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Relative cost to price passthrough with firm level data*

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Abstract

This paper presents estimates of the average elasticity of price increases to cost increases (relative passthrough) with survey-collected data from a sample of Spanish firms during the inflationary episode of 2022-2023. The descriptive information confirms that costs increases were generalized in the sample of firms (cost driven inflation), but not all firms that experience cost increases also increase prices or do so immediately. The two steps estimation (decision to increase price or not, and magnitude of the price increase) gives an estimate relative passthrough of 0.5 that rises to 0.6 when the passthrough is competed (cost absorbing passthrough). We find supportive evidence that firms that perceive a more competitive market environment have a higher relative passthrough and transmit faster the cost increase into price increase than firms otherwise. The results of the study reject the hypothesis of profit margin driven inflation and that firms in the sample pre-empted expected future cost increases by rising current prices beyond what could be expected from current cost increases.

Key words: Cost driven inflation, passthrough, market power, competition policy.

JEL codes: L11, L44, D43, E31

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1. Introduction

This paper extends previous research on the theory of absolute cost to price passthrough (Weyl and Fabinger, 2013; Ritz, 2024) to the calculation of relative passthrough, and uses survey collected firms' data to obtain estimates of static and dynamic transmission of relative cost increases to relative price increases. The research was initially motivated by the opinions issued by certain institutions (OECD, 2022; European Central Bank, 2023 issue 4) and commentators that the inflationary episode of years 2022-202, initially driven by worldwide increases in energy, raw materials and transportation costs was substantially amplified by firms with market power somehow arbitrarily increasing prices beyond cost increases. We show that the relative passthrough and market power (calculated by the ratio of price to marginal cost, (De Loecker et al., 2020)) are jointly determined as market equilibrium outcomes, and we write one as a function of the other. Then, cost increases will induce changes in both price and market power, but no causality can be inferred from market power to price inflation. The result is important for a proper assessment of what has been called profit margin driven inflation. The paper further examines the sensitivity of the magnitude and speed of passthrough to the intensity of market competition perceived by firms in the sample, with results that are relevant to inform the policy debate around market competition and cost driven inflation[1].

The paper draws from the theory on absolute passthrough of cost to price (Bulow and Peiderer, 1983; Weyl and Fabinger, 2013; Mrázová and Neary, 2017; Ritz, 2024), and extends it to the calculation of the relative passthrough (elasticity of changes in equilibrium price in response to generalized changes in marginal costs). The extension is relevant because inflation refers to relative, not absolute, price changes. Next, the paper poses and responds the following research questions: i) the determinants of relative passthrough greater, equal or lower than one that in turn determine when the passthrough will be cost *absorbing* (average price inflation will be lower than average cost inflation

[1] The OECD document acknowledges that "competition is vital for a low inflationary environment and enforcement should be prioritized, but not at the expense of fiscal or monetary policy" (page 22), which suggests lower cost passthrough under more intense competition than under less intense one. The Economic Bulletin of the ECB 2023-4 Box 3 starts with the sentence "Firms determine their desired profits by setting prices at a certain level in excess of costs in order to achieve remuneration on their capital", which ignores that price and profit margins are endogenously determined as market equilibrium outcomes in imperfectly competitive markets. Several economists from central banks have expressed their view that firms were using their market power to increase prices more than the increase in cost (Arce et al. 2023; Glover et al. 2023).

and profit margins will decrease), and when the passthrough will be cost *amplifying (*higher price inflation than cost inflation and rising profit margins). ii) The market characteristics that determine the sign of the effect of competition intensity in the magnitude and in the speed of the relative passthrough. One result of the paper new in the literature is that for constant elasticity of demand, the relative passthrough will be equal to the elasticity of supply divided by the sum of elasticity of supply and the elasticity of demand for any intensity of market competition; in the case of absolute passthrough this result holds only under perfect competition.

The empirical part of the study uses firms' level data collected through an on-line anonymous survey in November 2022 from firms located in Aragón (Spain). The survey asked firms about the current and prospect evolution of their costs, about their decision of maintaining or change prices, and the relative change in price for those that did so. In addition, firms were asked about the changes in profit margins so we could test predictions from passthrough of cost increases into changes in prices and in profit margins. Practically all firms respond that they experienced a cost increase in the period (confirming the episode of cost inflation), but not all of them increased prices and, overall, profit margins decreased. On average, conditioned to having decided to increase prices, when the transmission from cost increases to price increases was completed, the sample estimated passthrough of relative cost increase to relative price increase was around 0.6. The empirical results also show that the estimated relative passthrough as well as the speed of transmission are higher among firms that perceive higher intensity of competition. Finally, no evidence is found of profit margin driven inflation. The findings can be explained from predictions of the theory of relative passthrough.

Previous research has highlighted the need of empirical studies to sort out some of the ambiguities from the theoretical predictions on the determinants of cost absorbing or cost amplifying passthrough. However, previous research has not reached a consensus around this issue[2]. For example, Miller et al. (2017), with data from the cement industry, estimate

[2] The sources of cost changes considered in empirical research include: changes on exchange rates (Campa and Goldberg, 2005; Gopinath et al., 2011; De Loecker and Koujianou-Goldberg, 2014)); changes on taxation (sales taxes, e.g. Besley and Rosen (1998), Marion and Muehlegger (2011), Conlon and Rao (2016), and excise duties on petroleum products, e.g., Genakos and Pagliero, 2022); and costs imposed by regulations in medical (Cabral et al., 2015), energy (Fabra and Reguant, 2014) and cement (Miller et al., 2017) sectors. Another group of papers investigate the passthrough of changes in input prices (Borenstein et al., 1997; Genesove and Mullin, 1998; Kim and Cotterill, 2008; Nakamura and Zerom, 2010).

an absolute passthrough greater than one and decreasing with the number of competitors in the relevant market. On the contrary, Genakos and Pagliero (2022) estimate an absolute passthrough lower than one and increasing with the number of competitors (gas stations) in the market. Kim and Cotterill (2008), with a different research methodology obtain a higher passthrough when firms compete a la Nash-Bertrand than in monopoly markets. The evidence on static and dynamic relative passthrough and on their sensitive to competition conditions, which is the focus of this paper, is, however, scant.

The empirical part of paper has many similarities with Dogra et al. (2023) on cost to price passthrough with survey-collected firm level data from the US (although each work was done independently of the other). The two papers empirically model the relative price changes of firms, in the current year and in the incoming one (prospect data), as a function of the relative cost changes, to estimate the average passthrough from the sample data. However, there are also differences. Dogra et al. collect the data through a semi structured interview and are able to get qualitative insights on how firms make pricing decisions that are not possible with the anonymously collected data of our study. Dogra et al. link their paper with early literature interested on price rigidity to wage changes, while the theory background of our paper is the microeconomics of cost to price passthrough. Finally, we estimate a two-step regression model where the relative passthrough is estimated conditioned to the previous explained decision to increase prices or not (selection equation), and use the survey data on changes in profit margins to test hypothesis from market power explanations of the recent inflation episode[3].

Estimating the passthrough with survey firm level data has important limitations, in the form of measurement errors and its econometric implications, compared with estimating it with data on exogenously determined cost change (from changes in taxes, or in exchange rates, for example), and responses of actual price changes by firms. The limitations from measurement errors apply also to other variables such as the intensity of market competition perceived by surveyed firms, used in the paper for testing some of the theoretical predictions on passthrough. Finding unquestionable definitions of relevant

[3] Amiti et al. (2023) explains price inflation in the US as an outcome of cost inflation caused by supply chain disruptions and labor supply constraints, among other things, using a calibrated DSGE model (general equilibrium setting). Dogra et. (2023) highlight the complementarity between macro general equilibrium simulations of cost to price passthrough, and the fact that the two research methodologies find similar results on estimated average passthrough for the US economy.

the relevant market and of the intensity of competition within it is in general a difficult task (Berry et al., 2019; Conlon et al. 2022). Although we compare some of the results on the effect of market competition on the magnitude and the speed of cost to price passthrough with those of Genakos and Pagliero (2022), the measure of market competition that they use, number of gas stations located in a Greek island, would not be suitable in our analysis of the passthrough from cost to price inflation because price inflation is defined as increases in the economy-wide level of prices. In such situation, the only way to collect information about the structure and/or the rivalry of the relevant market for the respective firm will be asking each firm for this information.

The rest of the paper is organized as follows. Section one outlines the theoretical framework on the determinants of relative passthrough. Section two explains the data collection processes, describes the contents of the survey more directly related to the estimation of passthrough, and presents descriptive information on annual changes in costs, prices and margins, as well as on other relevant variables. Section three shows the results of the estimation of the empirical model, including some extension and a robustness analysis. The conclusion summarizes the main results and implications.

2. Relative passthrough

Consider a market with n symmetric firms producing a total market output Q at unit marginal cost equal for all firms $\frac{\Delta C(q)}{\Delta q} = c(q) = c$. The selling price is determined by the demand equation $p = p(Q)$. Each firm decides how much to produce maximizing profits and in the equilibrium each firm produces $q = \frac{Q}{n}$ from the symmetry hypothesis. The market equilibrium is perturbated by an external shock in the form of generalized increase in marginal production cost $\Delta c(q) = \Delta c$ and the market changes to a new symmetric equilibrium with change in price $\Delta p(q) = \Delta p$. Define,

$$Absolute\ passthrough\colon \quad \frac{\Delta p}{\Delta \mathrm{c}} = \rho \qquad [1]$$

$$Relative\ passthrough = \frac{\frac{\Delta p}{\mathrm{p}}}{\frac{\Delta c}{c}} = \beta = \frac{\Delta p}{\Delta c}\frac{c}{p} = \frac{\rho}{MP} \qquad [2]$$

The term $\frac{p}{c} = MP$, is the ratio of price to marginal cost, a conventional measure of market power directly related to the Lerner index, $LI = \frac{p-c}{p} = \frac{MP-1}{MP}$. Therefore, the relative passthrough is equal to the ratio between the absolute passthrough and the measure of market power. Since in general $p \geq c$, the relative passthrough will be less or equal to the absolute passthrough.

The theory of passthrough assumes that quantities produced, market price and marginal cost are market equilibrium outcomes from profit maximizing firms in markets with a given competition intensity. Therefore, absolute passthrough, market power and intimately relative passthrough are endogenously determined as equilibrium outcomes.

Define the demand elasticity $\varepsilon^D = -D'(p)\frac{Q}{p}$ and the weighted equilibrium Lerner index measure of intensity of competition,

$$\varepsilon^D \left(\frac{p - c(q)}{p}\right) = \theta^S \qquad [3]$$

Where $\theta^S = \frac{\theta}{n}$, with values between 0 and 1, is a measure of the competitive conduct of firms: $\theta = 0$ with perfect competition, $\theta = 1$ with Nash competitive behavior, and $\theta = n$ for the monopoly solution (perfect collusion).

Competing firms solve for their respective profit maximizing conditions. With condition [3], Ritz (2024) slightly modifies the previous result of Weyl and Fabinger (2013) in solving for the absolute passthrough of cost changes to price changes in the equilibrium with symmetric firms, as follows:

$$\frac{\Delta p}{\Delta c} = \rho(\varepsilon^D, \xi^D, \eta^S, \theta^S) = \frac{1}{1 + (\varepsilon^D - \theta^S)\eta^S + \theta^S(1 - \xi^D)} \qquad [4]$$

Where $\eta^S = c'(q)\frac{q}{c}$ is the elasticity of the marginal cost function (inverse of the elasticity of the supply function, $\eta^S = \frac{1}{\varepsilon^S}$); the elasticity of the supply function is an indicator of the flexibility of the production technology, with $\eta^S = 0$ in the case of constant marginal cost

(infinite supply elasticity). $\xi^D = -p''(Q)\frac{Q}{p'(Q)}$is a measure of the curvature of the demand function; $\xi^D \leq 0$ (> 0) for concave (convex) demand functions, and $\xi^D \leq 1$ (> 1) for log- concave (log-convex) demand functions. It is shown that $(1 - \xi^D)\varepsilon^D = -(1 - \varphi^D)$, where $\varphi^D$is the elasticity of the elasticity of the demand function (super-elasticity of demand).

Combining [3] and [4] the relative passthrough is given by:

$$\beta = \frac{\Delta p}{\Delta c}\frac{c}{p} = \frac{\varepsilon^D - \theta^S}{\varepsilon^D - \theta^S + (\varepsilon^D - \theta^S)\eta^S\varepsilon^D + \theta^S\varphi^D} = \frac{1}{1 + \eta^S\varepsilon^D + \frac{\theta^S\varphi^D}{\varepsilon^D - \theta^S}} \qquad [5]$$

The research interests are in the combinations of parameter values for which the relative passthrough is cost augmenting, $\beta > 1$or cost absorbing, $\beta \leq 1$; and on the conditions under which the passthrough increases or decreases with the intensity of market competition, sing of $\frac{\Delta\beta}{\Delta\theta^S}$.

We assume non-decreasing marginal cost functions, $\eta^S \geq 0$; from [5], the relative passthrough always decreases as production flexibility increases (higher η^S). A sufficient condition for relative passthrough less or equal to one $\beta \leq 1$ (cost absorbing), is that $\varphi^D \geq 0$, positive super-elasticity of the demand function (log concave demand function). For constant elasticity of demand, $\varphi^D = 0$, the relative passthrough is equal to $\beta(\varphi^D = 0) = \frac{1}{1+\eta^S\varepsilon^D} = \frac{\varepsilon^S}{\varepsilon^S+\varepsilon^D}$, always less or equal to 1, for any market structure and competition behavior (independent of θ^S). When the elasticity is not constant, the passthrough $\beta = \frac{\varepsilon^S}{\varepsilon^S+\varepsilon^D}$ is only true when markets are perfectly competitive ($\theta^S = 0$).

When $\varphi^D < 0$ (log convex demand function) the necessary and sufficient condition for relative cost absorbing passthrough is that $(\varepsilon^D - \theta^S)\eta^S\varepsilon^D \geq -\theta^S\varphi^D$. For this condition to be satisfied it will be required a minimum flexibility in the supply conditions, i.e., a minimum value of the elasticity of the cost function η^S.

The relationship between relative passthrough and intensity of competition can be assessed in two ways, comparing the passthrough in two markets with different intensity of competition, and from the sign of $\frac{\Delta\beta}{\Delta\theta^S}$. Reitz (2024) presents a detailed analysis of the sensitivity of absolute passthrough to differences in competition across markets and changes in competition within a given market. We extend some results to the case of relative passthrough. For example, in comparing two markets with the same elasticity of supply and demand functions but different intensity of competition, the sign of the difference in passthrough is determined as follows:

$$Sign\ of\ \beta_1(\varepsilon^D, \xi^D, \eta^S, \theta_1^S) - \beta_2(\varepsilon^D, \xi^D, \eta^S, \theta_2^S) = Sign\ of - \varphi^D \varepsilon^D (\theta_1^S - \theta_2^S) \quad [6]$$

If market 1 is more competitive than market 2 by assumption, $\theta_1^S - \theta_2^S < 0$, the relative passthrough will be higher in the more competitive market if $\varphi^D \geq 0$. Again, assuming that the rest of variables in the formula of relative passthrough stay constant, the sign of $\frac{\Delta\beta}{\Delta\theta^S}$ is determined by the sing of $-\varphi^D\varepsilon^D$. Since lower θ^Simplies more competition intensity, the condition for relative passthrough increasing with the intensity of competition is again $\varphi^D \geq 0$, i.e. the same condition that for cost absorbing passthrough. Otherwise, $\varphi^D < 0$, the relative passthrough will decrease with the intensity of competition. Therefore, if the relative passthrough is cost absorbing the passthrough will increase with market competition.

The analysis above on the determinants of absolute passthrough in a market with symmetric firms competing in quantity, has been extended to markets with profit maximizing firms selling differentiating products competing in prices (Ritz, 2024, section 6). The author concludes that "the main insights from the baseline model with homogeneous products extend to models of price competition with differentiated products" (page 154).

2.1. Competition and speed of passthrough

Other research questions posed in the literature on passthrough have to do with the speed at which cost increases are transmitted to price increases, and whether the speed can be

affected by the intensity of competition[4]. Firms have incentives to reduce the frequency of price changes to save in menu costs, and also have incentives to increase the frequency and speed up the passthrough to lower the opportunity losses from not being at the profit maximizing price. Gopinath and Itskhoki (2010) theoretically model the passthrough and the frequency of price changes for a monopolist firm and constant marginal cost (independent of output). They show that the optimal passthrough and the optimal frequency of price changes will increase with the elasticity of demand and will decrease with the super elasticity of demand. The two characteristics of the demand function imply lower markup and therefore they will result in market outcomes closer to the perfect competition ones (price equal to marginal cost). However, in the derivation of the passthrough above, market competition is related to the behavior of firms (Nash or collusion, for example) and to market structure variables (number of competitors), not to the demand elasticity.

The empirical results of Gopinath and Itskhoki (2010) in a setting of passthrough from changes in exchange rates, confirm their theoretical prediction of a positive correlation between the relative passthrough and the frequency of price changes; the result is viewed as consistent with the model prediction that the passthrough and frequency of price changes will both increase under demand conditions that favor market outcomes closer to those of perfect competition. Genakos and Pagliero (2022) find that firms gradually adjust prices in response to cost increases and that the speed at which prices converge to the desired ones increase with the number of competitors in the market[5]. Therefore, more competitive structural market conditions favor higher passthrough and faster speed of price adjustment. The authors interpret this result as evidence consistent with the theoretical prediction of Gopinath and Itskhoki (2010), although the latter was obtained in a monopoly setting.

The conclusions from the theory of passthrough in markets with symmetric firms (homogeneous and differentiated products) are summarized as follows: From [3], higher

[4] Dogra et al. (2023) motivate their paper on cost-price passthrough with firm survey data with early research on sticky prices in response to wage changes that also used information collected through semi structured interviews to business managers. Cavallo et al. (2024) present an update review of the literature of frequency of price changes and examine the speed of price changes to cost changes in the 2022 inflation episode.

[5] Bonadio et al. (2020) and Dogra et al. (2023) also report gradual adjustment of prices over time in response to cost changes but do not test for competition effects on the speed of adjustment.

intensity of competition will imply a lower level of equilibrium price for a given level of marginal production cost: lower market power and lower ex post markup. From [5], cost driven inflation can result in cost absorbing or in cost amplifying price inflation (relative passthrough lower or greater than one), depending on the characteristics of markets; cost absorbing relative passthrough is more likely with more flexible production technology (constant or slowly increasing marginal costs) and with log concave demand functions. The conditions that favor cost absorbing relative passthrough also favor that the relative passthrough and the speed in the transmission will increase with more intense competition If the passthrough is cost absorbing, more competition implies higher passthrough. But in general, the possibility of higher price inflation in less competitive markets cannot be ruled out, particularly when the elasticity of demand is rigid and when the elasticity of supply is small (the marginal cost of increasing production is high). Overall, the predictions from theoretical models are ambiguous, and they can accommodate the differences observed in estimated passthroughs in empirical research[6].

3. Description of the data sample and main variables of the survey

3.1. The sample and the survey

The data used in the empirical study were collected by the Instituto Aragonés de Fomento, IAF (a regional government agency for economic development of the Autonomous Community of Aragón, Spain) in November 2022, coinciding with the Business Barometer that regularly surveys the firms in the region. The information collected is used as input for better tunning of public programs aimed at improving regional competitiveness. Complementarily, each wave of the Barometer includes questions on the firms' perceptions about impacts, threats, opportunities, and business decisions brought up by external shocks that rise public concerns at the time of the survey: COVID19 (April 2020), economic recovery (February 2021), and inflation in November 2022.

[6] Recall the different results on estimated absolute passthrough and in the sensitivity of passthrough to structural measures of market competition (number of competitors) between Miller et al. (2017), Genakos and Pagliero (2022) and Kim and Cotterill (2008).

The target population of the Barometer includes 6622 firms of all sizes and from all economic sectors that have maintained and still maintain relationships with the IAF as suppliers and/or customers of the agency's regional and business development programs. All firms received a mail from the IAF explaining the content and motivation of the survey, inviting them to voluntarily and anonymously respond to the survey questions, accessible through a link included in the message. The online survey was open for firms to respond during three weeks, from November 8th to November 28th, 2022. The original survey was in Spanish. An English translation of parts of it relevant for this study is included in the Appendix. In the November 2022 survey 753 of the firms in the mailing list clicked the link to access the survey and 499 of them completed the survey with usable information (confidence level of 95%, the range of error for sample proportions is +/- 4.73%). Descriptive information on the distribution of firms across size classes and economic sectors, and its comparison with regional and country level data are included in the Appendix. Overall, the 499 firms could be considered representative of the population of firms in Aragón and in Spain.

The survey asks firms for general information about their size, economic sector, ownership, geographical markets…In another section firms respond to questions about their current and immediate future levels of activity (sales, employment, capital investment…). As indicated, the November 2022 survey included a special section dedicated to how firms were affected by the inflationary episode and how they were adapting to it. The special section on inflation had itself three parts. The first one includes questions about costs, prices and profit margins. The second part includes questions about possible positive and negative effects on business activity of shocks on several dimensions external to the firm. The third part asks firms about the business decisions in response to the external shocks.

3.2. Survey questions and summary of responses on cost, price and margin changes

Survey respondents were asked for the evolution of cost, price and profit margin in the year 2022 (actual) and their expectations about the evolution of these variables in 2023. For example, *in 2022 compared with 2021*, *your company Decreased*, *Maintained*, *Increased*, *respectively*, *cost (yes or no), price (yes or no) and profit margin (yes or no)*. Those who responded yes to increase (decrease) in cost, price or profit margin, were next

asked to respond *how much the cost, price, or margin had, increased (decreased) by choosing one of the intervals in the following binned scale*: *<5%, 5-10%, 10-15%, 15-30%, 30-50% or 50%.*

The question on prospects for year 2023 were formulated in similar terms: *In 2023 compared with 2022 your company expects to Decrease, Maintain, Increase (…)* and for those that answered yes to increase or decrease, the same question about expectations of percentage change choosing one interval of the binned scale.

Table 1 classifies the 466 firms according to their situation in terms of cost and price changes (increase, maintain, decrease) in the years 2022 and 2023, and proportions of transitions. 93% of the firms respond yes to the increase in their cost in 2022; 6.7% respond that their costs did not change; and only 2 firms (0.2% of the sample) respond that cost decreased. For the following year, 2023 with respect to 2022, the cost prospects are somehow better: the proportions of firms that expect higher, equal or lower costs are, respectively, 72.3%, 24.2% and 3.4%. The high proportion of firms that experience cost increases would confirm the cost inflation environment for firms in 2022 and 2023. There is some persistence in the evolution of costs over time since 74.8% of the firms whose cost increases in 2022 expect cost increases in 2023 too. Practically all firms (96.1%) that expect that their cost will increase in 2023 also experienced a cost increase in 2022.

Similar questions about increase, maintain or decrease prices in 2022 and prospects of doing so for 2023 give the following results: In 2022, 62.9% of the firms rise the price, 34.5% maintain their price and 2.6% decrease price. The prospects for 2023 are, respectively, 52.6% expect to increase price, 42.5% to maintain price and 4.9% to lower price. There are more firms that rise price in 2022 and that expect to do so in 2023 than firms otherwise (maintain or lower price), but there is no exactly overlap between cost and price increase. Price decisions in response to cost changes could be spread over time; in fact, from Table 1, there is also persistence in price increases: 62.1% of firms that increase price in 2022 expect to increase price in 2023, and 74.3% of the firms that expect to increase price in 2023 also increased price the year before.

Table 1. Number and distribution of firms among the classes that had decreased, maintained or increased costs/prices in 2022 and expected to decrease, maintain or increase them in 2023

	Costs23							
	Increase		Maintain		Decrease		Total	
Costs22	N	% R	N	% R	N	% R	N	% C
Increase	324	74.8%	94	21.7%	15	3.5%	433	92.9%
Maintain	12	38.7%	18	58.1%	1	3.2%	31	6.7%
Decrease	1	50.0%	1	50.0%	0	0.0%	2	0.4%
Total	337	72.3%	113	24.2%	16	3.4%	466	100%

	Prices23							
	Increase		Maintain		Decrease		Total	
Prices22	N	% R	N	% R	N	% R	N	% C
Increase	182	62.1%	100	34.1%	11	3.8%	293	62.9%
Maintain	60	37.3%	94	58.4%	7	4.3%	161	34.5%
Decrease	3	25.0%	4	33.3%	5	41.7%	12	2.6%
Total	245	52.6%	198	42.5%	23	4.9%	466	100%

% R: Percentage across columns
% C: Percentage across rows

For the variable profit margin, the distribution of firms in 2022 were, 64% decrease, 30% maintain and 6% increase profit margin; in 2023, 46% expect to decrease, 44% to maintain and 10 % to increase profit margin. These numbers -larger proportion of firms that decrease profit margin than firms that maintain and increase margin, particularly in 2022-, are broadly consistent with the fact that the proportion of firms that experience cost increases is higher than the proportion that increase price.

Figure 1 shows the distribution of firms (proportions) across percentage changes in cost, price and margin in 2022 and 2023 (prospects). Each value in the horizontal axe is the mean of the respective bin from the low *Decrease more than 50%* (value -60%) to the high *Increase more than 50%* (value +60%), with *zero* (0) for the response of *Maintain.*

Figure 1. Histograms of 2022 and 2023 (prospects) of changes in cost, in price and in profit margin

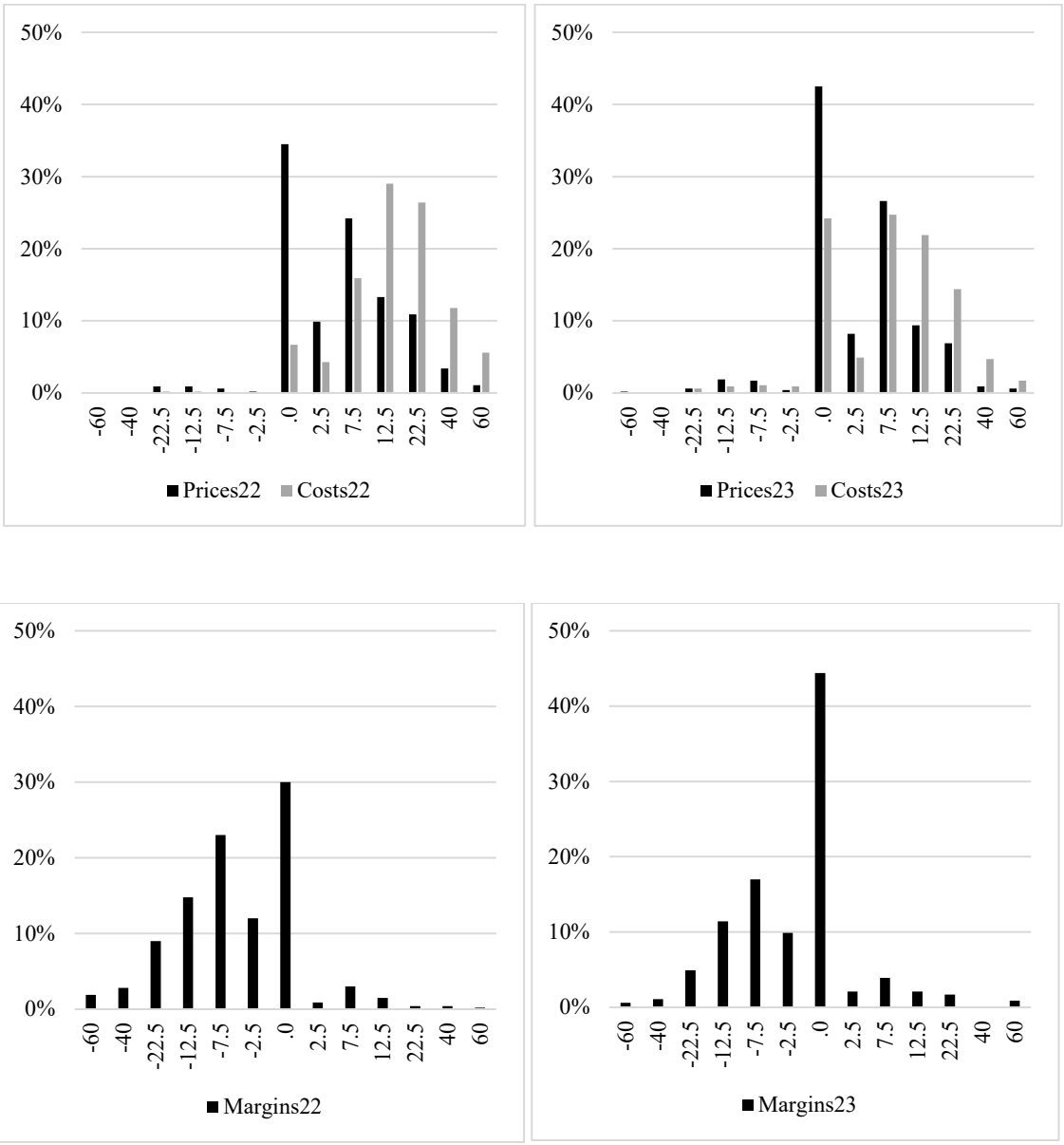


Table 2 summarizes the key statistic from the responses to the question about percentage changes in cost, price and margin in 2022 and 2023 (prospects). The mean of percentage change in cost for year 2022 is 18.9% for all the sample, and 20.4% when calculated with data from firms that increase cost. The means for percentage changes in prices for the same year are, respectively, 7.9% and 13.1%. Consistently with the evolution of the responses in Table 1, averages of cost and price increase in 2023 are 10.5% and 5%, respectively, lower than in 2022. On average, the change in profit margins is -7.3% in

3002 and -3.4% in 2003, consistent with the evolution of changes in costs and prices. Although centered at different values, the distributions of cost and price increases in the sample of firms are fairly similar in years 2022 and 2023. The distribution of profit margins is clearly skewed to the left (negative values) but more centered in 2023 than in 2022.

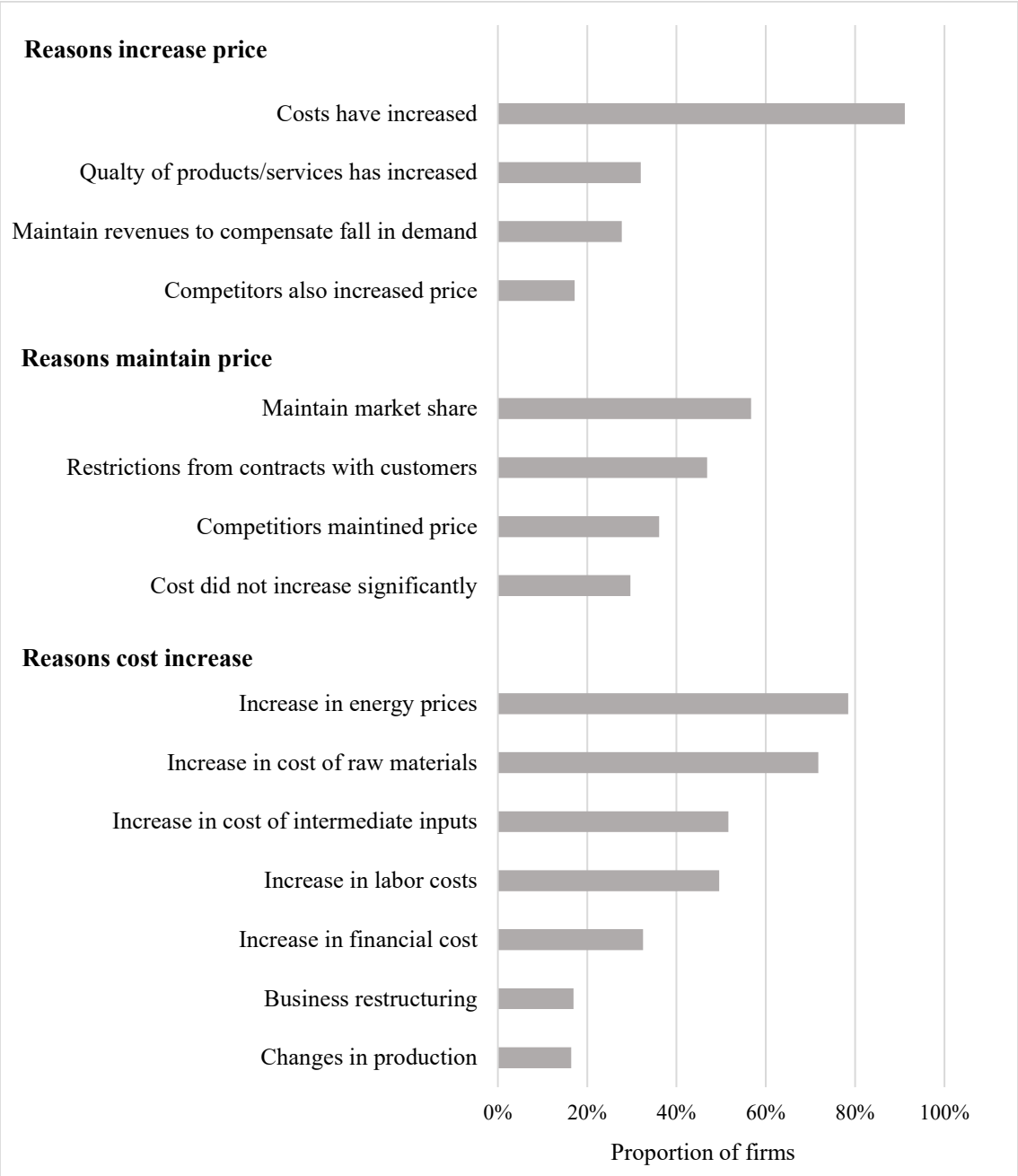
Table 2. Descriptive statistics for 2022 and 2023 (prospects) on rates of change in cost, in price and in profit margin

	Statistics for 2022			**Statistics for 2023**		
	Costs22	**Prices22**	**Margins22**	**Costs23**	**Prices23**	**Margins23**
Mean	18.9%	7.9%	-7.3%	10.5%	5.0%	-3.4%
Median	12.5%	7.5%	-7.5%	7.5%	2.5%	0.0%
Mode	12.5%	0.0%	0.0%	7.5%	0.0%	0.0%
Standard deviation	15.0%	11.3%	12.8%	12.4%	9.6%	11.3%
25th percentile	7.5%	0.0%	-12.5%	0.0%	0.0%	-7.5%
75th percentile	22.5%	12.5%	0.0%	12.5%	7.5%	0.0%
Minimum	-22.5%	-22.5%	-60.0%	-22.5%	-60.0%	-60.0%
Maximum	60.0%	60.0%	60.0%	60.0%	60.0%	60.0%
Average only those that increase (decrease margin)	20.4%	13.1%	-12.9%	15.0%	10.8%	-10.8%

For the year 2022, the survey asked firms for the factors, and their respective relative importance (in a Likert-scale from 1 to 10), of why costs increased, and why they had decided either to maintain prices (for those that did so) or to increase prices (again for those that did so). Figure 2 lists the items included among the reasons of cost increases, and those considered determinants of the decision to maintain or increase prices; for each, item the same figure shows the proportion of firms that assign a value of 8 or higher.

The most important factors behind the cost increase in 2022 were high energy and raw materials prices, followed by the increases in the cost of intermediate inputs and in the cost of labor. Less than one third of the firms considered that the increase in financial costs had high importance as determinant of the increase in cost (the increase in official interest rates started in the middle of 2022).

Figure 2. Comparative importance of the factors that caused the increase in cost, and of the reasons why firms made the decision to maintain price or to increase price



The importance attached to the factors behind the cost increases was similar across size classes, although the weight attached to financial costs decreases with firms' size, while that attached to labor costs increased with firm size (Appendix). To protect the market share was considered a high important reason to maintain price by 57% of firms; the second reason considered highly important by 47% of the firms was having binding

contract with customers. Among firms that increase price, the reason weighted high by a larger proportion of firms, 91%, was by large, cost increase; the second factor, at large distance, was that quality of product or service increased. Relatively few firms considered highly important the decision of competitors to increase price in their own pricing decision.

3.3. Survey questions and summary of responses on how the external environment affects business activity

Another block of questions in the Barometer asked firms about their perception on how external factors related to the markets and to the general economic environment, impact on the business activity. The questions were formulated as follows: *On a scale from 1 (highly negative), 4(neutral) to 7 (highly positive) indicate how each of the following characteristic of the relevant market (general economic environment) affect the activity of your business.*

From the responses to this question, we define three variables that will be included as explanatory of the decisions to increase prices or not and of the amounts of the increase, two referring to the general environment of the business *Inflation* and *Economic growth,* and one referring to the market environment of the business, *Competition:*

Inflation a 0/1 variable that takes the value of 1 if the respondent to the survey considers that the inflation will have a negative effect on the activity of the business (responds 1, 2 or 3 to the question above), and zero otherwise. It will be interpreted that negative impact of inflation in the business activity reflects the believe by the respondent of prospects of high inflation.

Economic growth is a 0/1 variable that takes the value of 1 if the respondent to the survey considers that economic growth will have a negative effect on the activity of the business, (values 1 to 3 of the Likert scale) and 0 otherwise Again, we interpret those respondents that estimate negative effects are also the respondents that have worst prospects on economic growth.

Competition is a 0/1 variable that takes the value of 1 if the respondent to the survey expects a negative impact of market competition on the activity of the business (again, responds 1, 2 or 3 to the question above) and 0 otherwise. It will be interpreted that firms with a value of 1 in this variable perceive that their relevant market is more competitive than firms otherwise.

The *Competition* variable will be used in the empirical analysis to test theoretical predictions on the effect of market competition in the magnitude and the speed of the relative cost to price passthrough. The theoretical passthrough explains the transmission of changes in cost to changes in prices across firms within a market of homogeneous or differentiated products. The data base includes firms from different economic sectors, and there is no way of identifying firms in the sample that are direct competitors (if there are any). The perceived intensity of market competition is the only kind of competition variable that can be used to the theoretical predictions, with the data available, even though the limitations from the subjectivity and potential measurement errors that it inevitably has[7].

3.4. Heterogeneity of firms

Firms in the sample are heterogenous in size, in sector of activity, products and markets, and in internal organization, production and financial conditions. The survey includes questions whose responses will inform about structural characteristics of firms, including economic sector and size class, and questions about how firms plan to react to the external shocks, beyond rising prices or not. From these questions, we characterize the firms according to their differences in sector, size and managerial responses to the external shocks.

Table 3 shows the list of variables of that will capture the differences in the environment of the business in which firms in the sample operate, as well as variables that capture the differences in how firms respond with managerial decisions and policies to the external changes. For each variable the Table shows the sample mean (for the 0/1 variables the

[7] An exploratory exercise indicates that firms that the competition variable is correlated with Industry (utilities and construction sectors) (-), Non market services (-), Export (+), Inflation (+), Economic Growth (+), although correlations are low.

proportions of firms with value 1). Since the survey is anonymous it is not possible to collect additional information about firms in the sample from sources different from the survey.

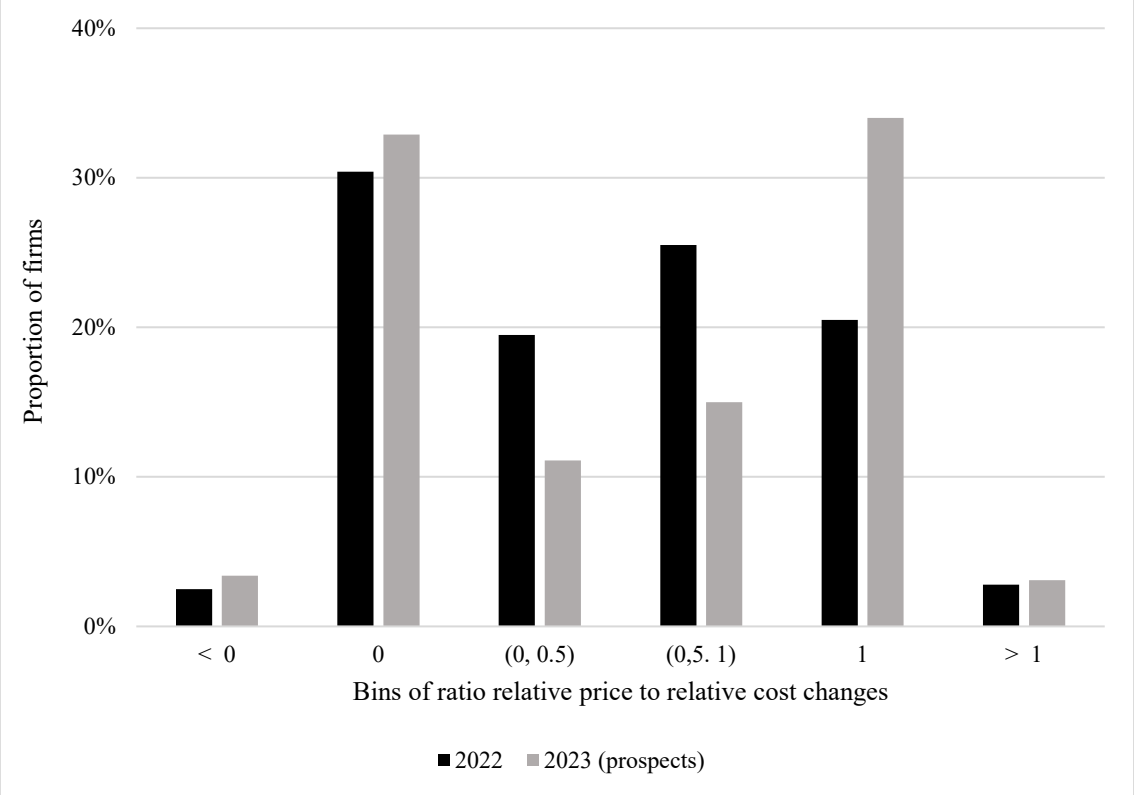
Table 3. Definition of explanatory variables used in the estimation of relative passthrough other than change in cost and that size and economic sector. Mean sample values of each of them in the column at the right

Variable	Description	Mean
Year 2023	Value of 1 if the observation belongs to year 2023 and zero otherwise	50.0%
Competition	Value 1 for firms that value 3 or less the effect of market competition on business activity (in a scale from 1 highly negative to 7 highly positive), and zero otherwise	32.3%
Inflation	Value 1 for firms that value 3 or less the effect of inflation on business activity (in a scale from 1 highly negative to 7 highly positive), and zero otherwise	88.1%
Economic growth	Value 1 for firms that value 3 or less the effect of inflation on business activity (from 1 highly negative to 7 highly positive) and zero otherwise	87.9%
Export	Value of 1 if the firm exports	26.8%
Import	Value of 1 if the firm imports	38.6%
Product/market development	Number in a scale from 1 (not relevant at all) to 10 (very relevant) on the relevance of product/service development as a firm's response to the external threats	6.8
Reduce production	Number in a scale from 1 (not relevant at all) to 10 (very relevant) on the relevance of product/service development as a firm's response to the external threats	3.1
Increase productivity	Number in a scale from 1 (not relevant at all) to 10 (very relevant) on the relevance of increase productivity as a firm's response to the external threats	7.4
Renegotiates debt	Number in a scale from 1 (not relevant at all) to 10 (very relevant) on the relevance of debt renegotiation as a firm's response to the external threats	3.0
Vulnerability	Percentage decrease in year sales that would be a serious threat for the survival of the company	-29.7%
Investment increases	Value of 1 if the firm increases investment and zero otherwise	33.7%
Rate of change in investment	Percentage rate of change in capital investment during the year	2.9%

4. The pass-through of cost changes into price changes: Empirical results

The main interest of the paper is to estimate the average passthrough of relative cost changes to relative price changes with information on cost and price changes from the sample data. The relative passthrough for a firm with non-zero cost change can be measured by the ratio $\beta = \left(\frac{\Delta p}{p}\right)_{it} / \left(\frac{\Delta c}{c}\right)_{it}$ (relative price changes divided by relative cost changes). Figure 3 shows the distribution of firms across different bins of ratios of relative change in price over relative change in cost from the sample data, year 2022 and year 2023 (prospect).

Figure 3. Distribution of values of the passthrough ratio (relative increase in price over relative increase in cost) in the sample of firm



4.1. Estimation of the average passthrough: empirical model

The average passthrough of the sample data is calculated with the estimation of the following empirical model that includes a regression and a selection equation:

Principal equation:

$$\left(\frac{\Delta p}{p}\right)_{it} = \beta\left(\frac{\Delta c}{c}\right)_{it} + X_{it}\gamma + \epsilon_{it} \qquad [7]$$

Selection equation:

$$Increase\ price_{it} = \begin{cases} 1 \ \ if \quad \alpha Cost\ increase_{it} + Z_{it}\varphi + \varepsilon_{it} > 0 \\ 0 \ \ if \quad \alpha Cost\ increase_{it} + Z_{it}\varphi + \varepsilon_{it} \leq 0 \end{cases}$$

The *principal* equation explains the rate of change in prices by firm i in period t as a function of the rate of change in costs for that firm, plus a vector of observable variables, X_{it}, that control for the heterogeneity of firms in the sample (Table 3); ϵ_{it} is the random error-term. The estimated value of the parameter β in the principal equation will give the average relative passthrough for the sample data. Given the relatively low proportion of firms with passthrough higher than one from Table 3, it is expected an estimated value of the relative passthrough lower than one.

The selection equation explains the decision to increase price or not, previous to how much to increase. The *Cost increase* variable takes the value of 1 for those firms that respond yes to the question of having experienced a cost increase in the corresponding year, and 0 for firms otherwise. It is assumed that experiencing a cost increase increases the likelihood of increasing prices, i.e. $\alpha > 0$.The vector of variables Z_{it} controls for the heterogeneity among firms that affect the decision to increase price or not (also from Table 3).

The error terms are assumed to satisfy the following conditions: $\epsilon_{it} \sim N(0,\sigma), \varepsilon_{it} \sim N(0,1),\ \ corr(\epsilon_{it}, \varepsilon_{it}) = \rho$. The empirical model also assumes that the observed explanatory variables are mean independent of the unobserved ones $E\left(\left(\frac{\Delta c}{c}\right)_{it}, X_{it}\ /\epsilon_{it}\right) = 0$.

The two-steps Heckman type estimation methodology of the relative passthrough, controls for possible biases in the results of the estimation of the principal equation from ignoring the correlation between the error terms of the two equations (the Mills' lambda calculated from the residuals of the selection equation is included as explanatory in the principal equation).

The possibility that menu costs condition the timing of the transmission of cost increases to price increases, already contemplated in the theory section, is also considered in the empirical analysis with an estimation that separates the short and the long-term values of average relative passthrough implicit in the sample data. For this purpose, [7] is modified as follows,

$$\left(\frac{\Delta p}{p}\right)_{it} = (1-\lambda)\left(\frac{\Delta p}{p}\right)_{it-1} + \lambda\beta\left(\frac{\Delta c}{c}\right)_{it} + X_{it}\gamma + \epsilon_{it} \qquad [8]$$

The parameter λ to be estimated will capture whether the transmission of cost increase to price increase will be faster (value close to 1) or slower (value close to zero). From the estimate of $\widehat{(\lambda\beta)}$and of $\widehat{(1-\lambda)}$, $\hat{\beta} = \frac{\widehat{(\lambda\beta)}}{1-\widehat{(1-\lambda)}}$ will be the estimate of the average passthrough when the transmission of cost to price increase is completed.

The theory in section 2 also predicts that the passthrough will be different across markets depending on the properties of their demand and cost functions, and depending on the intensity of competition. In the dynamic setting, the theory also predicts differences in the speed at which cost increases will be passed through depending on the intensity of market competition. In the estimation, equations [7] and [8] will be modified to allow for different passthrough (β) and for different speed of adjustment (λ) in the subsample of firms that perceive high intensity of competition in their market and in the subsample of firms otherwise.

The parameters of the principal equation will be estimated robust to heteroscedasticity; this requires estimating first the selection equation to obtain the Mills' lambda, and next estimating the principal equation with this lambda among the explanatory variables. We provide the results of two estimations of the principal equation, without and with

instrumentation of the change in cost of firm i. Following Berry et al (1995) we instrument the relative change in cost of firm i by the average of the relative change in cost for the rest of firms in the same economic sector than firm i (sector average excluding the respective firm). The instrumentation should reduce biases from measurement errors in the responses to the survey in the estimation of the relative passthrough, but does not exclude the possibility of unobserved characteristics correlated across sectors and firms that could still bias the results. When lagged price changes are included as explanatory variables, as in [8] the variable will also be instrumented again using as instruments the mean of the relative price changes of other firms in the same economic sector.

The results of the estimation of equation [7] with pooled 2022 and 2023 data are shown in Table 4. The standard errors of the estimated parameters are robust to heteroscedasticity. Column (1) corresponds to the selection equation (marginal effects). The last two columns show the results of estimating the principal equation with the Mills' lambda from the selection equation as explanatory variable; in column (2) the explanatory variable *%Change in cost* is not instrumented and in (3) the variable is instrumented (2SLS). Only some of the estimated coefficients of the explanatory variables are reported; the completed estimation results can be found in the supplementary material. The statistically significant estimated coefficient of the Mill's lambda justifies the use of the twostep estimation method.

The coefficient of the *Cost increase* variable, $\hat{\alpha} = 0.539$ [CI 95%: 0.425, 0.653], in the selection equation (column (1)) is the estimated marginal effect in the probability of increasing price, when the cost-increase variable changes from 0 to 1. In other words, the difference in the probability to increase price between firms that experience a cost increase and firms that do not is 0.539 points.

The estimated marginal effects of the external environment variables, *Competition* (-0.105)*, Inflation* (0.155) *and Econ growth* (-0.145) are all statistically significant. From the definition of these variables above, firms that perceive more intense market competition and firms that anticipate lower economic growth are less likely to increase prices when they experience a cost increase. On the other hand, firms that anticipate high inflation are more likely to increase price controlling for the rest of explanatory variables,

From the principal equation estimation, column (2), the estimated sample average passthrough is $\hat{\beta} = 0.499$ [CI 95%: 0.408, 0.590] statistically different from zero and lower than one: on average, firms in the sample passthrough to relative price increases 50% of their relative cost increases (cost absorbing passthrough). The estimated value is lower than the 0.66 relative passthrough estimated by Dogra et al. (2023) for US firms (their Table 3).

Table 4. Estimation of the relative cost to price passthrough: Equation [7]

	%Change price					
	Selection (1)		Principal OLS (2)		Principal IV-2SLS (3)	
	dy/dx	S.E.	Beta	S.E.	Beta	S.E.
Cost increase	0.539***	(0.058)				
%Change cost			0.499***	(0.046)	0.484***	(0.054)
Competition	-0.105***	(0.039)	0.721	(0.931)	0.739	(0.901)
Inflation	0.155**	(0.062)	-0.657	(1.466)	-0.718	(1.412)
Economic growth	-0.145**	(0.060)	-3.005***	(1.141)	-2.960***	(1.109)
Sector	*Yes*		*Yes*		*Yes*	
Size	*Yes*		*Yes*		*Yes*	
Other controls	*Yes*		*Yes*		*Yes*	
Year	*Yes*		*Yes*		*Yes*	
Mills/Lambda			8.115***	(2.285)	7.853***	(1.978)
R^2			0.449		0.449	
Wald chi^2 (22)	151.17***					
Wald chi^2 (23)			72.42***		169.73 ***	
Test of endogeneity						
Robust score chi^2 (1)					0.205	
Robust reg. (F1,486)					0.206	

Firms (observations) 878/selected 511
dy/dx refers to marginal effect (selection model)
S.E. refers to robust standard error
Levels of statistical significance: * p<0.10, ** p<0.05 and *** p<0.01

The estimated coefficients of *Competition* and *Inflation* in the principal equation are not statistically significant now. The coefficient of *Economic growth* continues negative and statistically significant, meaning that firms that expect low economic growth, on average,

increase price 3 percentage points less than firms that anticipate higher economic growth prospects, controlling for the rest of explanatory variables.

The results in column (3) with the variable %Change in cost instrumented are similar to those in column (2) without instrumentation. In fact, the results of the statistical test, robust score chi2 (1) and robust regression F (1, 486) do not reject the null hypothesis of exogenous variables.

4.2. Dynamics of passthrough

Table 5 shows the results of the estimation equation [8] that allows for dynamics in the relative passthrough. Column (1) shows the estimated parameters of the selection equation, the same for all regression models in the Table. The selection equation includes *Cost increase 22* and *Cost increase 23* as explanatory variables since lags in the increase in the transmission of cost to price increases can generate dynamics also in the decision to increase price, not only in how much cost increase to passthrough over time.

The estimated coefficients of the dummy variables *Cost increase 22* and *Cost increase 23* in the selection equation (1) are both positive and significant, respectively 0.469 [CI 95%: 0.342, 0.594], and 0.280 [CI 95%: 0.044, 0.517]. The two imply a cumulative probability of price increasing for firms experiencing a cost increase (Cost increase =1) of $\hat{\alpha}\ long\ run = 0.469 + 0.28 = 0.75$, higher than the 0.539 estimated in the static analysis (column (1) in Table 4). As for the rest of explanatory variables shown in Table 5, the estimated coefficient of *Competition* is now not statistically significant.

The estimated coefficients of % Cost increase 2023 and of %Price increase 2022 are both statistically significant, confirming dynamics in the cost passthrough, column (2) of Table 5. From equation [9], $\widehat{1-\lambda} = 0.297$ and a transmission parameter $\hat{\lambda} = 1 - 0.297 = 0.703$. From the estimated coefficient of %Change in cost variable $\widehat{\lambda\beta} = 0.42$ [CI 95%: 0.295, 0.544], the long run relative passthrough is equal to $\hat{\beta} = \frac{(\widehat{\lambda\beta})}{1-(\widehat{1-\lambda})} = \frac{0{,}420}{0.703} = 0.61$. When the dynamics of passthrough is considered, the proportion of relative cost increase that is passed through to relative price increase rises to 61%, compared with 50% estimated in the static model. Dogra et al. (2023) with US data estimate a value of $\hat{\lambda} =$

0.9, higher than the one estimated here, which means faster speed of transmission of cost increases to price increases in US firms (their estimated relative passthrough of 0.66 implies a higher long run passthrough, 0.7, than the 0.61 estimated here).

Table 5. Estimation of the relative cost to price passthrough with dynamics: Equation [8]. Test of the hypothesis that firms increase price in 2022 in anticipation of cost increases in 2023 (column (4))

	%Change price 23 [(a)]						**%Change price 22[(b)]**	
	Selection (1)		Principal OLS (2)		Principal IV-2SLS (3)		Principal OLS (4)	
	dy/dx	S.E.	Beta	S.E.	Beta	S.E.	Beta	S.E.
Cost increase 22	0.280***	(0.121)						
Cost increase 23	0.469***	(0.065)						
%Change cost 23			0.420***	(0.063)	0.391***	(0.078)	0.031	(0.084)
%Change price 22			0.297***	(0.081)	0.372***	(0.127)		
%Change cost 22							0.479***	(0.060)
Competition	-0.043	(0.056)	-1.088	(1.087)	-1.130	(1.053)	4.493**	(1.830)
Inflation	0.167**	(0.092)	2.570	(2.201)	2.463	(2.123)	-4.897**	(2.023)
Economic growth	-0.246***	(0.090)	-3.195**	(1.399)	-2.967***	(1.327)	-2.296	(1.580)
Sector	*Yes*		*Yes*		*Yes*		*Yes*	
Size	*Yes*		*Yes*		*Yes*		*Yes*	
Other controls	*Yes*		*Yes*		*Yes*		*Yes*	
Mills/Lambda			8.415***	(1.947)	7.838***	(1.637)	-6.126	(6.551)
R^2			0.582		0.576		0.472	
Wald chi^2 (22)	96.58***						47.33***	
Wald chi^2 (23)			39.19***		208.45***			
Test of endogeneity								
Robust score chi^2 (1)					1.746			
Robust reg. (F1,208)					1.125			

[(a)]Firms (observations) 439/selected 234 / [(b)]Firms (observations) 439/selected 277
dy/dx refers to marginal effect (selection model)
S.E. refers to robust standard error
Levels of statistical significance: * p<0.10, ** p<0.05 and *** p<0.01

Column (3) show the results of the estimation with the variables %Change in cost and %Change in price instrumented as explained above. The short term passthrough is slightly lower, $\widehat{\lambda\beta} = 0.391$ [CI 95%: 0.238, 0.544], and the coefficient of the lagged price change

slightly higher, $\widehat{1-\lambda}$ =0.372, but the statistical tests do not reject the null hypothesis of exogeneity. With the new estimates, the long run relative passthrough is 0.62, very close to the OLS estimator of 0.61.

The last analysis of the dynamics of passthrough investigates the possibility that in the middle of the inflationary episode of 2022, firms decided to increase prices anticipating future cost increases expected for year 2023. In column (4) of Table 5 the dependent variable is the increase in price in 2022 and the explanatory variables are cost increases in 2022 and in 2023. The anticipation hypothesis would not be rejected if current price increases in 2022 are correlated with future cost increases. The estimated coefficient of % Cost increase 2023 is not statistically significant. Therefore, there is no evidence that the inflationary episode of year 2022 was fueled up by firms anticipating future cost increases in current price increases for "just in case" reasons[8].

4.3. Passthrough and perceived competition

From the theory in section 1, equations [7] and [8] are modified to allow for differences in average passthrough and in the speed of transmission between firms that perceive high competition (*Competition*=1), and the rest of firms (*Competition*=0):

$$\left(\frac{\Delta p}{p}\right)_t = \vartheta_1\left(\frac{\Delta p}{p}\right)_{t-1} + \vartheta_2 Competiton * \left(\frac{\Delta p}{p}\right)_{t-1} + \beta_1\left(\frac{\Delta c}{c}\right)_t + \beta_2 Competition * \left(\frac{\Delta c}{c}\right)_t + X_{it}\gamma + \epsilon_{it} \qquad [9]$$

In the static estimation ($\vartheta_1 = \vartheta_2 = 0$) the estimated value of β_1 will give the average relative passthrough estimated for the subsample of firms that perceive low competition (*Competition*=0) and $\beta_1 + \beta_2$ the estimated passthrough of firms that perceive high competition (*Competition*=1). In the dynamic set up, the estimated parameter $\vartheta_1$will give the estimates of the speed of passthrough in the subsample of firms that perceive low competition, and $\vartheta_1 + \vartheta_2$that for firms that perceive high competition. Then, for the high

[8] For a comprehensive review of the different pronouncements about how firms may have taken advantage of the recent inflationary episode to increase prices and profit margins above what would had had been expected from their current increase in cost, see Storm (2023) and OECD (2022, especially section 3.2).

(low) competition sample, the long run passthrough will be equal to $(\beta_1 + \beta_2)/(1 - \vartheta_1 - \vartheta_2)$ $((\beta_1/(1 - \vartheta_1))$.

From the theory and the evidence of a relative passthrough lower than 1, the hypotheses are: higher passthrough in the subsample of firms that perceive more intense competition $\beta_2 > 0$, and higher speed of transmission in the subsample of firms with more intense competition implies $\vartheta_2 < 0$.

Columns (1) and (2) of Table 6 show the result of the estimation of [9] with the pool of data for years 2022 and 2023 and ignoring possible time dynamics. The results of the selection equation are not reported because the equation estimates are the same than that in Table 4. In the OLS and in the IV estimations, the estimated value of δ_2 =0.175 [CI 95%: -0.0281, 0.379], is positive and significant, p<10%), consistent with the hypothesis that more intense competition increases average passthrough. Consequently, the estimated average passthroughs from the pooled data are $\hat{\beta}_1$ =0.44 [CI 95%: 0.310, 0.571], for firms that perceive low intensity of competition in their markets (*Competition*=0) and $\hat{\beta}_1 + \hat{\beta}_2$ =0.44+0.175=0.615 for firms that perceive high intensity of competition (*Competition*=1). Compare with 0.5 sample average from Table 4.

The estimated parameters of [9] in its dynamic formulation are presented in columns (3) and (4). Again, the selection equations are not reported because they are the same as in Table 5. The null hypotheses on competition and passthrough are not rejected: $\hat{\beta}_2$ =0.276 [CI 95%: 0.003, 0.549], significantly different from zero, and $\hat{\vartheta}_2 = -0.429$ [CI 95%: -0.659, -0.200], significantly different from zero. Then, the estimated average relative passthrough are $\hat{\beta}_1$ =0.333 [CI 95%: 0.216, 0.450] for firms that perceive low intensity of competition, and $\hat{\beta}_1 + \hat{\beta}_2$ =0.333+0.276=0.61 for firms otherwise. As for the estimated parameters on the speed of transmission, the results of the estimation are $\hat{\lambda} = 1 - \hat{\vartheta}_1 = 1 - 0.545 = 0.455$ for firms that perceive low competition intensity (*Competition*=0), and $\hat{\lambda} = 1 - \hat{\vartheta}_1 - \hat{\vartheta}_2 = 1 - (0.541 - 0.43) = 0.93$ for firms that perceive high competition intensity (*Competition*=1). Then, the long run passthrough for firms that perceive high intensity of competition (Competition=1) is $\beta\ long\ run, competition = 1 = \frac{0.61}{0.93} = 0.66$, and for low competition intensity firms, $\beta\ long\ run, competition = 0 = \frac{0.333}{0.455} = 0.73$.

Table 6. Estimation of the relative passthrough of cost to price, allowing for different average passthrough and for different speed of adjustment in firms that perceive high intensity of market competition and in firms otherwise. Equation [9]

	%Change price [(a)]				**%Change price 23 [(b)]**			
	Principal OLS (1)		Principal IV-2SLS (2)		Principal OLS (3)		Principal IV-2SLS (4)	
	Beta	S.E.	Beta	S.E.	Beta	S.E.	Beta	S.E.
%Change cost	0.454***	(0.053)	0.440***	(0.067)				
Competition × %Change cost	0.163*	(0.096)	0.175*	(0.104)				
%Change price 22					0.545***	(0.093)	0.636***	(0.152)
Competition × %Change price 22					-0.430***	(0.116)	-0.517***	(0.160)
%Change cost 23					0.333***	(0.059)	0.335***	(0.073)
Competition × %Change cost 23					0.276**	(0.139)	0.273**	(0.142)
Competition	-1.968	(1.586)	-2.176	(1.802)	-1.077	(1.747)	-0.312	(1.702)
Inflation	-0.819	(1.467)	-0.871	(1.414)	2.563	(2.240)	2.830	(2.216)
Economic growth	-3.017***	(1.106)	-2.987***	(1.074)	-2.576*	(1.348)	-2.651**	(1.285)
Sector	*Yes*		*Yes*		*Yes*		*Yes*	
Size	*Yes*		*Yes*		*Yes*		*Yes*	
Other controls	*Yes*		*Yes*		*Yes*		*Yes*	
Year	*Yes*		*Yes*					
Mills/Lambda	7.462***	(2.145)	7.259***	(1.859)	7.212***	(1.484)	7.797***	(1.540)
R^2	0.455		0.455		0.644		0.639	
Wald chi^2 (24)	67.90***		180.1***					
Wald chi^2 (25)					181.44***		392.1***	
Test of endogeneity								
Robust score chi^2 (1)			0.118					
Robust reg. (F1,485)			0.116					
Robust score chi^2 (2)							2.417	
Robust reg. (F2,206)							1.304	

[(a)]Firms (observations)878/selected 511 / [(b)]Firms (observations) 439/selected 234

S.E. refers to robust standard error

Levels of statistical significance: * p<0.10, ** p<0.05 and *** p<0.01

The results of the estimation with instrumented variables do not alter the results and the null hypothesis of exogenous variables is not rejected. Therefore, according to these estimations, firms that perceive high intensity of competition in their relevant market have a higher relative short term passthrough than firms that perceive low competition intensity, 0.61 versus 0.333. But the speed of transmission of firms in high competition markets is higher than if firms otherwise so that the former passthrough 93% of the long run passthrough in the current year, while the latter, in the same time period, passthrough only 45.5%. The results confirm the theoretical prediction from Gopinath and Itskhoki (2010) that firms with high passthrough will translate cost increases into price increases faster than firms with low passthrough.

4.4. Passthrough and profit margin

Data on relative changes in profit margins, Table 2 and Figure 1, allows us to evaluate the robustness of the results on the estimation of the relative passthrough, and to investigate an alternative hypothesis on price formation where firms set markups independently of the changes in cost.

With the notation above, profit margin is given by $pm = \frac{p-c}{p}$. Profit margin formulated in terms of the Lerner index, can be related to the ratio of price to cost measure of market power (De Loecker et al. 2020) as follows, $MP = \frac{p}{c} = \frac{1}{1-pm}$. The two measures of market power are then monotonically related. From these definitions it can be shown that

$$\frac{\Delta pm}{\Delta c}\frac{c}{pm} = (\beta - 1)\frac{\varepsilon^D - \theta^S}{\theta^S} \qquad [10]$$

$$\frac{\Delta MP}{\Delta c}\frac{c}{MP} = \beta - 1 \qquad [11]$$

The relative passthrough β directly determines the elasticity to profit margin and of market power to relative cost changes and in the same direction (since $\varepsilon^D > \theta^S \geq 0$ the sign of the two elasticity depend on β greater or equal than one).

Alternatively, the market power of firms is formulated in terms of a markup that they individually choose to apply to marginal cost to set the selling price. Ex post, from estimated price and marginal cost, the markup is calculated as $\mu = \frac{p}{c} = MP$. From this identity,

$$\frac{\Delta\mu}{\mu} = \frac{\Delta MP}{\mathrm{MP}} = \frac{\Delta p}{\mathrm{p}} - \frac{\Delta c}{\mathrm{c}} \qquad [12]$$

Equation [12] implicitly assumes that the markup is exogenous and independent of the change in cost. Or alternatively, that firms can change prices to arbitrarily increase their mark ups and profit margins. In [10] and [11] the change in marginal cost induces a change in the equilibrium price and consequently a change in profit margin, measured in one way or the other.

We empirically estimate the elasticity of profit margin to changes in costs in [10] estimating the empirical model [7] with $\left(\frac{\Delta pm}{pm}\right)_t$ as dependent variable. The results are shown in Table 7 (pooled data for years 2022 and 2023). The selection equation is the same than that in the estimation of [7], Table 4 (firms that decide to increase price in the year) so only the results of the principal equations are reported. Column (1) shows the results of the OLS estimation and (2) the results of IV-2SLS estimation. The null hypothesis of exogeneity is now rejected at p<10%. Then we focus on the coefficients estimated in column (2).

Consistent with previous estimate of $\hat{\beta} = 0.5 < 1$, the estimated elasticity of profit margin to cost changes in Table 7 is -0.284 [CI 95%: -0.430, -0.138]. The results of the estimation also show that, controlling for the rest of variables, changes in profit margins are lower in firms with worst expectations on inflation and economic growth, but the coefficient of the variable Competition is not significantly different from zero. Notice also that the coefficient of Mills lambda now is not statistically significant, which would be consistent with the fact that profit margin changes with cost changes even if firms do not change prices.

Table 7. Estimation of the rate of change in profit margin as a function of the relative change in cost (from equation [10]). Test of the hypothesis of profit margin inflation (from equation [12]), column (3). Pooled data 2022-2023.

	%Profit margin change					
	Principal OLS (1)		Principal IV-2SLS (2)		Principal IV-2SLS (3)	
	Beta	S.E.	Beta	S.E.	Beta	S.E.
%Change cost	-0.220 ***	(0.067)	-0.284	(0.075) ***	-0.299 ***	(0.080)
%Change price					0.030	(0.080)
Competition	-1.389	(1.059)	-1.309	(1.037)	-1.331	(1.051)
Inflation	-4.982 **	(2.638)	-5.248	(2.686) *	-5.226 *	(2.702)
Economic growth	-4.084 **	(1.693)	-3.888	(1.663) **	-3.798 **	(1.692)
Sector	*Yes*		*Yes*		*Yes*	
Size	*Yes*		*Yes*		*Yes*	
Other controls	*Yes*		*Yes*		*Yes*	
Year	*Yes*		*Yes*		*Yes*	
Mills/Lambda	3.836 *	(2.163)	2.689	(2.215)	2.450	(2.230)
R^2	0.234		0.230		0.230	
Wald chi^2 (23)	17.14 ***		90.64 ***			
Wald chi^2 (24)					97.99 ***	
Test of endogeneity						
Robust score chi^2 (1)			3.036 *			
Robust reg. (F1,484)			2.966 *			
Robust score chi^2 (2)					3.027	
Robust reg. (F2,484)					1.549	

Firms (observations) 878/selected 511

dy/dx refers to marginal effect (selection model)

S.E. refers to robust standard error

Levels of statistical significance: * p<0.10, ** p<0.05 and *** p<0.01

Column (3) shows the results of the estimation of the principal equation including %Change in price as an additional explanatory variable. This is a way of testing equation [12] that predicts a positive association between price changes and changes in margins, independent of the effects from changes in relative costs. The estimated coefficient of the change in price variable is not statistically significant, which is what we would expect

from [10][9]. Therefore, no evidence is found supporting the hypothesis of profit margin driven price inflation in our data.

The model has been estimated adding Competition×%Change in cost as explanatory variable, which implies allowing for differences in elasticity of profit margin to relative cost changes in the group of firms that perceive high intensity of competition and in the group of firms otherwise. The results (not reported) showed that the estimated coefficient of the new variable is not statistically significant. The evidence would be consistent with the theory since the sign of the derivative of $(\beta-1)\frac{\varepsilon^D-\theta^S}{\theta^S}$ with respect to θ^S, $(\beta-1)\frac{-\varepsilon^D}{\theta^{S2}}+\frac{\varepsilon^D-\theta^S}{\theta^S}\frac{\Delta\beta}{\Delta\theta^S}$, is undetermined (the sign of the first term is positive for $\beta<1$, and the second one is negative since higher θ^S implies less competition and the relative passthrough decreases as the market becomes less competitive).

5. Conclusion

The paper presents estimates of relative cost to price passthrough from survey data collected directly from firms that almost unanimously declare experiencing cost increases in years 2022 and 2023. With a two steps estimation (selection and principal equations) we provide estimates of propensity to increase prices conditioned on experiencing cost increases, and of average proportion of relative increase in cost passed through to price increase (relative passthrough). The empirical results also show that in the subsample of firms that perceive more intense competition the relative passthrough is higher and the speed of transmission of cost increases to price increases faster than in the subsample of firms that perceive less intense market competition. We take advantage on information collected on changes in profit margins to check for the robustness of the estimated relative passthrough with data on price and cost changes, and to test the hypothesis of profit margin driven inflation (controlling for cost increases, changes in profit margins will be positively correlated with changes in prices). The results confirm the robustness of the result but do not support the hypothesis of profit margin driven inflation. The empirical results are matched with predictions from the theory of relative passthrough, and are

[9] Conlon et al. (2023) explain relative changes in markups calculated at the firm level as a function of changes in relative prices calculated at the industry level, with US data. They find a weak correlation between the two variables. Our empirical model is different because we control for relative changes in costs and they don't.

broadly comparable with other results on estimated relative passthrough estimated with US data similar to that used in this study.

The paper expands the existing knowledge on the theory and the evidences on relative passthrough and its determinants. Its theoretical and empirical results should be relevant for the clarification of the relationship between competition and price inflation driven by exogenously generated cost inflation. The use of survey collected data on cost and price changes directly from firms is growing, particularly among central banks (see the references in the paper by Dogra et al. (2023)). However, to the best of our knowledge this is the first paper that examines these data with the lens of the theory of relative passthrough. Challenges still remain on how to overcome the limitations of survey date for consistent and unbiased estimates of relative passthrough and their relationship with market competition.

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Appendix 1. MEASUREMENT OF THE VARIABLES

A. PRICES, COSTS AND MARGINS

A.1. Prices 2022, costs 2022 and margins 2022

In 2022 with respect to 2021 the level of **prices**, **costs**, **profit margins** of your company:

	Decreased	*Stayed the same*	*Increased*
Prices	○	○	○
Costs	○	○	○
Margins	○	○	○

FOR THOSE FIRMS THAT RESPOND: ***INCREASED***

In 2022 with respect to 2021 the selling **price** of your products/services has increased in:

< 5% 5–10% 10–15% 15–30% 30–50% > 50%

In 2022 with respect to 2021 the **cost** of your products/services has increased in:

< 5% 5–10% 10–15% 15–30% 30–50% > 50%

In 2022 with respect to 2021 the profit **margin** of your company has increased in:

< 5% 5–10% 10–15% 15–30% 30–50% > 50%

FOR THOSE FIRMS THAT RESPOND: ***DECREASED***

In 2022 with respect to 2021 the selling **price** of your products/services has decreased in:

< 5% 5–10% 10–15% 15–30% 30–50% > 50%

In 2022 with respect to 2021 the **cost** of your products/services has decreased in:

< 5% 5–10% 10–15% 15–30% 30–50% > 50%

In 2022 with respect to 2021 the profit **margin** of your company has decreased in:

< 5% 5–10% 10–15% 15–30% 30–50% > 50%

A.2. Factors that cause the cost increase and reasons for the price decisions

*FOR THOSE FIRMS THAT **INCREASE COSTS** IN 2022*

How **important** have been the following factors in your **cost increase** in 2022:

	Not Important										*Very Important*
Rising energy costs	0	1	2	3	4	5	6	7	8	9	10
Increased costs of raw materials	0	1	2	3	4	5	6	7	8	9	10
Increased costs of intermediate inputs	0	1	2	3	4	5	6	7	8	9	10
Increase in labor costs	0	1	2	3	4	5	6	7	8	9	10
Increase in financial costs	0	1	2	3	4	5	6	7	8	9	10
Production increase	0	1	2	3	4	5	6	7	8	9	10
Company restructuring	0	1	2	3	4	5	6	7	8	9	10

*FOR THOSE FIRMS THAT **DO NOT CHANGE PRICE** IN 2022*

How important have been the following factors in your decision to **maintain prices** in year 2022:

	Not Important										*Very Important*
Maintain market share	0	1	2	3	4	5	6	7	8	9	10
Required by contracts with clients	0	1	2	3	4	5	6	7	8	9	10
Competitors have maintained prices	0	1	2	3	4	5	6	7	8	9	10
Costs did not change	0	1	2	3	4	5	6	7	8	9	10

*FOR THOSE FIRMS THAT **INCREASE PRICES** IN 2022*

How important have been the following factors in your decision to **increase prices** in 2022:

	Not Important										*Very Important*
Costs have increased	0	1	2	3	4	5	6	7	8	9	10
Product/service quality has improved	0	1	2	3	4	5	6	7	8	9	10
Maintain revenues	0	1	2	3	4	5	6	7	8	9	10
Competitors have increased prices	0	1	2	3	4	5	6	7	8	9	10

A.3. Prices 2023, costs 2023 and profit margins 2023

At this time, your **expectation** for 2023 compared with 2022 in those **prices, costs, profit margins** will:

	Decrease	*Stay the same*	*Increase*
Prices	○	○	○
Costs	○	○	○
Margins	○	○	○

FOR THOSE FIRMS THAT RESPOND: ***INCREASE***

Your expectation for 2023 compared with 2022 is that the **selling price** will increase in:

< 5% 5–10% 10–15% 15–30% 30–50% > 50%

Your expectation for 2023 compared with 2022 is that the **cost** will increase in:

< 5% 5–10% 10–15% 15–30% 30–50% > 50%

Your expectation for 2023 compared with 2022 is that **profit margin** will increase in:

< 5% 5–10% 10–15% 15–30% 30–50% > 50%

FOR THOSE FIRMS THAT RESPOND: ***DECREASE***

Your expectation for 2023 compared with 2022 is that the **selling price** will decrease in:

< 5% 5–10% 10–15% 15–30% 30–50% > 50%

Your expectation for 2023 compared with 2022 is that the **cost** will decrease in:

< 5% 5–10% 10–15% 15–30% 30–50% > 50%

Your expectation for 2023 compared with 2022 is that **profit margin** will decrease in:

< 5% 5–10% 10–15% 15–30% 30–50% > 50%

B. FACTORS ARE AFFECTING THE ACTIVITY

How the following **factors** are affecting the activity of your business:

	Highly Negative	*Quite Negative*	*Somehow Negative*	*Neutral*	*Somehow Positive*	*Quite Positive*	*Highly Positive*
Market competition	1	2	3	4	5	6	7
Inflation	1	2	3	4	5	6	7
Economic growth	1	2	3	4	5	6	7

C. CHARACTERISTICS OF THE COMPANY

C1. Sector: What is the **main activity** of your company?

A-Agriculture, forestry and fishing
B-Mining and quarrying
C-Manufacturing
D-Electricity, gas, steam and air conditioning supply
E-Water supply; sewerage; waste management and remediation activities
F-Construction
G-Wholesale and retail trade; repair of motor vehicles and motorcycles
H-Transportation and storage
I-Accommodation and food service activities
J-Information and communication
K-Financial and insurance activities
L-Real estate activities
M-Professional, scientific and technical activities
N-Administrative and support service activities
O-Public administration and defense; compulsory social security
P-Education
Q-Human health and social work activities
R-Arts, entertainment and recreation
S-Other services activities
T-Activities of households as employers; undifferentiated goods- and services-producing activities of households for own use
U-Activities of extraterritorial organizations and bodies

C2. Size: What is the size of your company in terms of **number of employees** in year 2021?

1-9 employees
10-49 employees
50-249 employees
250 or more employees

C3. Exports: Your **customers** are mainly **localized** in (*Multiple response*):

Aragón
Other parts of Spain
Other countries in the European Union
Other countries outside the European Union

C4. Imports: Your **suppliers** are mainly **localized** in (*Multiple response*):

Aragón
Other parts of Spain
Other countries in the European Union
Other countries outside the European Union

C5. Firms react to external shocks

Policy actions and initiatives that your company is undertaking in response to the current economic situation:

	None relevant										*Highly relevant*
Develop new products/services	0	1	2	3	4	5	6	7	8	9	10
Reduce production	0	1	2	3	4	5	6	7	8	9	10
Improve productivity	0	1	2	3	4	5	6	7	8	9	10
Renegotiate bank debt	0	1	2	3	4	5	6	7	8	9	10

C6. Vulnerability

Your business would be in **serious trouble** if **sales** would **decrease** by:

< 5% 5–10% 10–15% 15–30% 30–50% > 50%

C7. Investment

In 2022 compared with 2021, the level of **investment** has:

	Decreased	***Stayed the same***	***Increased***
Investment	○	○	○

FOR THOSE FIRMS THAT RESPOND: ***INCREASED:***

In 2022 compared with 2021 your capital **investment** has increased in:

< 5% 5–10% 10–15% 15–30% 30–50% > 50%

FOR THOSE FIRMS THAT RESPOND: ***DECREASED:***

In 2022 compared with 2021 your capital **investment** has decreased in:

< 5% 5–10% 10–15% 15–30% 30–50% > 50%

At this time, your **expectation** for 2023 compared with 2022, the level of **investment** will:

	Decrease	***Stay the same***	***Increase***
Investment	○	○	○

FOR THOSE FIRMS THAT RESPOND: ***INCREASE:***

Your expectation for 2023 compared with 2022, your capital **investment** will increase in:

< 5% 5–10% 10–15% 15–30% 30–50% > 50%

FOR THOSE FIRMS THAT RESPOND: ***DECREASE:***

Your expectation for 2023 compared with 2022, your capital **investment** will decrease in:

< 5% 5–10% 10–15% 15–30% 30–50% > 50%

Appendix 2. COMPLEMENTARY INFORMATION ABOUT THE SURVEY AND THE COLLECTED DATA

The data used in the empirical study were collected by the Instituto Aragonés de Fomento, IAF, as part of the Business Barometer that regularly surveys firms located at the Autonomous Community of Aragón (Spain). The purpose of the Barometer is to follow up business activity and provide timely input information for better tuning of the regional government programs aimed at supporting firms in the region. Complementarily, each wave of the Barometer includes questions on the firms' perceptions about impacts, threats, opportunities, and responses brought up by external shocks at the time of the survey: COVID19 (April 2020), economic recovery (February 2021), and cost inflation in November 2022, the latter being the period covered by our sample.

The target population of the Barometer includes 6622 firms of all sizes and from all economic sectors that have maintained and still maintain relationships with the IAF as suppliers and customers of the agency's regional and business development programs. All firms received a mail from the IAF explaining the content and motivation of the survey, inviting them to voluntarily and anonymously (if they wish so) respond to the survey questions, accessible through a link included in the message. The online survey was open for firms to respond during three weeks, from November 8th to November 28th, 2022. The estimated response time was approximately 30 minutes. The rate of response has varied across barometers. In this occasion, 753 of the firms invited to participate clicked the link to access the survey, while 499 of them completed the survey with usable information, so with a confidence level of 95%, the range of error for sample proportions is +/- 4.73%[10]. Most available indicators suggest that the economic specialization of Aragón is representative of that for the whole country (Laborda et al., 2021).

Table 1A shows the distribution of the firms in the final sample across economic sectors. The first column corresponds to the sector distribution of the 499 firms; the second column to the sector distribution of the 466 firms that have complete data on prices and costs, the main variables of interest in this study; the third column shows the distribution across economic sectors of employment in Aragón. Overall, the distribution of firms in

[10] A complete description of the survey can be found in https://www.iaf.es/lab-gestion-empresarial/.

the sample across economic sectors is reasonably close to the relative weight of the respective economic sector in the regional economy. From the 499 responses to the survey, 466 firms provided complete information on cost and price variables. Note that the 33 firms missing are randomly distributed across sectors.

Table 1A. Distribution of firms by economic sector

		Barometer IAF-2022		Aragón Economy a
		% Firms	% Firms	% Firms
A	Agriculture, Forestry and Fishing	5.2%	4.7%	6.2%
B	Mining and quarrying	0.6%	0.6%	
C	Manufacturing	14.4%	15.5%	16.3%
D-E	Energy and Water: Electricity, Gas, Steam and Air Conditioning Supply/Water Supply; Sewerage, Waste Management and Remediation Activities	1.4%	1.3%	1.1%
F	Construction	6.8%	7.3%	6.1%
G	Wholesale and Retail Trade; Repair of Motor Vehicles	9.4%	9.4%	14.7%
H	Transportation and Storage	2.0%	1.9%	5.4%
I	Accommodation and Food Service Activities	4.4%	4.3%	6.7%
J	Information and Communication	4.6%	4.9%	1.9%
K-L-N	Financial, Insurance, Real Estate, Administrative and Auxiliary Services Activities	5.4%	5.6%	2.1%
M	Professional, Scientific and Technical Activities	11.6%	11.8%	3.8%
O	Public Administration and Defense; Compulsory Social Security	1.4%	0.9%	6.8%
P	Education	5.0%	5.2%	4.1%
Q	Human Health and Social Work Activities	5.4%	5.2%	9.3%
R	Arts, entertainment and recreation	4.0%	3.6%	
U	Activities of extraterritorial organizations	0.2%	0.0%	
S	Other Service Activities	18.0%	17.8%	15.6%
Agriculture (A)		5.2%	4.7%	6.2%
Manufacturing (C)		14.4%	15.5%	16.3%
Industry (B/D/E/F)		8.8%	9.2%	7.2%
Retail (G)		9.4%	9.4%	14.7%
Market Services (H/I/J/K/L/M/N/R)		32.1%	32.2%	19.9%
Non-Market Services (O/P/Q/U)		12.0%	11.2%	20.2%
Other Service Activities (S)		18.0%	17.8%	15.6%
Number of firms:		**499**	**466**	**91%**

[a] Source: Source: Own elaboration based on Gobierno de Aragón (1/2020).
[b] Firms that have complete and usable data on the main variables of interest in this study (prices and costs changes).

Table 2A shows the distribution of firms across size classes, micro (0 to 9 employees), small (10 to 49 employees), medium size (50 to 249 employees) and large (250 or more employees) firms. For each size class, the table shows the distribution across size classes of all firms in Aragón and the distribution of employment across size classes in Spain.

Clearly, micro firms are underrepresented in the sample, mainly because of the large number of solo self-employed in this size class. If the proportions are recalculated only for the other three size classes, the size distribution of firms in the sample is more similar to the size distribution of the population of firms. The 33 firms with missing data on costs or prices tend to concentrate in the class of micro firms.

Table 2A. Distribution of firms by size classes

	Barometer IAF-2022		**Aragón Economy**	**Spanish Economy** [a]	
	% Firms	% Firms	% Firms	% Firms	% Employment
Micro (less *than 10* employees)	58.9%	57.5%	95.2%	93.2%	31.0%
Small (*10* to *49* employees)	26.9%	28.1%	4.0%	5.5%	19.0%
Medium (*50* to *249* employees)	10.4%	10.5%	0.6%	0.9%	15.0%
Large (*250* or *more* employees)	3.8%	3.9%	0.2%	0.2%	35.0%
Number of firms:	499	466 [b]	91,224	100%	100%

[a] Source: DIRCE (Central Directory of Enterprises, INE). [b] Firms that have complete and usable data on the main variables of interest in this study (prices and costs).

Table 3A provides information disaggregated by firm size, on the perception of cost increases and the reasons behind the decision to maintain or increase prices in 2022. The proportion of firms that experience an increase in cost during 2022 is close to 100% in all size classes; in all size classes firms coincide on higher prices of energy, raw materials and intermediate inputs as the main reasons behind the cost increases. Labor costs contributed moderately to the increase in total costs, and financial costs contributed even less (the increase in interest rates took place in 2022). The importance attached to the factors behind the cost increases is similar across size classes, although it is worth observing that the effect of financial costs decreases as the size of the firm increases, while that of labor costs increases with firm size.

The proportion of firms that maintained or increases prices varies with firm size. Micro- and large firms have a higher (lower) propensity to maintain (increase) prices than small- and medium-sized firms. The main reason behind the decision to maintain prices is to protect the market share, with similar weight across all size classes. The second reason in importance was contractual restrictions, although this reason increased in importance from smaller to larger size classes of firms. Among the large firms, the reason for maintaining prices "because prices did not change" was significantly more important than

among the rest of firms. Finally, the main reason to increase prices across firms of all size classes was, by far, that costs increased, which confirmed that cost and price inflation were closely linked in 2022.

Table 3A. Percentages of firms with cost increase and proportions of firms that maintain or increase prices. Importance of factors that cause the cost increase and importance of reasons for the price decisions: By size classes and total in 2022 [a]

	Micro	Small	Medium	Large	Total
% of firms with cost increases	**90.3%**	**95.4%**	**100.0%**	**94.4%**	**92.9%**
Importance of causes of cost increases					
Rising energy costs	8.4	9.0	8.8	9.3	8.7
Increased costs of raw materials	7.4	8.6	8.7	7.8	7.9
Increased costs of intermediate inputs	6.9	7.2	7.4	7.4	7.1
Increase in labor costs	6.6	6.9	7.5	7.4	6.8
Increase in financial costs	5.5	5.3	5.2	4.4	5.4
Production increase	4.4	4.0	3.7	3.8	4.2
Company restructuring	3.7	3.7	3.5	2.9	3.6
% of firms that maintain prices	**41.4%**	**25.2%**	**18.4%**	**44.4%**	**34.5%**
Importance of reasons to maintain prices					
Maintain market share	7.3	8.0	6.8	7.9	7.4
Required by contracts with clients	5.8	7.6	7.8	8.8	6.4
Competitors have maintained prices	5.7	6.2	6.2	6.3	5.9
Costs did not change	5.0	4.7	4.0	8.1	5.0
% of firms that increase prices	**55.6%**	**72.5%**	**81.6%**	**50.0%**	**62.9%**
Importance of reasons to increase prices					
Costs have increased	9.0	9.6	9.6	9.4	9.3
Product/service quality has improved	6.3	5.2	5.3	4.9	5.8
Maintain revenues	5.4	4.1	5.1	4.1	4.9
Competitors have increased prices	4.4	4.4	3.8	4.8	4.3

[a] Likert scale from 0 (not important) to 10 (very important).


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