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Measuring Adjustments in Markups in Response to the Free Trade Agreement: An Analysis of the Pakistani Firms Gaining Market Access to Chinese Markets

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Abstract: *Adjustments in markups in response to a policy change like opening to trade are important for firms in order to make strategic decisions. These changing firm dynamics are also of great concern for the government authorities, particularly when formulating policies regarding competition. In this study, we investigate the impact of the Free Trade Agreement (FTA) between Pakistan and China on product and firm level markups, marginal cost, and prices. We specifically focus on the textile firms in Punjab, Pakistan. Using detailed disaggregated output and price data at the product level, we estimate markups based on the methodology by De Loecker, Goldberg, Khandelwal, and Pavcnik (2016). We also use the De Loecker & Warzynsksi's (2012) methodology together with the System GMM (Blundell and Bond (1998)) and Gandhi, Navarro, and Rivers (2020) framework. Our results suggest that firms exporting to China reduced prices by indulging in dynamic pricing as a way to compete with other world competitors within the Chinese market. We find evidence of a fall in marginal costs due to reduction in X-inefficiencies. However, there is lack of heterogeneity within the products exported to China. This limits the scope of quality differentiation and markup margins. We also find evidence of pro-competitive effects.*

Keywords: Firms, trade, markups, marginal cost.

JEL Classification: D22,D23, F14, F61, L11

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1. Introduction

The discussion on markups has always been crucial in the literature on firm dynamics. Policy makers have been interested in how changes in the level of competition under various policy measures impacts firm's market power, commonly estimated through adjustments in markups. We study markup heterogeneity in light of the policy of opening up to trade and examine the consequences of exogenous policy shock of reduced tariffs and increased export market opportunities in a developing country context.

In 2006, Pakistan and China signed a Free Trade Agreement (FTA) where both the countries lowered tariffs to increase trade flows. The aim of the FTA was to strengthen ties between both the countries by encouraging diversification and expansion of trade across borders. Lower tariffs on both sides resulted in an overflow of Chinese products inside Pakistan. The Pakistani firms, on the other hand also enjoyed a higher access to the Chinese markets. Gaining access to foreign markets because of the trade agreements can impact a firm's ratio of price to marginal cost (i.e., markups) (Jafari, Koppenberg and Hirsch, 2022). We examine the adjustments in markups by focusing on the later case of Pakistani exporters gaining increased market access in China under the FTA by particularly analyzing the textile sector, the largest exporting sector of Pakistan.

Literature has explored how firms adjust prices and markups in response to trade policy changes or export market entry, although regular patterns are still emerging. India's trade liberalization led firms to face more competition from abroad but also gave them access to cheaper imported inputs. As a result, the firms reduced prices less than marginal costs fell, thereby increasing markups (De Loecker, Goldberg, Khandelwal & Pavcnik, 2016). Hornok & Muraközy (2019) find that imports have a strong positive correlation with markups for both within and across firms in Hungary, particularly due to quality improvements after having access to high quality inputs from developed countries. However, they find no correlation between export activites of a firm and its markup, particulary due to the higher competition in the export market as compared to the domestic market. Fan et al. (2018) find similar evidence of a stronger markup increase for Chinese firms with higher import dependence.

On the other hand, Garcia-Marin and Voigtländer (2019) find that price and marginal costs of firms in Chile, Colombia, and Mexico fell almost in tandem when tariff reductions of export partners increased market access abroad, so that markups increased little, if at all. In contrast, liberalization of tariffs induced by the WTO accession led Ghanaian firms to reduce markups (Damoah, 2021).

A growing branch in literature compares the trade status with markups. Bellone, Musso, Nesta, & Warzynski (2016) argue that opening up to trade has two counterbalancing effects on the domestic exporters. On one hand is the price depressing effect due to freight cost absorption, which is stronger the more distant the export market is. On the other hand is the price increasing effect that works through a quality increasing channel, which is stronger the larger the export market is. They find evidence for French exporters that the scope for quality differentiation is higher in the export market than in the local market, hence markups are higher for exporters as compared to non-expoters. De Loecker & Warzynski (2012) find similar results of increased markups for exporters after the Slovenian firms gained export market access after the fall of the Eastern Bloc.

Moreover, the literature on the estimation of markups itself has evolved over time. The first generation models were based on strong assumptions regarding the nature of competition (Dixit–Stiglitz model assumed monopolistic competition without allowing for markup heterogeneity; the pure price models under Bertrand competition had limited implications of markup heterogeneity). Later works have attempted to allow for markup heterogeneity in various settings. Bernard et al., (2003) allows for heterogeneity amongst plants by introducing Bertrand competition in a Ricardian setting while the work by Melitz (2003) is based on a monoplistic setting with an extension of Krugman's (1980) model to allow for firm level productivity differences. Later works by Melitz & Ottaviano (2008) allow productivity and markups to vary according to market size and the extent of trade integration. Their model allows for more productive firms to have a higher markup along with higher profits. Using a monoplistically competitive model they generate markups based on the of the difference between firm's marginal cost and the cutoff marginal cost. Bellone et al., (2016) build on the Melitz & Ottaviano (2008) model by allowing for quality differences across firms and by allowing for firms location to impact its performance. Blas & Russ (2015) build on the Bernard et al., (2003) model by incorporating price rigidity and a finite number of rival firms in the model to allow trade costs and differences in technology to influence the markup distribution.

In this study, we estimate the production function to back out output elasticities needed for markup estimation by using both the proxy variable approach (as done by Olley & Pakes (1996) and Levinsohn & Petrin, (2003) with further modifications done by Ackerberg, Caves, & Frazer (2015)) and the dynamic panel methods approach based on using internal instruments (as done by Arellano & Bond (1991), Arellano & Bover, (1995) and Blundell & Bond (1998)). For the first part we use the methodology developed by De Loecker, Goldberg, Khandelwal, and Pavcnik (2016) (hence DGKP) to estimate markups. Their methodology helps correct for unobserved input price bias and unobserved input allocation bias in addition to the omitted price bias, something almost completely ignored in literature. Moreover, their estimation of the production function and markups is without assuming any level of compeition, consumer demand or market structure as done in much of the literature. Next, we estimate the output elasticities based on Blundell and Bond (2000) System GMM methodology (hence System GMM) with and without external instruments (based on Roux et al., 2021) under the dynamic approach model. We combine these output elasticities with the the De Loecker & Warzynsksi's (2012) (hence DW) methodlogy to compute markups. As an additional step, we also rely on Gandhi, Navarro, and Rivers (2020) (hence GNR) estimation of output elasticities in context of De Loecker & Warzynsksi's (2012) framework to compute markups due to the underlying differences in the model assumptions.

With this paper, we aim to contribute to the literature by exploring how increase in foreign market access under trade liberalization impacts markups. We measure markup and marginal cost both at the product level (based on DGKP) and at the firm level (based on DW). We are able to do this due to our rich data set which has disaggregated output and price information not just at the firm level but at the product level. Hence, we have product, firm and time variation in our data set something rare in most of the firm level studies. This disaggregated data helps us correct for the omitted price bias rather than relying on sectoral deflators. In addition, it allows us to control for unobserved input price bias and unobserved input allocation bias for multi-product firms as in DGKP. Moreover, this data set also allows us to take quality concerns into account as raised by Atkin et al. (2019) in our measure of markups.

Our results point out towards the idea of dynamic pricing as suggested by Garcia-Marin & Voigtländer (2019) where the firms exporting to China reduce their prices in order to compete with other firms within the Chinese market. Marginal costs did fall as a result of the FTA indicating the presence of productivity improvements for the exporters but the markup, at least at the firm level remains unresponsive to trade liberalization. Much of this is due to the fact that within the textile industry, Pakistan has mainly been exporting spinning products to China. Products within the spinning segment are less heterogeneous and have limited scope for quality differentiation as compared to products within other segments like clothing, finishing or interior. Thus, Pakistan has been exporting products to China which have a lower markup margin to begin with.

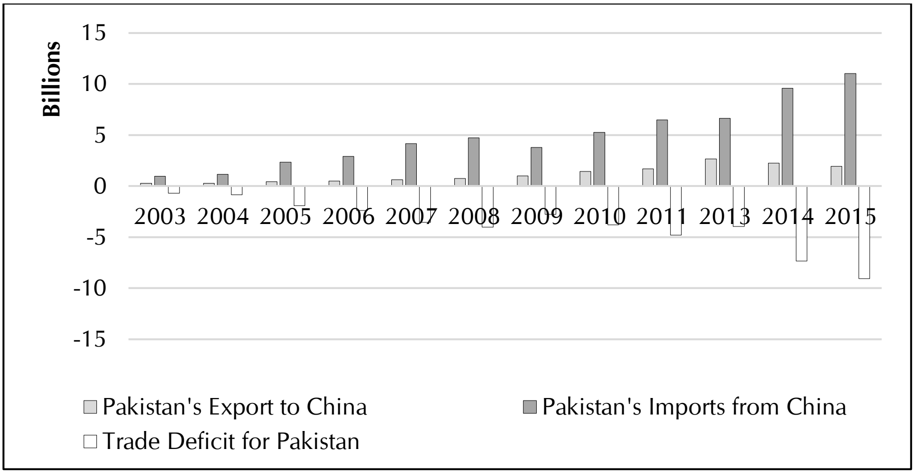
The rest of the paper is organized as follows. Section II describes the Free Trade Agreement between Pakistan and China. Section III discusses the empirical methodologies used to estimate markups and marginal costs both at the product level and at the firm level. Section IV describes the data used in the study. Section V discusses the results and section VI concludes.

2. Pakistan China Free Trade Agreement (FTA)

Pakistan and China are neighboring countries enjoying friendly political and economic relations. In 2006, both the countries negotiated on tariffs to enhance trade and to further strengthen their relation. The FTA between both the countries was designed in two phases. The first phase ended in 2012 and the second phase began in 2013. Diplomatic relations between both the countries have further improved after the China-Pakistan Economic Corridor (CPEC) project under China's One Belt One Road initiative.

Despite being a great opportunity for both the countries, the trade imbalance has increased in favor of China as opposed to Pakistan. Figure 1 shows that despite an increase in the Pakistani exports to China, the imports from China have increased at a faster pace making China the one to gain from the FTA. China has availed 57% of the concessions available under the FTA while Pakistan has only been able to avail 5% of the concessions (Mukhtar, 2019).

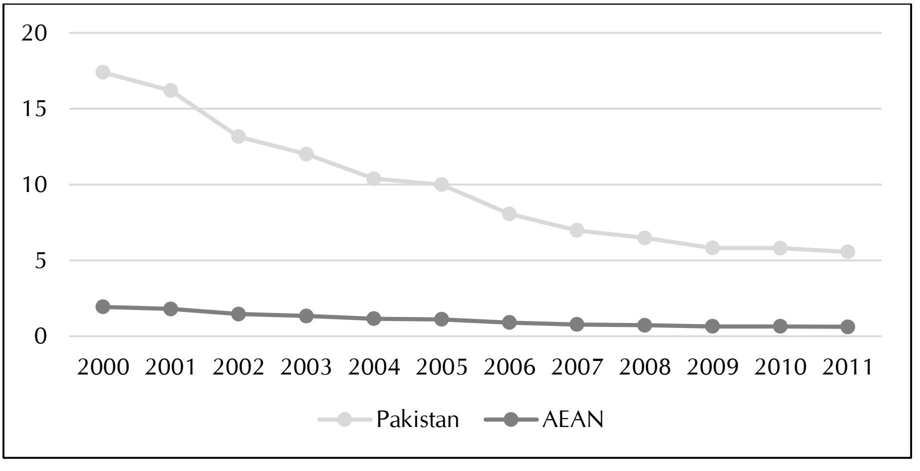
Figure 1: Trade FLows between Pakistan and China (US $ Billions)



Source: UN Comtrade Data.

One of the potential reasons for this is that even though China has lowered its tariffs on the Pakistani goods after the FTA, the tariff rates imposed by China on the products from the ASEAN countries are much lower (see Figure 2).

Figure 2: China's Average Tariff Rates (%) for Pakistan and ASEAN countries



Source: World Integrated Trade Solution (WITS).

In table 1a-1e, we further look at the FTA by specifically focusing on the largest exporting sector of Pakistan i.e., the textile sector. Dividing the textile sector into five segments namely, spinning, clothing, interior, finishing and technical we see that even after a decade of the FTA (as of 2017) Pakistan has only been able to make it amongst the top 5 import countries for China in the spinning segment[1].

According to Afraz and Mukhtar (2020) under the FTA "Priority 1" products for Pakistan are the ones which have the highest export potential within China with 401 product codes falling within this category. After the second phase of the FTA, Pakistan exported $1.6 billion worth of these products to China against China's world import of $148.8 billion. "Priority 2" products are the ones in which Pakistan has already established itself in the world market and China is an established world importer of these products. Within this category there are 391 product codes for which Pakistan has apoor access as compared to its world competitors within the Chinese market. This includes important textile product categories like 15 product codes within the cotton yarn category and 56 products codes within the non-cotton and man-made fiber men and women knitted garments category. "Priority 3" products are the ones which China imports, but Pakistan doesn't export which could be Pakistan's potential new exports. Within this category, 12 percent of the product lines for Pakistan still have higher tariffs imposed by China as compared to its high value trade partners.

Table 1A-1E: China's Principal Suppliers Segment Wise for the year 2017

Table 1A: Spinning Segment

Countries	Rank	No of Lines	Share	Value (thousands of US $)
Total		**62**	**100.00**	**5,168,998**
Vietnam	1	34	36.62	1,892,769
India	2	34	20.66	1,067,759
Pakistan	3	16	15.87	820,271
Indonesia	4	22	7.89	407,877
Uzbekistan	5	8	4.36	225,355
Chinese Taipei	6	47	3.63	187,573
Bangladesh	7	4	2.10	108,545
United States of America	8	35	2.09	107,873
Malaysia	9	13	1.89	97,579
Korea	10	49	1.56	80,679

[1] The products are classified into five segments as done by De Leocker (2011).

Table 1B: Clothing Segment

Countries	Rank	No of Lines	Share	Value (thousands of US $)
Total		**143**	**100.00**	**4,238,872**
European Union	1	143	21.87	927,020
Vietnam	2	103	17.29	732,724
Bangladesh	3	76	7.64	323,972
Korea	4	68	6.86	290,978
Chinese Taipei	5	95	6.82	289,128
Korea	6	128	6.29	266,579
Japan	7	129	5.20	220,591
Indonesia	8	82	4.47	189,617
Turkey	9	103	4.36	184,991
Cambodia	10	76	4.36	184,858
Pakistan	13	51	1.14	48,524

Table 1C: Interior Segment

Countries	Rank	No of Lines	Share	Value (thousands of US $)
Total		**135**	**100.00**	**441,922**
European Union	1	128	16.52	73,010
Korea	2	81	12.71	56,154
India	3	100	10.83	47,654
Japan	4	95	10.55	46,638
Chinese Taipei	5	72	9.78	43,211
United States of America	6	95	7.16	31,663
Turkey	7	71	6.79	30,021
Pakistan	8	39	6.17	27,286
Thailand	9	57	4.43	19,556
Bangladesh	10	25	2.86	12,623

Table 1D: Finishing Segment

Countries	Rank	No of Lines	Share	Value (thousands of US $)
Total		**126**	**100.00**	**2,200,595**
Japan	1	119	29.99	659,858
European Union	2	112	14.58	320,894
Korea	3	112	13.86	304,959
Chinese Taipei	4	94	11.91	262,005
United States of America	5	109	8.57	188,689
Thailand	6	65	5.03	110,640
Vietnam	7	59	3.06	67,438
Malaysia	8	47	2.25	49,536
Pakistan	9	32	1.70	37,375
Indonesia	10	52	1.68	37,035

Table 1E: Technical Segment

Countries	Rank	No of Lines	Share	Value (thousands of US $)
Total		**32**	**100.00**	**422,353**
European Union	1	32	23.93	101,080
Japan	2	31	19.36	81,761
Chinese Taipei	3	31	13.08	55,230
Korea	4	29	12.79	54,036
United States of America	5	30	7.27	30,699
India	6	18	4.46	18,830
Hong Kong, China	7	17	3.65	15,407
Vietnam	8	20	3.21	13,545
Thailand	9	18	2.97	12,537
Indonesia	10	17	2.15	9,079
Pakistan	37	4	0.00	13

Source: World Trade Organization (WTO) Tariff Analysis.

3. Empirical Methodology

In this section we discuss the estimation techniques used in this study. We estimate product level markups and marginal costs using the methodology developed by De Loecker, Goldberg, Khandelwal, and Pavcnik – DGKP (2016). Firm level markups and marginal costs are estimated by using the methodology developed by De Loecker & Warzynsksi (2012). We discuss both methodologies below.

Product Level Markup and Marginal Cost Estimation based on De Loecker, Goldberg, Khandelwal, and Pavcnik – DGKP (2016)

DGKP's (2016) methodology works well in the case of multi-product firms especially when disaggregated price and physical quantity data is available, as in our case. The main contribution of this methodology is that it estimates product level production function (as compared to firm level production function- which is the standard case in literature). Hence, the marginal cost and markups are estimated at the product level. In addition to this advantage, the DGKP methodology has added benefits of avoiding strong assumptions related to consumer demand, market structure or the nature of competition. Moreover, this methodology contributes to literature by addressing newer biases in production literature which are hardly ever addressed including the *omitted input price bias* and *unobserved allocation of the inputs* across firms producing multiple products.

Using materials as a proxy variable (flexible input) in the control function, DGKP (2016) estimate a quantity based gross production function by using disaggregated physical output and price data at the product level. Using disaggregated data helps control for the omitted output price bias. To control for the omitted input price bias, DGKP use the idea that high quality inputs (which are complements in the production process with other inputs) make high quality output and by this definition, the output prices contain information regarding input prices. Assuming that input prices increase monotonically in input quality which impacts output quality, they express input prices as a function of output prices, market share and firm product dummies to proxy for input prices. They estimate the production function using only the single product firms to avoid the biases that arise due to input allocation across multiproduct firms. However, since the choice to become multiproduct firm isn't random and is based on firms' productivity, DGKP apply a sample correction procedure where firms self-select into being multiproduct based on a productivity threshold and its previous information set.

Finally, the production function is estimated using the GMM approach based on the moment conditions related to the innovation in the productivity shocks in line with Ackerberg, Caves, & Frazer (2015) (commonly referred as ACF approach) using materials as static input and capital and labor as dynamic inputs. Below we briefly describe how DGKP (2016) use their methodology to estimate markups and the marginal cost at the product level.

Production function for the firm *f* can be expressed as in equation (1) where it produces product *j* at the time *t*

$$Q_{fjt} = F_{jt}(V_{fjt}, K_{fjt})\Omega_{ft} \tag{1}$$

where Q is the physical output, V is a vector of variables inputs which are adjust freely and K is a vector of fixed inputs which have some adjustment cost.Ω_{ft} is the firm specific productivity. J_{ft} are the number of products produced by firm *f* at time *t*. Defining W^{v}_{fjt} as the vector of variable input prices and W^{K}_{fjt} as a vector of dynamic input prices and assuming that the production function F_{jt} is continuous and twice differentiable with respect to at least once variable input V_{fjt}, the firms minimize their costs by taking output quantity and input prices W_{fjt} as given at the time *t*. The

Lagrangian for the cost minimization problem for firm *f* producing product *j* at time *t* can be written as:

$$L(V_{fjt}, K_{fjt}, \lambda_{fjt} = \sum_{v=1}^{V} W_{fjt}^{v} V_{fjt}^{v} + \sum_{k=1}^{K} W_{fjt}^{K} V_{fjt}^{K} + \lambda_{fjt}[Q_{fjt} - Q_{fjt}((V_{fjt}, K_{fjt}, \Omega_{ft})] \quad (2)$$

Taking the derivative with respect to any variable input V^V used in the production of product *j* and letting λ_{fjt} be the marginal cost we get

$$\frac{\partial L_{fjt}}{\partial V_{fjt}^{V}} = W_{fjt}^{v} - \lambda_{fjt} \frac{\partial Q_{fjt}(.)}{\partial V_{fjt}^{V}} \quad (3)$$

Rearranging and multiplying both sides of the equation with $\frac{V_{fjt}}{Q_{fjt}}$ we get

$$\frac{\partial Q_{fjt}(.)}{\partial V_{fjt}^{V}} \frac{V_{fjt}}{Q_{fjt}} = \frac{1}{\lambda_{fjt}} \frac{W_{fjt}^{v} V_{fjt}}{Q_{fjt}} \quad (4)$$

The left-hand side expression of equation (4) represents the output elasticity with respect to the variable input V^V. Denoting the output elasticity as $\theta = \frac{\partial Q_{fjt}(.)}{\partial V_{fjt}^{V}} \frac{V_{fjt}}{Q_{fjt}}$ and defining the markup as $\mu_{fjt} = \frac{P_{fjt}}{\lambda_{fjt}}$, expression (4) can be written as:

$$\mu_{fjt} = \theta_{fjt}^{V} \left(\frac{P_{fjt} Q_{fjt}}{W_{fjt}^{V} V_{fjt}^{V}} \right) = \theta_{fjt}^{V} (\alpha_{fjt}^{v})\text{-}1 \quad (5)$$

where α_{fjt}^{v} is the share of variable input V^V allocated in the production of product *j* in the total sales of product *j*. Both the components of expression (5) are unobservable in the case of a multi-product firm since all the variables are indexed by product *j*. In contrast to this, in the case of a firm level analysis, the output elasticity with respect to the variable input is directly estimated using a production function, typically based on using deflated revenues. While the firm specific input share is directly observed in the data. This approach of estimating the production function at the product level relies on estimating the output elasticity separately for each product manufactured and is based on estimating the product level share of every input, something which is rarely ever observed in the data[2].

Therefore, DGKP (2016) rely on developing a unique methodology to estimate the product level production function as in (5). Once the product level markupμ_{fjt} is estimated, the product level marginal cost is then derived as:

$$mc_{fjt} = \frac{P_{fjt}}{\mu_{fjt}} \quad (6)$$

In order to estimate the production function at the product level to compute output elasticities the production function defined in (1) is expressed in logs:

$$q_{fjt} = f_j\ (\chi_{fjt}; \beta + \omega_{ft} + \varepsilon_{fjt} \quad (7)$$

where $q_{fjt}$is the log of output which is a function of χ_{fjt}which represents a vector of the log of physical inputs $\{V_{fjt}, K_{fjt}\}$where *β* represents the respective coefficients. ω_{ft} is the log of productivity.

Let $\tilde{\chi}_{ft}$ be the observed vector of price index-deflated input expenditures. Product-level input quantities $\chi_{fjt}$for each input are then given as:

$$\chi_{fjt} = \rho_{fjt} + \tilde{\chi}_{ft} - w^{x}_{fjt} \quad (8)$$

whereρ_{fjt} is the share of firm input expenditures allocated to product *j* at time *t* (in logs) and w^{x}_{fjt} is the deviation of the unobserved firm-specific input prices from the industry-wide input price index (in logs). Substituting this expression of physical inputs into equation (7) and denoting w_{fjt}as a vector of log firm product specific input price, DGKP (2016) obtain:

$$q_{fjt} = f_j\ (\tilde{\chi}_{ft}; \beta + A \quad (9)$$

Equation (9) in comparison to (7) has two additional unobserved terms: *A(.)* represents the *input allocation bias* which is present due to the unobserved product-level input allocation ρ_{fjt} and *B(.)* represents the

[2] Input allocation across multiple products produced by a firm is hardly observed in any micro data set. Hence, many studies have made assumptions regarding this allocation based on the number of products (De Loecker (2011)) and revenue shares (Foster et. al (2008)).

input price bias which arises due to the unobserved firm-specific input prices w_{fjt}.

In order to estimate the production function, DGKP (2016) rely on single product firms which makes the term $A(.) = 0$ since $\rho_{fjt} = 1$ in that case. Equation (9) can now be written as:

$$q_{fjt} = f_j\ (\chi_{ft}; \beta + B\left(w_{fjt}, \rho_{fjt}, \chi_{ft}, \beta\right) + \omega_{ft} + \varepsilon_{fjt} \quad (10)$$

The main idea behind the DGKP (2016) approach is that the physical relation between the inputs and output is the same for both the single and multi-product firms which manufacture the same product and that the technology used to produce product *j* is independent of the technology used to produce other products by the firm. This input-output relation for single product firms then helps to estimate the input allocation across multiproduct firms.[3]

Using single product firms may however raise the issue of selection bias since firms' self-select into being a multiple product firm. A selection correction procedure is implemented to correct for this based on a productivity threshold and firms information set.

Their methodology next considers addressing the omitted input price bias in *B(.)* in equation (10). Assuming higher input quality (the expensive inputs) produce higher output quality, the input prices $w^x_{fjt}$are written as function of output quality $v_{ft}$and firm location G_f:

$$w^x_{fjt} = w_t\left(v_{ft}, G_f\right) \quad (11)$$

where output quality$v_{ft}$is estimated based on output price of the firm p_{ft}, vector of market sharems_{ft}, vector of product dummies $D_{f,}$ and export status of the firm exp_{ft}.Hence equation (11) can be written as:

$$w^x_{fjt} = w_t\left(p_{ft}, ms_{ft}, D_{f,} exp_{ft}, G_f\right) \quad (12)$$

Finally, the production function is estimated using the GMM procedure. Once the estimates of the production function are obtained, they are then used to back out the input allocation across multi-product firms by

[3] Using this input-output relationship, a single product firm manufacturing motorcycles will use the same technology as a multiproduct firm manufacturing motorcycles and cars.

simultaneously solving a system of $J_{ft} + 1$ equations for each multi-product firm where J_{ft} is the number of products produced by firm *f* in time *t*. This then helps to back out firm level productivity and product level markups and marginal cost as mentioned above.

Firm Level Markup and Marginal Cost Estimation based on De Loecker & Warzynksi (2012)

De Loecker & Warzynski (2012) introduce an empirical method for the estimation of firm level markups based on the standard cost minimization problem by relying on the variable input which have free adjustment costs. This framework estimates markups based on the output elasticity of the variable input and the share of the variable input's expenditure in total sales.

Assume firm *i* in time *t* has a production technology as follows

$$Q \;\; = Q \;\; ....., X^V, K \;\; , \omega \;\;) \qquad (13)$$

where V is a set of variable inputs like labor, materials, and other intermediate inputs. Moreover, the firm relies on the capital stock K which is dynamic in the production process. The only two assumptions to estimate markups are that Q (.)is continuous and is twice differentiable with respect to its elements[4].

Assuming producers indulge in cost minimization, the Lagrangian function associated with the problem can be written as

$$L ....., X^V, K \;\; , \lambda \;\;) = \sum_{v=1}^{V} P^{X^v} X^v + r \;\; K \;\; + \lambda \;\; (Q \;\; - Q \;\; (.)) \qquad (14)$$

where P^{X^v} are the prices for the variable input *v* and r is the price of capital. The FOC with respect to the variable input (without adjustment cost) gives us

$$\frac{\partial L}{\partial X^v} = P^{X^v} - \lambda \;\; \frac{\partial Q \;\; (.)}{\partial X^v} = 0 \qquad (15)$$

[4] This expression can encompass both a value-added function and a gross output function. In the former case, only labor and capital enter the input set while in the former the input set in addition to labor and capital is a function other intermediate inputs e.g., materials.

where λ is the marginal cost of production[5]. Rearranging and multiplying both sides of the expression by $\frac{X}{Q}$ we get:

$$\frac{\partial Q\quad(.)}{\partial X^{v}}\frac{X^{v}}{Q}=\frac{1}{\lambda}\frac{P^{X^{v}}X^{v}}{Q} \tag{16}$$

The above expression implies that the output elasticity of the variable input X^{v} should equal to its cost share $\frac{1}{\lambda}\frac{P^{X^{v}}X^{v}}{Q}$. This can be referred to as the *conditional cost function* as under this cost minimization problem we can simply condition on the use of dynamic inputs like capital (or any other inputs which has adjustment costs) without having to solve for the full firm dynamic problem. This helps in avoiding having to make more assumptions needed to estimate markups. It's worth noting that this holds for any cost minimizing firm irrespective of the competition and underlying demand structure.

As the last step to recover markups μ let it be defined as $\mu \equiv \frac{P}{\lambda}$. Using this definition of markup[6] the above equation can be written as

$$\theta^{X}=\mu\quad\frac{P^{X}X}{P\quad Q} \tag{17}$$

where θ^{X} is the output elasticity of input X . Rearranging we get

$$\mu \quad =\theta^{X}\left(\alpha^{X}\right)^{-1} \tag{18}$$

where α^{X} is the share of the expenditure of input X in the total sales $P \quad Q$. To estimate the markups, one only requires estimating the output elasticity of one (or more) of the variable input(s) which can be done by estimating the production function. The latter term of the expression is directly observed in most of the micro data sets. For our analysis, we

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[5] This is the marginal cost since $\frac{\partial L}{\partial Q}= \lambda$

[6] This expression for markup as a ratio of price over marginal cost is robust in various price (static) setting models and does not depend on a particular form of price competition amongst firms. However, it will depend on the specific nature of competition amongst firms. One restriction imposed is that prices are set period by period ruling out any cost adjustments of changing prices. Markups, however, will depend on the interaction amongst firms and the strategic interaction between them. We direct the reader towards the online appendix of De Leocker & Warzynski (2012) for discussion on some leading cases in this.

estimate the output elasticity by using an extended or system GMM estimator (Blundell & Bond, 2000) and Gandhi, Navarro, and Rivers -GNR (2020) methodology.

The extend or system GMM estimator (Blundell & Bond, 1998) helps us obtain the output elasticities with respect to the variable input helping us estimate markups and marginal cost strictly at the firm level (as opposed to product level). The system GMM is based on a differenced equation (using level of inputs as instruments) and an equation in levels (using differenced inputs as instruments).

In order to estimate the output elasticities using the system GMM we add in external instruments for labor and materials in addition to the internal instruments as used in the standard system GMM. Following Roux et al. (2021) we instrument labor using a measure of "bite" based on the ratio of the minimum wage as set by the government to the average wage paid by the firm. Once we have the measure of bite, we interact it with the change in minimum wage. This predicted change in the wage is then used as an instrument for labor. For materials, we use the exogenous variation in input prices as an instrument. A firm's demand for input x_{ft} will not only be based on its quality but also on the input price v_{ft}. Our argument is that a change in the prices of *other* goods that use the same input x will result in a shift in the input demand and hence, serves as an exogenous source of variation for input price v_{ft}. For this, we create a weighted average of the output prices that use a particular input to serve as a proxy for the demand for each material input. The material instrument for each firm is then constructed using firm's input expenditure as weights.

We also estimate the output elasticities to estimate firm level markups based on the GNR (2020) methodology. The GNR (2020) is based on the gross output production function. Collinearity may arise when output elasticity is estimated using materials as a fully flexible input. To correct this, they introduce additional restrictions based on the firm's first order conditions. The first order conditions are transformed into "share equations" which non-parametrically identify output elasticity with respect to materials[7].

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[7] If one is further interested to back out the capital and labor coefficients based on the GNR (2020), the next step is to rely on partial differential equations for the production function and integrate them based on moment conditions on innovation in productivity which follows the Markov process. This last step then helps recover the capital and labor coefficients.

Comparing the assumptions of the three methodologies used in this paper: DGKP (2016), system GMM (Blundell & Bond, 1998) and GNR (2020), the DGKP (2016) is based on the Olley-Pakes (1996) proxy variable technique where the timing of the firm's input usage is based on firm's knowledge of its idiosyncratic productivity which itself follows a Markov process. This technique assumes a monotonic relationship between firm productivity and the flexible input (materials in this case) to form the control function. The system GMM also relies on the timings of the input choices, but unlike the typical proxy variable techniques like Olley-Pakes (1996), it allows for firm fixed effects. Hence, it imposes more structure on the dynamics of firm level productivity based on the AR(1) process. The second equation based on levels using lagged differences as instruments allows stationarity to be imposed. Ackerberg (2016) comparing these assumptions of these models suggest that the tightening the timing assumption by just one more period in a proxy variable method case like the DGKP (2016) is almost equivalent to the gain with adding in the stationarity assumption under the GMM. GNR (2020) on the other hand assumes perfect competition both in the input and the output market while the system GMM and DGKP do not assume any explicit nature of competition in any market.

4. Data Sources

In this section we briefly describe the data sources used in this analysis.

Census of Manufacturing Industries (CMI) Punjab, Pakistan

Census of Manufacturing Industries (CMI) is a firm level census conducted after every 5 years by the Punjab Bureau of Statistics in Pakistan. It is a detailed survey containing information regarding firm's revenue along with its input usage including different capital stock measures, labor cost and energy utilization. We use three waves of the CMI conducted for the years 2000, 2005 and 2010 to construct an unbalanced panel data set for the firms in Punjab, Pakistan.

In our study, we focus on the textile sector which is the largest exporting sector of Pakistan. The main advantage of our data set is that unlike most of the micro data sets, it contains disaggregated prices and quantities details for each firm f at product level j for time period t. Hence, we have three variations in our data set, at the time, firm, and product level[8]. Using the actual output of the firm rather than relying on sectoral deflators helps us in eliminating the omitted output price bias in our estimation.

Table 2: Firm level summary stats for Textile Manufacturers according to the CMI

	Exporters			Non- Exporters		
	Pre FTA		***Post FTA***	***Pre FTA***		***Post FTA***
CMI Year	*2000*	*2005*	*2010*	*2000*	*2005*	*2010*
Capital (PKR)	362,840	506,279	654,148	217,971	276,705	325,222
Labor	445	456	475	161	252	266
Materials (PKR)	364,714	413,323	1,410,323	155,008	180,341	193,270
Number of Firms	90	108	147	433	366	378

Source: Based on authors' own calculation using the CMI wave of 2000-01, 2005-06 and 2010-11.

Table 2 shows us the size of the firms (as measured by their inputs) for exporters and non-exporters both pre-FTA (year 2000 and 2005) and post-FTA (year 2010). We can clearly see that the exporters to begin with are much bigger in terms of inputs than the non-exporters. Even after the FTA, the exporters remain much bigger as compared to the non-exporters[9].

Textile Export Transactions Database

We use the textile export transaction data set to identify firms which export specifically to China. This data set contains detailed information regarding the export shipment for each textile firm in Pakistan from the year 2000-2011. It contains details of every export transaction with information regarding the exporting firms name, export destination, shipment date, shipment product code along with the shipment value.

We match this data set with the firms in the CMI to identify the firms in our analysis which export to China. Table 3 below shows the number of exporters reporting China as one of its export destinations.

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[8] This means that our data set allows us observe the changes in the product mix for each firm at different points in time.

[9] 1 PKR equals to approximately $ 0.0044 as in 2022. The values reported in the table are current PKR.

Table 3: Exporter matching between the CMI and Textile Export Transaction Data base

	Pre FTA		*Post FTA*
CMI Year	*2000*	*2005*	*2010*
Number of Exporting Firms in the CMI	90	108	147
Percentage of Exporters matched with the CMI reporting China as their export destination	26%	21%	14%

Source: Authors' calculations based on the matching of the CMI and the Export Transactions Database.

World Trade Organization (WTO) Tariff Data

We use the World Trade Organization (WTO) Tariff Analysis Online Database to get information regarding the tariff rates applicable to each product in our analysis. The products are identified under the Harmonized System (HS codes) both in the CMI and the WTO tariff data. We focus on the tariffs imposed by China on the textile products imported from Pakistan. We use the product level tariffs as available in the case for our product level analysis. For the firm level analysis, we aggregate the product level tariffs using product revenue shares as weights to identify tariffs at the firm level.

5. Results and Discussion

We examine the impact of the Pakistan-China FTA on the prices, marginal costs, and markups of the textile firms in Punjab, Pakistan. The purpose of this is to s the extent to which firms adjusted their mark-ups and took advantage of the tariff reductions by move along the demand curve in order to capture a larger market share.

In order to test this, we analyze how marginal costs and markups have evolved with the FTA according to the export status of each firm. We begin with presenting the product level estimates of markups and marginal cost based on the methodology by DGKP (2016). We then present the results at the firm level based on the output elasticities obtained using the system GMM and the GNR approach in the De Loecker & Warzynsksi (2012) framework.

Product Level impact of the FTA on Markups, Prices and Marginal Costs

We study the impact of the FTA on markups, prices and marginal costs using equation (19):

$$Y_{jft} = \alpha_t + \alpha_s + \alpha_{st} + \gamma\tau_{jt} + \theta C_{ft} + \varepsilon_{jft} \qquad (19)$$

whereY_{ft} is the markup, price, and marginal cost respectively of product *j* produced by firm *f* at time *t*. α_t represent the year fixed effects, $\alpha_s$represent the segment fixed effects within the textile sector, and α_{st} are segment-year fixed effects[10].τ_{jt} are the product level tariff rates imposed by China on product *j* at time *t* for the textile firms in Pakistan. ***C*** is a vector of controls including pre-FTA inputs, productivity, quality, and number of products produced by firm *f* at time *t*. It also controls for the missing year dummies. ε_{jft} is the idiosyncratic error term. In addition to this, we also control for the product-firm fixed effects.

In order to understand how the impact of the FTA varies according to the export status of the firms, we divide the firms into three categories (i) *Exporters to China*: firms which are active in the Chinese market (ii) *Exporters to Other Destinations*: firms which export to countries other than China (iii) *Non-Exporters*: firms which are not active in the international market.

We extend equation (19) to allow for the export status of the firm according to our three categories along with the interaction of the export status with tariffs imposed by China to measure the impact of the FTA. The coefficient of this interaction term δ is our main variable of interest.

$$Y_{jft} = \alpha_t + \alpha_s + \alpha_{st} + B\left(\left(ExportStatus, ExportStatus * \tau_{jt}\right): \beta, \delta\right) + \theta C_{ft} + \varepsilon_{jft} \qquad (20)$$

Figure 3 show the product level distribution of markups, prices and marginal costs both before (2000-05) and after (2010) the Pakistan-China FTA went into effect for firms directly affected by the FTA i.e., the firms exporting to China. The distribution shows an apparent reduction in their

[10] Based on De Loecker's (2011) classification, we divide the textile sector into five segments: (i) finishing (ii) spinning, (iii) interior, (iv) clothing, and (v) technical.

markups and prices, although the marginal cost distribution seems more diffuse after the free-trade agreement.

Table 4: Impact of Pakistan-China FTA's Tariff Changes on Product-level Markup, Price and Marginal Cost in Pakistan's Textile Sector

Panel A: Impact of Tariff changes on Product Markup, Prices and Marginal Cost			
	Markup **(1)**	***Prices*** **(2)**	***Marginal Cost*** **(3)**
τ_{jt}	0.0151***	0.0057*	-0.0094*
	(0.0018)	(0.0033)	(0.0037)
N	2011	2011	2011
Panel B: Impact of Tariff changes on Product Markup, Prices and Marginal Cost by Export Status			
Exporters to China*τ_{jt}	0.0882***	0.1658***	0.0776***
	(0.0060)	(0.0103)	(0.0126)
Exporters to Other	-0.0029	-0.0438***	-0.0409***
Destinations*τ_{jt}	(0.0029)	(0.0050)	(0.0062)
Non-Exporters*τ_{jt}	0.0145***	0.0121**	-0.0024
	(0.0023)	(0.0040)	(0.0049)
N	2011	2011	2011

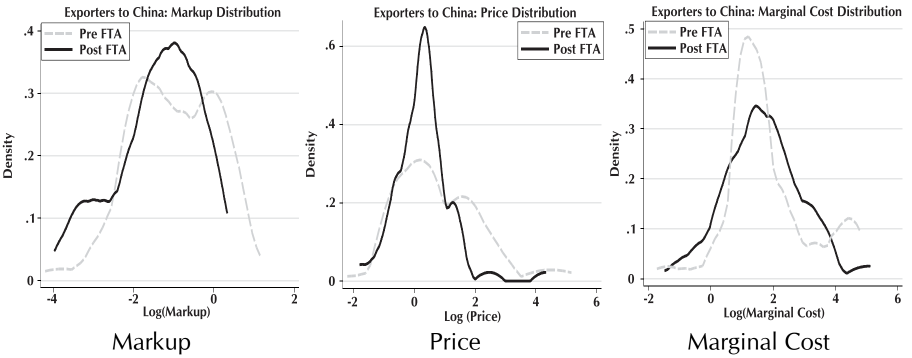
The table presents the analysis of the impact of product level tariff changes on product level markups, prices and marginal cost. Panel A shows the results of the impact of tariffs on markups, prices and marginal cost directly while panel B disaggregates the effect according to the export status of the firm. Controls include pre-FTA firm productivity, pre-FTA quality, Pre FTA-number of products, and firm inputs, dummies for missing data by year, segment, year and segment-year fixed effects. In addition to this, we also control for firm-product fixed effects. Robust Standard Error in parentheses.
***, **, * significant at 1%, 5% and 10% levels of significance respectively.

In Table 4, we see the impact of the tariff changes on the product-level prices, marginal costs, and markups. In Panel A we test the impact of tariff reductions on the markups, price, and marginal cost overall and in Panel B by the export status of the firm. From panel A, we can see that the tariff reductions under the FTA reduced the average product level markups and prices, while marginal cost slightly increases. When we explore the impact of the FTA according to the export status of the firm, we find that marginal costs and markups of firms exporting to China fell around 5 percent and prices fell around 10 percent.[11] Exporters to other destinations

[11] We multiply the coefficients by the average change in tariffs, which was 61.8% in our case to get the net impact.

raised their prices in response to higher marginal costs, while non-exporters lowered prices and markups marginally.

Figure 3: Distributions of Product Level Markups, Prices and Marginal Cost for firms Exporting to China



Source: Authors' Calculations based on CMI Punjab 2000-2001, 2005-06, 2010-11 using the methodology developed by DGKP (2016). The prices are the product level prices observed directly in the CMI dataset

Lamorgese, Linarello, & Warzynski (2015) get similar results in their study on the impact of the Chilean firms entering into three major FTAs with the US, the EU and the Republic of Korea. They find that the products directly exposed to tariff cuts experienced a fall in prices and unit average costs. However, markups in their case remained unaffected on average only increasing for differentiated good rather than homogeneous goods.

Yang (2020) examines the impact of China joining the World Trade Organization (WTO). With this, the Chinese firms faced lower export barriers and as a result, started exporting products which were only profitable in the domestic market. As a result, when these "domestic only" goods entered the product mix of exported products, the markups of exporters rose indicating that these domestic only goods were associated with a higher markups. However, with time, the Chinese firms noticed the potential to export products with lower markups. It took them some time to finally adjust their product mix in a more stable way. Once they finished adjusting their product mix and product switching, the exported products reverted back to the long term trend of being associated with lower markups. The possible explanation for this could be that Chinese firms exported products which were homogeneous in relation to the competitive industry (narrowly defined industry). Since such variety of products exported by the Chinese manufactures have a lower markup, this automatically resulted in lower markups over all.

The situtation of the exported Pakistani products is similar to Lamorgese, Linarello, & Warzynski (2015) and Yang (2020) . A possible reason for the fall in product level markups in our case could be that the main products Pakistan has been exporting to China have been relatively homogeneous. Figure 4 shows that the main exporting segment has been the spinning segment which is relatively homogeneous as compared to other segments like technical or clothing, which have a higher scope of product differentiation. This is mainly because under the FTA, Pakistan enjoys the lower tariffs on the products which are associated with the spinning segment as shown in figure 5. In other words, since Pakistan has been offered lower tariffs on products which belong to a relatively homogeneous segment and thus, have a lower margin for markup gains to begin with, the FTA overall has resulted in a lower product level markups.

Figure 4: Pakistan's Exports to China ($US Millions)- Segment Wise

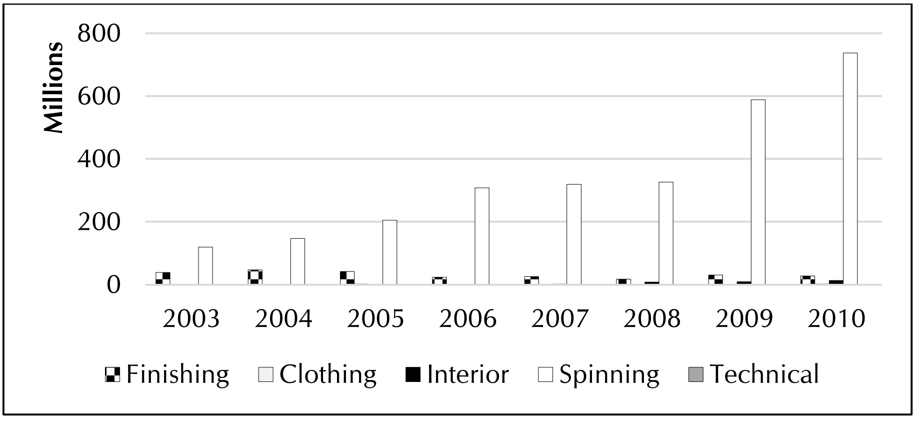
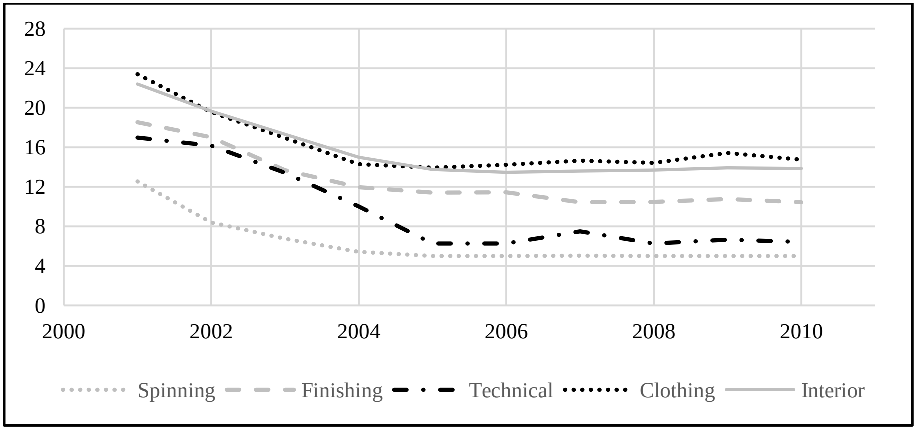


Figure 5: China's Segment Wise Tariff Rates for Pakistan



Firms exporting to China reduced their prices as a result of the FTA. This result is consistent with the idea of increased competitive pressure after output tariffs declines which ultimately leads the decline in prices. A 10 percentage point decline in tariffs is associated with a 1.658 percent decline in prices for firms exporting to China (as compared to 1.36 percent as in the study by DGKP(2016)). The average tariff decline under the FTA lead to a 10 percent decline in prices while the average decline in prices in the case of DGKP (2016) was around 8.4 percent[12].

Opening up to trade can move the marginal cost in either direction. Larger demand of the product might induce other firms to enter, or the firms might compete on inputs, driving the marginal cost up as a result of trade. Moreover, substantial quality improvements might also cause the marginal costs to increase. We see this as the case for the firms exporting to other destinations where the quality competition seems to be stronger due to larger market size (e.g., in the US or EU market) rather than in China.

For firms exporting to China, we see that the marginal costs fell, indicating an overall increase in productivity similar to Lamorgese, Linarello, & Warzynski (2015). There are several channels through which a fall in the marginal cost indicates productivity gains. Firms might self-select by reallocating resources either across firms or even across products within

[12] The average change in tariffs was 61.8% in our case. Hence, we multiply the coefficient with 61.8% i.e., (0.1658*61.8) to get an average price fall of 10.2 percent for the firms exporting to China. In the study on the Indian trade liberalization by DGKP (2016), the average tariff decline was of 62%. Hence the overall price decline was (0.136*62) 8.4 percent in their case.

firms or with reducing X-inefficiencies and with the adoption of better management practices (Bloom et al., (2013); Bloom, Draca, & Van Reenen (2016); Phan & Jeong (2016); Mayer, Melitz, & Ottaviano (2021)). Another branch of literature suggests that marginal cost might fall as firms increase productivity by investing more in R&D and capital (Bustos (2011); Stoyanov (2013); Peters, Roberts, & Vuong (2018); Maican, Orth, Roberts, & Vuong, (2020)).

In a follow up paper, we examine how this FTA impacted the productivity, quality, product mix and investment decision for Pakistani firms with in the textile sector. We find evidence that the firms exporting to China did increase in productivity by 3-8 percent while quality rose only by 1-2 percent. Since the productivity gains outweight the quality gains, falling marginal cost for firms exporting to China as a result of the FTA seems reasonable. Despite, these productivity gains, we find evidence that firms as a result of the FTA increased their labor and material usage, but not capital (Jamil, Chaudhry, & Chaudhry, 2022). Wadho & Chaudhry (2018) find similar results where the innovation activities amongst Pakistani textile exporters remained largely concentrated within the hand of the exporter active in larger markets like EU and US. Hence, while one branch of literature supports the idea that opening up to trade leads to more investments and R&D as the possible reason for the fall in marginal costs (Peters, Roberts, & Vuong (2018); Maican, Orth, Roberts, & Vuong, 2020) we find no such evidence in our case. On the other hand, the textile firms do reduce their product offerings as a result of the FTA, indicating reallocation of resources within the firms as a possible explanation for the fall in marginal costs (Jamil, Chaudhry, & Chaudhry, 2022).

While over all the product level markups fall in our case, as a result of a decline in product level prices and marginal costs, it will be misleading to say that pro-competitive effects exist (i.e., output tariff reductions put a downward pressure on markups). In order to conclude about the existence of pro-competitive effects, one needs to control for the impact of output tariff concessions on marginal costs in order to isolate its effect. For example, if output tariffs reduce X-inefficiencies in firms, and they end up reallocating resources, they might ultimately adjust their markups as a result of cost changes. This simultaneous effect of output tariff reductions on marginal costs and markups makes it difficult to comment on the existence of pro-competitive effects. Hence, to identify the pro-competitive effects, one needs to control for simultaneous shocks to marginal costs (DGKP, 2016).

Following DGKP (2016), we examine the impact of changes in output tariffs on markups conditional on marginal costs. This is done in order to isolate the direct effect of pro-competitiveness as a result of trade liberalization on product level markups. Results are presented in table 5. In column 1, we look at the impact of output tariffs on markups conditional on marginal costs. In column 2, we add in the interaction term *Exporters to China*$*\tau_{jt}$ to identify the existence of pro-competitiveness for firms exporting specifically to China.

Our results indicate the presence of pro-competitive effects of trade liberalization on product level markups. The coefficient in column (1) and (2) are significant and positive. Conditional on any potentially different impact of trade liberalization on the marginal costs, exporters to China with products which experience a 10 percentage point larger decline in tariffs experience a 1.067 percent relative decline in markups.

Table 5: Pro-Competitive Impact of Output Tariff on Product Level Markup

	Markup	
	(1)	**(2)**
τ_{jt}	0.0124***	0.0031**
	(0.0016)	(0.0015)
Exporters to China*τ_{jt}		0.1067***
		(0.0054)
N	2011	2011
Second- order polynomial of marginal costs	Yes	Yes

Controls include pre-FTA firm productivity, pre-FTA quality, Pre FTA-number of products, and firm inputs, dummies for missing data by year, segment, year and segment-year fixed effects. In addition to this, we also control for firm-product fixed effects. Robust Standard Error in parentheses.
***, **, * significant at 1%, 5% and 10% levels of significance respectively.

Firm Level impact of the FTA on Markups, Marginal Cost and Prices

We now examine the impact of the Pakistan-China FTA on firm level measures. We use the methodology by De Loecker & Warzynsksi (2012) designed to estimate markups and marginal cost at the firm level. We use the output elasticities based on the System GMM (Blundell & Bond, 1998) and GNR (2020).

We estimate equation (19) and (20) again but now without the subscript j. We now have the equations as:

$$Y_{ft} = \alpha_t + \alpha_s + \alpha_{st} + \gamma\tau^{firm} + \theta C_{ft} + \varepsilon_{ft} \tag{21}$$

$$Y_{ft} = \alpha_t + \alpha_s + \alpha_{st} + B\left(\left(ExportStatus, ExportStatus * \tau^{firm}\right): \beta, \delta\right) + \theta C_{ft} + \varepsilon_{ft} \tag{22}$$

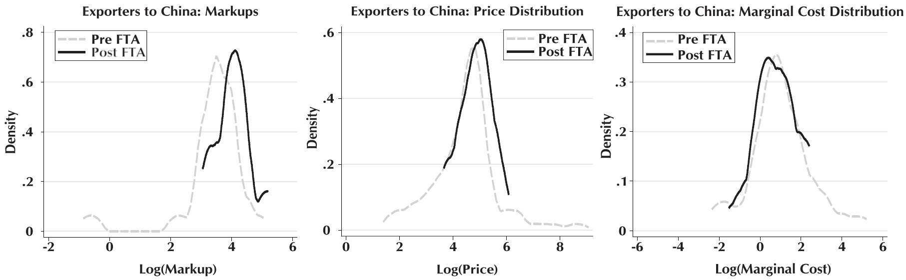
Figure 6a-6c show the distribution of firm-level markups, prices, and marginal costs both before (2000-05) and after (2010) the Pakistan-China Free Trade Agreement went into effect for exporters to China. The distributions indicate that exporters to China marginally increased their markups. The price seems to be less dispersed after the FTA went into effect while there is little change in the marginal costs.

In Tables 5, we present the results of the impact of the output tariff changes on the firm-level markups, prices, and marginal costs. In Panel A we test the impact of tariff reductions overall for each methodology and in Panel B by the export status of the firm.

Results from both the System GMM (Blundell & Bond, 1998) and GNR (2020) estimations do not show any significant changes in firm level markups for firms exporting to China as a result of the reductions in the output tariffs. These firms significantly lowered their prices along with a significant decline in their marginal costs. A 10 percentage point decline in tariffs is associated with a 1.770 percent decline in prices for firms exporting to China along with a 1.759 percent decline in the marginal costs (Panel B column 5). The net result at the firm level is no significant changes in markups due to output tariff reductions.

Our results are similar to the Garcia-Marin and Voigtländer (2019) who found little change in markups for firms in Mexico, Colombia, and Chile that gained market access. They found that firms, particularly the export entrants do experience efficiency gains, but they are passed over to the customers by lowering prices. Due to constant markups and falling prices, these firms showed a flat trajectory of the total factor revenue productivity (TFPR). Their results support the idea of "demand accumulation process" as suggested by Foster, Haltiwanger, & Syverson (2016) where firms lower their market price to attract more buyers. They show that exporters lowered their price much more than the firms selling domestically (19% versus 8%). Even in our case, while firms change their prices, the firms selling domesitcally (i.e., non-exporters) have the least change in prices (1.147 percent decline in prices for a 10 percentage point decline in tariffs).

Figure 6: Distributions of Firm Level Markups, Prices and Marginal Cost for firms exporting to China



Markups Prices Marginal Costs

Source: Authors' Calculations based on CMI Punjab 2000-2001, 2005-06, 2010-11 using the methodology developed by De Loecker & Warzynsksi (2012). We present the distributions based on the output elasticities estimated using the System GMM (Blundell & Bond, 1998). The distributions based on the output elasticities from the GNR (2020) are very similar. The prices are aggregated at the firm level using product revenue shares.

Table 5: Impact of Pakistan-China FTA's Tariff Changes on Firm Markup, Marginal Costs and Prices in Pakistan's Textile Sector

Panel A: Impact of Tariff changes on Firm Markups, Price and Marginal Cost					
	Markups		***Price***	***Marginal Costs***	
	System GMM Methodology	***GNR (2020) Methodology***	-	***System GMM Methodology***	***GNR (2020) Methodology***
	(1)	**(2)**	**(3)**	**(4)**	**(5)**
τ^{firm}	0.0019	0.0047	0.1232***	0.1212***	0.1185***
	(0.0170)	(0.0137)	(0.0298)	(0.0318)	(0.0311)
N	1177	1177	1177	1177	1177
Panel B: Impact of Tariff changes on Firm Markup, Price and Marginal Cost by Export Status					
Exporters to China*τ^{firm}	-0.0082	0.0011	0.1770***	0.1852**	0.1759**
	(0.0543)	(0.0435)	(0.0634)	(0.0784)	(0.0743)
Exporters to Other Destinations *τ^{firm}	0.0271	0.0192	0.1238***	0.0967*	0.1046*
	(0.0276)	(0.0231)	(0.0408)	(0.0476)	(0.0460)
Non-Exporters* τ^{firm}	-0.0035	0.0018	0.1147***	0.1182***	0.1129***
	(0.0180)	(0.0142)	(0.0308)	(0.0330)	(0.0321)
N	1177	1177	1177	1177	1177

Authors' calculations based on OLS regression analysis of the impact of tariffs on firm-level markups, marginal costs and prices. Panel A shows the results of the net impact of tariffs on markups, marginal cost and prices directly while panel B disaggregates the effect

according to the export status of the firm. We aggregate the product-level prices based on revenue shares. Controls include pre-FTA firm productivity, pre-FTA quality, pre-FTA number of products, and firm inputs, dummies for missing data by year, segment, year and segment-year fixed effects. Robust standard errors in parentheses.
***, **, * significant at 1%, 5% and 10% levels of significance respectively.

Hornok & Murakozy (2019) examine the impact of trade liberalization on firms in Hungary for the time 1995-2003. They find no evidence for an exporter markup premium. This may be due to strong competition faced in the international market or due to dynamic pricing as suggested by Garcia-Marin & Voigtländer (2019).

Xiang, Chen, Ho, & Yue (2017) on the other hand find that firm markup falls as output tariffs decrease. Following the methodology by De Loecker & Warzynski (2012) they compute firm level markups for the firms in China for the period 2000-2006. They show that output tariff decline of 9.5% is associated with a markup decline of 0.1%. Their results suggest that the effects of trade liberalization on firm markups depends upon the industry concentration. They compute Herfindahl–Hirschman index (HHI) and show that the pro-competitive effects of output tariff reduction are only found in industries with a higher HHI. This can be due to the fact that output tariffs may reduce marginal cost by reducing X-inefficiencies as suggested by DGKP (2016). Industries which are more concentrated have more room for improvement in X-inefficiencies and hence, the pro-competitive effect of output tariff reduction is more.

In our case, concluding anything about the pro-competitive effects from table 5 may be problematic. As suggested by DGKP (2016), markups might change due to changes in marginal cost, thus, it's important to isolate the direct effect of pro-competitiveness as a result of trade liberalization on markups. We examine the impact of changes in output tariffs on markups conditional on marginal costs at the firm level.

Results are presented in table 6. In column 1, we look at the impact of output tariffs on firm level markups conditional on marginal costs. In column 2, we add in the interaction term *Exporters to*

$China{*}\tau^{firm}$ to identify the existence of pro-competitiveness for firms exporting specifically to China.

Table 6: Pro-Competitive Impact of Output Tariff on Frim Markup

	Markups			
	System GMM Methodology		***GNR (2020) Methodology***	
τ^{firm}	0.0445**	0.0415**	0.0382**	0.0360**
	(0.0165)	(0.0166)	(0.0128)	(0.0129)
Exporters to China*τ^{firm}		0.0521**		0.0379**
		(0.0191)		(0.0168)
N	1177	1177	1177	1177
Second- order polynomial of marginal costs	Yes	Yes	Yes	Yes

Controls include pre-FTA firm productivity, pre-FTA quality, pre-FTA number of products, and firm inputs, dummies for missing data by year, segment, year and segment-year fixed effects. Robust standard errors in parentheses.
***, **, * significant at 1%, 5% and 10% levels of significance respectively.

Our results from table 6 indicate the presence of pro-competitive effects at the firm level. Conditional on any potentially different impact of trade liberalization on the marginal costs, exporters to China who experience a 10 percentage point larger decline in tariffs experience a 0.521 percent (as in System GMM approach) relative decline in markups (0.379 percent in case of GNR (2020) approach).

Our results suggest strong evidence of foregin competition faced by firms in the international market. As shown earlier in table 1A-1E, even after a decade of the Pakistan-China FTA, Pakistan (with the exception of the Spinning segment) is still not amongst the top importing choices for China within the textile sector. As discussed above, spinning is a homogeneous segment as compared to other segments like interior and clothing. These products are low markup products to start with. Epifani & Gancia (2011) suggest that markups can be improved and that the trade policy and domestic industrial policy are complimentary in the case of heterogeneous markups. Spinning segment limits the heterogeneity in our case.

Antoniades (2015) finds evidence that in industries where there is a greater scope of quality differentiation due to a high level of heterogeneity, the highly productive firms improve quality as a result of trade liberalization. Even if the marginal costs fall for such firms, the increase in markups offsets the falling costs and firm prices increases as productivity increases. However, when the firm is active in a more homogeneous segment, with limited scope of quality differentiation, an increase in markups is not sufficient to offset the falling costs and markups do not rise as fast as productivity rises. Hence, the price falls as productivity increases.

Moreover, figure 5 also shows that given the fact that the ASEAN nations face lower tariffs than the Pakistani textile firms, it seems like the firms in Pakistan do indulge in dynamic pricing in order to compete with other countries to capture the Chinese market despite more access under the FTA. Gust, Leduc, & Vigfusson (2010) develop a model to suggest that the environment in which the exporters set their prices depends upon strategic complementary. With more trade integration, the exporting firms become more responsive to the prices set by their competitors, which seems to be the case for firms in Pakistan.

6. Conclusion

Over the years with growing importance of international trade there has been an increase in the number of countries entering into Free Trade Agreements to enhance bilateral trade flows. While a substantial amount of literature focuses on the impact of better availability of intermediate inputs on firm level outcomes, the impact of the FTA on firms as a result of gaining more market access is limited. It is even more limited when studied in context to a developing country. We study how firms in the textile sector in Pakistan responded by changing markups, prices, and marginal cost as a result of increased trade liberalization.

We use the methodology developed by De Loecker, Goldberg, Khandelwal, and Pavcnik (2016) to estimate product level markups and marginal cost. We also conduct the analysis at the firm level by computing firm level markups and marginal cost by the methodology developed by De Loecker & Warzynski (2012). The output elasticities are computed based on the extended or system GMM estimator (Blundell & Bond, 1988) and Gandhi, Navarro, and Rivers (2020) methodology.

Our results suggest that the firms exporting to China did significantly lower their prices indulging in dynamic pricing as a way to compete with other firms within the Chinese market. Firms exporting to China became relatively disadvantaged when China eliminated most tariffs on textiles products coming from the ASEAN countries. The ASEAN countries enjoy lower tariffs from China and as a result, even after a decade of the FTA, Pakistan is still not amongst the major importing countries of textile for China.

Moreover, marginal costs did decline as a result of the FTA, indicating the reductions in X-inefficiencies as a result of trade liberalization. Markups at the firm level, however, remain unchanged. We also find evidence of the existence of pro-competitive effects due to the reduction in output tariffs on markups.

Our study points out towards the fact that one of the reasons why firm level markups remain unchanged (decreased in the case of product level analysis) is that amongst the textile segments (clothing, spinning, interior, finishing and technical), Pakistan has been exporting most within the spinning segment. The spinning segment is a homogeneous segment as compared to other segments which have a wide spectrum of quality and variety differentiated products. Such homogeneous segments are low markup segments to start with and as suggested by literature, they are not complimentary with variations in markups as a result of changes in trade policies. This points out towards the need for policy-makers in Pakistan to focus more on heterogeneous segments (clothing or interior) which are relatively elastic and have a higher markup potential for Pakistani exporters.

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