category c sold in month t, $p_{v,c,t}$, we compute the frequency of price changes at the CPI or PPI product category level, $f_{c,t}$, and aggregate at the economy level using the expenditure weights

$$f_t = \sum_c \omega_c f_{c,t} = \sum_c \omega_c \frac{\sum_{v \in c} D_{v,c,t}}{\sum_{v \in c} O_{v,c,t}} \tag{24}$$

where ω_c denotes the CPI and the PPI weights from the National Statistics Institute, $D_{j,c,t}$ is a dummy variable that takes value one when the product variety changes price, and $O_{j,c,t}$ is a dummy variable that takes value one when the price of the product variety is observed; so that $D_{j,c,t} \leq O_{j,c,t}$. From the frequency of price changes, we infer the price price duration as $-1/\ln(1-f_t)$.

The size of price changes (i.e., the magnitude of price changes conditional on the prices changing from $t-1$ to t) is similarly computed by aggregating the magnitude of non-zero price changes at the CPI and PPI category level $s_{c,t}$ weighted by expenditure

$$s_t = \sum_c \omega_c s_{c,t} = \sum_c \omega_c \frac{\Delta p^{\neq 0}_{v,c,t}}{O^{\neq 0}_{v,c,t}} \tag{25}$$

where $\Delta p^{\neq 0}_{v,c,t} = p_{v,c,t} - p_{v,c,t-1} \neq 0$ and $O^{\neq 0}_{j,c,t}$ is a dummy variable that takes value one when the price differs from the one of the previous month.

To understand whether price increases or decreases are more frequent, we also compute the frequency of price changes separately for positive and negative price changes, f_t^+ and f_t^- respectively. Analogously, we repeat the size calculations for price increases and decreases, s_t^+ and s_t^-, such that

$$\Delta p_t = f_t^+ s_t^+ + f_t^- s_t^- \tag{26}$$

The upper panel of Table B.1 reports the time average of the frequency measure, as defined in Equation 24. The frequency based on the weighted changes of median prices is

[28] For the period January 2018–December 2023, we can easily map product varieties to CPI and PPI categories using the CPC and COICOP classifiers as per the National Statistics Institute classification. Yet, for the period before January 2018, the mapping information is not available and we assume that the first available mapping holds backwards.

30.3 and 30.9 percent for CPI and PPI products, respectively. This implies that after the price of a product changes, it takes almost three months to change again. The frequency computed out of median prices is significantly smaller than that obtained from average prices, suggesting that a few CPI and PPI product categories have relatively higher frequencies.

The analog calculations for regular prices indicate that, as expected, the frequency estimate is smaller than for observed prices. For regular prices of CPI and PPI products, we find frequency estimates of 25.6 and 25.2 percent respectively, indicating a longer duration of about 3 months and a half. These results suggest that temporary sales are a feature of the data, both for products sold to final consumers and intermediate inputs. Another finding is that price increases are considerably more frequent than decreases, which is consistent with a monetary policy regime aimed at a positive inflation target. The frequency of observed price increases is about 5 percentage points higher than for price declines. The same is true for regular prices.

It is difficult to compare estimates across studies as methodologies, sample periods, and data sources vary considerably. However, the evidence on emerging markets suggests that our estimates of the frequency of price adjustment are broadly in the range of those of other countries. For example, Gouvea (2007) and Barros et al. (2009) use prices of CPI products and find an average frequency of 37.2 and 37 percent, respectively. Julio, Zárate and Hernández (2009) estimate the average frequency at 21.1 percent using CPI data for Colombia, while the median frequency is 11.9 percent. Gagnon (2009) uses price information of Mexican CPI products and finds that the average frequency changes substantially when inflation is low and high, from 22.1 percent to 61.9 percent. Creamer and Rankin (2008) examine both CPI and PPI products in South Africa and find that the frequency is 16 percent for the former and 19.5 percent for the latter. Earlier evidence on Chile by Medina, Rappoport and Soto (2007) is limited to CPI products in the pre-2005 period and reports an average frequency of 44.7 percent and a median frequency of 28.9 percent.

The lower panel of Table B.1 reports the time average of the size of price changes of CPI and PPI products, as defined in Equation 25. Using median prices, the average size of price changes of CPI and PPI products over the full sample period is 1.3 percent. Also, differences are small when the size of price changes is computed starting from average prices instead of median prices.

We find that removing instances of temporary sales does not significantly alter the size of price adjustments. The size of regular price changes is in fact only 0.2 percentage points smaller than that of observed price changes. When we separate price increases and

price decreases, however, we find that the size of regular price changes is smaller after excluding temporary sales. This suggests that price changes associated with temporary sales tend to be larger than other price adjustments.

Interestingly, while price decreases occur less frequently than price increases, they tend to be larger. For observed median prices, the size of price decreases is 15 percent for CPI products over the full sample, 2.3 percentage points larger than for price increases. In the case of PPI products, price decreases are 1.7 percentage points larger than price increases. These differentials are of similar magnitude for regular prices.[29]

Figure B.1 shows the distribution of the frequency and size of observed and regular price changes $f_{c,t}$ and $s_{c,t}$, separately for products entering the CPI and the PPI baskets. As shown in the top panels, regular prices have relatively fatter left tails than observed prices, indicating a lower frequency of adjustments as expected. The mode of the distribution for regular prices is about 0.25, meaning that one-fourth of the products change prices in a typical CPI/PPI category and month. Also, the right tails of the distributions are long, indicating a few instances in which a significantly larger share of products changed prices. The bottom panels show that, after excluding instances in which prices did not change, regular prices display smaller price changes than observed prices, with the mode of the distribution at around 1.5 percent both in the case of CPI and PPI product categories. The distributions in the two panels display relatively fat right tails, indicating that price increases are more frequent than price declines.[30]

The top panels of Figure B.2 illustrate the median frequency of price changes by CPI and PPI categories. Across categories, regular prices adjusted 5 to 15 percentage points less frequently than observed prices. However, there is substantial heterogeneity across categories. In the case of the CPI, 'restaurants and hotels' (along with 'miscellaneous') display the lowest frequency at 22 percent for regular prices, while 'housing, water, electricity, etc.' prices show the highest at 48 percent. For PPI, the category with the lowest frequency is 'tobacco', for which the median frequency is zero as most of the tobacco products did not change prices over the sample period, while about half of the products in the category 'coke and refined petroleum' changed prices. The bottom panels report the median size of price changes for CPI and PPI categories. Across CPI categories, the largest regular price adjustments take place in 'food and non-alcoholic beverages' with a median size of 1.7 percent, while the smallest price changes (about 0.2 percent) are in the 'clothing and footwear' category. With respect to PPI, the largest price changes hap-

[29] The results for the post-January 2018 period—for which the mapping between product and CPI and PPI categories is available—are remarkably similar to those for the entire sample period.

[30] Appendix A reports the frequency and size of price changes across CPI and PPI product categories.

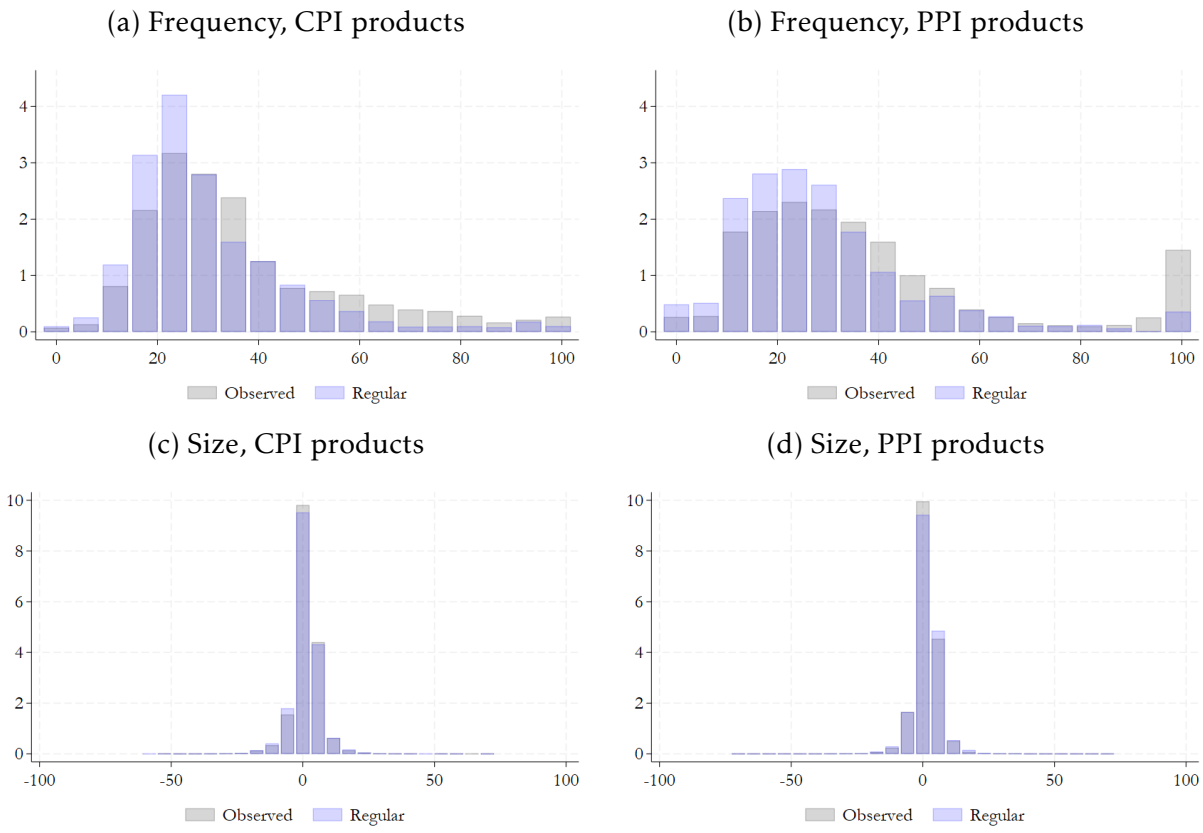
pened in the 'tobacco' category (about 4.5 percent), while the smallest took place in the 'non-metallic minerals' group.

Table B.1: Frequency and size of price changes of CPI and PPI products (Percent)

	CPI		PPI	
	Median prices	Average prices	Median prices	Average prices
Frequency				
Observed prices				
All changes	30.3	36.4	30.9	37.7
Duration (months)	2.8	2.2	2.7	2.1
Increases	17.3	21.2	16.6	22.0
Decreases	11.5	15.1	11.6	15.8
Regular prices				
All changes	25.6	30.0	25.2	28.9
Duration (months)	3.4	2.9	3.5	3.0
Increases	14.7	17.6	13.7	16.7
Decreases	9.5	12.1	9.1	12.2
Size				
Observed prices				
All changes	1.3	1.3	1.3	1.3
Increases	12.7	13.7	10.5	11.1
Decreases	-15.0	-15.8	-12.2	-12.6
Regular prices				
All changes	1.2	1.1	1.5	1.4
Increases	11.8	12.6	10.1	10.8
Decreases	-14.2	-15.0	-11.7	-12.3

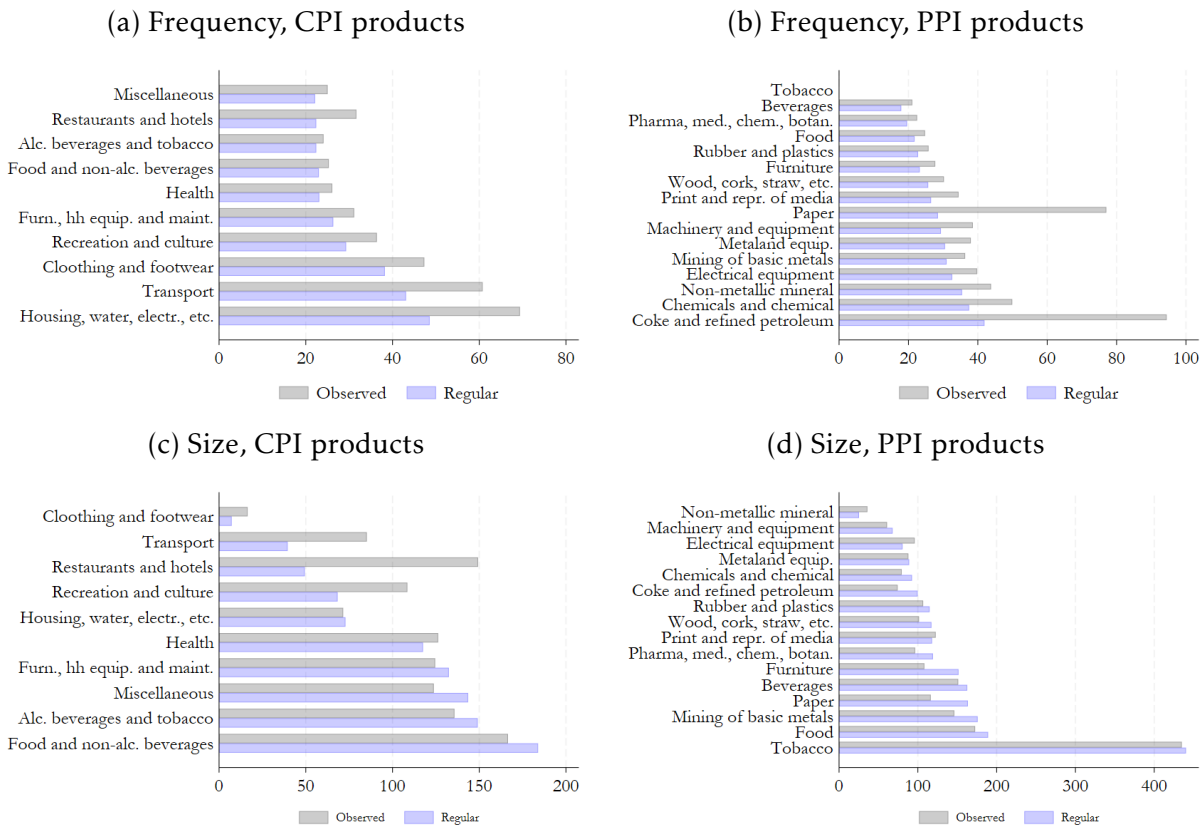
Notes: The table reports the frequency and size of price changes for CPI and PPI product varieties. Beginning in January 2018, product varieties are mapped to CPI and PPI categories using the COICOP and CPC classifications; for earlier periods, the same mapping is assumed. Regular prices (i.e., excluding sales) are identified using the filter of Nakamura and Steinsson (2008), which removes asymmetric V-shaped sales—temporary price reductions followed by a return to the regular price—applying a five-month return window. Implied duration is expressed in months.

Figure B.1: Distribution of frequency and size of price changes
(Percent)



Notes: The figure shows the density distribution of the frequency and size of (median) price changes for CPI and PPI product categories. Regular prices (i.e., excluding sales) are identified using the filter of Nakamura and Steinsson (2008), which removes asymmetric V-shaped sales—temporary price reductions followed by a change in the regular price—applying a five-month return window.

Figure B.2: Frequency and size of price changes by product category (Percent)



Notes: The figure shows the frequency and size of (median) price changes for CPI and PPI product categories. Regular prices (i.e., excluding sales) are identified using the filter of Nakamura and Steinsson (2008), which removes asymmetric V-shaped sales—temporary price reductions followed by a return to the regular price—using a five-month return window.

C Classification of product varieties into product categories

We follow the work of Acevedo et al. (2025) to classify the product varieties into product categories consistent with the Unique Product Classification (UCP) with 290 categories, a Chilean adaptation of the Central Product Classification (CPC) designed to better reflect the structure of goods production in the Chilean economy. In a nutshell, the algorithm is as follows

1. It builds a sample of text descriptors associated with each product category.
2. It then computes a score for each text descriptor within each economic sector of the seller based on the sales amount.
3. For each product category, it selects up to 2,000 text descriptors with the highest score and manually classifies them into product categories.
4. It cleans the text descriptors following Gentzkow, Kelly and Taddy (2019), as free text descriptors are unstructured and might contain uninformative parts.
5. It employs the FastText classification algorithm proposed in Joulin et al. (2016) to predict the product category using the text of the training sample.[31]
6. It finally uses the trained model on the untrained sample and obtains the mapping between product varieties and product categories.

[31] The algorithm also uses information about the economic sector of the selling firm and the price range of the product to improve the fit of the model, which can help distinguish between product categories. For example, the sale of a computer and its repair/maintenance may be described very similarly. However, if the trained model knows the sector and price range associated with a text descriptor, it can better distinguish between them.

D Statistical differences

Table D.1 reports the one-year cumulative coefficients on the interaction terms in Equation 17, Equation 18, Equation 19, and Equation 20, and their statistical significance for both marginal cost changes and competitors' price changes.

Table D.1: Differences in coefficients

	Changes in marginal costs	Changes in competitors' prices
Manufacturing firms - retail firms		
Pass-through	0.142***	-0.371***
Frequency	0.78***	-1.325***
Size	0.257***	-0.067
High inflation - low inflation		
Pass-through	0.091***	0.244***
Frequency	1.079***	1.87***
Size	0.100	0.617***
Positive changes - negative changes		
Pass-through	0.034	0.146***
Frequency	1.438***	1.176***
Size	-0.118	0.163
Many competitors - few competitors		
Pass-through	0.007	-0.083***
Large markets share - small market share		
Pass-through	-0.037	0.092***
Many buyers - few buyers		
Pass-through	-0.057**	0.196***

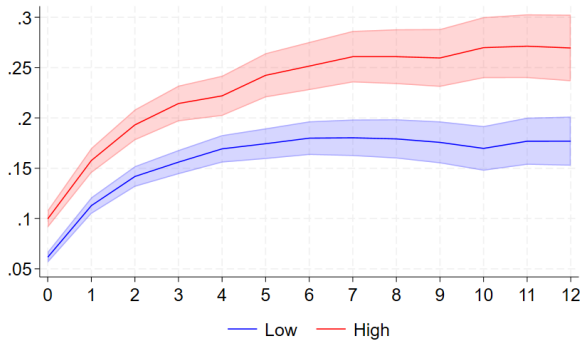
Notes: The table reports the one-year cumulated coefficients on the interaction terms with changes in marginal costs (column 1) and changes in competitors' prices (column 2) from the regressions of pass-through, frequency of price adjustments, and size of price adjustments. All specifications include firm and time fixed effects. Standard errors are clustered at the firm and time level. $^{***}p < 0.01$, $^{**}p < 0.05$, $^{*}p < 0.1$.

E Alternative definitions of high and low inflation

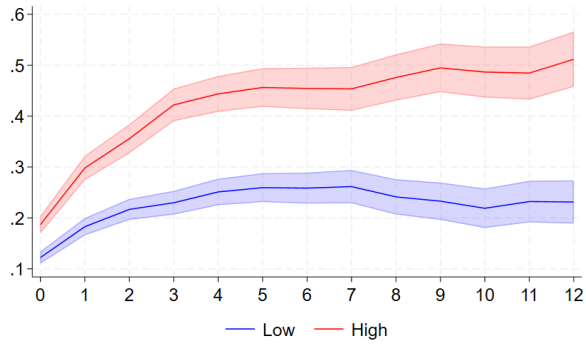
Figure E.1 reports the results about the pass-through of changes in marginal costs and competitors' prices in high and low inflation environments, using either the mean and standard deviation of monthly inflation or the mean and standard deviation of annual inflation.

Figure E.1: Pass-through estimates in high and low inflation periods
(Percentage points)

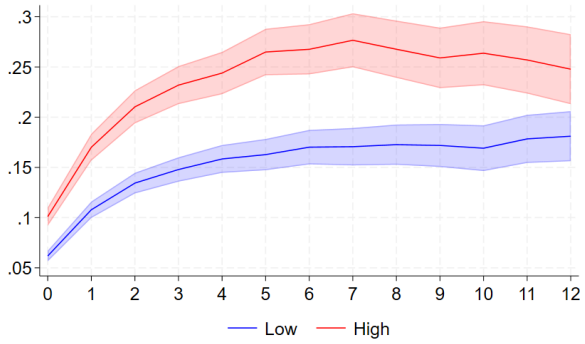
(a) Change in marginal costs, monthly inflation



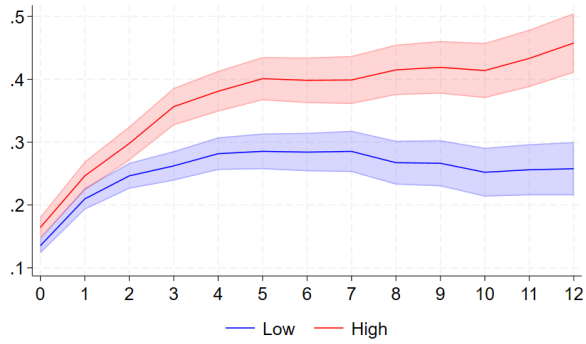
(b) Change in competitors' prices, monthly inflation



(c) Change in marginal costs, annual inflation



(d) Change in competitors' prices, annual inflation



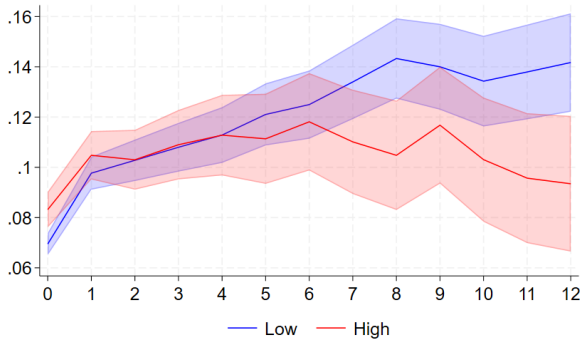
Notes: The figure shows the percent change in firms' sales prices in response to a one percentage point change in marginal costs and a one percentage point change in competitors' prices differentiating between periods of low and high inflation, along with the 90 percent confidence intervals. In panels (a) and (b), high inflation periods are identified using the mean and standard deviation of monthly inflation; while in panels (c) and (d) using the mean and standard deviation of annual inflation. The specifications include firm and time fixed effects. Standard errors are clustered at the firm and time level.

F Evidence on retail firms

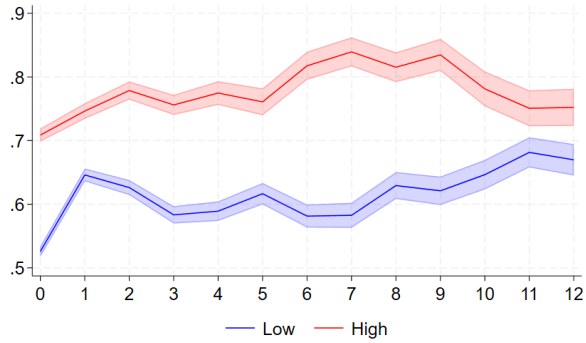
This section presents the results for the sample of retail firms. Figure F.1 shows the pass-through during high and low inflation periods, Figure F.2 reports the effects of positive and negative changes in marginal costs and competitors' prices, and Figure F.3 presents the pass-through estimates conditioning on the market structure.

Figure F.1: Retail firms' pass-through during high vs low inflation
(Percentage points)

(a) Change in marginal costs



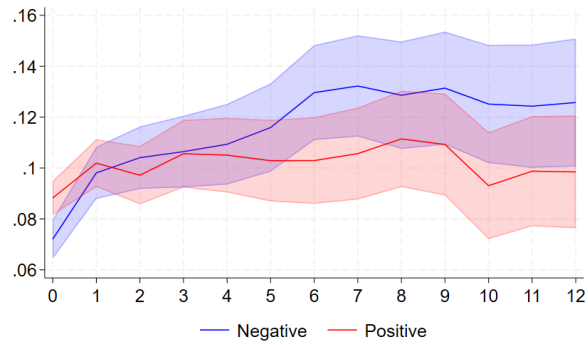
(b) Change in competitors' prices



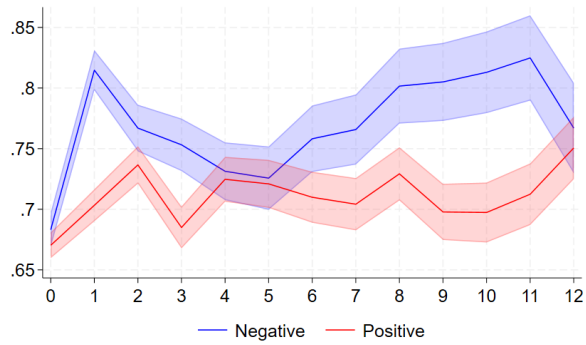
Notes: The figure shows the percent change in firms' sales prices in response to a one percentage point change in marginal costs and a one percentage point change in competitors' prices, along with the 90 percent confidence intervals. It compares the responses of retail firms during high inflation periods to those during low inflation periods. The specification includes firm and time fixed effects. Standard errors are clustered at the firm and time level.

Figure F.2: Asymmetric pass-through of retail firms
(Percentage points)

(a) Change in marginal costs



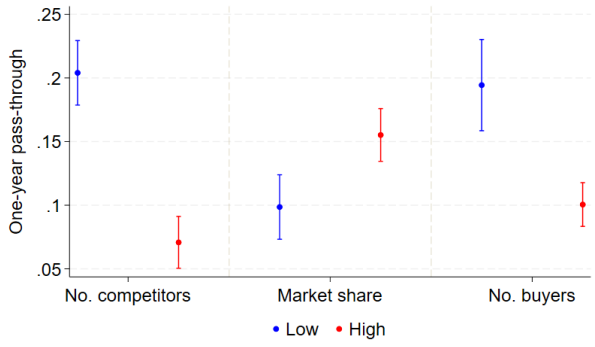
(b) Change in competitors' prices



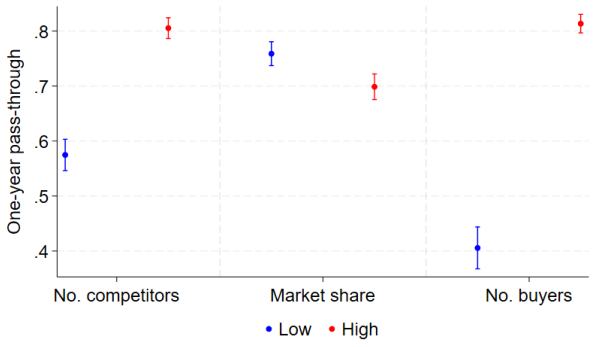
Notes: The figure shows the percent change in firms' sales prices in response to a one percentage point change in marginal costs and a one percentage point change in competitors' prices, along with the 90 percent confidence intervals. The figures compares the responses of retail firms to positive and negative changes in marginal cost and competitors' prices. The specification includes firm and time fixed effects. Standard errors are clustered at the firm and time level.

Figure F.3: Market structure of retail firms
(Percentage points)

(a) Pass-through, change in marginal costs



(b) Pass-through, change in competitors' prices



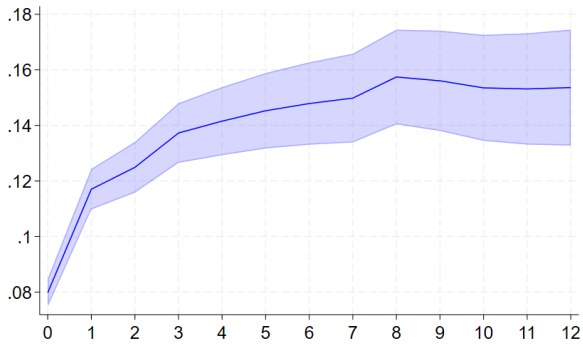
Notes: The figure shows the percent change in retail firms' sales prices one year after a change in their marginal costs and competitors' prices, conditional on the firm's number of competitors, market share, and number of buyers, along with the 90 percent confidence intervals. The specification includes firm and time fixed effects. Standard errors are clustered at the firm and time level.

G Results of robustness tests

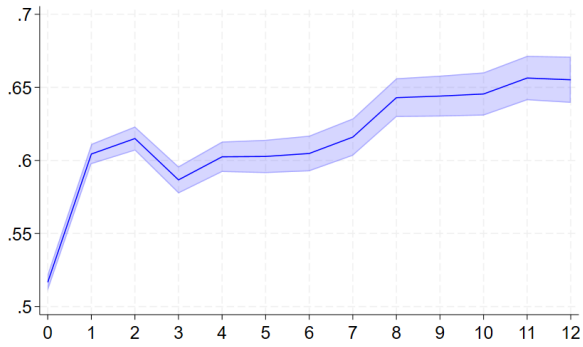
This section reports the results of different variations of the IV regressions (Figure G.1, Figure G.2, and Figure G.3), the pass-through estimates over a 24-month horizon (Figure G.4), and the results of the horizon-specific local projections (Figure G.5).

Figure G.1: Instrumenting changes in marginal costs
(Percentage points)

(a) Pass-through, change in marginal costs



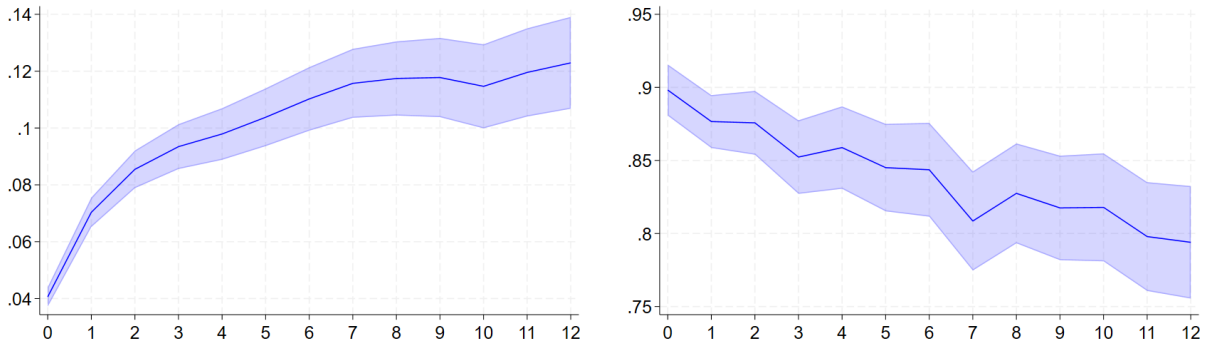
(b) Pass-through, change in competitors' prices



Notes: The figure shows the percent change in retail firms' sales prices, the percent change in the frequency of sales price adjustments, and the percent change in the size of non-zero sales price adjustments in response to a one percentage point change in marginal costs and a one percentage point change in competitors' prices, along with the 90 percent confidence intervals. The figure reports the results from IV regressions, in which changes in marginal costs are instrumented. The specification includes firm and time fixed effects. Standard errors are clustered at the firm and time level.

Figure G.2: Instrumenting changes in competitors' prices
(Percentage points)

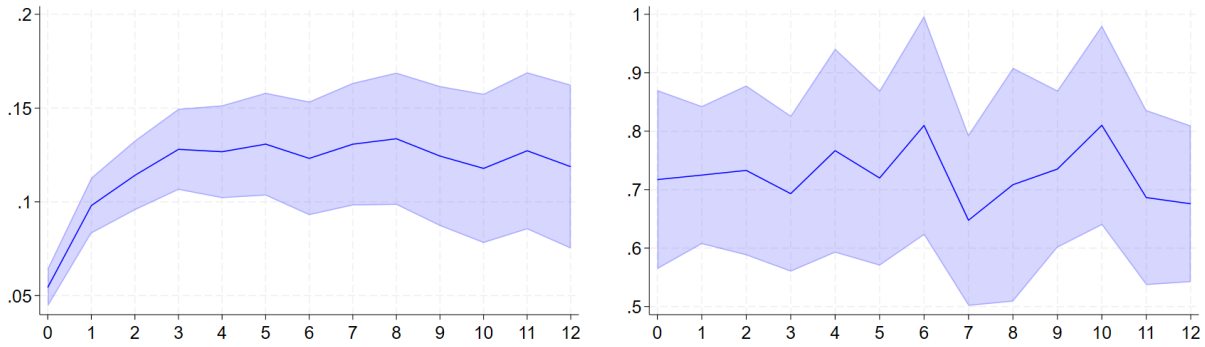
(a) Pass-through, change in marginal costs (b) Pass-through, change in competitors' prices



Notes: The figure shows the percent change in firms' sales prices, the percent change in the frequency of sales price adjustments, and the percent change in the size of non-zero sales price adjustments in response to a one percentage point change in marginal costs and a one percentage point change in competitors' prices, along with the 90 percent confidence intervals. The figure reports the results from IV regressions, in which changes in competitors' prices are instrumented. The specification includes firm and time fixed effects. Standard errors are clustered at the firm and time level.

Figure G.3: IV regressions for manufacturing firms
(Percentage points)

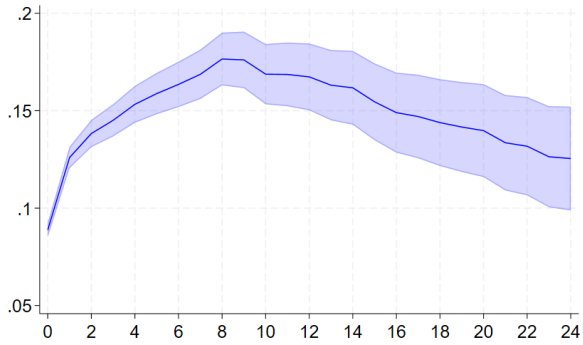
(a) Pass-through, change in marginal costs (b) Pass-through, change in competitors' prices



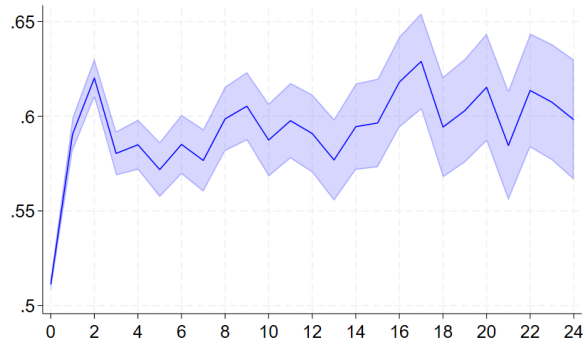
Notes: The figure shows the percent change in firms' sales prices, the percent change in the frequency of sales price adjustments, and the percent change in firms' size of non-zero sales price adjustments in response to a one percentage point change in marginal costs and a one percentage point change in competitors' prices, along with the 90 percent confidence intervals. The figure reports the results from IV regressions, in which changes in competitors' prices are instrumented. The specification includes firm and time fixed effects. Standard errors are clustered at the firm and time level.

Figure G.4: Longer horizon
(Percentage points)

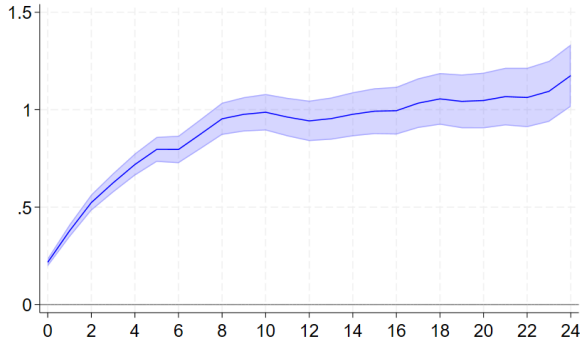
(a) Pass-through, change in marginal costs



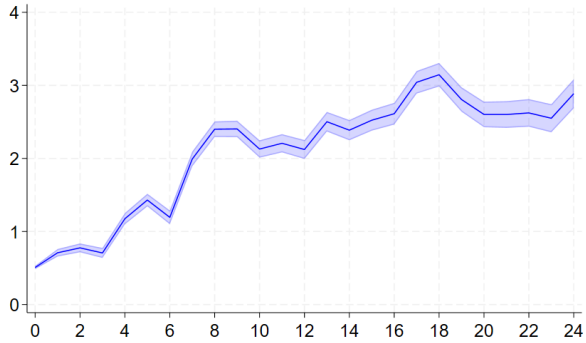
(b) Pass-through, change in competitors' prices



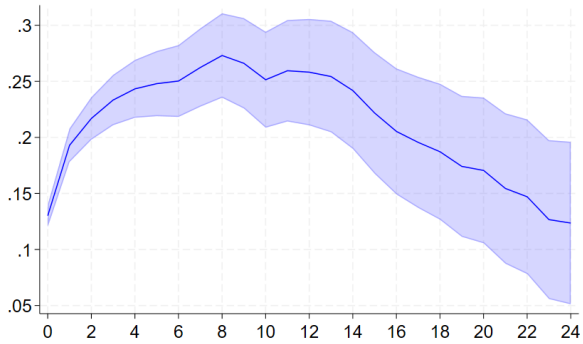
(c) Frequency, change in marginal costs



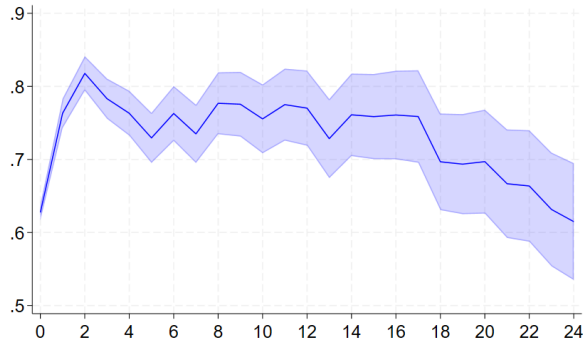
(d) Frequency, change in competitors' prices



(e) Size, change in marginal costs



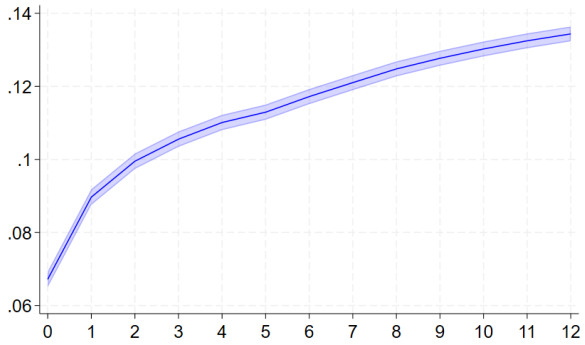
(f) Size, change in competitors' prices



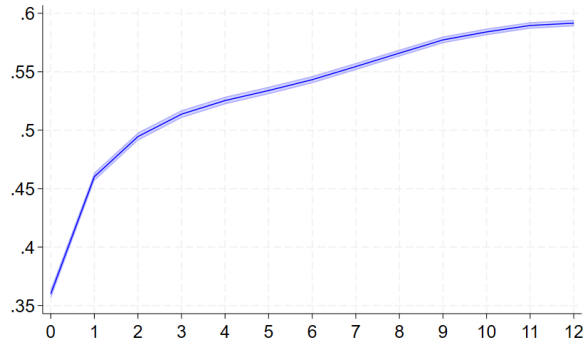
Notes: The figure shows the percent change in firms' sales prices, the percent change in the frequency of sales price adjustments, and the percent change in the size of non-zero sales price adjustments in response to a one percentage point change in their marginal costs and a one percentage point change in competitors' prices, along with the 90 percent confidence intervals. The specification includes firm and time fixed effects. Standard errors are clustered at the firm and time level.

Figure G.5: Horizon-specific elasticities
(Percentage points)

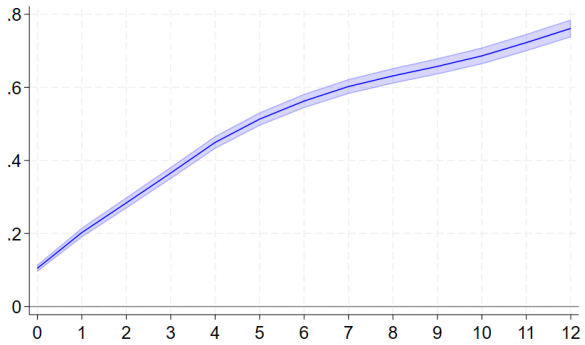
(a) Pass-through, change in marginal costs



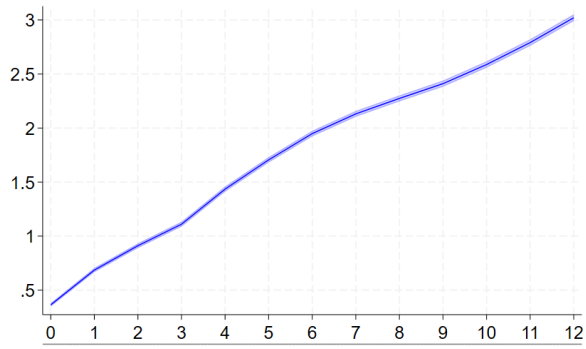
(b) Pass-through, change in competitors' prices



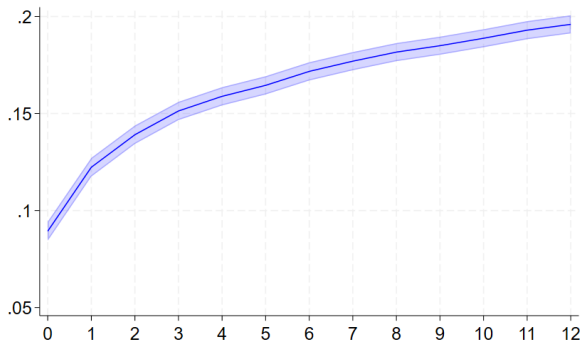
(c) Frequency, change in marginal costs



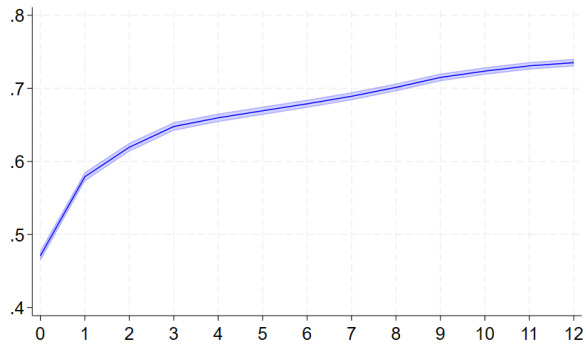
(d) Frequency, change in competitors' prices



(e) Size, change in marginal costs



(f) Size, change in competitors' prices



Notes: The figure shows the percent change in firms' sales prices, the percent change in the frequency of sales price adjustments, and the percent change in the size of non-zero sales price adjustments in response to a one percentage point change in their marginal costs and a one percentage point change in competitors' prices, along with the 90 percent confidence intervals. The specification includes firm and time fixed effects. Standard errors are clustered at the firm and time level.