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Trade Liberalization, Product Differentiation and Firm Productivity: Evidence from Vietnam

Doan Thi Thanh Ha

Graduate School of International Social Sciences, Yokohama National University

Abstract

This paper investigates the causal relationship between tariff reduction and firm total factor productivity, controlling for firm's product differentiation level. We utilize Vietnamese firm-level data covering the period 2001-2009, when substantial trade liberalization took place. Our research questions are two-fold: First, what is the change in productivity of manufacturing firms induced by liberalization? Second, how is the impact different across firms with different level of product heterogeneity? Our main findings are as follows: First, output tariff reduction hurts firms performance, while input tariff reduction boosted firms productivity. The magnitude of input tariff is larger, suggesting that changes in input tariff have made more pronounced impact on firm's productivity. Second, the impact of output tariff on firms productivity is smaller for firms that produce differentiated goods. One possible explanation is that firms producing differentiated goods face less severe competition in the final market. Therefore, they are less vulnerable to output tariff reduction. These two results together suggest that reduction of trade barriers would receive less resistance from firms in differentiated product industries, who experience more productivity enhancement effect.

1 Introduction

Does trade liberalization enhance firm's productivity? Do firms respond differently across sectors with different level of product differentiation? This paper aims at answering these two questions by incorporating a proxy for product differentiation into the empirical framework developed in Amiti and Konings (2007).

Our motivation comes from two strands of research. The first strand is the impact of tariff reduction on firm productivity. While this topic has been studied extensively, findings are still mixed. On the one hand, reduction in output tariff leads to import competition in the final goods market. Increased competition pressure could be a threat to domestic firms. They might experience loss in market share and reduction in output, which in turn discourages them to invest in superior technology to improve productivity. Luong (2011) on Mexico, Hu and Zhengning (2014) on China have found supporting evidence for this view.

On the other hand, elimination of trade barriers can be transmitted to an increase in firm productivity through several channels. Literature on economies of scale suggests that market expansion helps firm move down their average cost curves. Lower trade barriers in market abroad can assist firms in this sense (Tybout et al, 1991). Pro-competitive channel implies the reallocation of resources from the less productive firms to the more productive firms, since the cut-off productivity for survivals increases (Melitz, 2003). In addition, falling tariffs on intermediate inputs allow firms to obtain access to more advanced technologies embodied in imported inputs, more variety of inputs at lower prices. Advocates of endogenous growth theory argue that technological innovation is important to growth. From that perspective, access to superior foreign technology is important in fostering technical efficiency, and thus improving productivity.[1] These theoretical predictions have received substantial support from empirics.[2]

[1] See, for example, Grossman and Helpman (1991).

[2] See, for example, Pavcnik (2002) for Chile; Fernandes (2007) for Colombia; Topalova and Khandelwal

The second strand of research is the linkage between product differentiation and import competition. Competition pressure is heterogenous across firms with different levels of product differentiation. More differentiated products have lower substitutability. Consumer's love for variety implies that firms operating in more differentiated product sectors may find it easier to secure market share against foreign rivals. Bernhofen (2001) found that in the extreme case of product differentiation, international trade is driven solely by consumers' taste for variety. Also, the study found a positive relationship between product differentiation and the amount of intra-industry trade. In other words, firms with higher level of product differentiation are encouraged to increase their supplies of goods to the domestic and foreign markets.[3] Lundin (2004) have found strong empirical evidence for the theory in the case of Swedish manufacturing. Chaney (2008) have shown that more differentiated products, i.e products with low elasticity of substitution, is positively correlated with the sensitivity of firms towards trade barriers. Because consumers love variety, those firms will enjoy a larger gain given a small decrease in trade barriers.

There has been few studies on the linkage between trade liberalization and firm productivity that takes into account the product differentiation of a firm. This paper utilizes Vietnamese firm-level data to investigate the issue. The data covers the year 2001 to 2009 when substantial trade liberalization took place.[4] Our research questions are two-fold: First, what is the change in productivity of manufacturing firms induced by liberalization? Second, how is the impact different across firms with different level of product heterogeneity? Our main findings are as follows: First, output tariff reduction hurts firm's performance, while input tariff reduction boosted firm's productivity. Second, the impact of output tariff on firms productivity is smaller for firms that produce complex goods. One possible explanation is that firms producing differentiated goods face less severe competition in the final market.

(2011) for India; and Amiti and Konings (2007) for Indonesia.

[3]For detailed discussion, see Bernhofen (2001).

[4]The average output tariff decreased from 23 percent in 2001 to 13 percent in 2009.

Therefore, they are less vulnerable to output tariff reduction.

The study can contribute to the literature in several important ways. First, this is the first study that links input-output tariff reduction with firm productivity, controlling for product differentiation. The closest studies to ours are Yu and Li (2014) and Yu, Ye and Qu (2013). However, the proxies for trade in both studies are import value, not tariff lines. The former utilizes import penetration ratio, and the latter uses imported intermediate inputs. While those variables could reflect the extense of trade liberalization, they are the results of trade liberalization rather than liberalization itself. Second, this is the first study that examines this issue in the case of Vietnam. While certain attempts to measure the economy-wide effect of liberalization have been made, studies related to productivity at firm level are rare. Chu and Kalirajan (2011), for instance, examines the effect of tariff cuts on technical efficiency of manufacturing firms from 2000-2003. Yang and Huang (2012) also examines trade liberalization and productivity. Their trade policy variable, however, is only WTO's dummy, while we utilize tariff lines. Ha and Kiyota (2014) investigates productivity dynamics of Vietnamese firms during 2000-2009 period. The study, however, does not examine the causal relationship between trade liberalization and firm productivity. With a rich coverage of data from 2001-2009, our study can better capture the causal relationship between trade liberalization and firm performance.

The study joins the growing literature on international trade and firm heterogeneity and has important implications for policymakers. Understanding the dynamic gains from trade liberalization is vital in designing appropriate policies. Moreover, understanding producers' preferences over trade liberalization helps policymakers avoid strong opposition while negotiating trade agreements. Consequently, the process of arranging trade agreements would be smoother.

The rest of the paper is organized as follows: Section 2 describes methodology used to measure productivity and empirical model to investigate liberalization- productivity linkage.

Sector 3 presents data description. Section 4 illustrates preliminary results. Robustness checks are reported in section 5. Concluding remark is provided in section 6.

2 Methodology

To answer the two research questions above, we adopt the standard two-step approach following Fernandes (2002), Amiti and Konings (2007), Topalova and Khandelwal (2011). In the first step, we measure total factor productivity using the index approach developed by Good, Nadiri, and Sickles (1997) as in Ha and Kiyota (2014). The advantage of using this approach is that it does not assume a specific production function, and data requirement is low. Given data limitability, it is impossible for us to apply the parametric approach as in Olley and Pakes (1996) and Levinsohn and Petrin (2003). The multilateral index measures the TFP of firm i ($\in \Omega_t$) in year t relative to that of a hypothetical reference firm r in the base year ($t = 0$). The reference firm is the firm that has the arithmetic mean values of log output, log inputs, and cost shares over all firms in the same industry in each year. We denote the TFP of firm i and of the reference firm r in year t as φ_{it} and φ_{rt}, respectively. We normalize the TFP of the reference firm in the base year to unity: $\varphi_{r0} = 1$. The TFP index for firm i in year t relative to the reference firm r in the base year (i.e., $\ln \varphi_{it} - \ln \varphi_{r0} = \ln \varphi_{it}$) is written as:

$$\begin{aligned} \ln \varphi_{ijt} \simeq & \ln V_{it} - \overline{\ln V_{rt}} + \sum_{\tau=1}^{t} (\ln V_{r\tau} - \overline{\ln V_{r,\tau-1}}) - \sum_{j=1}^{J} \frac{1}{2}(s_{ijt} - \bar{s}_{rjt})(\ln X_{ijt} - \overline{\ln X_{rjt}}) \\ & - \sum_{\tau=1}^{t} \sum_{j=1}^{J} \frac{1}{2}(\bar{s}_{ij\tau} - \bar{s}_{rj,\tau-1})(\overline{\ln X_{ij\tau}} - \overline{\ln X_{rj,\tau-1}}), \end{aligned} \tag{1}$$

where $\ln V_{it}$, $\ln X_{ijt}$, and s_{ijt} are the log output, the log input of factor j, and the cost share of factor j in year t, respectively; $\overline{\ln V_{rt}}$, $\overline{X_{rjt}}$, and $\bar{s}_{rjt}$ are those of the reference firm r in year t (i.e., the arithmetic means of the corresponding variables over all firms in the same

industry).

The first two terms on the right-hand side are the deviation of the firm's output from the output of the reference firm in year t. The third term is the cumulative change in the output of the reference firm between year 0 (the base year) and year t. The same manipulations are applied to each input j, summed using a combination of the input share for each firm s_{ijt} and for the reference firm $\bar{s}_{rjt}$ as weights. The index provides a measure of the proportional difference in the TFP for firm i in year t relative to the reference firm in the base year. We use 2001 as the base year. The reference firm properties are estimated for each industry.

After measuring TFP, to estimate the impact of output tariff and input tariff on firm's productivity, we run the following regression:

$$\ln \varphi_{ijt} = \alpha + \beta_1 inputtariff_{jt} + \beta_2 outputtariff_{jt}$$
$$+\beta_3 outputtariff_{jt} * differentiatedproduct + \gamma_{size_{ijt}} + \epsilon_{ijt}, \quad (2)$$

where $\ln \varphi_{ijt}$ is total factor productivity (in log form) of firm i operating in industry j at time t. TFP is obtained from equation (1). $Size_{ijt}$ is firm size, defined by quartile based on real value-added. We expect that larger firms will have higher productivity. We include year fixed effects in all specifications to capture macroeconomic shocks that all firms expose. Firm fixed-effects are included to control for the unobserved time-invariant firm characteristics that affect productivity.

Input tariff is computed as

$$inputtariff_{jt} = \sum_{k=1} a_{jk} * outputtariff_{kt} \quad (3)$$

where a_{jk} is the cost share of input k in the production of output j. a_{jk} is derived from the Input-Output table. Two points are worth noted here. First, we do not use imported

input coefficients. As discussed in Amiti and Konings (2007), the use of imported input coefficients can result in endogeneity bias because import volume partly depends on import tariff. Instead, we use general input coefficients of sector j as a_{jk} , which includes both domestic and imported inputs. Second, we prefer simple average tariff over trade-weighted tariff for the same reason. High tariff sectors may have smaller import volume, rendering the weighted tariff of that sector small.

Our main coefficients of interest are β_1, β_2 and β_3, which capture the effects of tariff changes at industry-level on firm's productivity. We expect that lower input tariff would boost productivity through imported intermediate input channel, thus a negative β_1. The impact of output tariff on productivity is less clear-cut. Output tariff affects firm's productivity through increased competition. However, competition pressure could either enhance firm's productivity, i.e the pro-competition effect, or decrease productivity by shrinking firm's market share. Therefore, the sign of output tariff is an open question. However, our concern here is not merely the response of productivity to tariff reduction, but the correlation between productivity and tariffs interacted with an indicator of product differentiation. We thus include differentiated product dummy in equation (2), which equals one if the four-digit industry falls into differentiated goods category in Rauch (1999) classification, and zero otherwise. We expect that firms operating in more differentiated goods industries are more resilient to import competition A negative β_3 would imply that these firms would experience smaller productivity shocks from changes in output tariff. These shocks could be either negative or positive based on the coefficient on output tariff alone.

3 Data

Firm-level data

We use firm-level data from the Annual Enterprise Survey compiled by the General Statistics Office of Vietnam covering 2001-2009 period. This is by far the most comprehensive dataset available on Vietnamese firms, The survey information includes the type of ownership, assets and liabilities, number of employees, sales, capital stock, the industry that the firm belongs to, and obligations to the government, for example, taxes, among others, from January to December of that year. The survey covers all state-owned enterprises and foreign-invested firms without any firm size threshold. As for domestic private firms, however, firms with fewer than ten employees are chosen by random sampling.[5] Detailed description about firm-level dataset is provided in Ha and Kiyota (2014). We only include firms of which information on identification numbers and financial variables are available. After data-cleaning, we have an unbalanced panel of 52319 firm-year observations for estimation.

Tariff data

Output tariff at four-digit International Standard of Industrial Classification (ISIC) revision 3 is downloaded from the World Bank's World Integrated Trade Solutions database. We use simple average effectively applied tariff, which is the simple average of lowest applicable tariff for each of Vietnam's trade partner. Output tariff data is available from 2001 to 2009. We then match ISIC codes with Vietnam Standard Industrial Classification codes (VSIC). To compute input coefficients, we utilize Vietnams Input- Output Table at basic price constructed by the GSO in 2007. This IO table comprises of 138 sectors. The selection

[5]This threshold is applied for surveys before 2010. From 2010, different regions set different firm-size threshold. It is thus difficult for us to extend the analysis beyond 2010.

and categorization of these sectors are based on their economic importance.[6] Input tariff is computed from equation (3) using output tariff and these input coefficients. Concordance tables between ISIC, VSIC and IO codes are obtained from Vietnam's General Statistics Office. Table 1reports output tariff and input tariff at two-digit VSIC level. There was a gradual decrease with some fluctuations in both types of tariffs before the year 2007. After the accession to the World Trade Organization we observed a substantial reduction in tariffs.

—Table 1—

Product differentiation data

We define product heterogeneity based on Rauch (1999) classification.[7] Internationally traded goods are divided into three categories: those traded on organized exchanges, those that are not traded on organized exchanges but have reference prices that can be found in trade publications, and others. For the first two groups, it is possible to quote a reference price without mentioning the producers, or the brand. In other words, the goods are homogeneous. On the other hand, traded prices of heterogeneous goods are different by manufacturers, since they are different in many aspects including size, design, material. Therefore, Rauch (1999) defined the first two groups as homogeneous goods, and the third one as differentiated goods. Rauch (1999) adopts two methods of classification: the liberal method and the conservative method.[8] In this study, we use conservative classification in the baseline model. The liberal classification is used in the robustness check.[9] The classification is based on four-digit Standard International Trade Classification (SITC) revision 2. We

[6]While IO table constructed in 2000 is available, we only utilize IO table in 2007 due to the different coding systems between the two tables.

[7]Another widely used measure of product differentiation is from Broda and Wienstein (2006), who estimate elasticity of substitution for each Harmonized System ten-digit product. However, the lack of detailed product data prevented us from applying this approach. In addition, Rauch (1999) classification was already validated in Broda and Weinstein (2006). Rauch (1999) classification was updated in 2007.

[8]For details, please refer to Rauch (1999).

[9]Correlation between liberal classification and conservative classification is 94 percent.

then match SITC codes with ISIC codes using concordance tables provided by the United Nations Statistics Division.[10] Table 2 presents summary statistics of the main variables used in our regressions.

—Table 2—

4 Preliminary results

Baseline model

In the baseline model we include output tariff and input tariff as the measures of trade policy. We estimate equation (2) using fixed effects estimation with the inclusion of firm fixed effects and year fixed effects. Results are presented in table 3.

—Table 3—

Four features stand out from this table. First, consistent with previous studies, lower input tariff enhanced firm's TFP. Lower input tariff allow firms to have better access to foreign superior input as well as obtain more amount of an input. A one percentage point reduction in input tariff results in 2.0 percent to 2.7 percent increase in productivity. Interesting, coefficients on output tariff are positive and significant, which is in contrast with most other studies along this line such as Amiti and Koning (2007), Pavnick (2002), Topalova and Khandelwal (2011). The magnitude; however, is small. A one percentage point decrease in output tariff lowers productivity by a range from 0.3 percent to 0.9 percent. Pro-competitive effect of output tariff reduction is not observed in this case. Instead, the results suggest that higher tariff on final products is beneficial to Vietnamese firms, since they enjoy better protection from foreign rivals. Second, interaction terms between output tariff and product differentiation is negative and significant. This suggests that firms producing homogeneous

[10]Concordance tables can be downloaded at http://unstats.un.org.

goods tend to face more severe competition on the final goods market. Third, the larger the firm is in terms of value-added, the higher is the firm's total factor productivity.

Trade liberalization and firm ownership

In this section we investigate the impact of tariff reduction on firms across different ownership. For that purpose, we divide our sample into three sub-categories: FDI firms, SOEs and domestic non-SOE and rerun equation (2). Results are reported in table 4.

—Table 4—

Two main findings stand out from table 4. First, coefficients on input tariff and output tariff are similar in sign and are both significant as the baseline results. All three groups of firms experience productivity loss caused by lower output tariffs, and productivity gains thanks to lower input tariffs. The impact of tariff changes on productivity is more pronounced for SOEs and FDIs group. Second, heterogeneous impact of tariff on productivity between homogeneous and differentiated sectors is significant for domestic private firms. This result suggests that domestic private firms that produce homogeneous goods suffers stronger pressure from import competition.

5 Robustness check

Different measure of product differentiation

As discussed above, Rauch (1999) introduced two methods to classify product differentiation. As for the robustness check we use liberal method. Results are reported on the left panel of table 5. Estimated results are very close to what we obtain from the baseline regression.

—Table 5—

Different measures of productivity

While index approach is straighforward when data is limited, one disadvantage of this method is the assumption of perfect competition. As discussed by Blomstrom and Kokko (1996), in a labor-abundant country like Vietnam, labor was an important source of productivity enhancement. Therefore, in this section we estimate equation (2) using labor productivity as the dependent variable. Results are presented on the right panel of table 6. Similar to the findings above, lower input tariff boosted firms' productivity, while lower output tariff is negatively correlated with firms' efficiency. The impact of output tariff reduction on firm productivity becomes weaker as firms produce more differentiated goods. In sum, our results do not seem to be affected by the choice of product classification or productivity measurement.

6 Concluding remark

This chapter investigates the empirical linkage between trade liberalization and firms' total factor productivity, controlling for product differentiation in case of Vietnamese manufacturing. We employ Vietnamese firm-level data for the 2001-2009 period, when substantial trade liberalization took place.

Our trade policy variables include simple average output tariff and input tariff, and tariff interacted with product differentiation dummy. Major findings are three-fold: First, output tariff reduction reduces firm's TFP. This result suggests that Vietnamese firms have benefited from domestic protection before trade liberalization. Second, lower input tariff enhances firm's productivity. This finding is consistent with literature on international trade and firm productivity. Third, the impact of trade liberalization on firm productivity becomes weaker as firms product more differentiated goods. These results are robust across different specifications. We hypothesize that the weak impact on firms producing more differentiated

goods come from the less competition pressure that these firms face.

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Table 1: Average Output and Input Tariff Rate, by Industry and by Year

%

	Industry	Year 2001	2002	2003	2004	2005	2006	2007	2008	2009
1	Manufacture of food products and beverages	36.0	29.6	30.3	29.7	28.7	28.0	28.7	20.6	20.5
		11.0	10.1	10.8	10.6	10.7	10.4	10.2	8.0	7.9
2	Manufacture of tobacco products	81.7	88.3	67.7	67.7	72.6	70.0	65.0	68.2	82.6
		15.6	6.2	16.8	17.0	18.0	17.2	16.4	15.6	17.2
3	Manufacture of textiles	33.9	31.1	29.1	28.5	27.5	27.6	27.9	9.3	9.5
		18.5	17.2	16.4	16.2	15.6	15.7	15.9	6.1	6.2
4	Manufacture of wearing apparel; dressing and dyeing of fur	47.4	42.4	38.3	37.2	35.1	34.7	35.8	16.9	17.1
		22.8	21.2	19.8	19.4	18.6	18.7	18.9	6.7	6.8
5	Tanning and dressing of leather; manufacture of luggage, handbags, saddlery, harness and footwear	25.4	20.8	19.6	19.1	19.4	18.7	19.5	15.7	16.1
		13.6	13.1	12.5	12.1	11.8	11.6	11.8	8.5	8.3
6	Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials	13.2	11.0	9.5	9.3	9.7	8.8	9.8	7.2	6.5
		6.2	6.0	5.5	5.6	5.6	5.1	5.2	4.2	4.1
7	Manufacture of paper and paper products	19.7	18.9	17.4	17.1	16.3	15.7	16.5	12.2	12.2
		12.1	11.8	11.5	11.1	10.8	10.3	10.7	8.1	8.0
8	Publishing, printing and reproduction of recorded media	22.6	19.8	17.8	17.3	16.0	16.0	15.8	11.4	11.4
		10.0	10.0	9.7	9.6	9.4	9.1	9.2	7.0	6.7
9	Manufacture of coke, refined petroleum products and nuclear fuel	5.7	7.5	7.2	7.2	6.6	7.6	7.2	2.2	8.6
		2.2	2.6	4.1	2.6	2.3	3.8	3.5	1.4	2.1
10	Manufacture of chemicals and chemical products	5.3	4.1	4.3	4.2	4.2	4.0	4.1	3.2	3.3
		3.8	3.6	3.7	3.6	3.7	3.9	3.5	2.7	2.6
11	Manufacture of rubber and plastics products	17.2	15.4	15.3	15.1	15.1	13.9	14.2	11.9	11.2
		11.7	11.1	10.7	10.6	10.4	10.3	10.6	4.9	4.8
12	Manufacture of other non-metallic mineral products	19.1	17.1	16.4	16.1	15.8	15.2	16.0	13.6	13.0
		6.2	6.3	5.7	5.6	5.3	5.2	5.3	4.1	4.3
13	Manufacture of basic metals	3.8	3.1	3.2	3.2	2.9	3.0	3.1	2.2	2.3
		3.3	3.4	3.2	3.1	3.0	3.0	3.0	2.3	2.3
14	Manufacture of fabricated metal products, except machinery and equipment	16.5	15.5	15.6	15.5	15.2	15.1	15.1	11.9	11.6
		4.4	4.2	4.2	4.2	4.1	4.0	4.0	3.1	3.1

Table 1: Average Output and Input Tariff Rate, by Industry and by Year (cont.)

%

	Industry	Year 2001	2002	2003	2004	2005	2006	2007	2008	2009
15	Manufacture of machinery and equipment n.e.c.	6.18	5.51	5.64	5.56	5.37	5.18	5.08	3.6	3.8
		4.7	4.6	4.6	4.6	4.5	4.4	4.5	3.5	3.4
16	Manufacture of office, accounting and computing machinery	7.3	7.5	5.1	5.1	5.5	5.4	5.3	3.6	3.0
		2.9	3.8	6.6	6.9	6.2	7.7	4.2	2.7	4.1
17	Manufacture of electrical machinery and apparatus n.e.c.	12.8	11.9	11.4	11.3	11.0	10.9	10.7	8.0	8.3
		4.1	3.9	3.9	4.0	3.7	3.5	3.4	2.7	2.8
18	Manufacture of radio, television and communication equipment and apparatus	15.2	11.5	10.4	10.2	10.1	9.3	9.5	6.8	6.6
		5.3	4.7	4.3	4.2	4.2	4.1	3.8	2.2	2.4
19	Manufacture of medical, precision and optical instruments, watches and clocks	4.0	3.8	3.3	3.3	3.3	3.4	3.5	2.4	2.4
		3.1	3.3	2.9	3.0	2.9	2.9	2.8	5.3	2.0
20	Manufacture of motor vehicles, trailers and semi-trailers	33.1	25.0	26.7	26.6	27.9	26.7	26.8	16.4	17.7
		8.1	7.0	7.1	7.4	7.6	7.5	7.6	5.4	5.6
21	Manufacture of other transport equipment	24.4	22.4	23.1	23.1	24.1	19.1	19.7	18.1	15.1
		6.0	5.6	6.9	6.8	7.3	6.6	6.8	4.3	5.1
22	Manufacture of furniture; manufacturing n.e.c.	24.7	23.2	21.7	21.2	20.5	20.4	20.6	17.5	16.9
23	Recycling	NA	NA	NA	NA	NA	NA	NA	NA	NA

Note:

For each industry the first row reports output tariff, the second row reports input tariff. Both output tariff and input tariff are simple average effectively applied rate. Input tariff is computed from equation (3).

Source:

Author's calculations based on World Bank (2014) *World Integrated Trade Solutions (WITS)* and Year 2007 Input-Output table provided by the General Statistics Office of Vietnam.

Table 2. Summary statistics

Variables	Mean	Standard deviation
Total factor productivity (in log form)	0.08	1.02
Labor productivity (in log form)	2.98	1.05
Industry output tariff	17.58	10.17
Industry input tariff	7.81	4.42
Differentiated products (conservative classification)	0.63	0.48
Differentiated products (liberal classification)	0.62	0.48
State ownership	0.05	0.22
Foreign ownership	0.11	0.31
Domestic non-SOE ownership	0.79	0.41
Size	1.50	1.12

Source:

Author's calculation, based on *Annual Survey on Enterprises* by the GSO

Table 3. Tariff reduction and Firm productivity

Dependent variable: lntfp	(1)	(2)	(3)
Output tariff	0.007***	0.009***	0.003**
	(0.002)	(0.002)	(0.002)
Input tariff	-0.027***	-0.023***	-0.020***
	(0.003)	(0.003)	(0.002)
Output tariff*differentiated products		-0.007***	-0.008***
		(0.002)	(0.001)
2nd size quartile			0.827***
			(0.009)
3rd size quartile			1.452***
			(0.012)
4th size quartile			2.340***
			(0.017)
Constant	-0.147***	-0.142***	-0.961***
	(0.027)	(0.027)	(0.025)
N	162,109	162,109	162,109
R square	0.050	0.051	0.334
Number of id	52,319	52,319	52,319
Firm fixed effects	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes

Note: Differentiated product is a dummy that takes value of one if firm's product is differentiated, and zero otherwise. Classification is based on Rauch (1999). Firm size quartiles are based on value-added. Benchmark group is 1st quartile. Benchmark group for firm ownership is SOE firms. Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Source:

Author's calculation, based on *Annual Survey on Enterprises* by the GSO.

Table 4. Tariff reduction and firm ownership

Dependent variable: lntfp	State-owned enterprises			Foreign-invested enterprises			Domestic firms		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Output tariff	0.014*	0.015*	0.012*	0.015***	0.015**	0.013***	0.005**	0.006***	-0.002
	(0.007)	(0.007)	(0.006)	(0.006)	(0.006)	(0.005)	(0.002)	(0.002)	(0.002)
Input tariff	-0.040***	-0.034**	-0.026*	-0.030***	-0.031***	-0.026***	-0.020***	-0.017***	-0.011***
	(0.014)	(0.015)	(0.014)	(0.008)	(0.008)	(0.006)	(0.003)	(0.003)	(0.003)
Output tariff*Differentiated produc		-0.008	-0.008		0.001	-0.005		-0.005***	-0.006***
		(0.009)	(0.008)		(0.004)	(0.003)		(0.002)	(0.002)
2nd size quartile			1.663***			1.411***			0.820***
			(0.220)			(0.077)			(0.009)
3rd size quartile			2.807***			2.550***			1.416***
			(0.224)			(0.076)			(0.012)
4th size quartile			3.779***			3.714***			2.149***
			(0.234)			(0.077)			(0.018)
Constant	0.281***	0.281***	-3.260***	0.624***	0.623***	-2.806***	-0.086***	-0.086***	-0.688***
	(0.081)	(0.093)	(0.244)	(0.047)	(0.047)	(0.082)	(0.028)	(0.028)	(0.025)
N	6,638	6,638	6,638	18,128	18,128	18,128	128,728	128,728	128,728
R square	0.025	0.025	0.278	0.170	0.170	0.558	0.032	0.032	0.313
Number of id	1,784	1,784	1,784	4,547	4,547	4,547	46,093	46,093	46,093
Firm fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Note: Differentiated product is a dummy that takes value of one if firm's product is differentiated, and zero otherwise. Classification is based on Rauch (1999). Firm size quartiles are based on value-added. Benchmark group is 4th quartile. Benchmark group for firm ownership is SOE firms. Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Source:

Author's calculation, based on *Annual Survey on Enterprises* by the GSO.

Table 5. Robustness check

	Product Differentiation-liberal method		Labor productivity		
	(1)	(2)	(4)	(5)	(6)
Dependent variable	lntfp		labor productivity		
Output tariff	0.008***	0.003*	0.006***	0.007***	0.002
	(0.002)	(0.002)	(0.002)	(0.002)	(0.001)
Input tariff	-0.022***	-0.019***	-0.018***	-0.016***	-0.012***
	(0.003)	(0.003)	(0.002)	(0.003)	(0.002)
Output tariff*Differentiated products	-0.007***	-0.008***		-0.004***	-0.005***
	(0.002)	(0.001)		(0.001)	(0.001)
2nd size quartile		0.827***			0.853***
		(0.009)			(0.008)
3rd size quartile		1.452***			1.482***
		(0.012)			(0.011)
4th size quartile		2.340***			2.290***
		(0.017)			(0.016)
Constant	-0.139***	-0.957***	2.480***	2.483***	1.659***
	(0.027)	(0.025)	(0.024)	(0.024)	(0.020)
N	162,109	162,109	162,132	162,124	162,124
R square	0.051	0.334	0.139	0.139	0.438
Number of id	52,319	52,319	52,333	52,325	52,325
Firm fixed effects	Yes	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes

Note: Differentiated product is a dummy that takes value of one if firm's product is differentiated, and zero otherwise. Classification is based on Rauch (1999). Firm size quartiles are based on value-added. Benchmark group is 4th quartile. Benchmark group for firm ownership is SOE firms. Robust standard errors in parentheses

Source:

Author's calculation, based on *Annual Survey on Enterprises* by the GSO.