Free Trade Agreements and Firm-Product Markups in Chilean Manufacturing*

Andrea R. Lamorgese† Andrea Linarello‡ Frederic Warzynski§

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Abstract

In this paper, we use detailed information about firms' product portfolio to study how trade liberalization affects prices, markups and productivity. We document these effects using firm product level data in Chilean manufacturing following three major trade agreements with the EU, the US, and the Republic of Korea. The dataset provides information about the value and quantity of each good produced by the firm, as well as the amount of exports. One additional and unique characteristic of our dataset is that it provides a firm-product level measure of the unit average cost. We use this information to compute a firm-product level measure of the profit margin that a firm can generate. We find that new products start being sold on foreign markets as export tariff fall. Moreover, for those products, we observe a fall in both prices and unit average costs. Those effects are mainly driven by an increase in productivity at the firm-product level. On average, adjustment on the profit margin does not appear to play a role. However, for more differentiated products, we find some evidence of an increase in markups, suggesting that firms do not fully pass-through increases in productivity on prices whenever they have enough bargaining power.

JEL codes: F13, F14, L11

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†Bank of Italy

‡Bank of Italy

§Aarhus University Corresponding author, email address: fwa@asb.dk

1 Introduction

Seminal models of international trade with heterogeneous firms have stressed how firms self select into foreign markets based on their predetermined productivity (see e.g. Melitz, 2003; Bernard et al., 2003). In more recent extensions, prices and markups reflect the degree of competition on the markets where firms sell their product or source their intermediate factors.[1] Prices and productivity adjust as soon as firms manage to get access to international markets, and they often represent two distinct channels. Nevertheless, standard empirical applications estimate productivity by the way of proxies that mix up the two channels leading to a pricing heterogeneity bias (see e.g. Klette and Griliches, 1996; Foster et al., 2008; De Loecker, 2011)

Boosted by improved data availability, recent theoretical and empirical work in industrial organization have proposed methodologies to estimate productivity measures that control for input and output price heterogeneity and are therefore able to distinguish adjustments of markups and prices from those of quantity-based total factor productivities (see e.g. Eslava et al., 2004; Foster et al., 2008; De Loecker, 2011; De Loecker et al., 2012; Smeets and Warzynski, 2013).

In this paper, we take advantage of a unique dataset where firms agree to declare the variable costs of each good that they produce in order to improve our measurement of markups and productivity. We use detailed information about firms' product portfolio to estimate a measure of productivity that controls for both output and input price heterogeneity, and use our firm-product level measure of the unit average variable cost to compute a firm product level measure of the markup that a firm can generate. The advantage of our methodology is that we do not rely on estimated average costs, but we source this information directly from the firm for each product that it sells.

As a consequence, we obtain precise measures of price, average cost, markup and physical total factor productivity (TFPQ) at the firm-product level in Chilean manufacturing over the period 2001-2007. We relate adjustment along these margins

[1] Further developments of this class of models allow firms to change their productivity by adopting better technologies or innovating (Yeaple, 2005; Melitz and Ottaviano, 2008; Verhoogen, 2008; Lileeva and Trefler, 2010; Bustos, 2011). The most recent development consider multi-product firms and allow firms' productivity to change according to their product mix (see e.g. Eckel and Neary, 2010; Bernard et al., 2011b; Mayer et al., 2012; Dhingra, 2013; Eckel et al., 2015).

to the tariff drop that occurred during this period when Chile signed three important Free Trade Agreements (FTAs) with the European Union, the United States, and the Republic of Korea.

Using the fall in export tariff generated by the implementation of the FTAs, we document three main additional findings. First, export market participation of Chilean products increased as a result of tariff cuts. The probability for a product to be exported increased by 1% to 4%. Second, the entry into export markets led to a drop in the average unit cost as well as in price. Finally, when we distinguish between homogeneous and differentiated goods, we find evidence of an increase in markups only for differentiated products.

Our results are in line with theoretical predictions from several recent models of international trade with heterogeneous firms and variable mark-ups such as Melitz and Ottaviano (2008). In this class of models, the elasticity of demand (ε_i) and the mark up (μ) depend on the preference parameters (among which the degree of differentiation, γ), the number of competitors (N) and the average price of competing varieties ($\bar{p}$). In particular the mark-up is a function of the choke price, that is the maximum price that can be imposed without driving the demand to zero. Such price ($p_{\max}$ which in equilibrium is equal to the productivity cut-off, c_D) increases with the degree of differentiation (γ) and decreases with the number of competitors (N). Hence when trade opens, mark-ups and prices decrease due to the pro-competitive effect, but they decrease less for more differentiated goods. Allowing for endogenous quality upgrade in this class of models, the scope for quality differentiation scales up firms mark-ups, so when trade opens mark-ups can actually increase for products that have larger scope for differentiation (Antoniades, 2015; Bellone et al., 2015).

More recent contributions by (Bustos, 2011; Kugler and Verhoogen, 2012; Dhingra, 2013; Haichao, Fan and Yao, Amber Li and Stephen R. Yeaple, 2015) suggest that firms have stronger incentives to upgrade their technology, change their innovation strategy or upgrade their product when facing trade liberalization, when there is scope for product differentiation.

Several authors have previously used similar data to study price behavior in the US, Colombia, Belgium, Denmark and other countries (see e.g. Roberts and Supina, 1996, 2000; Foster et al., 2008, 2012; Kugler and Verhoogen, 2012; Dhyne et al., 2012; Petrin and Warzynski, 2012; De Loecker et al., 2012). These papers have generated stylized facts and methodologies to deal with these transaction datasets, but they did not have information about firm-product level costs. One exception is a recent paper by Garcia Marin and Voigtländer (2013) that uses the same Chilean dataset. They find that that marginal costs decline substantially after export entry, while markups are relatively stable – so that falling prices explain why revenue-based productivity measures typically found no effects after export entry. However, their focus is on the proper measurement of learning-by-exporting effect, while we are mostly interested in the evolution of markups, prices and efficiency following trade liberalization.

The rest of the paper is structured as follows. Section 2 describes our unique database. Section 3 introduces our methodology to derive measures of markups and physical productivity at the firm-product level. Section 4 discusses trade liberalization in Chile, presents our identification strategy and shows our results. Section 5 concludes.

2 Data

The plant level information that we use in this paper, the *Encuesta Nacional Industrial Annual* (ENIA) collected by the *Instituto Nacional de Estadisticas* (INE), is well known and has been used in several important contributions in the productivity literature (Pavcnik, 2002; Levinsohn and Petrin, 2003; Ackerberg et al., 2006). It contains all standard variables that researchers need to properly estimate production functions. The survey covers the universe of plants in manufacturing with at least 10 employees. Plants are required to answer by law. The survey is conducted at the plant level, but more than 90% of the firms are single plant. We use several waves covering the period 2001-2007.

We complement this standard dataset with more detailed information about firms' product mix. The survey also contains two additional forms that ask firms precise information about which product they make, and which intermediate products they buy. Starting from 2001, INE adopted the Central Product Classification V.1 (CPC) compiled by the UN.[2] The first 5 digits correspond exactly to the official

[2]Before 2001 INE used an ENIA specific product classification CUP (*Clasificador Unico de Producto*). More information about the CPC classification can be found on the UN webpage.

classification, while the last 2 digits are country specific. The adoption of the CPC substantially improves data quality. The new classification is homogeneous over time and the units of measurement are consistent within product category. Overall, we observe 1000 distinct products, table 1 illustrates an example of product classification and its level of detail.

At the product level, firms are asked about the value produced or bought, and the quantity produced or bought. For goods produced by the firm, it also indicates the quantity exported. More interestingly, it also contains a question about the total variable cost incurred by the firm to produce each product. We can therefore compute the average cost per unit produced, as well as the average revenue per unit produced (unit value, used as proxy for price). We also construct the ratio of our price proxy to average cost and refer to it as our firm-product level "markup" (μ).

We implement several data cleaning procedure both at plant and product level to reduce the influence of outliers, missing data and misreported information. In the plant dataset, we exclude from the sample all plants reporting zero or with a missing key variable such as employment, sales and intermediate input expenditure. We also exclude plants whose growth rate of quantity sold and revenues between adjacent periods is larger than the average by more than 5 standard deviations.

In the product dataset, we first match product descriptions to build a unique product identifier within firms.[3] Second, we drop all products that are reported only once in the dataset and firms whose number of products changes between adjacent periods by more than 5. Third, we drop from the sample those products whose quantity produced, quantity sold and total revenue growth rates exceed their averages by more than 5 standard deviations. Finally, following De Loecker et al. (2012), we trimmed unit values, average unit costs and markups below the 3rd and above the 97th percentile.

The final dataset, which includes all firms with available product information, is well suited to study the determinants and the evolution of markups and prices during a period of extensive trade liberalization. Other papers have the same information for other countries (e.g. India and Colombia) but our dataset is unique along two dimensions. First, it contains firm's proprietary information about variables costs

[3]This procedure allows us to treat as different, products within firms recorded using the same CPC 7-digit code.

by product that allows us to compute markups, without having to implement any particular estimation procedure. Second, during the period of our analysis, we observe the entry into force of two FTAs that created many new export opportunities for Chilean products, thus enabling us to study the effect of an export shock. Most of the existing literature focuses mainly on the effects of output tariff reduction.

Table 2 shows the number of firms in our final sample after data cleaning according to how many products they make. The number of firms increased from 2001 to 2005, then dropped sharply afterwards. We also observe a slight decline in the proportion of single product firms.

3 Firm-product productivity and markups

3.1 Firm-product productivity

We adapt the standard cost based measurement of physical total factor productivity (henceforth TFPQ; see e.g. Foster et al., 2008) to a multi-product setting. We use the fact that we know the share of total variable costs allocated to each product to weight the use of inputs for each product accordingly.[4] We therefore end up with a "double cost based" measure of TFPQ.

We define $TFPQ$ of product j made by firm i at time t as:

$$TFPQ_{ijt} = q_{ijt} - \alpha_{it}^{j}\alpha_{jt}^{L}log(L_{it}) - \alpha_{it}^{j}\alpha_{jt}^{M}log(M_{it}) - \alpha_{it}^{j}\alpha_{jt}^{K}log(K_{it}),$$

where q_{ijt} is the physical quantity of good j produced by firm i at time t, L is employment, M is material (deflated by a firm-specific material price index), K is capital, α_{jt}^{X} for $X = L, M, K$ is the average cost share of each input in the total cost of the firm and α_{it}^{j} is the share of the cost of product j in the total cost of the firm.[5] Our measure controls for both output and input price heterogeneity, since we compute for each firm its specific input price deflator.

[4] We avoid the task of estimating this shares. See e.g. De Loecker et al. (2012).

[5] Factor costs shares are computed in two steps. First, we computed the cost shares for each firms and for each factors. Second, we take the averages of these costs shares across products. The user cost of capital is computed using the real interest rate from Bank of Chile and capital specific depreciation rates (3% for building, 8% for machinery and 11% for vehicles; land is assumed not to depreciate).

Figure 1 shows the distribution of the demeaned variable for a few products with different degree of differentiation (bread, wine and jeans). We observe that dispersion is larger for the more differentiated goods like wine and especially jeans.

3.2 Firm-product markups

We use our firm-product level measure of the unit average variable cost to compute a firm-product level measure of the margin (we use the term markup) that a firm can generate. We then relate our price, average cost and markup measures to firm-product and firm level characteristics such as export status, being a multiproduct firms and firm size.

Table 3 shows our measure of the average markup by sector. We find realistic estimates between 1.32 and 1.88, in line with previous findings in the literature. Table 4 shows the evolution of the average markup over our period of analysis. The measure remains surprisingly stable over time, although we observe a small increase.

However, these figures represent averages over very different products. Figure 2 shows the distribution of the markups for three products: bread, jeans and wine. We expect bread to be the most homogeneous product, and therefore to display less dispersion in the markup. This is exactly what we observe. On the other, hand, for more differentiated products such as jeans but especially wine, we observe a more dispersed distribution.

3.3 The determinants of markups

We start our analysis by relating the firm-product price, average cost and markup to firm and firm-product characteristics. Our dependent variables y are the logs of prices, log of average unit costs and the markup:

$$y_{ijt} = \alpha + \beta x_{fit} + \delta_{jt} + \varepsilon_{ijt}.$$

The explanatory variables include the log of firm size (number of employees), the log of the level of firm's output, the log of total factor productivity (TFPQ), a dummy which takes value 1 if the firm is a multiproduct firm, and a dummy which takes value 1 if the firm exports. All regressions include product-time fixed effect (δ_{pt}). Standard errors are clustered at the product level.

Results are shown in table 5. We find a negative relationship between TFPQ and both price and marginal cost. Because the coefficient is slightly lower for average cost, the relationship with the markup is positive. These correlations are in line with previous results in the empirical literature (e.g. Foster et al., 2008) and with the predictions of several theoretical models, such as Melitz and Ottaviano (2008). When we control for export status and the multi-product dummy, we find that both measures have positive and significant coefficients in the price and average costs specifications. When we look at the markup, we find that exported products have on average higher markups, but multi-product firms have lower markups. This is because the coefficient is larger in the cost specification than in the price specification. From a theory point of view, it can be explained by the fact that multi-product firms sell many products that might not be in their core competence (see e.g. Mayer et al., 2014) or sell in larger quantity.

Adding firm size as an additional control does not change the basic message. Firm size is positively correlated with price, marginal cost and the markup. This might indicate that larger firms have access to better inputs and produce higher quality goods (see e.g. Kugler and Verhoogen, 2012).

4 Trade Liberalization

4.1 Trade Policy Background

Chile's integration into international trade has a long tradition. Starting in the late 70s, the country progressively reduced import tariffs, eliminating all differences across industries. As a consequence, Most Favored Nation (MFN) tariffs applied to imports from abroad in 2002 equal 8% in all industries. Among developing economies, Chile can be considered as one of the most open and integrated into international trade.

More recently, Chile has signed several Free Trade Agreements (FTAs) with its most important trading partners. In this paper we will focus on three important FTAs signed respectively with the EU, the US, and Korea. The negotiation with the EU started in November 1999, the agreement was signed in November 2002 and the FTA started in February 2003. The negotiation with the US started in December 2000, the agreement was signed in June 2003 and the application started in January

2004. Another FTA with Korea came into force in April 2004 after 7 rounds of negotiations started in 1999. By the date of entry into force of the FTAs, almost all barriers to trade were removed.[6]

The entry into force of these FTAs had a big impact on Chilean exports. Overall, these three markets accounted for 50% of aggregate exports in 2002 and exports almost tripled between 2002 and 2006 (see Figure 3). We will use the change in export tariff as source of variation to identify the effect of the FTAs on Chilean products.

We combine the information on MFN tariff applied by partner countries in 2002 to construct a weighted export tariff, i.e. the tariffs faced by Chilean products before entry into force of the FTAs. For each product j, we define the export tariff as:

$$\tau_j^{exp} = \frac{\tau_j^{EU} \cdot M_j^{EU} + \tau_j^{US} \cdot M_j^{US} + \tau_j^{KOREA} \cdot M_j^{KOREA}}{M_j^{US} + M_j^{EU} + M_j^{KOREA}}$$

where τ are the MFN tariffs and M are the values of imports. Tariffs are aggregated at 4-digit ISIC level.

Table 6 reports summary statistics for MFN tariff cuts. Export tariffs faced by Chilean products fell on average by 5,2%, ranging from 0 to 25%. The heterogeneity across industries reflect different protection schemes applied by partner countries which are not specific to Chile. Indeed, the share of Chilean imports is less than 1% for all countries.

4.2 Identification Strategy

In this section, we try to relate the changes in prices, markups, average costs and firm-product productivity to the fall in export tariff experienced by Chilean products. Consider the following equation:

$$y_{ijst} = \gamma_0 + \gamma_1 \tau_{jt}^e + \delta_{ij} + \delta_{st} + \eta_{it} \quad (1)$$

[6]While the application of FTA with the US and Korea was sharp, the same is not true for EU For some goods tariff elimination was scheduled in 2006, they accounted for less than 8% of total export towards EU For a wide range of agricultural and food products quotas protections were defined. Quotas were increasing over time, and scheduled to be eliminated within 5 to 8 years. All products imported within quotas were tariff free, while tariffs were applied to extra quantities. The application of quotas were applied on the basis of arrival time. Finally, the entry into force of EU FTA was *provisional* and become definitive in 2006, this caveat had no impact on tariff eliminations.

where j is a product index, i is a firm index, s is a sector index and t time. The dependent variable y_{ijst} is in turn prices, markups, average costs and firm-product productivity. Our main coefficient of interest is γ_1, which identify the causal effect of a fall in the export tariff τ^e_{jt}. δ_{ij} represent firm-product fixed effects that will allow us to control for unobserved heterogeneity and exploit the time variation of the tariff cut. Finally, δ_{st} are sector time fixed effects which control for sector characteristic that varies over time.

Bertrand et al. (2004) discuss several pitfalls in estimating eq. 1 using OLS. Export tariffs drop to zero after FTAs for all firms product introducing serial correlation across observations. Moreover, our main dependent variables are likely to be highly serial correlated across time. The presence of such problems make estimation of the coefficients with OLS unbiased, but will not yield the correct standard errors. We will solve these problems in two steps following one of the proposed solutions by Bertrand et al. (2004).

First, we take averages of our main variables before the FTAs (years 2001 and 2002) and after (from 2003 to 2007):

$$\overline{y_{pijst}} = \frac{1}{T}\sum_{t}^{T} y_{pijst}.$$

Second, we take differences in order to eliminate the unobserved firm-product fixed effect δ_{pi}. In order to increase the precision of our estimates we will add some additional firms and industry controls measured before the FTAs. The final estimation equation is:

$$\Delta\overline{y_{pijst}} = \gamma_0 + \gamma_1\Delta\tau^e_{jt} + Z_{ijsB} + X_{jsB} + \delta_s + \Delta\eta_{it} \quad (2)$$

Since the tariffs measure varies at 4-digit ISIC industry level, we cluster our standard errors at this level. Firm controls Z_{ijsB} include the log of employment measured in efficiency units and the log of firm productivity measured before the FTAs. The inclusion of these variables is aimed at controlling for the presence of observable firm characteristics that have an impact on prices, markups and average unit costs. Industry controls X_{jsB} (elasticity of demand, skill shares and capital intensity measured at 4-digit ISIC industry in the US) controls for the differences in the magnitude of tariffs cuts across industries.

4.3 Entry into the Export market

In this subsection, we describe entry into the export market observed in Chile after the FTAs. Overall, 336 new products out of 8043 in our sample start to be exported after 2003 (197 exit the export market, 1027 are always exported). Among those newly exported products, 190 are exported by firms that were not exporting before the FTAs. The probability for a product to be exported passes from 15.1% to 16.9%, suggesting that the FTAs created several new export opportunities for Chilean products and firms.

Table 7 shows that the new products start to be exported in response to the cut in export tariff. For each observation we created a dummy equal 1 if the product is exported ($dummy_{exp}$). In the second column, the dependent variable is the dummy for the period after the trade liberalization, but we add as control the past export status. This specification controls for the fact that in presence of sunk export costs, current export status might depend on past export status. In column (c), we restrict the analysis to the sub sample of firms-products that were not exported before the FTAs. Finally, in the last column, we restrict the sample to firms that were not exporting before the FTAs. The estimated coefficients are always negative, as expected, and significant. They imply that the average fall in tariff (5.2%) increases the probability of export between 1.6% and 4.4%.

By restricting the analysis to the sub sample of non exported products or non exporting firms, the point estimate passes from $-.85$ to $-.76$ and $-.47$. This is likely to be the case because Chile before the FTAs exports products with high tariffs. In these industries non exporting firms and products are likely to be less productive then in industries with low tariffs, generating a negative correlation between export tariffs and unobserved productivity. Coefficients drop after the inclusion of firms and industry controls, but the estimated coefficients are always negative and significant.

4.4 Main results

Table 8 shows the effect of the fall in tariffs on prices, average unit costs, markups and productivity. Panel A, B and C show three different specifications, with an increasingly sharper control for unobserved heterogeneity, obtained by adding firm controls (employment and sales per worker) in Panel B and industry controls (elasticity of demand and skill intensity measured at 4-digit ISIC industry in the US) in Panel C.

In column 2, the estimated coefficient is positive implying that the average tariff cut (5.2%) reduces prices by 1 to 1.5%. Tariff cuts lower factory-gate prices of exported products in destination markets. Chilean firms face tough competition in larger market such as EU and US. In both cases, a decline in export tariff is associated with a decline in prices. This is a standard result in modern trade literature as trade has a pro-competitive effect.

The richness of our data allow us to explore more deeply which are the determinants and the margins along which adjustment occurs at firm-product level in response to the FTAs. The reduction in prices, in fact, can be due both to an increase in productivity or a reduction in markups. On the one hand, a larger market allows firms to invest in better technology (Yeaple, 2005; Verhoogen, 2008; Bustos, 2011), thus allowing an increase in productivity and a decrease in marginal costs. Following a fall in variable trade costs, productivity may also increase because of selection, that is reallocation of resources across firms (Bernard et al., 2003; Melitz, 2003) or across products within the firm (Bernard et al., 2011b; Mayer et al., 2012). On the other hand, in a larger market, firms face tougher competition, thus are force to reduce their markups (Melitz and Ottaviano, 2008).

In column 3, we report the effect of the tariff cut on our measure of average unit costs and surprisingly we do not find any effect. In two specifications, the estimates are positive, implying a reduction in average unit cost following the trade liberalization, but they are not significant. The last column reports the effect on product TFPQ. All estimated coefficients are negative and significant. The implied jump in productivity ranges between 5.2% to 5.8%. This is the first important result of our paper. While the existing literature sometimes has struggled to find a positive effect of export entry on productivity (for a review of the literature see Bernard et al. (2011a)), our estimates show that productivity increases for Chilean products mostly affected by the FTAs. Our results differ from the most of the existing literature along two important dimension. First, our product TFPQ do not suffer from price and markup heterogeneity, because we measure it starting from physical quantities. Second, our identification relies on two important episodes of trade liberalization that increase substantially export opportunities for Chilean firms.

Column 1 shows the estimated effect of tariff cuts on markups. All coefficients are positive, meaning that a reduction in variable trade costs reduced markup of Chilean products. The estimated decline without controlling for firms and industry characteristics is 1.2%; the sign of the relation between trade liberalization and mark-ups remains positive in the specification with industry and firms controls, but the estimates are less precise. We attribute this poor precision to a composition effect between homogeneous and differentiated goods: since in the first part of this paper we document substantial heterogeneity on the determinants of markups at firm level, when distinguishing between homogeneous and differentiated goods we deem that estimates conceal different markups adjustment for different product category. We investigate such heterogeneity by adding to our main specification an interaction term of the tariff cut with the degree of differentiation measured at industry level.

$$\Delta\overline{y_{pijst}} = \gamma_0 + \gamma_1 \Delta\tau^e_{jt} + \gamma_2 \Delta\tau^e_{jt} * Diff_j + Diff_j + Z_{ijsB} + X_{jsB} + \delta_s + \Delta\eta_{it} \quad (3)$$

Following Nunn (2007), we measure the share of differentiated products for each industry ($Diff_j$) starting from Rauch's original classification (Rauch, 1999). The average share of differentiated product per industry is .66 (std. dev .37). Table 9 shows the main results. The first column shows that on average markups drop by 2% ($= .3921 * -0.52$). The interaction term is negative and significant, implying that markups increase for industry with larger shares of differentiated products. In industries where all products are differentiated, the implied average net increase in markup is around 1.2%. Columns 2 to 4 of table 9 show the results on prices, average unit costs and product TFPQ. The estimated coefficient on prices are positive but not significant confirming our previous results that tariff cuts led to drop in prices. Product tfpq falls exactly by the same amount as estimated in the baseline specification and there is no differences between homogenous and differentiated products. Finally, there is some evidence on the reduction of average unit costs only for differentiated industries.

In line with the recent theoretical and empirical literature, our results suggest that the new export opportunities generated by the FTAs led to a reduction in average unit costs due to an increase in TFPQ. Firms as a consequence reduced their prices. Markups adjustment depend on the type of products firm exports.

We find evidence of markups reduction for homogenous products and increase in markups for differentiated ones.

4.5 Robustness

We now discuss several robustness checks to our baseline results. Panel A of table 10 shows the baseline results when we drop from our sample years 2003 and 2004. We discussed earlier that the implementation of the FTAs took place in different periods between February 2003 and April 2004 with the US. Given that we do not observe export destination at product level, we do not know how long it took for firms to react to this new export opportunity and with respect which market. This my bias our baseline results downward, since the *treatment* my have started later than we think. Panel A shows that our point estimates increase, as well as their precision. Productivity increases by 7.5%, prices fall by 2.4% and markup drop by 1.8%.

In panel B, we restrict the analysis to the sample of firms which were not exporting before the FTAs. We want to be sure that the patterns that we documented so far are not driven by product exported by already exporting firms. Not surprisingly we find that non exporting firms experience larger productivity gains. Productivity soars by 12%. These firms were the least productive. We also find that prices and average unit costs fall by 3.9% and 3.2%.

Finally, we want to check that observed productivity gains and price falls are not driven by an increase in competition faced by Chilean firms in domestic markets or by the access to foreign intermediate input. The entry into force of FTAs generated new export opportunity for Chilean firms abroad, but at the same time, the Chilean import tariff elimination increases the export opportunity for foreign firms in Chile. Thus Chilean firms could have faced higher foreign competition in domestic market. We control for these trends by adding the change in share of import before/after from partner countries measured at industry level in our main specification. Our baseline results, as we expected, remain unchanged both in magnitude and significance. Chile undertook unilateral trade liberalization starting in the late 70s. The level of protection were low compared to other developing economies when the FTAs were signed. Moreover all industries were protected with the same tariff. As a consequence the Chilean output tariff elimination was orthogonal to change in export tariff, leaving estimates unchanged.

5 Conclusion

In this paper, we use detailed information about firms' product portfolio and input decisions to understand firm-product markup heterogeneity in Chilean manufacturing. In line with the recent theoretical and empirical literature, we find that, on average, more efficient firms have lower average costs, charge lower prices and have higher margins. Firms also have higher prices and margins when they export their product, even controlling for productivity, but do not necessarily have lower costs. Once we distinguish between differentiated and homogeneous products, we find that larger firms have higher prices and also higher marginal costs when there is scope for differentiation. This suggests that larger firms produce higher quality goods, and more efficient firms charge lower prices conditional on size.

We use our measures to look at the effect of trade liberalization on prices, average costs, margin and productivity. We find that both prices and average costs are decreasing after a drop in tariffs, while firm-product productivity is increasing. Markups appear to be unaffected on average, but are increasing for more differentiated products. This indicates that firms do not fully pass-through increases in productivity on prices. Our paper complements several recent contributions using Colombian and Indian data. An additional channel through which trade liberalization could affect firms' competitiveness is product upgrading. We plan to study this topic in future research.

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Figures and Tables

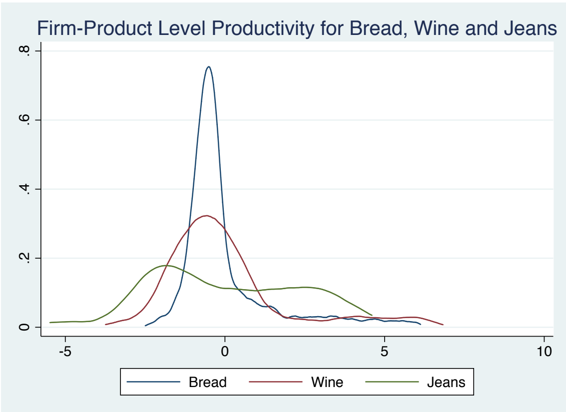

Figure 1: Firm-product level productivity distribution for bread, jeans and wine

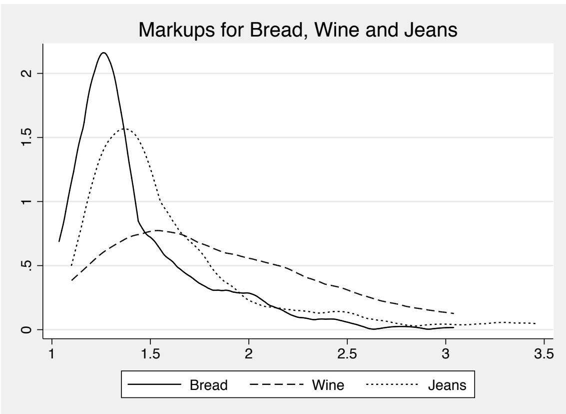

Figure 2: Markup distribution for bread, jeans and wine

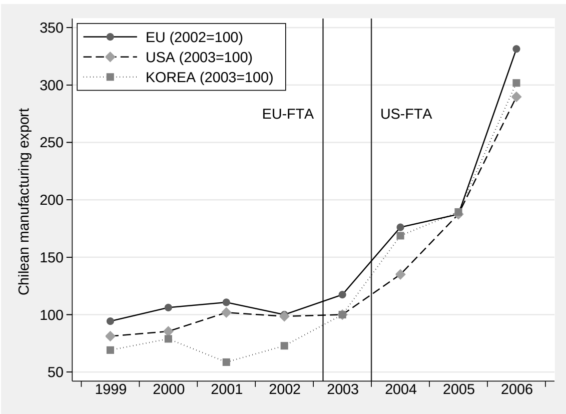

Figure 3: Evolution of aggregate export flows following FTAs

Table 1: Example of Central Product Classification (CPC)

Section	Division	Group	Class	Subclass	INE	Unit	Description
2							Food products, beverages and tobacco; textiles, apparel and leather products
	24						Beverages
		242					Wines
			2421				Wine of fresh grapes, whether or not flavoured; grape must
				24211			
					2421101	l	Sparkling wine of fresh grapes
				24212			
					2421201	l	wine of fresh grapes, except sparkling wine
					2421202	kg	grape must
				24213			
					2421301	l	Vermouth and other wine of fresh grapes flavoured with plats or aromatic substances

Notes: This table provides an example of product classification. Columns Section to Subclass correspond to the original UN CPC V.1 classification. The column INE refers to the actual product classification with the last two digits added by the Chilean statistical agency (INE). In some cases, the last two digits refers to products recorded with different unit of measurement. In our final dataset, we observe 1,061 7-digit products which correspond to 650 different 5-digit products. Notice that 463 INE products correspond exactly to the CPC products, like products 24211 and 24213 int the table.

Table 2: Number of Firms by Product Category

year	Number of products: Single product		between 1 and 5		between 5 and 10		more than 10		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%
2001	1,971	52.23	1,503	39.83	227	6.01	73	1.93	3,774	100.00
2002	1,998	49.28	1,660	40.95	318	7.84	78	1.92	4,054	100.00
2003	1,925	48.05	1,678	41.89	329	8.21	74	1.85	4,006	100.00
2004	2,064	48.71	1,728	40.78	354	8.35	91	2.15	4,237	100.00
2005	2,216	50.06	1,756	39.67	358	8.09	97	2.19	4,427	100.00
2006	2,119	50.01	1,668	39.37	354	8.35	96	2.27	4,237	100.00
2007	1,807	48.73	1,505	40.59	307	8.28	89	2.40	3,708	100.00
Total	14100	49.57	11,498	40.42	2247	7.90	598	2.10	28,443	100.00

Notes: The table categorizes firms according to the number of products manufactured. Products are defined according the the CPC classification. For each category, the first column report the absolute number of firms, while the second the percentage distribution by year. The last row shows the overall figure.

Table 3: Distribution of Markups by Sector

Sectors	Mean	Standard Deviation	1st Percentile	Median	99th Percentile
15 Food & beverages (28%)	1.53	0.38	1.06	1.40	2.76
17 Textiles (4%)	1.58	0.40	1.08	1.45	2.69
18 Wearing apparel (7%)	1.62	0.45	1.10	1.47	3.16
19 Leather,footwear (2%)	1.63	0.54	1.10	1.44	3.77
20 Wood (5%)	1.50	0.38	1.03	1.38	2.86
21 Paper (3%)	1.62	0.42	1.08	1.51	2.93
22 Publishing (3%)	1.54	0.35	1.11	1.43	2.66
23 Coke, petroleum (0%)	1.32	0.34	1.05	1.15	2.46
24 Chemicals (8%)	1.88	0.76	1.04	1.64	4.64
25 Rubber,plastics (6%)	1.64	0.45	1.10	1.51	3.13
26 Non-metallic mineral (4%)	1.57	0.40	1.08	1.43	2.94
27 Basic metal (2%)	1.56	0.50	1.00	1.40	3.24
28 Fabricated metal prod (7%)	1.53	0.37	1.10	1.41	2.81
29 Machinery and equip (4%)	1.60	0.41	1.10	1.47	2.90
31 Electrical mach n.e.c (1%)	1.53	0.38	1.08	1.43	2.78
33 Medical mach, watches (0%)	1.87	0.55	1.09	1.75	3.36
34 Motor vehicles (1%)	1.57	0.35	1.11	1.48	2.66
35 Other transport equip (0%)	1.41	0.25	1.06	1.32	2.30
36 Furniture; man. n.e.c (7%)	1.55	0.38	1.08	1.43	2.70
Total (100%)	1.59	0.46	1.07	1.44	3.09

Notes: The table displays summary statistics by sector for the sample over the period 2001-2007. Markups are trimmed above and below the 3rd and the 97th percentiles within each sector. The share of observations by sector in the overall sample is reported in parentheses.

Table 4: Distribution of Average Markup by Sector and Year

	year							
Sectors	2001	2002	2003	2004	2005	2006	2007	Total
15 Food % beverages (28%)	1.48	1.52	1.51	1.52	1.53	1.55	1.56	1.53
17 Textiles (4%)	1.56	1.58	1.62	1.59	1.57	1.58	1.58	1.58
18 Wearing apparel (7%)	1.57	1.64	1.64	1.63	1.61	1.62	1.66	1.62
19 Leather,footwear (2%)	1.57	1.61	1.71	1.63	1.62	1.65	1.65	1.63
20 Wood (5%)	1.42	1.50	1.47	1.50	1.52	1.54	1.55	1.50
21 Paper (3%)	1.58	1.57	1.67	1.64	1.60	1.62	1.65	1.62
22 Publishing (3%)	1.46	1.51	1.52	1.52	1.54	1.56	1.64	1.54
23 Coke, petroleum (0%)	1.30	1.33	1.28	1.32	1.31	1.29	1.42	1.32
24 Chemicals (8%)	1.88	1.98	1.83	1.91	1.86	1.80	1.89	1.88
25 Rubber,plastics (6%)	1.63	1.65	1.65	1.62	1.60	1.62	1.68	1.64
26 Non-metallic mineral (4%)	1.57	1.60	1.64	1.60	1.55	1.51	1.56	1.57
27 Basic metal (2%)	1.49	1.46	1.55	1.58	1.58	1.57	1.67	1.56
28 Fabricated metal prod (7%)	1.50	1.52	1.54	1.53	1.55	1.51	1.53	1.53
29 Machinery and equip (4%)	1.50	1.65	1.63	1.64	1.59	1.60	1.59	1.60
31 Electrical mach n.e.c (1%)	1.48	1.45	1.52	1.52	1.54	1.57	1.66	1.53
33 Medical mach, watches (0%)	1.81	1.80	1.85	1.81	1.86	1.77	2.11	1.87
34 Motor vehicles (1%)	1.57	1.62	1.62	1.59	1.51	1.53	1.56	1.57
35 Other transport equip (0%)	1.29	1.45	1.36	1.37	1.42	1.46	1.47	1.41
36 Furniture; man. n.e.c (7%)	1.52	1.58	1.59	1.54	1.53	1.53	1.56	1.55
Total (100%)	1.55	1.59	1.59	1.59	1.58	1.58	1.62	1.59

Notes: The table displays the average markup by sector and by year. Markups are trimmed above and below the 3rd and the 97th percentiles within each sector. The share of observations by sector in the overall sample is reported in parentheses.

Table 5: Correlation between Prices, Markup and Costs and Firm's Characteristics

	$log(Price)$	Markup	$log(AverageCost)$
Product TFPQ	-0.3565***	0.0075***	-0.3624***
	[0.007]	[0.001]	[0.007]
Multiproduct dummy	1.2670***	-0.0339***	1.2901***
	[0.043]	[0.010]	[0.043]
Exporter dummy	0.0774*	0.0293**	0.0648
	[0.041]	[0.015]	[0.041]
Log Employment	0.2793***	0.0209***	0.2688***
	[0.016]	[0.005]	[0.015]
Product-Year effects	Y	Y	Y
Industry effects	Y	Y	Y
Observations	67,670	67,717	67,661
R^2	0.821	0.199	0.824

Notes: The table uses the 2001-2007 sample. The dependent variables are reported at the top of each columns: log of unit values, markups and log unit average costs. The table trim the observartions above and below the 3rd and the 97th percentiles within each sector. Coefficients from regressions with product-time and firms main industry fixed effects. Industry effects are defined as the industry category with the greatest share of plant sales. Standard errors in brackets clustered at firm level. * 0.10, ** 0.05, *** 0.01 Significance level.

Table 6: Most Favoured Nation Tariffs Reduction by Sector

Sector	Average	Standard Deviation	Minimun	Median	Maximun
Food & beverages	-0.075	0.042	-0.247	-0.063	-0.021
Textiles	-0.089	0.021	-0.123	-0.093	-0.061
Wearing apparel	-0.117	0.000	-0.117	-0.117	-0.117
Leather,footwear	-0.087	0.024	-0.104	-0.104	-0.043
Wood	-0.012	0.015	-0.049	-0.002	-0.002
Paper	-0.023	0.004	-0.028	-0.021	-0.016
Publishing	-0.010	0.008	-0.019	-0.010	-0.000
Coke, petroleum	-0.045	0.000	-0.045	-0.045	-0.045
Chemicals	-0.032	0.018	-0.063	-0.039	-0.007
Rubber,plastics	-0.056	0.011	-0.060	-0.060	-0.024
Non-metallic mineral	-0.026	0.015	-0.066	-0.020	-0.010
Basic metal	-0.024	0.005	-0.029	-0.019	-0.019
Fabricated metal prod	-0.028	0.002	-0.038	-0.030	-0.025
Machinery and equip	-0.017	0.011	-0.049	-0.015	-0.000
Electrical mach n.e.c	-0.029	0.007	-0.037	-0.024	-0.022
Medical mach, watches	-0.014	0.012	-0.035	-0.015	-0.003
Motor vehicles	-0.031	0.010	-0.080	-0.030	-0.025
Other transport equip	-0.029	0.027	-0.072	-0.017	-0.007
Furniture; man. n.e.c	-0.009	0.008	-0.038	-0.006	-0.006
Total	-0.052	0.042	-0.247	-0.047	-0.000

Notes: Authors' calculations using WITS-World Bank dataset. MFN tariffs refer to 2002.

Table 7: Entry into Export Market

	$dummy_{exp}$ (a)	$dummy_{exp}$ (b)	$dummy_{exp}$ (c)
Panel A			
$\Delta\tau$	-0.7083***	-0.5454***	-0.3793***
	[0.168]	[0.178]	[0.111]
Firm-level controls	no	no	no
Industry-level controls	no	no	no
Sector dummies	yes	yes	yes
Observations	7866	6722	6133
R^2	0.580	0.018	0.017
Panel B			
$\Delta\tau$	-0.5787***	-0.3531***	-0.3367***
	[0.165]	[0.132]	[0.093]
Firm-level controls	yes	yes	yes
Industry-level controls	no	no	no
Sector dummies	yes	yes	yes
R^2	0.595	0.063	0.037
Panel C			
$\Delta\tau$	-0.6111***	-0.3819**	-0.3685***
	[0.158]	[0.168]	[0.113]
Firm-level controls	yes	yes	yes
Industry-level controls	yes	yes	yes
Sector dummies	yes	yes	yes
R^2	0.596	0.063	0.037

Notes: The dependent variable at the top of the column. Column (b) includes only non exported products before FTAs. Column (c) includes only non exporting firms before FTAs. Δ denotes changes in a variable before/after the FTA. Firm level controls includes employment measured in efficiency unit and output per worker measured before FTA. Industry controls includes demand elasticity and skill intensity measured at 4-digit ISIC industry in the US. Standard errors in brackets clustered at 4-digit ISIC industry level. * p<0.10, ** p<0.05, *** p<0.01. Significance level.

Table 8: Main Results

	Δ Markup	Δ Prices	Δ Costs	Δ TFPQ
	(1)	(2)	(3)	(4)
Panel A				
$\Delta\tau$	0.1158	0.3222	0.2645	-0.9593*
	[0.138]	[0.272]	[0.293]	[0.570]
Firm-level controls	no	no	no	no
Industry-level controls	no	no	no	no
Sector dummies	yes	yes	yes	yes
Observations	7866	7866	7866	7866
R^2	0.015	0.008	0.009	0.007
Panel B				
$\Delta\tau$	0.0549	0.2832	0.2720	-0.7754
	[0.133]	[0.294]	[0.292]	[0.600]
Firm-level controls	yes	yes	yes	yes
Industry-level controls	no	no	no	no
Sector dummies	yes	yes	yes	yes
R^2	0.017	0.008	0.009	0.008
Panel C				
$\Delta\tau$	0.0571	0.4476**	0.4451**	-0.9871*
	[0.149]	[0.202]	[0.184]	[0.510]
Firm-level controls	yes	yes	yes	yes
Industry-level controls	yes	yes	yes	yes
Sector dummies	yes	yes	yes	yes
R^2	0.017	0.009	0.010	0.009

The dependent variable at the top of the column: log of unit values, markups, log unit average costs and log product tfpq. Δ denotes changes in a variable before/after the FTA. Dependent variable trimmed below the 3rd and above the 97th percentile. Firm level controls includes employment measured in efficiency unit measured before FTA. Industry controls includes demand elasticity and skill intensity measured at 4-digit ISIC industry in the US. Standard errors in brackets clustered at 4-digit ISIC industry level. * p<0.10, ** p<0.05, *** p<0.01. Significance level.

Table 9: Differentiated vs. Homogenous products

	Δ Markup	Δ Prices	Δ Costs	Δ TFPQ
$\Delta\tau$	0.4273***	0.2949	-0.0128	-1.4359**
	[0.117]	[0.312]	[0.350]	[0.584]
$\Delta\tau$ x $Diff_j$	-0.9332***	0.3402	1.2479	2.7004
	[0.287]	[0.804]	[0.802]	[1.705]
$Diff_j$	-0.0531***	0.0243	0.0608	-0.0177
	[0.017]	[0.054]	[0.057]	[0.089]
Firm-level controls	yes	yes	yes	yes
Industry-level controls	yes	yes	yes	yes
Sector dummies	yes	yes	yes	yes
Observations	7858	7858	7858	7858
R^2	0.018	0.009	0.010	0.010

The dependent variable at the top of the column: log of unit values, markups, log unit average costs and log product tfpq. Δ denotes changes in a variable before/after the FTA. Variable $Diff_j$ is defined as the share of products within an industry that is non exchanged on a organized base. Firm level controls includes employment measured in efficiency measured before FTA. Industry controls includes demand elasticity and skill intensity measured at 4-digit ISIC industry in the US. Standard errors in brackets clustered at 4-digit ISIC industry level. * $p<0.10$, ** $p<0.05$, *** $p<0.01$. Significance level.

Table 10: Robustness

	Δ Markup	Δ Prices	Δ Costs	Δ TFPQ
	(1)	(2)	(3)	(4)
Panel A: Exclude from sample 2003 and 2004				
$\Delta\tau$	0.2422	1.0267***	0.8432***	-2.0695***
	[0.151]	[0.266]	[0.313]	[0.743]
Firm-level controls	yes	yes	yes	yes
Industry-level controls	yes	yes	yes	yes
Sector dummies	yes	yes	yes	yes
Observations	5786	5786	5786	5786
R^2	0.025	0.009	0.012	0.011
Panel B: Sub Sample of non exporting firms				
$\Delta\tau$	0.1124	1.1969***	0.9415**	-2.2592**
	[0.126]	[0.368]	[0.364]	[0.883]
Firm-level controls	yes	yes	yes	yes
Industry-level controls	yes	yes	yes	yes
Sector dummies	yes	yes	yes	yes
Observations	6126	6126	6126	6126
R^2	0.016	0.009	0.011	0.014
Panel C: Control for import competition				
$\Delta\tau$	0.0591	0.4869**	0.4763**	-1.0153*
	[0.150]	[0.214]	[0.191]	[0.531]
[1ex] Firm-level controls	yes	yes	yes	yes
Industry-level controls	yes	yes	yes	yes
Sector dummies	yes	yes	yes	yes
Observations	7858	7858	7858	7858
R^2	0.017	0.009	0.010	0.009

The dependent variable at the top of the column: log of unit values, markups, log unit average costs and log product tfpq. Δ denotes changes in a variable before/after the FTA. Dependent variable trimmed below the 3rd and above the 97th percentile. Firm level controls includes employment measured in efficiency measured before FTA. Industry controls includes demand elasticity and skill intensity measured at 4-digit ISIC industry in the US. In Panel C we add to the regression the change in the share of import from the EU, the US, and South Korea measured at industry level as additional control. Standard errors in brackets clustered at 4-digit ISIC industry level. * $p<0.10$, ** $p<0.05$, *** $p<0.01$. Significance level.