# Trade Liberalization and Markup*

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**Abstract**

The "import as market discipline" is a long standing but important hypothesis in the international economic literature. It states that more imports can bring more competition, hence bring down the market power of the firm. In this paper, we analyse the impact of trade liberalization on the firm's markup, a measure of market power. Beside trade liberalization in the final market that has been the main line of investigation in the literature, we also consider the intermediate markets which are no less important. Our model, using a general framework, shows that while output tariff cuts lower the firm's markup, reducing input tariffs leads to a rise of this measure. In particular, our model shows that more efficient firms charge higher markup. And firms become more efficient when they can import better inputs thanks to input tariff cuts. Therefore ignoring the input tariffs could lead to a biased estimated impact. We then use our Chinese data to test our predictions. We estimate the firm markup by a methodology proposed by De Loecker et al. (2014). This method allows us to have multiple product firms, where each product line has its own markup, a salient feature in our data. Our regressions, robust to a variety of specifications, confirm our predictions. Moreover, we also find heterogeneous impacts across different types of products and firms.

**Keywords:** Input tariff; Output tariff; Markup

**JEL Classification codes:** F12, F14F1, F4, O4

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# 1 Introduction

The idea that trade liberalization reduces market competition is a long standing but important insight in the international trade field (Helpman and Krugman). The theoretical background is borrowed from the IO literature, where under classic competition mode (for instance Cournot competition) more competition brings down the market power of the firm. In the international trade context, trade reforms allow more foreign companies in the domestic market, intensify the market competition. This "import as market discipline" hypothesis has been tested intensively, starting with the work by Levinsohn (1993). He finds that after trade liberalization in Turkey, the markups which are an indicator of firm's market power rose in the industry that face more tariff cuts. Other recent papers also follow. De Blas and Russ (2010): more competing firms reduce the firm's markup. It is because the firm can not charge higher than the marginal cost of its best rival (next efficient firm). More firms reduces the gap between the firm and its best rivals. Chen, Imbs and Scott (JIE 2009) adopt the Melitz and Ottaviano (REStud, 2008) framework and find that as tariffs fall, the increase in foreign firms exporting to the domestic market leads to a rise in varieties and so raises the elasticity of demand. Given the structure of the market this results in a fall in markups and prices, so that domestic firms with high costs cease production. The end result is a net increase in the number of firms, lower prices, lower markups and a trade induced rise in average productivity. In the *short run*, they find that trade liberalizations have standard pro-competitive effects.However, in the *long run* firms respond to increased competition by relocating to more protected markets overseas, as the fall in trade costs makes it more viable to serve the domestic market through exports from there. As a result, the supporting evidence is weak. Interestingly Konings et al. (2001) document that while import penetration has no significant impact on the firm's markup, it even raises the markups in the Netherlands. they explain this result by the existence of cartels in the Netherlands and the evolution of European industries towards more intra-industry trade.

Most of these papers, however, only focus on trade liberalization in the final market. There is an important side of trade reforms that can not be ignored, which is the fact that input tariffs also fall. Indeed **a significant share of the volume of international trade – possibly up to two-thirds – is accounted for by shipments of intermediate inputs (see Johnson and Noguera, 2012)**. Amiti and Konings (2007) document that cutting input tariffs even has a larger impact than output tariffs on productivity. The gap can be as high as 6 times. In our context, cutting input tariffs has the opposite impact on market competition. This is because it allows domestic firms to reduce their production costs, therefore can have a higher profit margin.

With our Chinese data, we are able to distangle the effects of output and input tariffs. **In fact, Brandt et al. (2014) document that the price-cost margin in China drops after tariffs**

**cuts. What we find here is the conclusion depends on the types of tariffs.** Moreover, we can investigate the differential impact across different types of products and different types of firms. With our rich dataset, we have information about the firms and the products they sell. Our estimation stategy yields markup at the product-level which allows us to study the impact of tariffs on different firm-product pairs.

China experienced a large trade reforms since joining the WTO in 2001. It is, in particular, the biggest importer in the world. More importantly, most of its imports are intermediate inputs. Our main data source is an annual manufacturing census, merged with a Custom data from the years 2000 to 2006. Figure 2 from out data show that since 2001, the imports of intermediate inputs account for more than half of total imports in China. As a result, China presents a good case study for us to look at the impact of input tariffs reduction on the market power of the firms, proxied by markups.

We estimate the firm-product markup following De Loecker et al. (2014) methodology. This method allows for multiple product firms where each product line can have different markup. Regress the estimated markup on final output and intermediate input tariffs, we find that the impact of input tariffs is largely important. In some cases, it even eclipses the output tariffs. Indeed, Figure 3 shows that while in some industries, average markups fall after trade liberalization as predicted by the "imports as market discipline" hypothesis, in other industries markups even rise. Even more impressive is that at the end of our sample (2006), the rise in markups are more remarkable (see Figure 4). In Levinsohn (1993) the only industries that see markups rising are those that were perfectly competitive before trade reforms. This is not the case in our study as all of our industries have the level of markups higher than 1, implying that they are under imperfect competition.

Another interesting feature of our results is that we have a quasi-control group in the name of processing trade. By law, these firms are not subject to tariffs and hence, should not experience any changes in markups due to trade reforms.

The rest of the paper is organized as follows. Section II presents our theoretical model. Section III describes our estimation strategy. The results are presented in Section IV. We carry our robustness check in Section V while concluding remarks are in Section VI.

## 2 The model

In this section we build a partial equilibrium model of trade with heterogeneous firms where each firm uses both domestic and imported intermediate inputs for production to study how import tariff reduction impacts existing two-way traders' unit value export prices via their choice of quality and imported inputs.

## 2.1 Consumers

We employ the model proposed by Arkolakis, Costinot and Donaldson (2012). All consumers have the same preferences. If a consumer with income $w$ faces a schedule of prices $p = \{p_\omega\}_{\omega \in \Omega}$, her Marshallian demand for any differentiated good $\omega$ takes the form[1]

$$\ln q_\omega(p_\omega, p^*(p,w), w) = -\beta \ln p_\omega + \gamma \ln w + d(\ln p_\omega - \ln p^*(p,w)) \tag{1}$$

where $p^*(p,w)$ **is our price index**, which is symmetric in all prices $p_\omega$. Three properties of our demand system are worth emphasizing. First, the price elasticity $-\beta + d'(\ln p_\omega - \ln p^*(p,w))$ is allowed to vary with prices, which will generate variable markups under monopolistic competition. Second, other prices only affect the demand for good $\omega$ through their effect on the aggregator $p^*(p,w))$. **This property brings the monopolistic competition to our model.** The following restrictions imposed:

Assumption A1: The elasticity of demand must be higher than one: $\frac{\partial \ln q(p,p^*,w)}{\partial \ln p} < -1$

This assumption implies that the percentage change in quantity demanded is greater than that in price. Hence, as the price decreases, the total revenue increases, and vice versa. It is satisfied by all efficiency sorting Melitz-type model.[2]

Assumption A2: For all $x$, $d''(x) < 0$.

This assumption is equivalent to the assumption that demand functions are log-concave for all differentiated goods. It is satisfied by the demand systems considered in Krugman (1979), Ottaviano, Tabuchi, and Thisse (2002), and Feenstra (2003).

## 2.2 Firms

Production.—The supply side is characterized by monopolistic competition. Each variety is produced by a single firm, and we focus on existing firms in the industry. Firms are heterogeneous in their initial productivity. This idiosyncratic component of initial productivity is indexed by $\varphi$. Each manufacturing firm $i$ produces output with productivity $\varphi$ using the following production function:

$$Y = \varphi X^\mu L^{1-\mu} \tag{2}$$

[1] This demand system encompasses three proposed alternatives to generate the variable markups: (i) separable, but non-CES utility functions, as in the pioneering work of Krugman (1979); (ii) a quadratic, but nonseparable utility function, as in Ottaviano, Tabuchi, and Thisse (2002); and (iii) a translog expenditure function, as in Feenstra (2003).

[2] quality sorting

where $X$ denotes the intermediate inputs bundle, $L$ denotes labor employed in the production. The intermediate inputs bundle $X$ is assembled from a combination of a bundle of diverse intermediate inputs produced domestically, $Z$, and another bundle of imported intermediate inputs, $M$, according to the CES aggregator:

$$X = \left(Z^{\frac{\varsigma-1}{\varsigma}} + M^{\frac{\varsigma-1}{\varsigma}}\right)^{\frac{\varsigma}{\varsigma-1}} \tag{3}$$

where the input bundles themselves are CES aggregates:

$$Z = \left(\int_0^1 z_l^{\frac{\theta-1}{\theta}} dl\right)^{\frac{\theta}{\theta-1}} \tag{4}$$

$$M = \left(\int_\Omega m_h^{\frac{\theta-1}{\theta}} dh\right)^{\frac{\theta}{\theta-1}} \tag{5}$$

$z_l$ represents the firm's use of domestically produced inputs $l$, $\Omega$ is the set of foreign input varieties imported by the firm and $m_h$ is the quantity of imported input $h$. The set of foreign input varieties imported by each firm, $\Omega$, is different. The elasticity of substitution $\theta > 1$ is the same within domestic varieties and within foreign varieties, while $\varsigma$ is the elasticity of substitution between the bundles of imported and domestically produced inputs.

Import Decision.—**We assume that there is no fixed importing cost. This implies that all types of inputs will be imported. In other words,** conditional on being an importer, the import decision a firm needs to make is how much of each varieties to import. The firm chooses labor $L$, and the amount of domestic inputs $\{z_l\}$, given the wage rate $W$ and the price of domestic intermediate input $\{p_l\}$. The firm $i$ chooses the amount of each imported variety $m_h$, given the price $\{p_h\}$ and import tariff $\tau_h$ for each imported product $h$. The common cost index of the (net quality) inputs, $c_i$, satisfies:

$$c = \frac{B^\mu}{\varphi} \frac{W^{1-\mu} P_Z^\mu}{\mu^\mu (1-\mu)^{1-\mu}} \tag{6}$$

where $P_z = \left(\int_0^1 p_l^{1-\theta}\right)^{\frac{1}{1-\theta}}$ denotes the domestic input price index, $\frac{W^{1-\mu} P^\mu}{\mu^\mu (1-\mu)^{1-\mu}}$ is the cost index (net quality) for a non-importimg firm. The use of imported inputs leads to a cost-reduction factor $B \equiv \left(1 + (P_M/P_Z)^{1-\varsigma}\right)^{\frac{1}{1-\varsigma}}$, where $P_M$ is the imported input price index:

$$P_M = \left(\int_\Omega (\tau_h p_h)^{1-\theta}\right)^{\frac{1}{1-\theta}} \tag{7}$$

## 2.3 Firm's behavior

Consider the optimization problem of a firm producing good $\omega$ in country $i$ and selling it in a certain destination $j$. To simplify notation, and without risk of confusion, we drop indexes and $p^*$ and $w$ denote the choke price and the wage in the destination country, respectively. Under monopolistic competition with segmented good markets and constant returns to scale, the firm chooses its market-specific price $p$ in order to maximize profits in the market

$$\max_{p} \ (p-c)\, q(p, p^{*}, w)$$

taking $p^*$ and $w$ as given. The associated first-order condition is

$$\frac{p-c}{p} = -\frac{1}{\frac{\partial \ln q(p,p^{*},w)}{\partial \ln p}} = \frac{1}{\beta - d'(\ln p - \ln p^{*}(p,w))} \tag{8}$$

We use $\mu = \ln(p/c)$ as our measure of firm-level markups. Marginal cost pricing corresponds to $\mu = 0$. Combining the previous expression with equation (1), we can express $\mu$ as the implicit solution of

$$\mu = \ln\left(\frac{\beta - d'\left(\mu - v\right)}{\beta - 1 - d'\left(\mu - v\right)}\right)$$

where $v = \ln(p^*/c)$ can be thought of as a measure of the efficiency of the firm relative to other firms. Whether markups are monotonically increasing in productivity depends on the monotonicity of $d'$.

**Lemma 1** *A more efficient firm charges higher markups.*

*Proof.* Let's denote $f\left(\mu,\nu\right) = \mu - \ln\left(\frac{\beta-d'(\mu-v)}{\beta-1-d'(\mu-v)}\right)$

$$f_{\mu}\left(\mu,\nu\right) = 1 + \left[\frac{1}{\beta - d'\left(\mu - v\right)} - \frac{1}{\beta - 1 - d'\left(\mu - v\right)}\right] d''\left(\mu - v\right)$$
$$f_{\nu}\left(\mu,\nu\right) = -\left[\frac{1}{\beta - d'\left(\mu - v\right)} - \frac{1}{\beta - 1 - d'\left(\mu - v\right)}\right] d''\left(\mu - v\right)$$

Note that $\beta - d'\left(\mu - v\right) > \beta - 1 - d'\left(\mu - v\right) > 0$, where the last inequality follows from Assumption A1. Together with Assumption A2, it is clear that $f_{\mu}\left(\mu,\nu\right) > 0$ and $f_{\nu}\left(\mu,\nu\right) < 0$. Applying the implicit function theorem to the function $f\left(\mu,\nu\right)$ knowing that our markup $\mu$ is a solution to this we then have $\mu'\left(\nu\right) = -\frac{f_{\mu}(\mu,\nu)}{f_{\nu}(\mu,\nu)} > 0$.

**Proposition 1** *Given the productivity level, a reduction in import tariff induces the firm to set a higher markup*

The following proposition is interesting because while the firm reduces its price as the import tariff falls, it raises its markup.

**Proposition 2** *Given the productivity level, a reduction in import tariff implies a fall in the price but a rise in the markup.*

*Proof.* A reduction in import tariffs leads to a reduction in the imported input price index $P_M$ and hence, the cost-reduction factor $B$. Equation 6 then implies that the marginal cost also falls. From Equation 8 the firm's price $p$ is the solution of an implicit function

$$g\left(p,c\right)=1-\frac{c}{p}-\frac{1}{\beta-d'(\ln p-\ln p^{*}(p,w))}$$

We then have

$$g_{p}\left(p,c\right)=\frac{c}{p^{2}}-\frac{\left(\frac{1}{p}-\frac{\partial p^{*}}{\partial p}\frac{1}{p^{*}}\right)}{\left[\beta-d'(\ln p-\ln p^{*}(p,w))\right]^{2}}d''\left(\ln p-\ln p^{*}(p,w)\right)$$

and

$$g_{c}\left(p,c\right)=-\frac{1}{p}$$

Since $d''\left(\ln p-\ln p^{*}(p,w)\right)<0$ by assumption and $\frac{1}{p}-\frac{\partial p^{*}}{\partial p}\frac{1}{p^{*}}>0$, it is clear that $g_{p}\left(p,c\right)>0$ and $g_{c}\left(p,c\right)<0$, therefore $p'\left(c\right)=-\frac{g_{p}(p,c)}{g_{c}(p,c)}>0$.

Moreover, a cut in import tariff lowers the marginal cost. In other words, the firm becomes more efficient which by Lemma 1 implies a rise in the firm's markup.

# 3 Empirical Specification, Data and Measurement

## 3.1 Identification strategy

We rely on Chinese accession to the WTO in 2001. Write some paragraphs about this with numbers and pictures.

## 3.2 Empirical Specification

Benchmark regression - Our model suggests that together with the usual pro-competitive effect (from the output tariff), trade liberalization could influence the firm's markup via the marginal cost effect. Our benchmark regression is then:

$$\mu_{fpt}=\alpha*input\_tariff_{it}+\beta*output\_tariff_{it}+\delta_{i}+\delta_{t}+\delta_{fp}+u_{fpt}$$

We control for the time fixed effect, the industry fixed effect, the firm-product fixed effect to account for all the characteristics that are time-varying, industry and firm-product related. We can also control for the firm characteristics such as productivity, capital-labor ratio, employment and labor wage. Moreover, we should expect no changes in markup for processing trade that, by law, are not subject to any duties.

*Underlying mechanism* - Our model suggests that trade liberalization reduces the marginal costs. We therefore expect the importing firms have lower marginal costs than non-importing firms:

$$mc_{fpt} = \eta * importing\_firm_{ft} + \gamma X_{ft} + \delta_i + \delta_t + \delta_{fp} + u_{fpt}$$

This reduction of marginal cost must be due to the fall of tariffs, in particular input tariffs:

$$mc_{fpt} = \alpha * input\_tariff_{it} + \beta * output\_tariff_{it} + \gamma X_{ft} + \delta_i + \delta_t + \delta_{fp} + u_{fpt}$$

We then can interact input tariffs with the import intensity as the impact of tariffs should be more pronounced among more intensive importing firms. If the marginal cost is the main channel to explain the impact of input tariffs, we should expect most of the impact (or at least the major part) of input tariff drain once we control for the marginal costs:

$$\begin{aligned} \mu_{fpt} = \alpha * input\_tariff_{it} + \beta * output\_tariff_{it} + \vartheta * input\_tariff_{it} * import_{ft} + \\ + \iota * mc_{fpt} + \gamma X_{ft} + \delta_i + \delta_t + \delta_{fp} + u_{fpt} \end{aligned}$$

*Across products* - Our markup at the firm-product level allows us to see the impact of tariffs across different types of products and different types of firms. In particular, we will look at the products that are growing and shrinking, the main product line of the firms as well as the firms with different market shares.

### 3.3 Firm-Product-level Trade Data and Firm-level Production Data

To test our propositions, we need to use both firm-level information to measure firm attributes such as TFP, and product-level trade data on export prices, export values and the customs regime. Therefore, we use a merged dataset based on the two databases: (1) the firm-product-level trade data of each transaction from Chinese customs, and (2) the firm-level production data, collected and maintained by the National Bureau of Statistics of China (NBSC). Our sample period is between 2000 and 2006.

The main database we use is the Chinese trade data at the transaction level, provided by China's General Administration of Customs. The transaction-level trade data provide information of exporting or importing firm and the product information at the HS 8-digit level, covering the universe of all Chinese exports and imports in 2001-2006. It records detailed information of each trade transactions, including import and export values, quantities, products, source or destination countries, contact information of the firm (e.g., company name, telephone, zip code, contact person), type of enterprises (e.g. state owned, domestic private firms, foreign invested, and joint ventures), and customs regime (e.g. "Processing and Assembling"and "Processing with Imported Materials"). As firms under processing trade regime are not subject to tariffs, we focus on firms under ordinary trade regime.[3] Then, we aggregate transaction-level data to firm-product-level trade data. For each HS 8-digit product, we use import and export values and quantities to compute unit value price of imported inputs and exports by each firm.[4]

To characterize firms' attributes such as TFP and capital intensity, we also use the NBSC firm-level production data from the annual surveys of Chinese manufacturing firms, covering all state-owned enterprises (SOEs), and non-state-owned enterprises with annual sales of at least 5 million RMB (Chinese currency). The NBSC database contains detailed firm-level information of manufacturing enterprises in China, such as employment, capital stock, gross output, value added, firm identification (e.g., company name, telephone number, zip code, contact person, etc.), and complete information on the three major accounting statements (i.e., balance sheets, profit & loss accounts, and cash flow statements).[5] Due to mis-reporting by some firms, we use the following rules to delete the unsatisfactory observations and construct our sample, according to Cai and Liu (2009) and the General Accepted Accounting Principles: (i) the total assets must be higher than the liquid assets; (ii) the total assets must be larger than the total fixed assets; (iii) the total assets must be larger than the net value of the fixed assets; (iv) a firm's identification number cannot be missing and must be unique; and (v) the established time must be valid.

Then we match the firm-product-level trade data from the Chinese Customs Database to the NBSC Database, according to the contact information of manufacturing firms, because there is no consistent coding system of firm identity between these two databases.[6] Our matching procedure is done in three

[3] As imports under ordinary trade regime include final goods and intermediate goods, I use the Broad Economic Categories (BEC) classification to distinguish final goods and intermediate goods.

[4] For exported goods, I use two measures to compute their unit value export prices: (1) the export prices of the HS 8-digit goods by each firm, and (2) the export prices of the HS 8-digit goods shipped to different destination country by each firm, i.e., I view the same HS 8-digit goods exported to different destination countries as "different" varieties. In the main tests, I report my results based on the second measure, but I also report the results based on the first measure as robustness check. The results remain the same.

[5] The firm identification information will be used to match the NBSC database with the customs database.

[6] In the NBSC Database, firms are identified by their corporate representative codes and contact information. While in the Customs Database, firms are identified by their corporate custom codes and contact information. These two coding

steps: (1) by company name, (2) by telephone number and zip code, and (3) by telephone number and contact person name together (see detailed description of the matching process in Fan, Lai, and Li, 2012). Compared with the exporting and importing firms reported by the Customs Database,[7] the matching rate of our sample (in terms of the number of firms) covers 45.3% of exporters and 40.2% of importers, corresponding to 52.4% of total export value and 42% of total import value reported by the Customs Database.[8]

### 3.4 Measure of Markup

Consider the following production function for firm $f$ to produce a product $h$ (sold to destination country $c$) at time $t$:

$$Q_{fh(c)t} = F_t(X_{fh(c)t}) \exp(\omega_{ft}) \tag{9}$$

where $Q_{fh(c)t}$ is physical output and $X_{fh(c)t}$ is a vector of inputs. There are only two assumptions about productivity that are essential for the subsequent analysis. First, productivity $\omega$ enters in log-additive form and is Hicks-neutral. Second, we assume that productivity is firm-specific. This second assumption follows a tradition in the trade literature that models productivity along these lines (e.g., Bernard et al. (2011)).

We assume that producers minimize costs. Let $V_{fh(c)t}$ denote the vector of variable inputs used by the firm to produce a product $h$ (sold to destination country $c$ when product is defined as product-country combination). We use the vector $K_{fh(c)t}$ to denote dynamic inputs of production. Any input that faces adjustment costs will fall into this category; capital is an obvious one. We consider the firm's conditional cost function where we condition on the set of dynamic inputs $K_{fh(c)t}$. The associated Lagrangian function is:

$$L\left(V_{fh(c)t}, K_{fh(c)t}, \lambda_{fh(c)t}\right) = \sum_{v=1}^{V} P^v_{fh(c)t} V^v_{fh(c)t} + \sum_{d=1}^{D} r^d_{fh(c)t} K^d_{fh(c)t} + \lambda_{fh(c)t}\left[Q_{fh(c)t} - Q_{fh(c)t}\left(V_{fh(c)t}, K_{fh(c)t}, \omega_{ft}\right)\right]$$

where $P^v_{fh(c)t}$ and $r^d_{fh(c)t}$ denote the firm's input prices for the variable inputs $v = 1, ..., V$ and the prices of dynamic inputs $d = 1, ..., D$, respectively. The first order condition for any variable input free of adjustment costs is:

$$\frac{\partial L_{fh(c)t}}{\partial V_{fh(c)t}} = P^v_{fh(c)t} - \lambda_{fh(c)t} \frac{\partial Q_{fh(c)t}(\cdot)}{\partial V_{fh(c)t}}$$

systems are neither consistent, nor transferable with each other.

[7] As I merge the Customs Database with the manufacturing firms in the NBSC database, I exclude all intermediary firms or trading companies from the customs database.

[8] I do not compare my sample with the NBSC Database because it does not contain any information on firms' import status.

where the marginal cost of production at a given level of output is $\lambda_{fh(c)t}$ since $\frac{\partial L_{fh(c)t}}{\partial Q_{fh(c)t}} = \lambda_{fh(c)t}$. Rearranging terms and multiplying both sides by $V_{fh(c)t}/Q_{fh(c)t}$, provides the following expression:

$$\frac{\partial Q_{fh(c)t}(\cdot)}{\partial V_{fh(c)t}} \frac{V_{fh(c)t}}{Q_{fh(c)t}} = \frac{1}{\lambda_{fh(c)t}} \frac{P^v_{fh(c)t} V_{fh(c)t}}{Q_{fh(c)t}}$$

The left-hand side of the above equation represents the elasticity of output with respect to variable input $V_{fh(c)t}$ (the "output elasticity"). The approach simply requires one freely adjustable input into production. This becomes important in settings, such as ours, where there are frictions in adjusting capital. Define the markup $\mu_{fh(c)t}$ as $\mu_{fh(c)t} = P_{fh(c)t}/\lambda_{fh(c)t}$, where $P_{fh(c)t}$ is the price for product $h$ (to destination $c$) produced by firm $f$ at time $t$. As De Loecker and Warzynski (2012) and De Loecker, Goldberg, Khandelwal and Pavcnik (2014) show, the cost-minimization condition can be rearranged to write the markup for each product $h$ (to destination $c$) produced by firm $f$ at time $t$ as:

$$\mu_{fh(c)t} = \theta^v_{fh(c)t} \left(\alpha^v_{fh(c)t}\right)^{-1} \tag{10}$$

where $\theta^v_{fh(c)t}$ denotes the output elasticity on variable input $V^v_{fh(c)t}$ and $\alpha^v_{fh(c)t} = \frac{P^v_{fh(c)t} V^v_{fh(c)t}}{P_{fh(c)t} Q_{fh(c)t}}$ is its expenditure share of revenue for each product $h$ (to destination $c$) produced by firm $f$ at time $t$. This expression forms the basis for our approach. To compute the markup, we need the output elasticity and the share of the input's expenditure in total sales.

Consider the log version of the general production function given in equation (9):

$$q_{fh(c)t} = f\left(x_{fh(c)t}; \beta\right) + \omega_{ft} + \epsilon_{fh(c)t} \tag{11}$$

where lower case letters denote logs. The quantity of product $h$ (to destination $c$) by firm $f$ at time $t$, $q_{fh(c)t}$, is produced using a set of firm-product-(country)-year specific inputs, $x_{fh(c)t}$. The error term $\epsilon_{fh(c)t}$ captures measurement error in recorded output as well unanticipated shocks to output. As noted earlier, the productivity term $\omega_{ft}$ is assumed to vary at the firm level.

For multi-product firms, a new idendification problem arises since the data do not record how the inputs are allocated across the products within a firm. To understand this, denote the log of the share of input $X$ in the production of product $h$ as $\rho^X_{fh(c)t} = x_{fh(c)t} - x_{ft}$, for any input $X = \{L, M, K\}$, where $L$ is labor, $M$ is materials and $K$ is capital. We only observe firm-level inputs $X_{ft}$ and not how each of them is allocated across products. Substituting this expression into equation (11) yields:

$$q_{fh(c)t} = f\left(x_{ft}; \beta\right) + \omega_{ft} + A_{fh(c)t}\left(\rho^X_{fh(c)t}; x_{ft}; \beta\right) + \epsilon_{fh(c)t} \tag{12}$$

where $x_{ft}$ denotes the log of inputs $X_{ft}$. For multi-product firms, the production function contains an additional component in the error term, $A_{fh(c)t}(\cdot)$, that will generally be a function of the unobserved input shares ($\rho^X_{fh(c)t}$), the firm level inputs ($x_{ft}$) and the production function coefficients, $\beta$. In the case of a translog production function, the vector of log inputs $x_{ft}$ are labor, material and capital, their squares, and their interaction terms; the vector of coefficients is $\beta = (\beta_l, \beta_m, \beta_k, \beta_{ll}, \beta_{mm}, \beta_{kk}, \beta_{lm}, \beta_{lk}, \beta_{mk})$. Based on the methodology of De Loecker and Warzynski (2012), we use the firm-level production survey data from the National Bureau of Statistics of China (NBSC) to estimate the production function coefficients, $\beta$, based on the production function, $q_{ft} = f(x_{ft}; \beta) + \omega_{ft} + \epsilon_{ft}$.

Let $\rho_{fh(c)t} = \ln\left(\frac{\widetilde{X}_{fh(c)t}}{\widetilde{X}_{ft}}\right)$ be the input cost share of product $h$ (sold to country $c$), where $\widetilde{X}_{ft}$ denotes total deflated expenditures on each input by firm $f$ at time $t$. We assume that this share does not vary across inputs. We solve for $\rho_{fh(c)t}$ as follows. We first eliminate unanticipated shocks and measurement error from the output data. We project output quantity, $q_{fh(c)t}$, on all inputs, output and input tariffs, the output price, region-industry-product-(country) dummies and time dummies and obtain the predicted values. We next compute a firm-product-(country)-specific term $\widehat{\omega}_{fh(c)t}$: $\widehat{\omega}_{fh(c)t} = E\left(q_{fh(c)t}\right) - f\left(x_{ft}, \widehat{\beta}\right)$. From (12), this becomes:

$$
\begin{aligned}
\widehat{\omega}_{fh(c)t} &= \omega_{ft} + A_{fh(c)t}\left(\rho_{fh(c)t}; x_{ft}; \widehat{\beta}\right) \\
&= \omega_{ft} + \widehat{a}_{ft}\rho_{fh(c)t} + \widehat{b}_{ft}\rho^2_{fh(c)t}
\end{aligned}
$$

where the second equation follows from applying our translog functional form. The terms $\widehat{a}_{ft}$, and $\widehat{b}_{ft}$ are functions of the estimated parameter vector $\widehat{\beta}$, which satisfy:

$$
\begin{aligned}
\widehat{a}_{ft} &= \widehat{\beta}_l + \widehat{\beta}_m + \widehat{\beta}_k + 2\left(\widehat{\beta}_{ll} l_{ft} + \widehat{\beta}_{mm} m_{ft} + \widehat{\beta}_{kk} k_{ft}\right) + \widehat{\beta}_{lm}\left(l_{ft} + m_{ft}\right) + \widehat{\beta}_{lk}\left(l_{ft} + k_{ft}\right) + \widehat{\beta}_{mk}\left(m_{ft} + k_{ft}\right) \\
\widehat{b}_{ft} &= \widehat{\beta}_{ll} + \widehat{\beta}_{mm} + \widehat{\beta}_{kk} + \widehat{\beta}_{lm} + \widehat{\beta}_{lk} + \widehat{\beta}_{mk}
\end{aligned}
$$

we can construct $\widehat{\omega}_{fh(c)t}$ for each multiproduct firm observation (firm-product-(country)-year triplet/quartet). For each year, we obtain the firm's productivity and input allocations, the $J+1$ unknowns $(\omega_{ft}, \rho_{f1t}, ..., \rho_{fJt})$ by solving a system of $J+1$ equations:

$$
\begin{aligned}
\widehat{\omega}_{f1t} &= \omega_{ft} + a_{ft}\rho_{f1t} + b_{ft}\rho^2_{f1t} \\
&\ldots\ldots \\
\widehat{\omega}_{fJt} &= \omega_{ft} + a_{ft}\rho_{fJt} + b_{ft}\rho^2_{fJt}
\end{aligned}
$$

and the equation that the sum of $\rho_{fh(c)t}$ across product (and destination) equals to the share of total export in the toal sales. We numerically solve this system for each firm in each year. We now have all the ingredients to calculate markups and the implied marginal costs for the multiproduct firms according to equation (10):

$$\widehat{\mu}_{fh(c)t} = \widehat{\theta}^{M}_{fh(c)t} \frac{P_{fh(c)t} Q_{fh(c)t}}{\exp\left(\widehat{\rho}_{fh(c)t}\right) P^{M}_{ft} Q^{M}_{ft}}$$

where the product-(country)-specific output elasticity for materials $\widehat{\theta}^{M}_{fh(c)t}$ is a function of the production function coefficients; $P_{fh(c)t} Q_{fh(c)t}$ is the export value for product $h$ (sold to destination $c$), which is data; $\exp\left(\widehat{\rho}_{fh(c)t}\right) P^{M}_{ft} Q^{M}_{ft}$ denotes the materials allocated to produce the product $h$ (sold to destination $c$). The expression for the materials output elasticity for product $h$ (sold to destination $c$) at time t is:

$$\widehat{\theta}^{M}_{fh(c)t} = \widehat{\beta}_m + 2\widehat{\beta}_{mm}\left(\widehat{\rho}_{fh(c)t} + m_{ft}\right) + \widehat{\beta}_{ml}\left(\widehat{\rho}_{fh(c)t} + l_{ft}\right) + \widehat{\beta}_{mk}\left(\widehat{\rho}_{fh(c)t} + k_{ft}\right)$$

Finally, marginal costs for the product $h$ (sold to destination $c$) at time $t$ are then recovered by dividing prices by the markup according to the following equation:

$$\widehat{mc}_{fh(c)t} = \frac{P_{fh(c)t}}{\widehat{\mu}_{fh(c)t}}$$

### 3.5 Measure of Markup

To measure the firm's mark up, we follow closely De Loecker et al. (2014). In order words, in the first stage we estimate the output of a product $j$ by firm $f$ at time $t$ by a second order or the third order polynomial:

$$\widehat{q}_{fjt} = \phi\left(l_{ft}, k_{ft}, m_{ft}, z_{ft}\right)$$

where $x_{ft} = (l_{ft}, k_{ft}, m_{ft})$ are expenditures on labor, capital and materials, $z_{ft}$ are output prices ($p_{ft}$), product dummies ($I_{ft}$), product market shares ($ms_{ft}$).

Then for a vector of $\beta = (\beta_l, \beta_m, \beta_k, \beta_{ll}, \beta_{mm}, \beta_{kk}, \beta_{lm}, \beta_{lk}, \beta_{mk}, \beta_{lmk})$, we recover the productivity as:

$$\begin{aligned}
\widehat{\omega}_{fjt}(\beta) &= \widehat{q}_{fjt} - f\left(x_{ft}, \beta\right) \\
&= \widehat{q}_{ft} - \beta_l l_{ft} - \beta_m m_{ft} - \beta_k k_{ft} - \beta_{ll} l^2_{ft} - \beta_{mm} m^2_{ft} - \\
&- \beta_{kk} k^2_{ft} - \beta_{lm} l_{ft} m_{ft} - \beta_{lk} l_{ft} k_{ft} - \beta_{mk} m_{ft} k_{ft} - \beta_{lmk} l_{ft} m_{ft} k_{ft}
\end{aligned}$$

We then create three additional parameters:

$$a_{ft} = \beta_l + \beta_m + \beta_k + 2\left(\beta_{ll} l_{ft} + \beta_{mm} m_{ft} + \beta_{kk} k_{ft}\right)$$
$$+ \beta_{lm}\left(l_{ft} + m_{ft}\right) + \beta_{lk}\left(l_{ft} + k_{ft}\right) + \beta_{mk}\left(m_{ft} + k_{ft}\right)$$
$$+ \beta_{lmk}\left(l_{ft} m_{ft} + l_{ft} k_{ft} + k_{ft} m_{ft}\right)$$

$$b_{ft} = \beta_{ll} + \beta_{mm} + \beta_{kk} + \beta_{lm} + \beta_{lk} + \beta_{mk} + \beta_{lmk}\left(l_{ft} + m_{ft} + k_{ft}\right)$$

$$c_{ft} = \beta_{lmk}$$

A system of (J+1) equations help us to solve (J+1) unknowns $\left(\omega_{ft}\left(\beta\right), \rho_{f1t}\left(\beta\right), ..., \rho_{fJt}\left(\beta\right)\right)$ with J the number of products produced by firm's $f$:

$$\widehat{\omega}_{f1t}\left(\beta\right) = \omega_{ft}\left(\beta\right) + a_{ft}\rho_{f1t}\left(\beta\right) + b_{ft}\rho_{f1t}^2\left(\beta\right) + c_{ft}\rho_{f1t}^3\left(\beta\right)$$

......

$$\widehat{\omega}_{fJt}\left(\beta\right) = \omega_{ft}\left(\beta\right) + a_{ft}\rho_{fJt}\left(\beta\right) + b_{ft}\rho_{fJt}^2\left(\beta\right) + c_{ft}\rho_{fJt}^3\left(\beta\right)$$

$$\sum_{j=1}^{J} \exp\left(\rho_{fjt}\left(\beta\right)\right) = 1$$

We then estimate $\widehat{\omega_{fjt}}\left(\beta\right)$ by $\widehat{\omega}_{fjt-1}\left(\beta\right)$, $\widehat{\omega}_{fjt-1}^2\left(\beta\right)$, input and output tariffs $\tau_{it}$. The residual is denoted by $\xi_{fjt}\left(\beta\right)$. Let $Y_{ft} = \left(l_{ft-1}, l_{ft-1}^2, m_{ft-1}, m_{ft-1}^2, k_{ft-1}, k_{ft-1}^2, l_{ft-1}m_{ft-1}, l_{ft-1}k_{ft-1}, m_{ft-1}k_{ft-1}, l_{ft-1}m_{ft-1}k_{ft-1}\right)$ In the second stage, we need to find the vector $\beta$ such that

$$E\left(\xi_{fjt}\left(\beta\right) Y_{ft}\right) = 0$$

After finding $\beta$ we can calculate the output elasticities on materials for each product $j$ by firm $f$ at time $t$:

$$\widehat{\theta}_{fjt}^{M} = \widehat{\beta}_{m} + 2\widehat{\beta}_{mm}m_{ft} + \widehat{\beta}_{ml}l_{ft} + \widehat{\beta}_{mk}k_{ft}$$

The mark up at the firm-product level is then recoverd by

$$\widehat{\mu}_{fjt} = \widehat{\theta}_{fjt}^{M}\frac{P_{fjt}Q_{fjt}}{\exp\left(\rho_{fjt}\left(\beta\right)\right)P_{fjt}^{M}Q_{fjt}^{M}}$$

Our estimated markup are summarized in Table 1. In all sectors, the average markup is higher than 1. The highest being in Furniture and in Transport Equipment (with an average markup of 2.5) whereas the lowest are in Medicines (average markup is 1.3).

### 3.6 Measure of input tariff and output tariff

To construct the tariffs, we first draw the tariff lines from the WTO and the trade analysis and information system (TRAINS). To be consistent with the Input-Output (IO) table that we will use later, we then map the harmonized system (HS) eight-digit tariffs into the five-digit IO code. Our five-digit output tariff, then, is the simple average of the tariffs in the HS eight-digit codes within each five-digit IO industry code.

To compute the input tariff, we use an input cost weighted average of output tariffs where:

$$\tau_{it}^{input} = \textstyle\sum_{k} a_{ki}\tau_{kt}^{output}$$

where $\tau_{kt}^{output}$ is the tariff on industry $k$ at time $t$, and $a_{ki}$ is the weight of industry $k$ in the input cost of industry $i$. For instance, if industry $i$ incurs 80% of its costs in steel and 20% of its costs in rubber then steel tariffs receive a 80% weight in our calculation of input tariffs in industry $i$, while rubber tariffs receive a 20% weight.

Since our production data utilizes the CIC 4-digit code, we then map the IO 5-digit input and output tariffs into the CIC 4-digit industry code. This procedure then yields a set of input and output tariffs at CIC 4-digit code.

Output tariffs:

Industry-level tariff

To compute the input tariffs at the industry level, we follow Amiti and Konings (2007):

$$input\_tariff_{i}^{t} = \sum_{j \in I} w_{ji}^{1999} * output\_tariff_{j}^{t} \tag{13}$$

where $w_{ji}^{1999} = \frac{\sum_{k\in\Theta} input\_expenditures_{ijk}^{1999}}{\sum_{k\in\Theta j\in I} input\_expenditures_{ijk}^{1999}}$, $I$ and $\Theta$ are the set of the industries and inputs,$input\_expenditures_{ijk}^{1999}$ is the expenditure of input $k$ from industry $j$ used in industry $i$.

### 3.7 Ordinary trade vs. Processing trade

Processing trade is a prevalent feature of Chinese imports. A Chinese firm could receive inputs from its trading partners, assemble them and export directly to its trading partners. This type of trading activities is recorded as "processing with supplied inputs" in the custom documents. Alternatively they could pay for imported inputs from foreign suppliers and export all the processed goods. This practice is documented as "processing with imported inputs". Both these types of processing trade firms are duty-free. With processing trade, a firm can fall into one of the three categories: non-importing firms, ordinart importers and processing importers. As the latters are not subject to any import tariffs, we should expect that the marginal cost effect do not have any impact on them.

As we want to show the difference between Ordinary trade and Processing trade, and the Chinese data is unique in that it allows us to investigate these both types of trade. Here we define the type of trade at the firm-product level: there are firms that carry both ordinary and processing trade (hybrid firms).

## 4 Main Results

### 4.1 The effect of trade liberalization

We now examine how our estimated markup responds to tariffs reduction as China joined WTO in 2001. We begin by our benchmark regression:

$$\mu_{fpt} = \alpha * input\_tariff_{it} + \beta * output\_tariff_{it} + \delta_s + \delta_t + \delta_{fp} + u_{fpt} \tag{14}$$

We first run our regression with ordinary trade observations. Table 2 reports a clear pro-competitive effect of trade liberalization: a cut of output tariff by 1 percent, leading to more competition in the domestic market from the foreign companies, is associated with a reduction of markup by 2 to 3 percent. But more interestingly is the impact of input tariff. Not only that the effect is statistically significant but its magnitude is also important. Cutting input tariffs by 1 percent raises the markup by more than 5 percent (Column 1). Even when we control for the firm characteristics such as the firm performance, the labor-capital ratio or the labor wage we still find the same impact (Column 2).

The effect of input tariffs depend on the extent to which the firm uses imported inputs. In particular, for an importing firm, the impact is higher by 27 percent (Column 3). More precisely, for every 10 percent rise in the import share, the impact of input tariffs rises by 14 percent (Column 4). These results are consistent with Amiti-Itskhoki-Konings (AER 2014). Indeed they show that import intensity and market share are positively correlated. Moreover, firms with larger market shares (and therefore higher markups) adjust their markups more in response to trade liberalization.

Since our dependent variable is the estimated markup at the firm-product level, the level of confidence varies with the number of observation. In particular, our estimates of mark-up have more of our confidence if the number of observations is large enough. To account for this, we then weight the previous regressions by the number of observation in the industry-year pair. In Column 5 through Column 8 in Table 2 the coefficients of interest are of similar sign and magnitude, suggesting that our findings are robust to these specifications.

Processing trade - A resilient feature of Chinese export is that there are "processing trade" firms who by laws are not subject to tariffs. Therefore we should expect the impact of tariffs to be absent among those firms. Table 3 confirm our belief: In all specifications that we employ none of them suggests that import tariffs (both input and output tariffs) have significant impact on the markup.

### 4.2 The underlying mechanism

Our model suggests that input tariff reduction lower the marginal cost which then allows the firm to raise its markup. Table 6 provdies supporting evidence to our prediction. Indeed it reports that the importing firms are more productive (and have lower marginal costs) than non importing firm (Column 1). In particular, an increase of import share by 10 percent is associated with a drop of 6 percent in marginal cost (Column 2).

Moreover, it reveals that cutting the input tariff by 1 percent will lower the marginal cost by 4 percent. This effect only applies to ordinary trade (Column 3 to 5) but have no significant impact on processing trade marginal cost (Column 6 to 8). Moreover, the change in marginal cost rises with the import intensity: importing input by 10 percent more raises the impact of input tariff by 12 percent (Column 4). In general, an import-intensive firm changes its markup by 29% more than a non import-intensive firm (Column 5).

We then augment our regression (14) by controlling for the marginal cost. Column 1 of Table 7 shows that the impact of input tariffs falls significantly: our coefficient of interest drops from 5.2 (Column 1,

Table 2) to only 0.7 (Column 1, Table 7). More than half of the effect is picked up by the marginal cost. The marginal cost effect works for both ordinary trade and processing trade (Column 1 to 6) but the impact of tariffs clearly have no impact on processing trade (Column 4 to 6).

Table 7 reveal two results: First, the impact of input tariffs has a smaller magnitude, which confirms our predictions that the impact of input tariffs is via the cost channel. Second, there is still a considerable residual effect even when we control for the marginal costs. This might be because of the variety effects that we do not pick up: lowering the inputs tariffs raise the number of varieties of inputs -> markup changes. These two results are consistent with what are found in Amiti, Itskhoki and Konings (AER, 2014).

**Also Table 7 confirms our Lemma 1 that more efficient firms charge higher markups.**

### 4.3 Across product

The product cycle —The marginal cost effect exerts different pressure on products under different stage of development. In Table 8 we interact our input tariffs with the product cycle indicator. In particular it indicates whether the product is in the growth stage (when sales are growing) or decline stage (when sales are dropping). Column 1 and 2 show that trade liberalization in the intermediate market raises the markup of products with growing sales but decrease that of products with declining sales: a 10 percent cut in input tariffs is associated with a 0.5 percent rise in markup of product whose sales grew by 10 percent. Column 2 and 3 report that the combination of import intensity and sales growth leads to large rise in markup in response to trade liberalization in China. These results also apply for products whose sales growth are among the highest (Column 4 to 6).

Core v.s non-core products——The marginal cost effect also varies with different types of products. In particular, in Table 9 the effect of input tariff is even more pronounced for the core product, defined as the one with the highest sale value (Column 1). The combination of import intensity and core product leads to an even more pronounced effect of input tariff (Column 2 to 3). We have the similar results with the products whose sale values belong to the top half of the firm (Column 4 to 6).

Higher market share vs. lower market share—-Amiti et al. (2014) argue that market share is a sufficient statistic of markup: firms with high market share dictate high markup. The first 3 columns of Table 10 confirm this prediction. On top of that, our results report that the firm with high market share adjusts its markup more in response to input tariff reduction. And among them, the firms that import intensively have the highest adjustment (Column 2 and 3). These results are also valid when we use the market share in 2000, the first year of our sample (Column 4 to 6). Note that in the previous section, we report that firms with higher import intensity adjust their markups more. Therefore these results just confirm what is reported in Amiti, Itskhoki and Konings (AER, 2014): that market share and import intensity are highly correlated and they control the extent to which input tariffs affect markups.

# 5 Robustness check

In this section we will run a battery of robustness check.

## 5.1 Instrumental variables

**In this section, we relax the assumption that the trade reforms in China during the period 2000-2006 is exogenous, which invalidates our identication strategy. Indeed, one could argue that tariff levels are set subject to the lobby effort. If the political pressure is only industry specific but time invariant then our control for the industry fixed effect alleviates this concern. When the factors are time variant, we need to rely on the instrumental variable approach. The usual instrument for tariff changes is the level of past tariffs (Goldberg and Pavcnik, 2005). Initial industry-level characteristics are also suggested to be used as instruments in a differenced equation (Trefller, 2004).**

**Follow Amiti and Davis (2011), we use the initial tariffs and the proportion of skilled labor as our instruments. As China entered the WTO in 2001 and started to reduce its tariffs significantly since then, we select the output tariff level in 2001 into our set of instruments. Since the proportion of skilled labor is only available in 2004, we will have to make the assumption that this proportion does not change overtime (practically the industries have a Cobb-Douglas production function that is time invariant). Column 1 of Table 4 reports that all our coefficients are still significant and have the expected signs.**

**One concern of the instrumental variable approach is the weak instrument. Our tests reveal that our instruments explain 89% of the tariff variation. If we exclude the other exogenous variables, our instruments still account for 62% of the output tariff variation and 12% of that of input tariffs. More importantly, the minimum eigenvalue statistic is 68, significantly higher than the critical value suggested by Stock and Yogo (2005). This suggests that we can reject the null hypothesis that our instruments are weak.**

**As our instruments contain the proportion of skilled labor that is only available in 2004, we check if our results are robust to different set of instruments. To do this we replace the proportion of skilled labor by the capital-labor ratio at the 4-digit CIC industry level in 2001. Column 2 in Table 4 document similar statistics to Column 1, suggesting that**

**the results are robust to the set of instruments.**

### 5.2 Pre trade reform

**Although China entered WTO in 2001, the process of trade reforms might have happened before that period. In fact, the beginning steps were set as early as in the early 1990s. Brandt et al. (2014) document that there are two periods where Chinese tariffs were cut significantly: 1992-1997 and after 2002. This is consistent with Figure 1 which shows that there is a drastic drop of tariff rates in 2001. Especially input tariffs dropped from more than 15% on average to 10% a year later.**

**This prompts us to check whether there are any effects of tariffs on the firm's markup before our trade reform period. In Table 5 we report the results when we restrict the sample in the 2000-2001 period. Column 1 shows that both input and output tariffs have insignificant impact during this period. One can argue that the changes of tariff rates might be different across industries. Indeed, the change of output tariffs across industries from the year 2000 to 2001 were as low as 0.3% and as high as 3%. The median was 1.3%. The changes of input tariffs are smaller as we can see in Figure 1, but could be as high as 1.3%. The median was 0.8%. Therefore we restrict our sample even more by looking at the industries where tariffs cut was small. In Column 2 we look at industries whose input tariff cuts were less than 0.5%. The result shows that there is no significant impact of input tariffs. Similarly, if we reduce our sample to industries whose output tariff cuts were less than 0.5%, the impact of output tariffs were also insignificant (Column 3).**

### 5.3 One year change

Our results above still hold when we employ the changes of markup and tariffs. Indeed, in Table 11 the dependent variable is the change of markup to the previous year whereas the explanatory variables of interest are the changes of tariffs, also to the previous year. Our table reports that the marginal cost effects apply to ordinary trade (Column 1 to 3) but not to processing trade (Column 4 to 6). Moreover, these effects rise with the firm's import intensity (Column 2 and 3).

### 5.4 The IO table

Our tariffs used in all previous section are at the industry level. In particular, the IO-table we use to compute the input tariffs are taken from the Chinese Statistical Yearbook. It does not reflect, however,

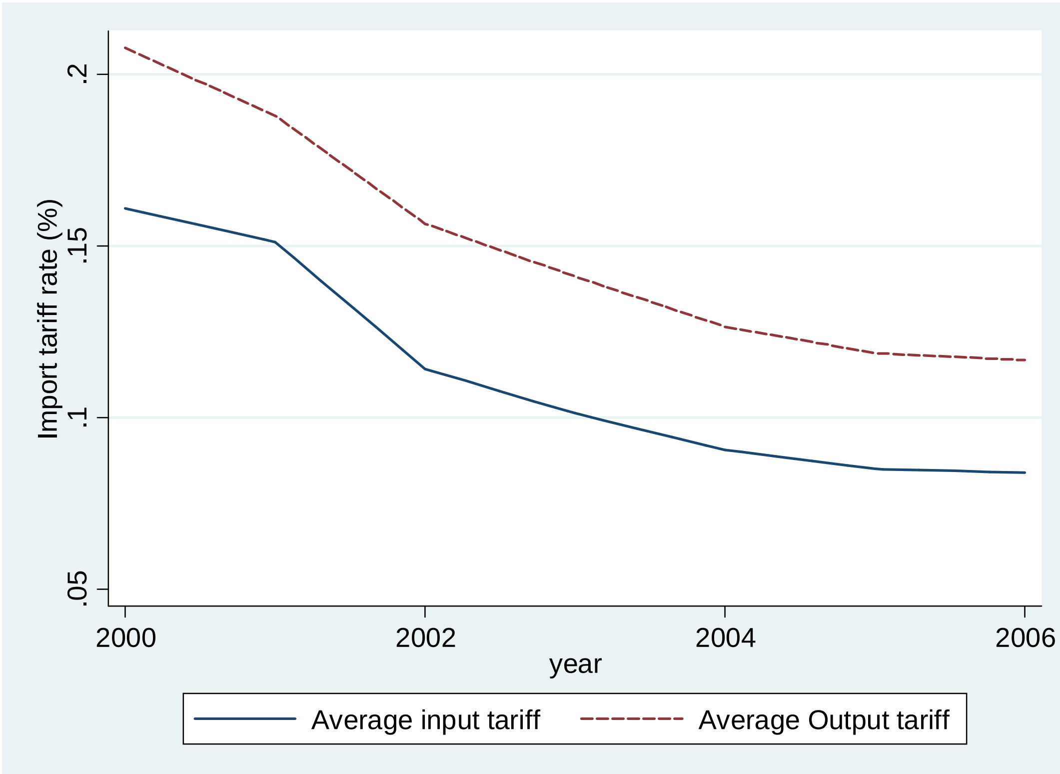


Figure 1: Tariff rate in 2000-2006

the difference in input import across firms. Since this is the key thing that drives our result, we replace here the input tariffs at the firm level, taking into account its use of imported input. In particular in Table 12 we use the simple average tariff of all the inputs the firm imports (in Column 1 and 5) and the average tariff, weighted by the value of its imported input (Column 2 and 6). Both results confirm that cutting the firm-level input tariffs still raises the firm markup for the ordinary trade (Column 1 and 2) but not for processing trade (Column 5 and 6).

Another problem with the IO table is that not all of the imported goods are used as inputs. Some of them can be used as final goods. To address this issue we drop any imports defined as final product using the Broad Economic Codes (BEC) and calculate the simple average tariff (Column 3 and 7) and the weighted average tariff (Column 4 and 8). Our results again are robust.

### 5.5 The exchange rate reform

China refomed its exchange regime in July 2005 from a peg system to a more flexible system which affects the profit margin of the firm To isolate this effect from our study, we then drop the year 2006 in Table 13. We can see clearly that all of our results go through: that input tariffs has a signigicant impact on the markup only with ordinary trade, and this impact rises with import intensity.

### 5.6 Manufacturing data

It is arguable that manufacturing data is more reliable. Therefore in Table 14 we drop the non-manufacturing sectors according to the UN classification (i.e., chapters 1-15, 25,26,27 and 93). Again there is no signifinicant change regarding our coefficients of interest. The signs and magnitude of the input tariff coefficients are pretty much similar to what we obtained in the previous tables.

### 5.7 Without SOE

One might be concerned with the presence of the state-owned companies in China. They receive special treatments from the government and their concern might not be pure profit but for instance, employment. Therefore to address this concern, we redo all of our excercises with the sample excluding the SOE. We can see from Table 15 that none of our results change when we exclude the SOE firms.

## 6 Conclusion

To be completed.

## 7 Appendix

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Figure 2: Import value in China

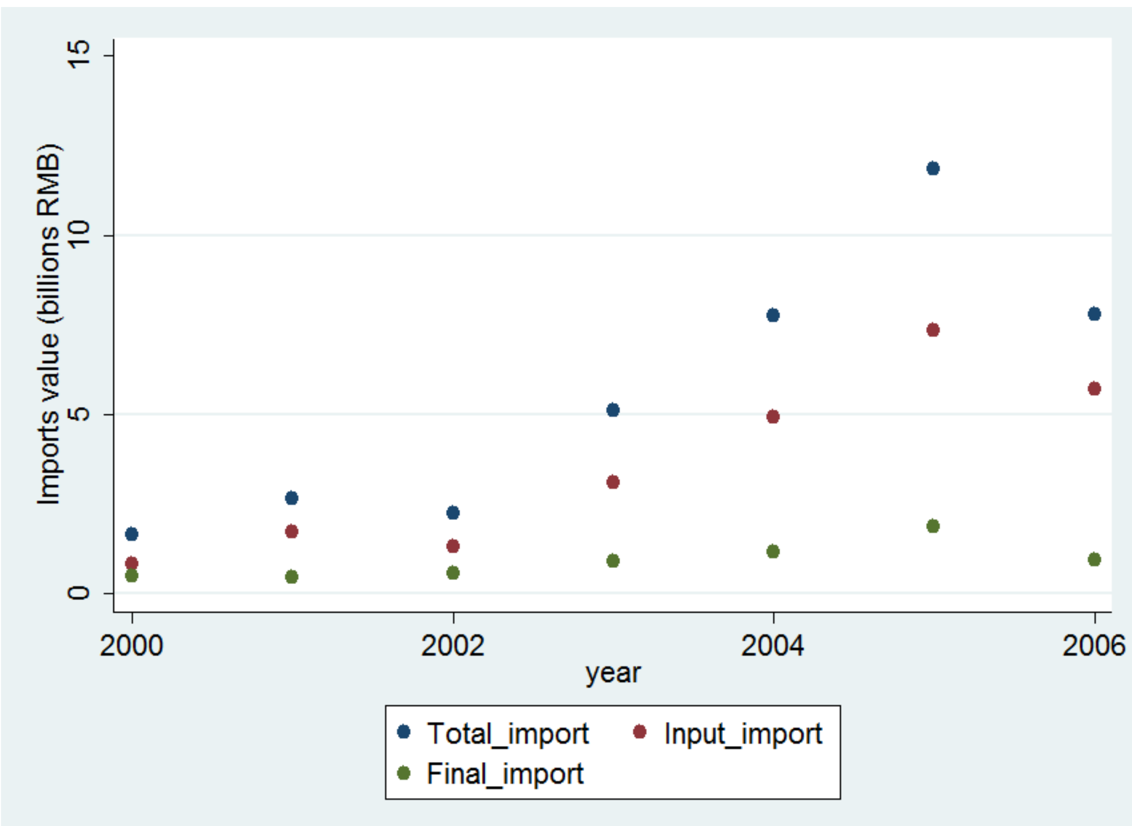

Figure 3: Markups in China 2000-2003

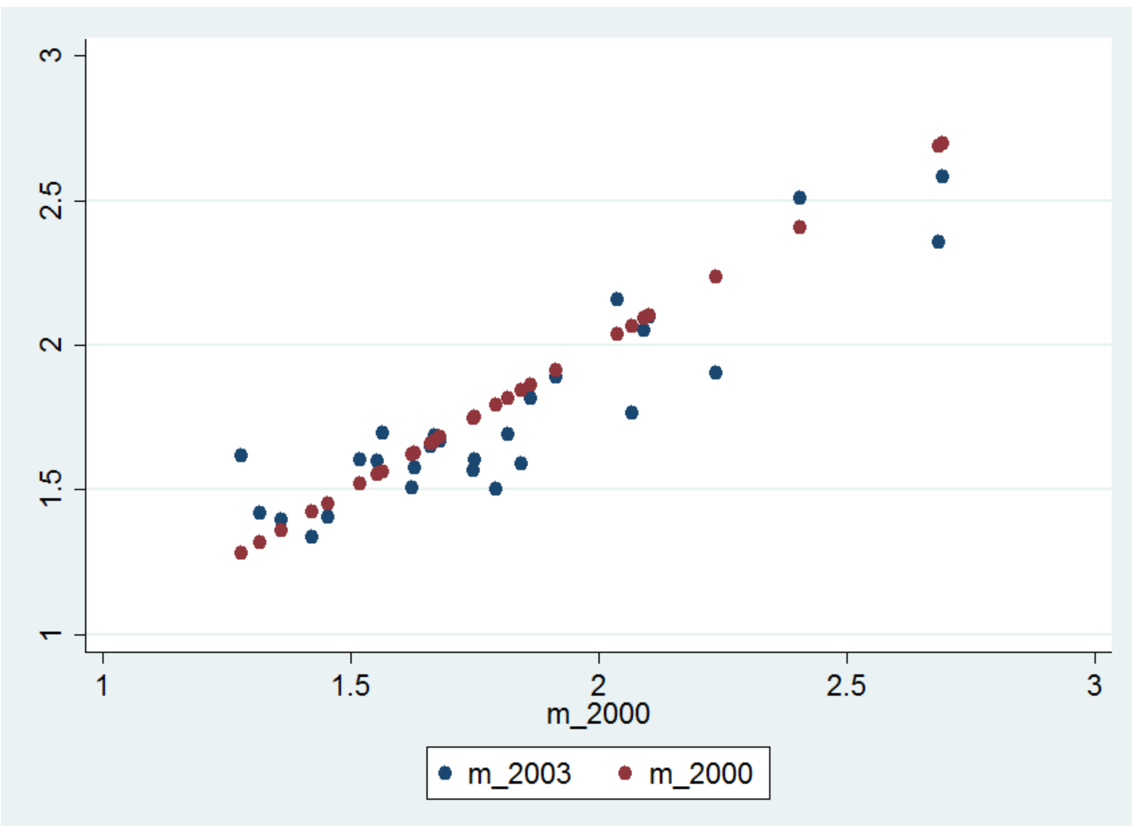

Figure 4: Markups in China 2000-2006

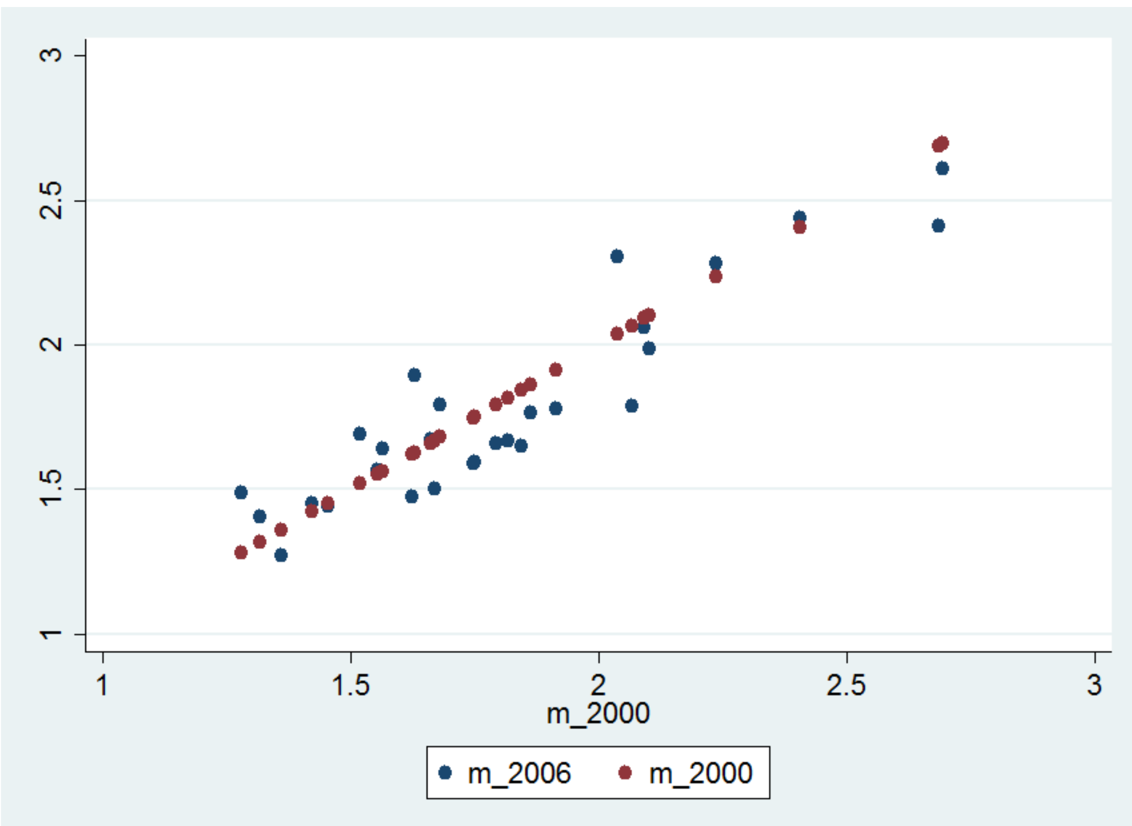

Table 1: Markup, by Sector

| | Markup | |
|---|---|---|
| Sector | Mean | Median |
| Processing of Food from Agricultural Products 13 | 2.2026769 | 1.2677851 |
| Foods 14 | 1.6559686 | 1.2610546 |
| Beverages 15 | 2.1520956 | 1.3178359 |
| Textile 17 | 1.6178902 | 1.0558161 |
| Wearing Apparel, Footware, and Caps 18 | 1.4053659 | .75763565 |
| Leather, Fur, Feather and Related Products 19 | 1.6599999 | 1.1221893 |
| Processing of Timber, Manufacture of Wood, Bamboo, Rattan, Palm, and Straw Products 20 | 2.4857801 | 1.2716784 |
| Furniture 21 | 1.7934953 | 1.0720984 |
| Paper and Paper Products 22 | 1.5556375 | 1.0606008 |
| Printing, Reproduction of Recording Media 23 | 1.6266523 | 1.1099905 |
| Articles For Culture, Education and Sport Activity 24 | 1.8379768 | 1.1004338 |
| Petroleum, Coking, Processing of Nuclear Fuel 25 | 1.9641813 | 1.2829993 |
| Raw Chemical Materials and Chemical Products 26 | 1.6513247 | 1.1907145 |
| Medicines 27 | 1.2982079 | 1.0080323 |
| Chemical Fibers 28 | 1.8191736 | 1.2034684 |
| Rubber 29 | 1.5880558 | 1.1394931 |
| Plastics 30 | 1.7075108 | 1.0966201 |
| Non-metallic Mineral Products 31 | 1.4139139 | 1.0562911 |
| Smelting and Pressing of Ferrous Metals 32 | 1.4470833 | 1.1728897 |
| Smelting and Pressing of Non-ferrous Metals 33 | 1.4495704 | 1.1205271 |
| Metal Products 34 | 1.5206625 | 1.0534359 |
| General Purpose Machinery 35 | 2.0485038 | 1.152124 |
| Special Purpose Machinery 36 | 1.6537164 | 1.2031413 |
| Transport Equipment 37 | 2.5000045 | 1.2888315 |
| Electrical Machinery and Equipment 39 | 1.8307147 | 1.1684803 |
| Communication Equipment, Computers and Other Electronic Equipment 40 | 2.5525376 | 1.2276316 |
| Measuring Instruments and Machinery for Cultural Activity and Office Work 41 | 1.6187061 | 1.0537849 |
| Artwork and Other Manufacturing 42 | 2.1125352 | 1.1418584 |
| Average | 1.735908 | 1.082974 |

Note: Table displays the mean and median markup by Sector for the sample 2000-2006. We trim observations with markup lower or higher than 2nd and 98th percentile within each Sector.

Table 2: Ordinary Trade

| Dependent variable: Firm-product markup | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
|---|---|---|---|---|---|---|---|---|
| Input tariff | -5.215*** | -4.764*** | -3.891*** | -4.107*** | -6.825*** | -5.033*** | -3.999*** | -4.536*** |
| | (0.966) | (0.966) | (1.064) | (0.982) | (1.136) | (1.133) | (1.174) | (1.138) |
| Output tariff | 1.692*** | 1.691*** | 1.657*** | 1.689*** | 3.845*** | 3.110*** | 3.024*** | 3.062*** |
| | (0.571) | (0.571) | (0.571) | (0.571) | (0.754) | (0.752) | (0.752) | (0.752) |
| Interaction1 | | | -1.060** | | | | -1.137*** | |
| | | | (0.537) | | | | (0.342) | |
| Importing firm | | | 0.142** | | | | 0.111*** | |
| | | | (0.0575) | | | | (0.0398) | |
| Interaction2 | | | | -5.571*** | | | | -4.105*** |
| | | | | (1.452) | | | | (0.881) |
| Import share | | | | 1.141*** | | | | 0.548*** |
| | | | | (0.176) | | | | (0.122) |
| ln(TFP) | | 1.060*** | 1.059*** | 1.031*** | | 1.057*** | 1.055*** | 1.049*** |
| | | (0.0363) | (0.0363) | (0.0365) | | (0.0229) | (0.0229) | (0.0231) |
| capital-labor ratio | | 0.0772*** | 0.0767*** | 0.0757*** | | 0.00133 | 0.00257 | 0.00532 |
| | | (0.0207) | (0.0207) | (0.0208) | | (0.0115) | (0.0115) | (0.0115) |
| labor | | -0.0350 | -0.0396 | -0.0383 | | -0.0242 | -0.0249* | -0.0193 |
| | | (0.0255) | (0.0255) | (0.0255) | | (0.0151) | (0.0151) | (0.0151) |
| ln(wage) | | 0.0479** | 0.0471** | 0.0469** | | 0.0333*** | 0.0335*** | 0.0353*** |
| | | (0.0191) | (0.0191) | (0.0191) | | (0.0114) | (0.0114) | (0.0114) |
| Year Fixed Effect | YES | YES | YES | YES | YES | YES | YES | YES |
| Industry Fixed Effect | YES | YES | YES | YES | YES | YES | YES | YES |
| Firm-Product Fixed Effect | YES | YES | YES | YES | YES | YES | YES | YES |
| Observations | 620,150 | 619,738 | 619,738 | 619,738 | 620,150 | 619,738 | 619,738 | 619,738 |
| R-squared | 0.753 | 0.754 | 0.754 | 0.754 | 0.776 | 0.778 | 0.778 | 0.778 |

Note: We only use ordinary trade in this Table. Standard errors are reported in parentheses *** $p<0.01$, ** $p<0.05$, * $p<0.1$
In specifications 5 to 8 we run the regressions weighted by the number of observations in the Industry-Year pair
Interaction1: input tariff and import status interaction; Interaction2: input tariff and import share interaction

Table 3: Processing trade

| Dependent variable: Firm-product markup | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
|---|---|---|---|---|---|---|---|---|
| input tariff | -0.845 | -0.735 | -1.863 | -0.986 | -1.473 | -1.916 | 0.389 | -2.303* |
| | (0.895) | (0.895) | (1.895) | (0.948) | (1.320) | (1.313) | (2.256) | (1.330) |
| output tariff | 0.338 | 0.379 | 0.380 | 0.363 | -0.242 | -0.355 | -0.367 | -0.383 |
| | (0.476) | (0.475) | (0.475) | (0.476) | (0.844) | (0.838) | (0.838) | (0.838) |
| Interaction1 | | | 1.129 | | | | -2.268 | |
| | | | (1.661) | | | | (1.795) | |
| Importing firm | | | -0.0829 | | | | 0.208 | |
| | | | (0.174) | | | | (0.206) | |
| Interaction2 | | | | 0.735 | | | | 1.062* |
| | | | | (0.912) | | | | (0.590) |
| importshare | | | | -0.135 | | | | -0.234*** |
| | | | | (0.116) | | | | (0.0824) |
| ln(TFP) | | 0.954*** | 0.954*** | 0.962*** | | 1.040*** | 1.040*** | 1.054*** |
| | | (0.0429) | (0.0429) | (0.0436) | | (0.0282) | (0.0282) | (0.0286) |
| capital-labor ratio | | 0.0543** | 0.0543** | 0.0538** | | 0.0148 | 0.0147 | 0.0128 |
| | | (0.0262) | (0.0262) | (0.0263) | | (0.0173) | (0.0173) | (0.0175) |
| labor | | -0.00829 | -0.00866 | -0.00788 | | -0.0223 | -0.0227 | -0.0234 |
| | | (0.0299) | (0.0299) | (0.0299) | | (0.0212) | (0.0212) | (0.0213) |
| ln(wage) | | 0.00511 | 0.00500 | 0.00520 | | -0.0159 | -0.0157 | -0.0178 |
| | | (0.0183) | (0.0183) | (0.0183) | | (0.0125) | (0.0125) | (0.0125) |
| Year Fixed Effect | YES | YES | YES | YES | YES | YES | YES | YES |
| Industry Fixed Effect | YES | YES | YES | YES | YES | YES | YES | YES |
| Firm-Product Fixed Effect | YES | YES | YES | YES | YES | YES | YES | YES |
| Observations | 184,094 | 183,931 | 183,931 | 183,931 | 184,094 | 183,931 | 183,931 | 183,931 |
| R-squared | 0.688 | 0.690 | 0.690 | 0.690 | 0.780 | 0.784 | 0.784 | 0.784 |

Note: Only processing trade are considered. Standard errors are reported in parentheses *** p<0.01, ** p<0.05, * p<0.1
In specifications 5 to 8 we run the regressions weighted by the number of observations in the Industry-Year pair
Interaction1: input tariff and import status interaction; Interaction2: input tariff and import share interaction

Table 4: Instrumental variable

| Dependent variable: Firm-product markup | | |
|---|---|---|
| | (1) | (2) |
| duty_in | -310.9*** | -94.64*** |
| | (74.65) | (29.72) |
| duty_out | 51.61*** | 16.08*** |
| | (12.27) | (4.85) |
| Ho: coefficient on output tariff equals 0 | | |
| R-sq | 0.89 | 0.89 |
| partial R-sq | 0.62 | 0.62 |
| F-stat | 127,260 | 126,882 |
| Ho: coefficient on input tariff equals 0 | | |
| R-sq | 0.89 | 0.89 |
| partial R-sq | 0.12 | 0.12 |
| F-stat | 14,809 | 14,107 |
| Weak instrument test (5 % relative bias) | | |
| Minimum eigenvalue statistics | 68.46 | 195.421 |
| 2SLS Size of nominal 5% Wald test | 7.03 | 7.03 |
| Observations | 580,437 | 580,558 |

Note: Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1
In all specification we add the year and industry fixed effects and the firm characteristics are productivity, employment, capital-labour ratio and labour wage. The instruments used are output tariff levels in 2001 and the skill proportion in 2004 (specification 1) and output tariff levels and the capital-labour ratio in 2001.

Table 5: Pre trade reforms

| | (1) | (2) | (3) |
|---|---|---|---|
| Dependent variable: Firm-product markup | | | |
| duty_in | -1.649 | -0.216 | |
| | (7.604) | (41.52) | |
| duty_out | -4.266 | | -7.969 |
| | (3.357) | | (6.873) |
| TFP | 0.986*** | 0.984*** | 0.990*** |
| | (0.208) | (0.253) | (0.258) |
| K_L | 0.00720 | -0.209 | -0.155 |
| | (0.131) | (0.144) | (0.189) |
| l | -0.230 | -0.0274 | -0.0161 |
| | (0.164) | (0.174) | (0.225) |
| wage | -0.303*** | 0.212*** | 0.0451 |
| | (0.0759) | (0.0823) | (0.113) |
| Constant | 2.650 | -0.132 | 1.250 |
| | (1.767) | (7.594) | (2.328) |
| Observations | 83,149 | 6,250 | 9,708 |
| R-squared | 0.908 | 0.868 | 0.868 |

Standard errors in parentheses *** $p<0.01$, ** $p<0.05$, * $p<0.1$

Table 6: The Impact of Import intensity and Tariffs on Marginal costs

| Dependent variable: Firm-product marginal cost | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| Importing firm | -0.0430* | | | | -0.142** | | | 0.121 |
| | (0.0227) | | | | (0.0582) | | | (0.176) |
| Import share | | -0.614*** | | -1.080*** | | | 0.231** | |
| | | (0.0881) | | (0.178) | | | (0.117) | |
| Input tariff | | | 4.221*** | 3.707*** | 3.391*** | 0.829 | 1.250 | 2.195 |
| | | | (0.979) | (0.995) | (1.078) | (0.907) | (0.960) | (1.920) |
| Output tariff | | | -1.733*** | -1.730*** | -1.699*** | -0.322 | -0.295 | -0.323 |
| | | | (0.578) | (0.578) | (0.578) | (0.482) | (0.482) | (0.482) |
| Interaction1 | | | | | 1.008* | | | -1.362 |
| | | | | | (0.544) | | | (1.684) |
| Interaction2 | | | | 4.423*** | | | -1.232 | |
| | | | | (1.471) | | | (0.924) | |
| ln(TFP) | -1.032*** | -1.004*** | -1.030*** | -0.999*** | -1.030*** | -0.906*** | -0.920*** | -0.906*** |
| | (0.0368) | (0.0370) | (0.0368) | (0.0370) | (0.0368) | (0.0435) | (0.0442) | (0.0435) |
| capital-labor ratio | -0.0789*** | -0.0746*** | -0.0800*** | -0.0771*** | -0.0792*** | -0.0453* | -0.0445* | -0.0453* |
| | (0.0210) | (0.0210) | (0.0210) | (0.0210) | (0.0210) | (0.0266) | (0.0266) | (0.0266) |
| labor | 0.0513** | 0.0510** | 0.0465* | 0.0501* | 0.0515** | 0.0379 | 0.0371 | 0.0380 |
| | (0.0259) | (0.0258) | (0.0258) | (0.0258) | (0.0259) | (0.0303) | (0.0303) | (0.0303) |
| ln(wage) | -0.0433** | -0.0429** | -0.0439** | -0.0429** | -0.0431** | 0.00387 | 0.00371 | 0.00393 |
| | (0.0193) | (0.0193) | (0.0193) | (0.0193) | (0.0193) | (0.0185) | (0.0185) | (0.0185) |
| Year Fixed Effect | YES | YES | YES | YES | YES | YES | YES | YES |
| Industry Fixed Effect | YES | YES | YES | YES | YES | YES | YES | YES |
| Firm-product Fixed Effect | YES | YES | YES | YES | YES | YES | YES | YES |
| Observations | 619,738 | 619,738 | 619,738 | 619,738 | 619,738 | 183,931 | 183,931 | 183,931 |
| R-squared | 0.805 | 0.805 | 0.805 | 0.805 | 0.805 | 0.814 | 0.814 | 0.814 |

Ordinary trade observations are used in Specifications 3 to 5 whereas processing trade are employed in Specifications 6 to 8.
Interaction1: input tariff and import status interaction; Interaction2: input tariff and import share interaction
Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Table 7: The Marginal Cost effect

| Dependent variable: Firm-product markup | | | | | | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Input tariff | -0.664*** | -0.503*** | -0.589*** | 0.119 | 0.270 | 0.324 |
| | (0.171) | (0.174) | (0.189) | (0.167) | (0.177) | (0.354) |
| Output tariff | 0.00722 | 0.0100 | 0.00786 | 0.0569 | 0.0662 | 0.0561 |
| | (0.101) | (0.101) | (0.101) | (0.0888) | (0.0889) | (0.0888) |
| Interaction1 | | | -0.0857 | | | -0.200 |
| | | | (0.0952) | | | (0.310) |
| Importing firm | | | 0.00489 | | | 0.0373 |
| | | | (0.0102) | | | (0.0325) |
| Interaction2 | | -1.275*** | | | -0.443*** | |
| | | (0.257) | | | (0.170) | |
| Import share | | 0.0923*** | | | 0.0885*** | |
| | | (0.0311) | | | (0.0216) | |
| Marginal cost | -0.971*** | -0.971*** | -0.971*** | -0.969*** | -0.969*** | -0.969*** |
| | (0.000365) | (0.000365) | (0.000365) | (0.000649) | (0.000649) | (0.000649) |
| ln(TFP) | 0.0588*** | 0.0598*** | 0.0587*** | 0.0758*** | 0.0698*** | 0.0759*** |
| | (0.00645) | (0.00649) | (0.00645) | (0.00804) | (0.00816) | (0.00804) |
| capital-labor ratio | -0.000477 | -0.00400 | -0.00508* | -0.00594 | -0.00554 | -0.00574 |
| | (0.00367) | (0.00304) | (0.00303) | (0.00371) | (0.00372) | (0.00371) |
| ln(wage) | 0.00518 | 0.00414 | 0.00409 | 0.00671** | 0.00667** | 0.00667** |
| | (0.00338) | (0.00335) | (0.00335) | (0.00339) | (0.00339) | (0.00339) |
| Year Fixed Effect | YES | YES | YES | YES | YES | YES |
| Industry Fixed Effect | YES | YES | YES | YES | YES | YES |
| Firm-product Fixed Effect | YES | YES | YES | YES | YES | YES |
| Observations | 619,738 | 619,738 | 619,738 | 183,931 | 183,931 | 183,931 |
| R-squared | 0.992 | 0.992 | 0.992 | 0.989 | 0.989 | 0.989 |

Ordinary trade observations are used in Specifications 1 to 3 whereas processing trade are employed in Specifications 4 to 6.
Interaction1: input tariff and import status interaction; Interaction2: input tariff and import share interaction
Standard errors in parentheses *** $p<0.01$, ** $p<0.05$, * $p<0.1$

Table 8: Expanding and Shrinking Products

| Dependent variable: Firm-product markup | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| Input tariff | -1.892 | -2.392 | -1.443 | -2.238 | -2.617* | -1.778 |
| | (1.552) | (1.585) | (1.579) | (1.554) | (1.585) | (1.581) |
| Output tariff | 0.116 | 0.0871 | 0.102 | 0.151 | 0.112 | 0.134 |
| | (0.913) | (0.913) | (0.913) | (0.912) | (0.912) | (0.912) |
| Interaction1 | | 0.590 | | | 0.477 | |
| | | (0.414) | | | (0.405) | |
| Interaction2 | | | -3.336 | | | -3.371 |
| | | | (2.570) | | | (2.573) |
| Interaction3 | -3.632*** | -2.281*** | -3.160*** | -3.354*** | -2.076*** | -2.873*** |
| | (0.541) | (0.630) | (0.549) | (0.537) | (0.623) | (0.544) |
| Interaction4 | | -1.714*** | | | -1.633*** | |
| | | (0.406) | | | (0.402) | |
| import share | | 0.369** | 1.100*** | | 0.373** | 1.099*** |
| | | (0.159) | (0.312) | | (0.159) | (0.312) |
| Expanding | -0.505*** | -0.521*** | -0.496*** | -0.533*** | -0.548*** | -0.524*** |
| | (0.0600) | (0.0601) | (0.0600) | (0.0594) | (0.0595) | (0.0594) |
| Interaction5 | | | -6.054*** | | | -6.219*** |
| | | | (1.128) | | | (1.121) |
| ln(TFP) | 1.019*** | 1.001*** | 0.998*** | 1.019*** | 1.001*** | 0.997*** |
| | (0.0591) | (0.0596) | (0.0596) | (0.0591) | (0.0595) | (0.0596) |
| capital-labor ratio | 0.0118 | 0.0114 | 0.0144 | 0.0144 | 0.0139 | 0.0171 |
| | (0.0373) | (0.0374) | (0.0374) | (0.0373) | (0.0374) | (0.0374) |
| labor | -0.120** | -0.116** | -0.120** | -0.121** | -0.118** | -0.121** |
| | (0.0474) | (0.0474) | (0.0473) | (0.0473) | (0.0474) | (0.0473) |
| ln(wage) | 0.0434 | 0.0441 | 0.0452 | 0.0429 | 0.0433 | 0.0447 |
| | (0.0320) | (0.0320) | (0.0320) | (0.0320) | (0.0320) | (0.0320) |
| Year Fixed Effect | YES | YES | YES | YES | YES | YES |
| Industry Fixed Effect | YES | YES | YES | YES | YES | YES |
| Firm-product Fixed Effect | YES | YES | YES | YES | YES | YES |
| Observations | 194,256 | 194,256 | 194,256 | 194,256 | 194,256 | 194,256 |
| R-squared | 0.766 | 0.766 | 0.766 | 0.766 | 0.766 | 0.766 |

Note: In specification 1-3, the expanding products are the ones with growing sales, relative to the previous year.
In specification 4-6, the expanding products are the ones with the largest sale growth.
Interaction1: input tariff and import status interaction; Interaction2: input tariff and import share interaction
Interaction3: input tariff and expanding good interaction; Interaction4: input tariff, import status and expanding good interaction
Interaction5: input tariff, import share and expanding good interaction. Standard errors in parentheses *** $p<0.01$, ** $p<0.05$, * $p<0.1$

Table 9: Core Products

| Dependent variable: Firm-product markup | | | | | | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Input tariff | -4.542*** | -3.952*** | -4.573*** | -3.408*** | -2.892*** | -3.857*** |
| | (0.959) | (0.976) | (0.977) | (0.958) | (0.974) | (0.976) |
| Output tariff | 1.822*** | 1.825*** | 1.839*** | 1.297** | 1.287** | 1.286** |
| | (0.565) | (0.565) | (0.565) | (0.557) | (0.557) | (0.557) |
| Interaction1 | | | -0.00393 | | | 0.600*** |
| | | | (0.219) | | | (0.230) |
| Interaction2 | | -5.046*** | | | -4.236*** | |
| | | (1.453) | | | (1.447) | |
| Interaction3 | -3.854*** | -3.774*** | -2.285*** | -1.525*** | -1.119** | 0.367 |
| | (0.550) | (0.562) | (0.609) | (0.432) | (0.442) | (0.497) |
| Interaction4 | | | -2.372*** | | | -2.397*** |
| | | | (0.389) | | | (0.309) |
| Interaction5 | | -1.245 | | | -3.890*** | |
| | | (1.130) | | | (0.854) | |
| import share | | 1.029*** | 0.498*** | | 1.081*** | 0.508*** |
| | | (0.174) | (0.0867) | | (0.172) | (0.0854) |
| Core Product | -1.048*** | -1.043*** | -1.064*** | -1.614*** | -1.616*** | -1.636*** |
| | (0.0584) | (0.0584) | (0.0585) | (0.0465) | (0.0465) | (0.0466) |
| ln(TFP) | 1.058*** | 1.032*** | 1.035*** | 1.050*** | 1.023*** | 1.027*** |
| | (0.0360) | (0.0362) | (0.0362) | (0.0355) | (0.0357) | (0.0357) |
| capital-labor ratio | 0.0682*** | 0.0673*** | 0.0661*** | 0.0663*** | 0.0655*** | 0.0620*** |
| | (0.0205) | (0.0206) | (0.0206) | (0.0202) | (0.0203) | (0.0203) |
| labor | -0.0839*** | -0.0866*** | -0.0835*** | -0.0862*** | -0.0887*** | -0.0878*** |
| | (0.0252) | (0.0252) | (0.0253) | (0.0248) | (0.0248) | (0.0249) |
| ln(wage) | 0.0316* | 0.0309 | 0.0319* | 0.0323* | 0.0319* | 0.0319* |
| | (0.0189) | (0.0189) | (0.0189) | (0.0186) | (0.0186) | (0.0186) |
| Year Fixed Effect | YES | YES | YES | YES | YES | YES |
| Industry Fixed Effect | YES | YES | YES | YES | YES | YES |
| Firm-product Fixed Effect | YES | YES | YES | YES | YES | YES |
| Observations | 619,738 | 619,738 | 619,738 | 619,738 | 619,738 | 619,738 |
| R-squared | 0.759 | 0.759 | 0.759 | 0.766 | 0.766 | 0.766 |

Note: In specification 1-3, the core product is defined as the largest sale value product within HS-2 digit.
In specification 4-6, the core products are the ones whose sales are higher than the median.
Interaction1: input tariff and import status interaction; Interaction2: input tariff and import share interaction
Interaction3: input tariff and core product interaction; Interaction4: input tariff, import status and core product interaction
Interaction5: input tariff, import share and core product interaction. Standard errors in parentheses *** $p<0.01$, ** $p<0.05$, * $p<0.1$

Table 10: Market share

| Dependent variable: Firm-product markup | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| Input tariff | -4.220*** | -3.766*** | -3.453*** | -5.653*** | -5.145*** | -3.408** |
| | (0.969) | (0.985) | (1.066) | (1.410) | (1.442) | (1.609) |
| Output tariff | 1.662*** | 1.680*** | 1.630*** | 3.262*** | 3.315*** | 3.180*** |
| | (0.571) | (0.571) | (0.571) | (0.832) | (0.832) | (0.832) |
| Interaction1 | | | -0.935* | | | -2.493*** |
| | | | (0.541) | | | (0.860) |
| Interaction2 | | -4.417*** | | | -4.605** | |
| | | (1.466) | | | (2.064) | |
| Interaction3 | -69.72*** | -50.16*** | -67.89*** | -72.12*** | -48.85*** | -66.17*** |
| | (9.451) | (10.46) | (13.38) | (14.06) | (16.41) | (23.51) |
| Interaction4 | | | -1.305 | | | -3.402 |
| | | | (10.00) | | | (17.48) |
| Interaction5 | | -85.58*** | | | -84.63*** | |
| | | (21.64) | | | (31.04) | |
| import share | | 1.060*** | | | 1.619*** | |
| | | (0.176) | | | (0.292) | |
| market share | 10.18*** | 9.364*** | 10.10*** | | | |
| | (1.354) | (1.360) | (1.363) | | | |
| Importing firm | | | 0.129** | | | 0.307*** |
| | | | (0.0576) | | | (0.107) |
| ln(TFP) | 1.060*** | 1.031*** | 1.059*** | 1.069*** | 0.980*** | 1.064*** |
| | (0.0363) | (0.0365) | (0.0363) | (0.0783) | (0.0793) | (0.0784) |
| capital-labor ratio | 0.0761*** | 0.0741*** | 0.0755*** | 0.0774* | 0.0741* | 0.0767* |
| | (0.0207) | (0.0208) | (0.0207) | (0.0405) | (0.0406) | (0.0405) |
| labor | -0.0396 | -0.0428* | -0.0440* | -0.0366 | -0.0430 | -0.0469 |
| | (0.0255) | (0.0255) | (0.0256) | (0.0469) | (0.0469) | (0.0472) |
| ln(wage) | 0.0461** | 0.0448** | 0.0454** | -0.0213 | -0.0251 | -0.0227 |
| | (0.0191) | (0.0191) | (0.0191) | (0.0357) | (0.0357) | (0.0357) |
| Year Fixed Effect | YES | YES | YES | YES | YES | YES |
| Industry Fixed Effect | YES | YES | YES | YES | YES | YES |
| Firm-product Fixed Effect | YES | YES | YES | YES | YES | YES |
| Observations | 619,738 | 619,738 | 619,738 | 147,375 | 147,375 | 147,375 |
| R-squared | 0.754 | 0.754 | 0.754 | 0.672 | 0.672 | 0.672 |

Note: In specifications 1-3, we use the current market share whereas in specifications 4-6 we use the market share in 2000 which is the first year in our sample.
Interaction1: input tariff and import status interaction; Interaction2: input tariff and import share interaction
Interaction3: input tariff and market share interaction; Interaction4: input tariff, import status and market share interaction
Interaction5: input tariff, import share and market share interaction. Standard errors are reported in parentheses *** $p<0.01$, ** $p<0.05$,

Table 11: One year change

| Dependent variable: The change in Firm-product markup | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| $\Delta$input tariff | -6.188** | -1.885 | -4.438* | -3.953 | 0.802 | -4.206* |
| | (2.869) | (1.589) | (2.464) | (2.348) | (1.769) | (2.464) |
| $\Delta$Output tariff | 1.078 | 1.113 | 1.327* | 1.668** | 1.677** | 1.681** |
| | (0.725) | (0.753) | (0.731) | (0.626) | (0.629) | (0.633) |
| Interaction1 | | -5.598* | | | -4.897 | |
| | | (2.942) | | | (2.893) | |
| Importing firm | | -0.0442 | | | -0.0689 | |
| | | (0.0308) | | | (0.0417) | |
| Interaction2 | | | -14.14* | | | 0.629 |
| | | | (7.050) | | | (1.197) |
| Import share | | | -0.0241 | | | 0.0866 |
| | | | (0.0549) | | | (0.0576) |
| $\Delta$ln(TFP) | 1.064*** | 1.064*** | 1.066*** | 0.996*** | 0.996*** | 1.002*** |
| | (0.0964) | (0.0967) | (0.0970) | (0.0389) | (0.0390) | (0.0399) |
| $\Delta$capital-labor ratio | 0.0278 | 0.0264 | 0.0302 | 0.0860 | 0.0858 | 0.0899 |
| | (0.0333) | (0.0329) | (0.0331) | (0.0673) | (0.0674) | (0.0664) |
| $\Delta$labor | -0.0733 | -0.0746 | -0.0729 | 0.0525 | 0.0524 | 0.0545 |
| | (0.0528) | (0.0536) | (0.0527) | (0.0552) | (0.0553) | (0.0543) |
| $\Delta$ln(wage) | 0.0449 | 0.0448 | 0.0449 | -0.0135* | -0.0134* | -0.0135* |
| | (0.0569) | (0.0567) | (0.0567) | (0.00674) | (0.00669) | (0.00674) |
| Year Fixed Effect | YES | YES | YES | YES | YES | YES |
| Industry Fixed Effect | YES | YES | YES | YES | YES | YES |
| Firm-product Fixed Effect | YES | YES | YES | YES | YES | YES |
| Observations | 193,640 | 193,640 | 193,640 | 66,527 | 66,527 | 66,527 |
| R-squared | 0.005 | 0.005 | 0.005 | 0.007 | 0.007 | 0.007 |

Note: Firm characteristics (changes in productivity, labor-capital ratio, labor, labor wage) are included in all specifications.

Interaction1: the change in input tariff and import status interaction; Interaction2: the change in input tariff and import share interaction

Note: Specifications 1-3 employ ordinary trade data whereas specifications 4-6 employ processing trade data.

Robust standard errors in parentheses *** $p<0.01$, ** $p<0.05$, * $p<0.1$

Table 12: Problems with the IO table

| Dependent variable: Firm-product markup | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
|---|---|---|---|---|---|---|---|---|
| Input tariff1 | -1.094*** | | | | 0.0480 | | | |
| | (0.347) | | | | (0.281) | | | |
| Input tariff2 | | -0.882*** | | | | 0.280 | | |
| | | (0.261) | | | | (0.209) | | |
| Input tariff3 | | | -0.878** | | | | 0.224 | |
| | | | (0.386) | | | | (0.275) | |
| Input tariff4 | | | | -0.753*** | | | | 0.384* |
| | | | | (0.279) | | | | (0.201) |
| ln(TFP) | 1.111*** | 1.107*** | 1.114*** | 1.111*** | 0.957*** | 0.957*** | 0.967*** | 0.967*** |
| | (0.0649) | (0.0649) | (0.0695) | (0.0695) | (0.0455) | (0.0455) | (0.0457) | (0.0457) |
| labor | -0.113** | -0.114** | -0.0372 | -0.0372 | -0.00666 | -0.00809 | 0.00661 | 0.00540 |
| | (0.0469) | (0.0469) | (0.0524) | (0.0524) | (0.0313) | (0.0313) | (0.0316) | (0.0316) |
| capital-labor ratio | -0.0252 | -0.0238 | 0.0232 | 0.0253 | 0.0544** | 0.0536* | 0.0460* | 0.0453 |
| | (0.0404) | (0.0404) | (0.0460) | (0.0461) | (0.0276) | (0.0276) | (0.0279) | (0.0279) |
| ln(wage) | 0.0334 | 0.0329 | 0.0316 | 0.0315 | 0.00514 | 0.00494 | 0.0109 | 0.0106 |
| | (0.0336) | (0.0336) | (0.0363) | (0.0363) | (0.0191) | (0.0191) | (0.0193) | (0.0193) |
| Year Fixed Effect | YES | YES | YES | YES | YES | YES | YES | YES |
| Industry Fixed Effect | YES | YES | YES | YES | YES | YES | YES | YES |
| Firm-Product Fixed Effect | YES | YES | YES | YES | YES | YES | YES | YES |
| Observations | 311,855 | 311,855 | 265,658 | 265,658 | 176,593 | 176,593 | 172,676 | 172,676 |
| R-squared | 0.790 | 0.790 | 0.798 | 0.798 | 0.690 | 0.690 | 0.693 | 0.693 |

Input tariff1: non weighted average firm-level input tariff; Input tariff2: weighted average firm-level input tariff

Input tariff3: non weighed average firm-level intermediate input tariff; Input tariff4: weighed average firm-level intermediate input tariff

Note: Specifications 1-4 employ ordinary trade data whereas specifications 5-8 employ processing trade data.

Standard errors in parentheses *** $p<0.01$, ** $p<0.05$, * $p<0.1$

Table 13: Exchange rate reform

| Dependent variable: Firm-product markup | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| Input tariff | -4.662*** | -3.698*** | -4.003*** | -0.203 | -0.955 | -0.529 |
| | (1.186) | (1.306) | (1.208) | (1.062) | (2.219) | (1.124) |
| Output tariff | 0.361 | 0.334 | 0.373 | 0.786 | 0.786 | 0.756 |
| | (0.724) | (0.724) | (0.723) | (0.568) | (0.568) | (0.569) |
| Interaction1 | | -1.195* | | | 0.761 | |
| | | (0.676) | | | (1.946) | |
| Importing firm | | 0.163** | | | -0.0115 | |
| | | (0.0827) | | | (0.230) | |
| Interaction2 | | | -5.610*** | | | 0.936 |
| | | | (1.785) | | | (1.059) |
| Import share | | | 1.052*** | | | -0.107 |
| | | | (0.249) | | | (0.150) |
| ln(TFP) | 1.131*** | 1.131*** | 1.105*** | 0.942*** | 0.942*** | 0.942*** |
| | (0.0561) | (0.0561) | (0.0566) | (0.0559) | (0.0559) | (0.0569) |
| capital-labor ratio | 0.0899*** | 0.0887*** | 0.0919*** | 0.0560 | 0.0561 | 0.0538 |
| | (0.0332) | (0.0333) | (0.0333) | (0.0367) | (0.0367) | (0.0368) |
| labor | 0.00238 | -0.00263 | 0.00171 | -0.0110 | -0.0121 | -0.0119 |
| | (0.0396) | (0.0397) | (0.0396) | (0.0411) | (0.0411) | (0.0411) |
| ln(wage) | -0.0161 | -0.0165 | -0.0173 | -0.000528 | -0.000775 | -0.000536 |
| | (0.0257) | (0.0257) | (0.0257) | (0.0216) | (0.0216) | (0.0216) |
| Year Fixed Effect | YES | YES | YES | YES | YES | YES |
| Industry Fixed Effect | YES | YES | YES | YES | YES | YES |
| Firm-product Fixed Effect | YES | YES | YES | YES | YES | YES |
| Observations | 330,687 | 330,687 | 330,687 | 115,750 | 115,750 | 115,750 |
| R-squared | 0.788 | 0.788 | 0.788 | 0.734 | 0.734 | 0.734 |

Interaction1: input tariff and import status interaction; Interaction2: input tariff and import share interaction

Note: Specifications 1-3 employ ordinary trade data whereas specifications 4-6 employ processing trade data.

Standard errors in parentheses *** $p<0.01$, ** $p<0.05$, * $p<0.1$

Table 14: Manufacturing Data

| Dependent variable: Firm-product markup | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| Input tariff | -4.213*** | -3.252*** | -3.439*** | -0.610 | -1.169 | -0.964 |
| | (0.962) | (1.063) | (0.978) | (0.895) | (1.937) | (0.948) |
| Output tariff | 1.887*** | 1.848*** | 1.878*** | 0.316 | 0.317 | 0.293 |
| | (0.560) | (0.560) | (0.560) | (0.474) | (0.474) | (0.474) |
| Interaction1 | | -1.142** | | | 0.556 | |
| | | (0.538) | | | (1.706) | |
| Importing firm | | 0.146*** | | | -0.0497 | |
| | | (0.0565) | | | (0.176) | |
| Interaction2 | | | -6.277*** | | | 1.025 |
| | | | (1.405) | | | (0.907) |
| Import share | | | 1.200*** | | | -0.183 |
| | | | (0.169) | | | (0.115) |
| ln(TFP) | 0.992*** | 0.991*** | 0.963*** | 0.960*** | 0.960*** | 0.971*** |
| | (0.0353) | (0.0353) | (0.0356) | (0.0426) | (0.0426) | (0.0433) |
| capital-labor ratio | 0.0347* | 0.0344* | 0.0339* | 0.0452* | 0.0452* | 0.0444* |
| | (0.0201) | (0.0202) | (0.0202) | (0.0261) | (0.0261) | (0.0261) |
| labor | -0.0287 | -0.0331 | -0.0318 | -0.00614 | -0.00615 | -0.00567 |
| | (0.0247) | (0.0248) | (0.0247) | (0.0297) | (0.0297) | (0.0297) |
| ln(wage) | 0.00908 | 0.00824 | 0.00811 | 0.00362 | 0.00358 | 0.00373 |
| | (0.0186) | (0.0186) | (0.0186) | (0.0182) | (0.0182) | (0.0182) |
| Year Fixed Effect | YES | YES | YES | YES | YES | YES |
| Industry Fixed Effect | YES | YES | YES | YES | YES | YES |
| Firm-product Fixed Effect | YES | YES | YES | YES | YES | YES |
| Observations | 603,705 | 603,705 | 603,705 | 182,076 | 182,076 | 182,076 |
| R-squared | 0.743 | 0.743 | 0.743 | 0.688 | 0.688 | 0.688 |

Interaction1: input tariff and import status interaction; Interaction2: input tariff and import share interaction

Note: Specifications 1-3 employ ordinary trade data whereas specifications 4-6 employ processing trade data.

Standard errors in parentheses *** $p<0.01$, ** $p<0.05$, * $p<0.1$

Table 15: SOE exclusion

| VARIABLES | (1) markup_fpt | (2) markup_fpt | (3) markup_fpt | (4) markup_fpt | (5) markup_fpt | (6) markup_fpt | (7) markup_fpt | (8) markup_fpt |
|---|---|---|---|---|---|---|---|---|
| duty_in | -5.123*** | -4.666*** | -3.737*** | -3.958*** | -0.775 | -1.827 | -1.045 | -1.464 |
| | (0.988) | (0.988) | (1.095) | (1.005) | (0.902) | (1.913) | (0.954) | (1.329) |
| inputfm | | | -1.106** | | | 1.053 | | |
| | | | (0.557) | | | (1.679) | | |
| FFM | | | 0.147** | | | -0.0751 | | |
| | | | (0.0591) | | | (0.176) | | |
| duty_out | 1.614*** | 1.627*** | 1.587*** | 1.629*** | 0.372 | 0.372 | 0.354 | -0.245 |
| | (0.582) | (0.582) | (0.582) | (0.582) | (0.477) | (0.477) | (0.478) | (0.850) |
| TFP | | 1.054*** | 1.053*** | 1.021*** | 0.952*** | 0.952*** | 0.961*** | |
| | | (0.0368) | (0.0368) | (0.0370) | (0.0431) | (0.0431) | (0.0438) | |
| K_L | | 0.0777*** | 0.0773*** | 0.0757*** | 0.0537** | 0.0538** | 0.0532** | |
| | | (0.0209) | (0.0209) | (0.0210) | (0.0263) | (0.0263) | (0.0263) | |
| l | | -0.0417 | -0.0461* | -0.0457* | -0.00897 | -0.00934 | -0.00856 | |
| | | (0.0259) | (0.0260) | (0.0259) | (0.0299) | (0.0299) | (0.0299) | |
| wage | | 0.0534*** | 0.0526*** | 0.0522*** | 0.00689 | 0.00678 | 0.00699 | |
| | | (0.0193) | (0.0194) | (0.0193) | (0.0183) | (0.0183) | (0.0183) | |
| inputimp | | | | -5.910*** | | | 0.786 | |
| | | | | (1.471) | | | (0.917) | |
| value_f | | | | 1.262*** | | | -0.144 | |
| | | | | (0.178) | | | (0.116) | |
| Constant | 8.267*** | 7.221*** | 7.126*** | 7.151*** | 0.445 | 0.514 | 0.496 | 3.035 |
| | (0.480) | (0.523) | (0.525) | (0.523) | (0.645) | (0.666) | (0.647) | (2.193) |
| Observations | 604,019 | 603,629 | 603,629 | 603,629 | 181,930 | 181,930 | 181,930 | 182,090 |
| R-squared | 0.756 | 0.757 | 0.757 | 0.757 | 0.691 | 0.691 | 0.691 | 0.781 |

Standard errors in parentheses

*** $p<0.01$, ** $p<0.05$, * $p<0.1$