Trade Liberalization and Wage Differentials of Heterogeneous Firms: Three Empirical Studies of Chinese Firms

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Abstract

This thesis includes three independent empirical studies that examine the relationship between trade and wages for Chinese manufacturing industries for the period immediately following China's entry into the WTO (2002-2006). Following a brief introduction, Chapter 2 uses highly detailed firm-level industrial production data merged with product-level trade transaction data to make a direct test of the model developed by Amiti and Davis (2011). Specifically, we investigate how output and input tariff reductions following China's membership of the WTO affected the wages paid to workers in Chinese manufacturing firms, and whether the effect of tariff liberalization on workers' wages is dependent on the extent of firms' global engagement. Our findings are compared to those of Amiti and Davis (2011) who examined the impact of tariff reductions in Indonesia. The potential endogeneity issue of tariffs is addressed in several ways although our results support the premise that post-WTO period tariff reductions were exogenous. In Chapters 3 and 4 we focus on the unique position that Chinese trading firms have in Chinese trade patterns paying close attention to processing trade. Chapter 3 reexamines the relationship between tariff reductions and firm wages taking into account the special tariff treatment given to processing firms. We find that processing firms who enjoy tariff exemptions on imported intermediates pay higher wages following a fall in firm-level output tariffs. However, only workers working in the more traditional non-processing firms get higher wages after a fall in firm-level input tariffs. Finally, Chapter 4 examines the impact of tariff reductions on the decision of firms to switch between different modes of exporting and explores how export switching affects firm wages through trade liberalization. The results highlight that input tariff reductions at the firm level determine a firm's decision and direction of export switching, and most importantly, such reductions always encourage exporting firms to switch to another export status to upgrade their productivity level. The thesis concludes with some discussion of future research ideas.

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Chapter 1. Introduction

China's decision to become a member of the WTO in December 2001 is considered to be a momentous event in China, with Chinese President HU Jintao believing that "China's accession to the WTO was a milestone in China's reform process". The central theme of this thesis is to study the relationship between trade reforms, the local economy and labormarket outcomes in China.

From Figure 1.1 it is clear that China experienced a substantial reduction in tariffs during the period 1992-2011 with tariffs decreasing from more than 40% in 1992 to nearly 3% in 2011. There were two large drops, one in 1997 and the other at the end of 2002. These large reductions in Chinese tariffs reduced the trade barriers between China and other countries, which resulted in a major boom in China's business that targeted foreign markets although it also may have hurt the domestic Chinese economy including local workers in China's domestic labormarket. The motivation for this thesis is to investigate how trade liberalization affected China's labormarket with a special focus on firm wages. With wages in China increasing rapidly in the last decade it is more important than ever to understand the mechanisms by which firms react to changing trade barriers and how this affects wages.

[Figure 1.1 about here]

This thesis consists of three main empirical chapters in addition to a short introduction and conclusion. Following Amiti and Davis (2011), Chapter 2 examines whether firm wages vary between different types of global engagement following a period of tariff reform, focusing on non-trading firms who source their inputs locally and serve domestic consumers, and trading firms who export or import only through the ordinary trade channel. To evaluate the impact of trade reforms in China we use China's 2002 Input-Output (IO) table and construct industry-level output and input tariffs. In addition, to capture the net effect of tariff reductions on outputs and intermediate inputs we construct a measure of industry-level effective rate of protection (ERP) for each firm within a given industry. By using several measures of trade protection, chapter 2 finds that the main conclusions hold even when we include additional controls for firm characteristics and use an instrumental variable (IV) approach to taken into account potential endogeneity concerns. Our results differ in certain dimensions from Amiti and Davis (2011) for Indonesia but are consistent with those of Kamal *et al.* (2012). Most importantly, the results imply that workers in firms that do not engage in international trade share part of the productivity gains from China's WTO accession documented by Brandt *et al.* (2012), and also highlight the importance of trade policy in determining the outcomes for the home country market.

Chapter 3 is mainly focused on trading firms paying special attention to processing firms who import processing inputs. Trading firms are classified into two groups: processing firms and non-processing firms. Firm-level output and input tariffs are measured following Yu (2015) and special tariff treatment is given to firms engaged in processing trade when calculating their tariffs since they can enjoy tariff exemption on processing imports. Chapter 3 then investigates the impact of tariff liberalization on firm wages and whether such an effect is dependent on the extent of firm's engagement in processing trade. Our findings differ to those of Yu (2015) for output tariff reductions but are generally consistent with those for input tariff reductions.

Finally, Chapter 4 is focuses on providing a description of how firms move between different exporter types (ordinary exporter and trade processor), how firms make the decision to switch between different types of export status and how switching status affects firm wages. The results are intuitive in that input tariff reductions mean that trade barriers become weaker and firms are better able to access to high quality imported inputs, and hence, firms are more like to switch from a low productivity level exporter to a higher productivity exporter.

Chapter 2. **Trade Liberalization and Wage Differentials of Heterogeneous Firms: An Empirical Study of Chinese Firms**

Abstract

In this paper we investigate how output and input tariff reductions following China's membership of the WTO affected the wages paid to workers in Chinese manufacturing firms, and whether the effect of trade liberalization on workers' wages is dependent on the extent of firms' global engagement. Our results indicate that a decrease in both output and input tariffs increases the wages of non-exporting firms and the wages of non-importing firms respectively. Additionally, we find that a decrease in output tariffs causes a negative wage differential in exporting firms relative to non-exporters but the net effect for exporting firms is insignificant different from zero, suggesting wages of workers in exporting firms remain unchanged. Generally, the results indicate that a 10% decrease in input tariffs leads to a 3.6% increase in wages for non-importing firms, which is at least thrice as high as any wage gains from decreasing output tariffs. Our findings are in contrast to those of Amiti and Davis (2011) either theoretically or empirically for Indonesia.

2.1. Introduction

Over the last three decades China has experienced spectacular growth in its international trade flows. This performance can be attributed to the reforms that China undertook through its "open-door" policy from 1978 that culminated with entry into the World Trade Organization (WTO) at the end of 2001. As the largest exporter and second largest importer of manufacturing goods in the world (World Trade Organization, 2011), China's changing trade patterns are the focus of interest from both academics and policymakers.

Given the importance of international trade for China, the impact of trade on the economy is determined not only by the export of final goods, but also through the import of intermediate inputs. In many developing countries, increasing exposure to international trade and world markets has been accompanied by various changes, for example, increases in productivity, quality upgrading, resources reallocation and rising wage inequality.

Previous research has shown that globalization directly cause wage inequality and widen wage gaps. Globalization covers many aspects it includes, for example, a reduction in trade protection or barriers; an increase in foreign direct investment (FDI); and a rise in the outsourcing of production overseas. In this chapter, we aim to examine the impact of falls in trade barriers on wage differentials.

Our starting point is to consider the channels through which trade liberalization could affect the compensation paid to labour. The contributions of theoretical and empirical studies to understanding how international trade affects labormarkets have focused on two main facts. The first is the role of firm heterogeneity, where the issue is discussed within the new-new trade theory literature. The second is the role of imports of intermediate inputs on domestic wages.

Figure 2.1 shows that while both output and input tariffs individually, and as well as the composite of these, the effective rate of protection (ERP) experience a downward trend, the firm's average wage has trended upwards. In this paper our primary aim is to investigate whether there is a causal link between tariff cuts and the wage increases. Current empirical studies based on China rarely discuss the link between a firm's engagement in international trade and the wages paid to workers. Our paper seeks to fill this. Amiti and Davis (2011) present a theoretical model, where a key point is that following a decline in tariff rates, the workers' average wage is determined by firm's different engagement in globalization. the wage consequence following a decline in tariffs is dependent on the mode of global engagement of the firm where workers are employed. In this paper we test the theoretical predictions of Amiti and Davis (2011) to determine whether the results they obtained from Indonesia also hold for China, and hence we focus on the influence of tariffs (including final output tariffs and intermediate input tariffs) reductions on wage differentials. Specifically, this is the first paper to contrast the roles of final output and intermediate input tariffs in terms of mean wages for the firms engaged in different modes of globalization in China.

[Figure 2.1 about here]

Contributions of the paper are addressed in several ways. First, this empirical study is the first to explore the impact of trade liberalization on firm wages in China concerning about firm's different engagement in globalization. Secondly, using highly detailed Chinese manufacturing firm data we test Amiti and Davis (2011) model and find that our empirical results do not support their predictions and are in contrast to those found in Indonesia. We document that in comparison to exporting or importing firms, in China domestic-oriented firms would benefit from trade liberalization and hence pay higher wages. Generally, our results demonstrate that a 10% fall in input tariffs leads to a 3.6% gain in firm wages for non-importing firms, at least three times as high as any gains from decreasing output tariffs, which is consistent with the findings in Kamal *et al.* (2012).

Besides, our results imply that the gains in firm wages share part of the productivity gains from China's WTO accession documented by Brandt *et al.* (2012). Hence, our results highlight the importance of trade policy in determining the trade reform outcomes, which may affect domestic economy most.

We turn next to a brief overview of trade liberalization in China. We argue that existing evidences support both the views that manufacturing firms in China are heterogenous and that wages vary greatly according to firm's engagement in globalization. The remainder of the paper is organized as follows. In section 3 we briefly review the theoretical and empirical literature, also review the theoretical model introduced by Amiti and Davis (2011) that we intend to test and illustrate our empirical estimation strategy whilst in section 4 we describe the data used for estimation. Section 5 presents and shows the empirical results on the impact of falling tariff rates (both output and input tariffs) on firm wages by firm's different engagement in globalization. In section 6 we conclude the findings and discuss the policy implications.

2.2 Trade Liberalization in China

2.2.1 WTO Accession and Tariff Reduction in China

China's membership of the WTO in December 2001 was seen as a momentous event in China, with Chinese President HU Jintao believing that China's accession to the WTO was a milestone in China's reform process. According to the commitments to the WTO, China would provide a fair environment for investment and trade and gradually remove a variety of trade barriers including tariffs. Prior to China's entry into the WTO the Chinese government had already started to reduce tariffs. As documented by the China's Customs, in 1992, China's mean tariff rate was 43.2% (at that time the average tariff for developed and other developing countries was 6.3% and 15.3% respectively). From 1992 to 1996, China's average tariff fell to 23% and was reduced further to 17% by 1999. As a member of the WTO, China also promised to reduce tariffs for agricultural products and industrial manufactured products to a mean rate of 15% and 8.9% respectively by the end of 2004. By 2004, China had achieved these targets since the government adjusted the tax policies by reducing or exempting import tariffs on 1st January 2004. Compared even to the developed countries, China's average tariff is considered to be fairly low especially compared to other developing countries. As addressed in both Brandt *et al.* (2012) and Kamal *et al.* (2012), reductions in Chinese tariffs were phased over a decade but in most instances the bulk of the tariff falls occurred immediately on January 1st, 2002, after China joining the WTO. From a simple average tariff rate of 23% in 1996, Chinese duties were reduced to an average of 14% in 2001 and 10% by 2010 (Hong, 2010). The average effectively applied tariff rate on manufactured goods was lowered from about 20 percent in 1998 to about 2 percent by 2007 (Kamal *et al.*, 2012).

In addition to removing restrictions on exports and imports, Chinese government reduced tariff rates drastically. Table 1.1 shows that at the three-digit industry level, average output tariffs fell from nearly 13 % in 2000 to almost 7% in 2006, and during this period the standard deviation of those tariff rates fell by almost 45%.[1] The structure of Chinese tariff system has been changed at the industry level by the trade reforms. Besides, output tariff rates are higher than input tariff rates, suggesting that the government treats tradable intermediate input and final output differently. Hence, the effective rates of trade protection (ERP) are supposed to be higher, consistent with the other empirical findings (Brandt *et al.*, 2012; Kamal *et al.*, 2012). Similarly, industry ERP experiences a downward trend during the sample period, as well as output and input tariffs.

[Table 1.1 about here]

Following the study of Indonesia in Amiti and Konings (2007), we calculate both output and input tariff rates at the Chinese Input-Output (IO) sector level, which is

[1] Note that this is the summary statistics based on the industry trade protection data not merging with the firm data. The 4-digit industry output tariffs cover 424 manufacturing industries and the 3-digit industry output and input tariffs and effective rate of protection (ERP) cover 122 IO sectors.

equivalent to 3-digit Chinese Industry Classification (CIC) level. The measurement of tariff rates is explained in detail in section 3.3 and the variation of output (input) tariff rates is wide across Chinese IO sectors. At the IO sector level there is wide variation in both output tariffs and input tariffs. Excluding the tobacco industry (CIC: 161, 162, 169), in 2000 the highest output tariff was 52.75% for the alcohol and wine industry (CIC: 151, 152) and the lowest output tariff was 3.19% for the ferroalloy smelting industry (CIC: 324). The highest input tariff was 21.29% for the catering industry (CIC: 671, 672, 673, 679) and the lowest input tariff was 2.71% for the other transportation equipment manufacturing industry (CIC: 373, 374, 376, 379). We also estimate 2-digit CIC industry output tariffs and input tariff rates.[2] At this more aggregated level the gap between the highest and the lowest industry output tariffs is less than 29% in 2000, with the highest rate of 35.32% (Manufacture of Drink Products, CIC: 15) and the lowest rate of 6.57% (Manufacture of Non-ferrous Metal Casting, CIC: 33). For input tariffs in 2000, the gap between the highest and the lowest is around 12%, with the highest rate of 17.59% (Manufacture of Agriculture Products, CIC: 13) and the lowest rate of 5.09% (Manufacture of Non-ferrous Metal Casting, CIC: 33). At the highest level of aggregation we find a lower variation in tariff rates. It is necessary to consider the output and input tariffs at a more disaggregated level as the data show that inter-industry tariff differentials arise significantly at a less aggregated level in both output and input tariffs.

In China's 2002 Input-Output table there are 122 sectors reported. To save space in Table 1.2 we present China's 2-digit industrial output and input tariffs for 2000-2006 and the corresponding 6-period change in tariff rates.[3] There are 29 manufacturing industries in total.[4] Generally, output tariffs are greater than input tariffs; almost one and a half times the rate of the latter. Both types of tariffs have experienced a reduction over the sample period and the fall is around 1% in each year. Specifically, mean output tariffs

[2] We use the 4-digit adjusted CIC codes from Brandt *et al.* (2012) to compute our 2-digit CIC codes.

[3] Table 1.2 is based on the industrial tariff rates that have already been merged with our sample data after cleaning.

[4] At the 2-digit level, there are 29 manufacturing industries in our sample involving the 2-digit CIC codes: 13-15, 17-37, and 39-41. Using the 4-digit adjusted CIC codes there are 424 manufacturing industries covering 26 of the 122 IO sectors.

dropped from 17.29% in 2000 to 9.44% in 2006, while mean input tariffs dropped from 11.66% in 2000 to 6.41% in 2006. However, on average output and input tariffs experienced a sharp cut in 2002 and fell by approximately 30% while in 2006 average output and input tariffs only declined by 1.2% and 0.4% respectively. Once again providing support for the finding that the sharpest fall in tariffs occurred immediately after accession to the WTO. What Table 1.2 reveals is that both output and input tariffs have considerable variation across and within 2-digit CIC industries. When we compare the tariffs year by year we find the largest tariffs reductions for our sample period appeared in 2002 after China joined the WTO on 11th December 2001, a 3.8% decrease in output tariffs on average from 2001 to 2002 and a 2.88% decrease in input tariffs on average for the same period. After 2002, the magnitude of tariffs reduction decreased. In general, the reduction of output tariffs fell from 1.03% in 2003 to less than 0.11% in 2006. Meanwhile, the reduction of input tariffs fell from 0.57% in 2003 to 0.02% in 2006. Excluding the tobacco industry, the furniture manufacturing industry experienced the largest output tariff change with a drop of 18.75% and the manufacturing industry of apparel and footwear had the biggest input tariff change with a cut of 8.49%.

[Table 1.2 about here]

Figures 2.2 and 2.3 describe the trends in output and input tariff rate movements for 2000 to 2006 based on the 2-digit industrial level classification.[5] From these two figures we observe that all manufacturing industries in China had their highest output and input tariff rates in 2000 after which tariff rates began to fall. After the accession to the WTO in 2001 industries reduced their tariffs sharply in 2002 but the reduction weakened after 2002. However, there are three industries that saw little change in their output and input tariffs during our sample period.[6] What is clear is that, China joining the WTO led to a substantial reduction in tariff rates for the majority of manufacturing industries. Besides, Figure 2.4 describes the trends in 2-digit industrial ERP movements for 2000 to 2006 and

[5] The names and codes of 2-digit industry are listed in Table 1A.24.

[6] Those three industries are Processing crude oil, nuclear fuel (2-digit CIC code: 25), Manufacture of ferrous metal casting (2-digit CIC code: 32), Manufacture of non-ferrous metal casting (2-digit CIC code: 33).

such trends are similar to those found in output and input tariffs.

[Figure 2.2 about here]

[Figure 2.3 about here]

[Figure 2.4 about here]

Figures 2.5 and 2.6 show that in a specific year output and input tariffs can vary considerably between 3-digit industries. In addition, both tariffs mean values tend to decrease over time. Our mean values for both input and output tariffs are comparable to Brandt *et al.* (2012). Both rates fell rapidly in 2002 but after 2002 the mean value of both output and input tariffs tended to decline but much more slowly. It is useful to point out the differences between our measures and the work of others. For example, we find that our mean values tend to be larger than those calculated by Hu and Liu (2014) at the 2-digit industrial level, especially for input tariffs. This variation may be due to different choices of coding system, as our measurement is based on Chinese Industrial Coding System (CIC) while theirs is based on International Standard Industrial Classification (ISIC). Yu (2014) uses the same CIC coding system, however our mean input tariffs are generally higher and our mean output tariffs are a little lower. We believe this is because we use industrial output tariffs to calculate industrial input tariffs whilst Yu (2015) may have used inputs' import tariffs for his calculation. Despite these small discrepancies, the trends in output and input tariffs shown in our work are broadly consistent with Brandt *et al.*, 2012; Hu and Liu, 2014; and Yu, 2015. Moreover, Figure 2.7 shows that in a specific year industry ERP can vary considerably between 3-digit industries and industry ERP is heterogenous across industries in each particular year.

[Figure 2.5 about here]

[Figure 2.6 about here]

[Figure 2.7 about here]

The correlations between output tariffs and input tariffs are around 0.80 over the time period. As shown in Figure 2.8 the highest correlation is 0.84 in 2000. The correlation then declines and reaches 0.77 in 2006. Hence at the 3-digit CIC industry level, tariffs levels for outputs and inputs are highly correlated.

[Figure 2.8 about here]

Finally, Table 1.3 reports the correlations of output and input tariffs of different levels of aggregation and the correlations between their one-year lag values. It shows that there are high correlations between output and input tariff rates at the three-digit industry level, whether in levels or in one-year lag values, and all correlations are equal to 0.79.[7] Yu (2015) also finds a strong positive but slight lower correlation between the three-digit industry output and input tariffs, with the correlation equal to 0.578. However, it shows that the four-digit output tariffs are weakly correlated with the three-digit input tariffs with correlation around 0.5, both in levels and in one-year lag values.

[Table 1.3 about here]

2.2.2 Firm Heterogeneity

Similar to the findings in Amiti and Davis (2011) for Indonesia, less than one fifth of manufacturing firms in China are global engaged. As described in Figures 2.9, only 10% of all manufacturing firms both export and import, firms that export some of their outputs but do not import only account for one half of the former fraction, 2% of firms that source imported intermediate inputs only, and the majority of manufacturing firms in China only source intermediate inputs domestically and sell final products in the domestic market. Compared with domestic only firms, globally engaged firms are playing an important role in China's economy as they are larger and higher productivity firms. As shown in Figures 2.10 and 2.11, in our sample internationally oriented firms account for

[7] This correlation is based on our firm-level panel that has merged with industry-level tariffs. The correlation between industry-level tariffs before merging is much smaller, at 0.71 for level and at 0.70 for lagged values.

17% of all firms but account for over 30% of total employment and almost 40% of total added-value, while over 80% of all firms are domestic oriented firms, which account for approximately 70% and 60% of total employment and added-value respectively. Moreover, as shown in Table 1.4, over the period we examine, 11% of China's manufacturing output was sold to overseas markets, which means less than 90% of manufacturing output was sold directly to the domestic market. Our finding is consistent with that in Brandt *et al.* (2012) as they point out that nearly 80% of China's manufacturing output was sold domestically during 1995-2007. Those 17% of trading firms also import slightly more than 9% of intermediate inputs from aboard and during the time period, their propensity of exporting and importing continued to grow.

[Figure 2.9 about here]

[Figure 2.10 about here]

[Figure 2.11 about here]

[Table 1.4 about here]

Hence, global engaged firms play an important role to China's economy, but attracting more attention is manufacturing activity directed to the local market, including sourcing intermediates and selling final products, and domestic-oriented firms are dominant in China. This pattern is different from that in Indonesia as documented by Amiti and Davis (2011). In Indonesia, less than one third of manufacturing firms are global engaged, but they hire over two thirds of total employment and create approximately 80% of total added-value. Additionally, similar patterns are also found in developed countries (Bernard *et al.*, (2007) for the United States and Eaton *et al.*, (2008) for France) and other developing countries (Verhoogen, (2008) for Mexico). One potential explanation for such difference may be the huge demand of consumption in China's domestic market.

2.2.3 Wage Heterogeneity

Over the sample period, within the same industry there is small variation in firm wages. Considering firm-level mean wage relative to industry-level mean wage around 2000-2006, a standard deviation of 1.18 shows that wage is greatly heterogeneous across firms. In our sample, only 11.43% (15.52%) of firms pay wages higher (lower) than one half of mean wages at the industry level, which is similar to the findings in Indonesia that about 14% (16%) of firms pay wages higher (lower) than one half of mean wages at the industry level (Amiti and Davis, 2011). We also check the relative wage in 2000 (before WTO accession) and in 2002 (after WTO accession) separately. In 2000, firms paying wages higher than half of industrial mean wages account for 13.36% and firm paying wages lower than half of industrial mean wages account for 18.22%; while in 2002, firms paying wages higher than half of industrial mean wages account for 12.52% and firms paying wages lower than half of industrial mean wages account for 17.37%. China's accession to WTO did not appear to result in greater wage heterogeneity across firms within the same industry, even though it helped Chinese firms to enter the global market. However, the percentage of firms that pay wages greater than the industry mean is decreasing during the period.

As discussed in section 2.2, our sample data perfectly fits one of the key elements in Amiti and Davis (2011), which addresses that firms are heterogenous and hence our Chinese data is ideally supportive to conduct an empirical study on testing the Amiti and Davis (2011) model. Thus, we first review the literature related to our empirical study as well as the theoretical foundation of our estimations and then introduce our empirical estimation strategy in the following section.

2.3. Related Literature, Theoretical Model and Empirical Strategy

2.3.1 Literature

There is a vast literature on exploring or examining the effect of trade liberalization on local economy. Early literature states one key channel, a home country's exposure to foreign trade, and the breadth and depth of such an exposure may in turn have a considerable impact on resources reallocation across industries in the home country.

First, we only focus on the studies that investigate the relationship between labormarket and the power of trade protection. One inference of Bernard *et al.* (2007) is that workers in different types of firm will experience different pay and conditions and it is also one of the first papers to highlight the difference in behavior of importers and exporters and demonstrating that trading activity is concentrated in large and high-productive firms which pay relative high wages to workers but only account for quite a small proportion of total firms.

More recently, a number of within-sector explanations for different wages have emerged. Using Mexican plant level data for 1993-2001, Verhoogen (2008) shows a link between trade and inequality and finds that initially larger, more productive firms had a higher export propensity and higher wages. Most interestingly, when a depreciation of peso came in the late-1994, those firms were more willing to export more and pay wages.

In addition, combining three data sources: the Encuesta Industrial Annual (EIA) dataset, Mexican employer-employee dataset and the Instituto Mexicano del Seguro Social (IMSS) dataset, Frías *et al.* (2009, 2012) investigates the mechanisms linking trade and within plant wage distributions. The results are consistent with the interpretation that firms initially raise the wages of technical workers and the workers with high skills following an export shock. However, wages at the lower end of the distribution should catch up over the medium run and explore the dynamic adjustment of the within-plant wage distributions.

As documented by Yi (2003), the impact of intermediate inputs also plays an important role. Given the relationship between export and import tariffs it is important to consider them together. The majority of the existing literature concentrates on exporting often ignoring the import effect.

Returning to the determinants of wages, Melitz (2003) and Kasahara and Lapham (2007) present models based on two assumptions, one is worker homogeneity and the other is that a labor market is perfect and completely competitive. In this case, workers' wages at the firm level do not rely on firm performance, which means that the total amount of wages paid to employees is not connected to firm profits. Then the concept of fair wage was introduced by Grossman and Helpman (2007). In their model they model the relationship between fair wages and outsourcing.[8] This approach is extended by Amiti and Davis (2011), whose general equilibrium model is developed by introducing three key factors: heterogeneous firms, tradable intermediate inputs and final outputs, and specific firm wages. Although the authors pay close attention to homogeneous labor, a variant form in fair wages is used to improve the model. Using the firm-level comprehensive Indonesian census data for manufacturing industries in 1991-2000, Amiti and Davis test their theoretical model. The empirical results support their hypotheses that a reduction in either final product tariffs or intermediate input tariffs increase wages for firms involved in international trade, either exporting or importing. However, such tariff reductions should also lead to a fall in wages for domestic non-trading firms. The paper is the first attempt to investigate how decreasing tariffs (output tariffs and input tariffs) affects workers' wages at firms with different modes of globalization by using both theoretical and empirical ways. Consistent with their work, using Indian firm-level

[8] The concept of fair wage means that all workers have a fair-wage demand and in specific, workers who are employed in zero operating profits firms should be paid the same wage, no matter if they are in either intermediate input sector or final output sector. Moreover, wage payment is dependent on firm profits and is positively correlated to firm profits. So workers worked in high-profit firms demand relative high wages and hence require wage premia. (Akerlof, 1982).

data Ahsan and Mitra (2014) document that on average, small and more labor-intensive firms enjoy a growth in the share of total wages over total revenue, however, large and less labor-intensive firms experience a decline in that share following trade liberalization.

The Amiti and Davis (2011) results are, however, in contrast to the results of previous studies. Goldberg and Pavanik (2005) use Colombian industry-level data and find that cutting output tariff rates leads to lower industry wages. Similarly, Revenga (1997) finds the same result at the firm-level using plant-level Mexican data. There also exist some studies that find tariff liberalization is not related to firm wages. In an industry-level study using Brazilian data Pavcnik *et al.* (2004) did not find significant effects of final output tariffs cut on wages. Using firm-level data to test the impact of NAFTA, Trefler (2004) did not find relationship between output tariff changes and changes in wages, which means that even though the government reduced final output tariffs in order to stimulate exporting, there was no impact on workers' wages at the firm level.

We then focus on the studies that investigate the relationship between trade liberalization and Chinese economy. First of all, some researchers find a positive impact of trade liberalization on productivity. Brandt *et al.* (2012) argue that trade liberalization can boost local economy. They explore how tougher import competition induced by lower trade barriers affects firm performance by exploiting Chinese tariff variations at the Input-Output (IO) sector level and argue that such variations in tariff reductions make a great contribution to increasing firm productivity in 1995-2007. Hu and Liu (2014) address that in 2002- 2006 Chinese manufacturers make an annual growth of 0.94% in productivity after China's entry into WTO, and such a gain is the net effect of a negative effect caused by decreasing output tariffs and a positive effect caused by decreasing input tariffs. Yu (2015) finds that decreasing both output and input tariffs can increase productivity for firms engaged in global trade, but those positive impacts induced by tariff reductions become smaller by increasing a firm's share in processing trade. Most importantly, reductions on both output and input tariffs contribute to more than 14.5% gain in overall productivity.

Moreover, some empirical studies try to investigate the connection between tariff reductions and the ability of firm production. As in Qiu and Yu (2014), they predict that cutting tariff rates of the home country reduces the export scopes of the home country and their empirical analysis confirms the predictions and shows that both Chinese tariff cut and foreign countries' tariff cut result in the Chinese firm reducing their export product scope. Cheng (2012) finds that falls in output tariff rates decrease real outputs while falls in input tariff rats increase real output, and such effects are smaller in prefectures with policy zones.

Finally, to examine the impact of trade liberalization on labor market, Kamal *et al.* (2012) use firm-level Chinese manufacturing data and find support for a significantly positive effect of liberalization on the wage share of sales and on the wage share of value added, operating both through input choices and through rent sharing, whilst Cheng (2012) demonstrates that cuts in output tariff rates increase economic zones' employment while cuts in input tariff rates decrease that employment, but in non-economic zones they find an opposite conclusion.

In conclusion, the empirical results are vast and mixed. Nonetheless, the current empirical studies based on China rarely discuss the linkage between a firm's global engagement and firm wages and our study seeks to fill this by using Chinese manufacturing firm data to test the theoretical model of Amiti and Davis (2011). Hence, we introduce their model in the following section.

2.3.2 Theoretical Model

The theoretical foundation of our paper is from Amiti and Davis (2011), which in turn is based on Grossman and Helpman (2007). We describe the Amiti and Davis (2011) general equilibrium model below.

The Amiti and Davis model consists of three key elements:

(1) Heterogeneous firms following Melitz (2003).

(2) Tradable intermediate inputs for manufacturing production following Kasahara and Lapham (2007).

(3) Imperfect factor markets, of which the key point is featuring firm-worker rent sharing, following Helpman, Itskhoki and Redding (2010).

2.3.2.1 Final goods consumption

The demand function comes from Dixit and Stiglitz (1977). In this framework, the expenditures E are allocated by consumers across a variety of final goods that is available and continuum:

$$Min\ E = \int p(v)q(v)dv \qquad s.t. \left[\int q(v)^{\frac{\sigma-1}{\sigma}} dv\right]^{\frac{\sigma}{\sigma-1}} = U$$

Here, σ is the elasticity of one consumed goods that can be substituted by other goods, and σ > 1. Therefore, consumers demanding final goods v can be expressed as $q(v) = \left[\frac{P(v)}{P}\right]^{-\sigma} Q$ and product revenue can be expressed as $r(v) = R\left[\frac{P(v)}{P}\right]^{1-\sigma}$, where $Q \equiv U$. The price index P is aggregated and measured as $P = [\int p(v)^{1-\sigma}\, dv]^{\frac{1}{1-\sigma}}$ with $PQ = R$.

2.3.2.2 The Constraint under Fair Wage Assumption and the Labor Market

There are two elements which induce workers' wage differentials at the firm-level. One is that firms are heterogeneous, with their specific trade costs and productivity levels and the other is firm performance. These two factors are modeled using the concept of "fair wage".

Amiti and Davis (2011) include firms with zero and positive operating profits. In particular, zero-profit firms are located in either the intermediate input sector with complete competition or the final output sector with imperfect competition, and in the latter sector, firms are marginal firms and other firms have profits greater than zero. All workers have the same demand of fair wages. Specifically, workers who are employed in zero operating profits firms should be paid the same wage, no matter if they are in the intermediate goods sector or the final goods sector. Workers' wages for zero-profit firms are hence taken as the numéraire.

Compared to zero-profit firms, the wage of any other firm *v* is given by *Wv*. It is assumed that *Wv* is determined by firm performance, which means that an increase in profit will lead to an increase in wage. Because the concept of "fair wage" is considered that zero-profit firms pay the same wages and firms with higher profits pay higher wages (Akerlof, 1982). Therefore, in a condition of exerting effort workers employed by more profitable firms requires higher wages and hence requires a wage premia. Moreover, positive-profit firms would like to pay a wage premia since it can encourage workers. In addition, the wages will not be bid down once they have been set because of all workers' demand to be treated fairly. Still, Amiti and Davis (2011) assume that workers are hired freely and are not queuing for these jobs. However, the workers will accept any job offers if they pay the same amount of wages that the current employment provides. In sum, the situation could be expressed as:

$$W_{(0)} = 1,\ Wv = W(\pi_v),\ 0 < W'(\pi_v) < \infty,\ W_v \leq \overline{W}.$$

Under the fair-wage constraint, the nominal wage of zero-profit firms is determined to be the same and it is unity. However, the wage of any positive-profit firm *v* is given as an increasing function depending on firm profits, and represented by $Wv = W(\pi_v)$. The condition of $0 < W'(\pi) < \infty$ indicates that a stable behavioural relation exists. Since the demands of fairness are limited, the wage curve has an upper bound but finite.

2.3.2.2a Firm Production and Profits by Modes of Global Engagement

As discussed above, wages should be set according to profits subject to the fair-wage assumption. Similarly, firms' profits are a result of the choices of wages paid as they are included n firm costs. What's more, if the firm's global engagement is different, then the relationship between wages and profits will also differ. The assumption is that firms will always choose the specific mode to maximize its profits.

Assume that manufacturing production contains 2 sectors, the intermediate input sector and the final output sector, .each produced with one homogeneous labor. In each country a variety of intermediate goods are available to access and they are measured in the fixed interval of unity, $m_{(j)}$ for $j \in [0, 1]$. The production of intermediate goods is in a condition of constant returns to scale and free entry and their price are equal to their marginal costs. One unit of labor produces one unit intermediate while the price of intermediate inputs in the home country market is assumed to be unity because of the numéraire labor and the unity wage in this sector. Based on the unity price, suppliers of intermediate inputs can catch any increases in demand coming from the final output sector.[9]

In the final output sector, the decision sequence follows Melitz (2003). From an unbounded mass of potential firms, a mass M_e pays a fixed cost f_e in units of labor. Since a firm has paid such a fixed cost, it obtains a triplet of information $\lambda_v = (\varphi_v, t_{Mv}, t_{Xv})$. The distribution of the information λ_v is following the density function $g\ (\lambda_v)$ of joint probability and the information includes firm productivity φ_v , marginal export costs t_{Xv} and marginal import costs t_{Mv}.

Amiti and Davis extend the model by adding marginal export and import costs, where the Melitz model only took the marginal physical productivity parameter ϕ to capture firm heterogeneity. As a result, firm categories can be enlarged in the model. The assumption is that variation in trading shares is considerable large for all firms; otherwise, as in Melitz, either exporting firms or importing firms export/import the same proportion of their outputs/intermediate inputs, which not fits the reality well. The Amiti and Davis (2011) characterize t_{Xv} and t_{Mv} as export costs and import costs, which also can be used to measure how efficient a firm serves foreign markets or sources imported intermediates respectively. In this model only export costs τ_X and import costs

[9] The model allows for love of variety in intermediate goods but take the measure of varieties in each market exogenously.

τ_M can be varied.

The marginal probability density function $g_{\varphi}(\emptyset) \equiv \iint g(\lambda) dt_X \, dt_M$ and the associated cumulative density function $G_{\varphi}(\emptyset) \equiv \int_0^{\varphi} g_{\varphi} \, (u) du$ are introduced in Amiti and Davis (2011). After learning, some firms cannot survive from the market and exit, those survived firms M will decide the elements (labor, inputs and outputs) for production to get maximum profits. δ describes the rate of firm death and it is constant to satisfy the steady requirement.

At any point in time, each final output producer obeys the given demand curve for maximizing its own profits. It is assumed that the wage of activities with fixed costs is proportional to unity.[10] But the model is developed firm wages Wv of activities with varying costs. For the purpose of producing in any period, each final output producer pay fixed costs to hire f units labor and follow the Cobb–Douglas production function.

For profit maximization, a firm can choose its engagement in globalization and further determine its profits and so on wages. Hence, assumed that the marginal cost is constant, the isoelastic profits are expressed as:

$$\pi_v = Max[0, \quad \frac{r_v}{\sigma} - F_v]$$

The function F_v is used to describe the fixed costs induced by firm's different engagements in globalization. Let n denote the quantity of oversea markets and fixed export and import costs are f_X and f_M respectively, and hence:

$$F_v = \begin{cases} f & (a) \\ f + nf_M & (b) \\ f + nf_X & (c) \\ f + n(f_M + f_X) & (d) \end{cases}$$

Equation (a) is for firms that only serve domestic market, neither importing nor

[10] For simplicity, the fixed costs can only change in wages with the concern of varying labor cost.

exporting; equation (b) is for firms that use imported intermediate inputs; equation (c) is for firms that export final outputs and equation (d) is for both exporting and importing firms.

The cost of using any domestic intermediate is equal to 1, the same as the free on board (FOB) price of exporting any intermediate input, but the common landing, insurance and freight (CIF) price for importing any intermediate input is greater than 1 and we use τ_M to represent. Firm-specific iceberg transport costs are assumed to defined as $t_{Mv} \in [1, \overline{t_M}]$. Finally, we set the total effective price τ_{Mv} equal to $\tau_M t_{Mv}$ with the value greater than 1, allowing the trade liberalization is assumed to only affect the τ_M term. The fixed Relative to other firms, firms with low-idiosyncratic import costs can start to import at a relative low productivity level since it is much easier for them to pay the fixed costs of importing, and they can obtain high profits and thus pay high wages because they can import intermediates at a lower price.

The cost for the producers of final goods varies according to their decision on whether to import intermediate inputs. Marginal costs c_v are Cobb–Douglas in the input prices:

$$c_v = \frac{1}{\varphi_v} \left(\frac{W_v}{\alpha}\right)^{\alpha} \left(\frac{P_{Mv}}{1-\alpha}\right)^{1-\alpha} = \frac{K W_v^{\alpha} P_{Mv}^{1-\alpha}}{\varphi_v} \qquad \text{where} \quad K \equiv \alpha^{-\alpha} (1-\alpha)^{\alpha-1}$$

Note that the costs involve two endogenous variables, workers' wages paid by producers and the price of the composite intermediate. The former as a condition of determining firm costs and revenues which further affect profits, whilst the firm wage itself is not determined at this early stage; the latter is dependent on the extent of importing intermediate inputs upon love of intermediate variety. If an importing firm wants to additionally source one unit interval of domestic inputs, it has to additionally source n unit intervals of imported inputs. Here γ is the elasticity of one variety of intermediate inputs can be substituted by another variety and its value is greater than 1. The intermediates price P_{Mv} is dependent on firm's input choice. If a firm sources intermediate inputs domestically, it is assumed that $P_{Mv} = 1$, while a firm using imported intermediate inputs, it will pay P_{Mv}=$[1+n\tau_{Mv}^{1-\gamma}]^{\frac{1}{1-r}}$, where P_{Mv}<1.[11]

As a result, the choice of globalization determines marginal costs, also affects P_{Mv} and the equilibrium wage W_v, which is determined below. If a firm uses no imported intermediate inputs, then the marginal cost c_v is equal to ($\frac{KW_v^{\alpha}}{\varphi_v}$). If a firm uses imported intermediate inputs, c_v is now lower than before and is equal to $\frac{KW_v^{\alpha}}{\varphi_v}(1+n\tau_{Mv}^{1-\gamma})^{\frac{1-\alpha}{1-\gamma}}$. Given isoelastic demand and monopolistic competition, the domestic price of a variety of final goods is the standard mark-up on marginal costs, where $P_{vd}=\frac{\sigma}{\sigma-1}c_v$.[12]

In terms of revenue, domestic revenue is set as $r_{vd}=RP^{\sigma-1}p_{vd}^{1-\sigma}$, which depends on the price. Since importing action affects costs, it also affects the final goods price, and hence revenues will be affected. The revenue of non-importing firms is described as $r_{vd}=RP^{\sigma-1}(\frac{KW_v^{\alpha}}{\rho\varphi_v})^{1-\sigma}$, while the revenue of intermediate importing firms is $r_{vd}=\Gamma_{Mv}RP^{\sigma-1}(\frac{KW_v^{\alpha}}{\rho\varphi_v})^{1-\sigma}$, where the $\Gamma_{Mv}\equiv(1+n\tau_{Mv}^{1-\gamma})^{\frac{(1-\alpha)(1-\gamma)}{1-\gamma}}>1$ is an "import globalization" indicator and reflects the marginal import costs because the decreased prices or costs is induced by importing intermediate inputs and hence lead to higher revenues. The markup is $\frac{1}{\rho}$, where $\sigma=\frac{1}{1-\rho}$.

Total revenues r_v are dependent not only on the depth of the firm's entry into each market but also on the market breadth that the firm can effectively and efficiently serve. A firm who serves an oversea market is supposed to have idiosyncratic iceberg costs, given by τ_{Xv}, which can be decomposed into an idiosyncratic component t_{Xv} Є [1, $\overline{t_{Xv}}$], where $\tau_{Xv}=\tau_X t_{Xv}$ and a common exporting cost $\tau_X>1$. Firm revenues from any foreign country are proportionally decreased in comparison to the revenues from home country, considering that final products export to those foreign markets are sold at higher

[11] Here Amiti and Davis (2011) combine the issues of whether extensive and intensive margins can increase firm imports.

[12] In the electronic appendix of Amiti and Davis (2011), they point out that constant markup pricing is still optimal for firms that know their global engagement can affect their wages. Because firm wages are positively correlated with firm profits and hence, at the equilibrium level treat is as parametric.

prices after including iceberg costs τ_{Xv} for exported final products. All else equal, a firm who exports final outputs with relative low-idiosyncratic costs will begin to export at a lower idiosyncratic productivity level and will export a larger proportion of final outputs.

Let r_{vd} be the revenues of a firm who only sells final outputs domestically, an exporting firm will have revenues of $\Gamma_{Xv}\ r_{vd}$. Here $\Gamma_{Xv} \equiv (1 + n\tau_{Xv}^{1-\sigma}) > 1$ is an "export globalization" indicator, considering that a firm can efficiently serve *n* additional foreign markets and export its final outputs to those markets. Hence, the revenue from each foreign market is indicator $n\tau_{Xv}^{1-\sigma}$multiplies the revenue from domestic market where $n\tau_{Xv}^{1-\sigma} < 1$.

We now have the full dimensions to describe the firms' global engagement, which are dependent on whether they import intermediate inputs or export final products. Since firm profits are defined as firms revenues less total costs and are non-negative, then profits can be expressed as $\pi_v \ = \frac{r_v}{\sigma} - F_v$. Setting variable profits for domestic oriented firms to be $\pi_{vdVar} = \left(\frac{RP^{\sigma-1}}{\sigma}\right)(\frac{KW_v^{\alpha}}{\rho\varphi_v})^{1-\sigma}$, then firm profits, conditional on firm wages, are as follows:

$$\pi_v(W_v) = \begin{cases} 0 & (a) \\ \pi_{vdVar} - f & (b) \\ \Gamma_{Mv}\,\pi_{vdVar} - (f + nf_M\,) & (c) \\ \Gamma_{Xv}\,\pi_{vdVar} - (f + nf_X\,) & (d) \\ \Gamma_{Xv}\,\Gamma_{Mv}\,\pi_{vdVar} - [f + n(f_X\, + f_M\,)] & (e) \end{cases}$$

Equation (a) represents firms that do not produce; equation (b) represents firms that still produce but only operate domestically and neither import nor export; equation (c) represents firms that use imported foreign intermediates; equation (d) represents firms that export final goods and equation (e) represents firms that import intermediates and export final goods.

In addition, Amiti and Davis (2011) emphasize the dependence of profits on wages for each mode of globalization, and as $\pi_v^{'}(W_v) < 0$, the negative first conditional differences means that the revenue curve is downward sloping, which identifies that higher wage setting will result in lower profits.

Firm wages are determined at this stage. Remember that the assumption of fair-wage is that wages are positively related to firm profits. However, according to the type of mode of globalization, there is a second relationship between wages and profits, in which they are negatively related. As a result of combining such two relations, firms will always choose the best mode of globalization for them with the purpose of maximizing profits and so determine the wages, or they exist if this maximum is negative. The same mechanism works on firms' equilibrium wages. Hence, based on the assumptions previously discussed, Amiti and Davis (2011) outline how to determine profits and wages as well as other variables at the firm level with condition of macro variables.

2.3.2.3 General Equilibrium

In Amiti and Davis (2011) model there are two simple assumptions are introduced in determining the market equilibrium.

Assumptions:

$$\boldsymbol{f_X \geq f}.$$

Condition A ensures that firms with zero profits are not willing to export within strictly positive exporting costs τ_X >1, the profit from any one foreign market is always lower than that from the home market since the foreign revenue is proportional to domestic revenue, and hence, they cannot cover the common exporting costs.

If a firm earns zero-profit, then $\pi_{vdVar} - f = 0$, therefore $f = \pi_{vdVar}$. As the revenue earned in each foreign market is proportionally decreased relative to that from local markst, then the profits obtained from each foreign market can be expressed as $(\tau_{xv}^{1-\sigma}\pi_{vdVar} - f_X)$, where $\tau_{xv}^{1-\sigma} < 1$. Assumed that the foreign variable profits are lower than the domestic one, suggesting that if a zero-profit firm intends to export it will earn negative profits in a foreign market, then the expression turns to be $\tau_{xv}^{1-\sigma}\pi_{vdVar} - f_X < 0$ and combine the condition that $f = \pi_{vdVar}$, it can be derived as $\tau_{xv}^{1-\sigma} f - f_X < 0 \Rightarrow f < \frac{f_X}{\tau_{xv}^{1-\sigma}}$. In the condition of $\tau_{xv}^{1-\sigma} < 1$, then $\frac{f_X}{\tau_{xv}^{1-\sigma}} < f_X$ and hence $f \leq f_X$.

B. $\boldsymbol{f_M > \frac{f}{n}(\Gamma_{Mmax} - 1)}$**, where** $\boldsymbol{\Gamma_{\mathrm{Mmax}} \equiv (1 + \mathrm{n}\tau_{\mathrm{M}}^{1-\gamma})^{\frac{(1-\alpha)(1-\sigma)}{1-\gamma}}}$**, i.e.** $\boldsymbol{t_{Mv} = 1}$**.**

Condition B ensures that zero-profit firms have no advantages of importing intermediate inputs when it fails to import. To address this, it is noted that the net gains due to imported inputs are equal to $(\Gamma_{Mv} - 1)\pi_{vdVar} - nf_M$; for a firm with zero profits, it is clear that $\pi_{vdVar} = f$ and when setting $t_{MV} = 1$ to maximize Γ_{Mv} , then the condition that firms who import intermediate inputs have negative net gain is imposed, where $(\Gamma_{Mmax} - 1)f - n\, f_M < 0$. As a zero-profit firm find the net gains from imported inputs is negative, then it can derived that $n\, f_M > f(\Gamma_{Mmax} - 1)$ $\Rightarrow f_M > \frac{f}{n}(\Gamma_{Mmax} - 1)$. Moreover, as $\Gamma_{Mv} \equiv \left(1 + n\tau_{Mv}^{1-\gamma}\right)^{\frac{(1-\alpha)(1-\gamma)}{1-\gamma}}$ and $\tau_{Mv} = \tau_{\mathrm{M}} t_{Mv}$, with setting $t_{Mv} = 1$ to achieve maximum value of Γ_{Mv} , and hence $\tau_{Mv} = \tau_{\mathrm{M}}$ and so $\Gamma_{\mathrm{Mmax}} \equiv (1 + \mathrm{n}\tau_{\mathrm{M}}^{1-\gamma})^{\frac{(1-\alpha)(1-\sigma)}{1-\gamma}}$.

Combining the two assumptions above ensures that firms with zero profits do not engage in international trade and also suggest that the general equilibrium cut-off will satisfy a condition that a firm can survive if and only if $\emptyset \geq \emptyset^*$.

Based on such assumptions and the cut-off condition, the firm profits can be expressed as $\pi_v = \pi(\lambda_v, \widehat{\emptyset}^*)$ where $\widehat{\emptyset}^*$ is the notional cut-off level of productivity. Given within the fair-wage constraint, the wage of zero-profit firms is equal to 1. Hence:

$$\pi\left(\widehat{\emptyset}^*, W_{(0)}\right) = \left(\frac{RP^{\sigma-1}}{\sigma}\right)\left(\frac{K}{\rho\widehat{\emptyset}^*}\right)^{1-\sigma} - f = 0$$

This yields precisely the macro values consistent with the notional cut-off level of productivity $\widehat{\emptyset}^*$.

$$RP^{\sigma-1} = \sigma f \left(\frac{K}{\rho \widehat{\emptyset}^{*}} \right)^{\sigma-1}$$

Hence, there is no need to determine the profits $\pi_v = \pi(\lambda_v, \widehat{\emptyset}^{*})$ which are consistent with the notional cut-off level of productivity $\widehat{\emptyset}^{*}$. As a result, Amiti and Davis (2011) announce five propositions given as follows and the proofs for such propositions are stated in their electronic appendix.

Proposition 1: Unique autarky equilibrium exists under the constraint of fair wage.

Proposition 2: Unique equilibrium with export and import exists under the constraint of fair wage.

Proposition 3: A shift from autarky to either export or import increases the equilibrium cut-off, i.e. $\emptyset^{*} \geq \emptyset^{*\mathbf{A}}$.

Proposition 4: A shift from autarky to export or import will lead to:

A. Exit of firms with the least productivity level, $\emptyset_{\mathbf{v}} \in (\emptyset^{*\mathbf{A}}, \emptyset^{*})$.

B. A decrease in firm wages for all domestic firms.

C. A decrease in firm wages for marginal exporting firms and marginal importing firms.

D. An increase in firm wages for sufficiently large exporters or importers.

Proposition 5: Holding all else equal, firms with a greater proportion of exported final outputs (imported intermediate inputs) will make higher firm profits and hence pay higher firm wages.

For the purpose of testing Amiti and Davis (2011) model by using the Chinese manufacturing industry data, we introduce our various measures of trade protection and empirical strategies in the following sections. Most importantly, we address the potential endogeneity concern of tariff reductions that a researcher might face when conducting an empirical study in a real-world setting.

2.3.3 Measures of Trade Protection in China

2.3.3.1 Industry Output and Input Tariffs

To measure average tariff rate for China we follow the methodology of Amiti and Konings (2007). To do this we construct output and input tariffs in China using IO (Input/Output) sector categories, which are equivalent to the 3-digit Chinese Industry Classification (CIC) level. We use the same weight to average Harmonized System (HS) 6-digit product tariffs to construct output tariffs within each IO sector. As the Amiti and Davis (2011) model attempts to identify the impact of decreasing output tariff rates on firm wages from that of decreasing input tariff rates, in our analysis we construct input tariffs as well. For each IO sector, the input tariff is measured by using an input-cost share as the weight to aggregate those IO sector output tariffs. The measurement is as follows:

$$input\ \ tariff_{jt} = \sum_{j} s_{ij,2002} \times output\ \ tariff_{jt} \qquad (1)$$

$$where \quad s_{ij,2002} = \frac{\sum_{k} input_{kij}^{2002}}{\sum_{kj} input_{kij}^{2002}}$$

We use the input-output shares from China's 2002 IO table as the weights $s_{ij,2002}$, which are the proportions of total inputs from industry i over total outputs of industry j, summed up from 2002 firm data into 3-digit industrial cost-shares (IO sector-level) by National Bureau of Statistics of China (NBSC).[13] Here, i or j denotes an industry, t denotes a different year and k denotes a firm. The measurement of input tariffs is such

[13] Firm's inputs/outputs and compilation of the input-output tables for China is conducted by NBSC every five years. There are five IO tables for China, 1987, 1992, 1997, 2002 and 2007. Since our sample period is 2000 to 2006, we choose the 2002 IO table and use its input-cost shares as the weights to calculate our 3-digit industry input tariffs during the sample period.

that if for industry *j*, cotton accounts for 80% of its total costs and wool accounts for 20%, then the measurement weight on cotton tariff rate is 80% and the measurement weight on wool tariff rate is 20%, and the input tariff of industry *j* is calculated as the sum of those output tariff rates on both cotton and wool, with a 80% weight giving to the former and a 20% weight giving to the latter.

To measure the IO sector output tariff rates, we first need to know the product line for each sector. However, the direct connection between IO sectors and HS codes is not readily available. There are two possible methods to address this problem: one is to rely on the linkage between the International Standard Industrial Classification (ISIC) coding system and CIC coding system and to utilize multiple concordance tables to indirectly obtain an IO-HS concordance table.[14] The other possible solution is to rely on the 2007 IO-HS concordance table as China Customs reports the product line within each IO sector directly. However, both products and sectors are based on the China's new coding system, HS2007 and IO2007. For our sample period, some additional adjustment is needed.[15] Our strategy is to combine both approaches to drop the repeated products of each sector to derive our comprehensive IO-HS concordance table, which is based on the HS 6-digit product level.

As a first step for method 1, we adjust the IO sectors with the 4-digit CIC industry codes. Specifically, we match 122 IO sectors with 861 CIC industries (2000-2002) and with 913 CIC industries (2003-2006) separately.[16] Secondly, we convert the CIC coding system into the ISIC coding system and further connect our IO sectors with ISIC

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14 These multiple concordance tables we utilized are: ISIC/Rev.3-HS1996, ISIC/Rev.3-HS2002, GB/T4754-2002-ISIC/Rev.3, GB/T4754-2002-IO2002 and GB/T-4754-2002- GB/T4754-1994.

15 Here we need concordance tables HS1996-HS2007, HS2002-HS2007 and IO2002-IO2007.

16 During the sample period there are two versions of industry classification, so we adjust the IO sectors with both of them separately. In 2000-2002 the industry classification is based on old coding system, GB/T4754-1994, therefore there are 861 industries in total. After 2002 the new coding system, GB/T4754-2002, is introduced to classify industry, hence there are 913 industries in total. As in Brandt *et al.* (2012), they only concordance the manufacturing industries with the IO sectors therefore 71 IO sectors are reported in their IO-CIC concordance table. Based on their work, we extend the adjustment as our IO-CIC concordance table including all 122 sectors appeared in 2002 input-output table, which includes all the industries not only manufacturing industries.

industries.[17] Then using the ISIC/Rev.3-HS concordance tables we link the ISIC industry codes with China's HS 6-digit products.[18] Finally we find the correspondence between the IO sectors and the HS 6-digit products according to method 1. Later we convert the 2007 IO-HS concordance table into a new version to correspond to our time period as outlined in method 2. Eventually, by integrating the results from methods 1 and 2, we acquire our own IO-HS concordance tables, which cover almost 7,000 HS 6-digit products within 122 IO sectors.[19]

With our own IO-HS table, we use China's HS 6-digit effectively applied tariffs and take a simple average to obtain IO sector output tariff rates.[20] Based on IO sector output tariffs, we turn to calculating IO sector input tariff rates. To measure IO sector input tariffs we use the input-cost shares from the 2002 IO table as a weight to average the IO sector output tariffs as calculated previously. Since we assume in our sample period each IO sector does not change its cost distribution for each production line, we fix the input-cost shares. That is, we implicitly assume that technology remains constant. Further, since we use industry input-shares for input tariff rate calculations, which is at a more aggregated level, our measurement for input tariffs would not be biased by a single firm's own input choices. To save space we only report China's 2-digit manufacturing industrial output and input tariffs for 2000-2006 in Table 1.2 as discussed before and there are 29 manufacturing industries in total.

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[17] NBSC report the concordance table between GB/T4754-2002 and ISIC/Rev.3. In practice a CIC code may correspond to three ISIC codes. For example, Manufacture of Stationery (CIC: 2411) is concorded with Manufacture of Plastic Products (ISIC: 2520), Manufacture of Other Metal Products (ISIC: 2899) and Manufacture of Others (ISIC: 3699). In this case we give a 1/3 weight to each ISIC industry and sum up those 3 ISIC output tariffs if we would like to get the CIC output tariff in Manufacture of Stationery. Later when we calculate the IO sector output tariffs, we treat each product's tariff under each ISIC industry equally.

[18] The tariffs of 6-digit products obtained from the WITS around our sample are based on different HS versions. Tariffs in 2000 and 2001 use the HS1996 coding system while tariffs in 2002-2006 use the HS2002 coding system. So we use two concordance tables: ISIC/Rev.3-HS1996 and ISIC/Rev.3-HS2002.

[19] We generate two concordance tables, IO2002-HS1996 and IO2002-HS2002. The former covers 6,886 HS 6-digit products within 122 sectors and the latter covers 7,031 HS 6-digit products within 122 sectors.

[20] Some IO sectors do not report the HS 6-digit outputs and hence their output tariff rates are missing. This is because that those 122 IO sectors include all the industries, not only manufacturing industries but also service industries, such service industries do not produce products and hence they would not induce tariffs. Therefore, it is reasonable that we treat those missing ISIC output tariffs as zero.

2.3.3.2 Effective Rate of Protection (ERP)

We further also construct effective rate of protection (ERP) to evaluate the trade reform in China. Two forces drive this additional measurement. First, At the industry level, the disciplining effect of decreasing output tariff rates might be balanced by decreasing input tariff rates. Second, given the high correlation between output and input tariff rates at the 3-digit industry level (as seen in Table 1.2 of section 2.1), rather than include both measures in the same equation, we use the 3-digit industry level ERP to account for both types of protection.

Following Corden (1966), we therefore measure industrial ERP to capture the net effect of both types of protection on outputs and intermediates,

$$ERP_{jt} = \frac{output\ tariff_{jt} - input\ tariff_{jt}}{1 - \sum_{j} \alpha_{ij,2002}} \qquad (2)$$

where $\alpha_{ij,2002}$ are the input-value proportion of industry *i* for producing the total outputs of industry *j*, also derived from the input-output table of China in 2002. It is noted that the weights $\alpha_{ij,2002}$ to measure ERP are different from the weights $s_{ij,2002}$ to measure input tariffs. The former is the proportion of inputs from industry *i* in the total input costs occurred in the production of total outputs in industry *j*, and the latter is the proportion of inputs from industry *i* in the total value of outputs in industry *j*. Hence, $(1 - \sum_{j} \alpha_{ij,2002})$ can be expressed as:

$$1 - \sum_{j} \alpha_{ij,2002} = 1 - \frac{total\ input_{jt}}{total\ output_{jt}} = \frac{total\ output_{jt} - total\ input_{jt}}{total\ output_{jt}} = \frac{total\ value\text{-}added_{jt}}{total\ output_{jt}}$$

which is equivalent to the proportion of value-added in the value of outputs in industry *j*. As seen in section 2.1, Table 1.1 gives the summary statistics of trade barriers measured in different ways in 2000-2006, including output and input tariffs and ERP as well.

2.3.4 Empirical Strategy

Based on the predictions of Amiti and Davis (2011) outlined in Section 3.2, we investigate the impact of cutting output and input tariff rates on firm average wage by estimating the following:

$$\ln(\text{wage})_{kjt} = \alpha_1 \text{OT}_{jt-1} + \alpha_2 \text{OT}_{jt-1} \times \text{FX}_{kjt} + \alpha_3 \text{IT}_{jt-1} + \alpha_4 \text{IT}_{jt-1} \times \text{FM}_{kjt} + \theta \text{X}_{kjt} + \theta_k + \theta_{lt} + \varepsilon_{kjt}. \qquad (3)$$

The dependent variable $\ln(\text{wage})_{kjt}$ is the logarithm of firm *k*'s average wage per worker in industry *j* in year *t*, and firm average wage is the total wage payment averaged by the total employment.[21] OT_{jt-1} and IT_{jt-1} describe the one-year lagged of industry-level output and input tariffs respectively, where the former is at the four-digit industry level and the latter is at the three-digit industry level.[22] As the model predicts that tariff reductions will induce differential effects on the firm's wage payment as a result of a firm's different types of engagement in the globalization process, the interaction terms between the industrial tariffs and the firm's global status are also included. To capture the differential effect we include an interaction term of the lagged output (input) tariff rates and an exporter (importer) dummy. FX_{kjt} is an exporter dummy that is equal to one if the total exports of a firm *k* is non-zero in year *t*, and zero otherwise; FM_{kjt} is an importer dummy that is equal to one if the total imports of a firm *k* is non-zero in year *t*, and zero otherwise.[23]

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21 Here the total wage bill only includes the standard payment to workers and does not include the welfare and unemployment insurance. For robustness, we add-in those extra payment components to construct a variable of total compensation payment, and the average of which is used as a dependent variable. The results are quantitatively similar but not reported here for reasons of space.

22 To identify how output and input tariffs affect wages separately, we require that the movement between those two tariffs should be independent. As we show in Table B2, lagged 4-digit industrial output tariffs are weakly correlated with lagged 3-digit industrial input tariffs. Note that lagged 3-digit industrial output tariffs are highly correlated with lagged 3-digit industrial input tariffs and hence including both of them in regressions may induce a collinearity problem.

23 Since the change in output and input tariffs affect the two sectors, intermediate sector and final goods sector, of production respectively, to detect either of such two effects, it is enough to group firms into importer (exporter) and non-importer (non-exporters) according to a firm's activity in the intermediate (final goods) sector, and hence we only include two dummy variables to denote firm's global engagement. For those firms that only export (import), we can combine the effect of

The vector X_{kjt} includes the firm's global status and other firm level characteristics as controls. Thus it contains the dummy variables FX_{kjt} and FM_{kjt} to indicate the firm's global status and other characteristics such as the firm size, the firm performance (total factor productivity, TFP), skill intensity (the share of workers with professional qualifications in total employment) and ownership variables. [24] [25] Following Yu (2015), we use the variable $\ln K_{kjt}$, the logarithm of firm *k*'s capital, instead of the logarithm of firm *k*'s total employment to control for firm size.[26] There are three dummy variables to describe the firm's ownership structure: state-owned enterprise (SOE), foreign-owned, Hong Kong/Macao/Taiwan owned (HMT), and a dummy for other types of firms is omitted.[27] The SOE dummy is equal to one if a firm *k*'s government share is no less

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falling output (input) tariff rates on exporters (importers) and the effect of falling input (output) tariff rates on non-importers (non-exporters). Moreover, for those firms that both export and import, we can combine the effect of falling output tariff rates on exporters and the effect of falling input tariff rates on importers.

24 Skill intensity is defined following Upward *et al.* (2013), and is 4-digit industry-specific intensity not firm-specific intensity. During our sample period, the workers' education and professional qualification information are only available for 2004 from the China Economic Census. Even though the census reports the firm-level information, due to different sampling, we cannot merge the firms in the census with the firms in our sample. So using the data in the census we construct the industrial skill intensity at a more aggregated level, based on the sampling rule in CASIF that only includes SOEs and non-SOEs with annual turnover exceeding 5 million RMB. We merge this 2004 industrial skill intensity with the observations in our sample to roughly control for a firm's skill propensity as a robustness check.

25 Our TFP is estimated by following the De Loecker (2007) approach and the modification conducted by Elliott *et al.* (2015) and present our measurement in Appendix 1B. As a supplementary, we also use $\ln(\text{value added per worker})_{kjt}$ to control for the firm performance, which is following Amiti and Davis (2011) that they use the log of value-added per worker as the indicator to control for firm productivity, and report the results in Table 1A.16 of Appendix Tables.

26 In our estimates the dependent variable is the logarithm of firm *k*'s average wage, which could be written as: $\ln(\text{wage})_{kjt} = \ln(\text{total wage bill/labor})_{kjt} = \ln(\text{total wage bill})_{kjt} - \ln(\text{labor})_{kjt}$. Since the logarithm of firm labor is used as the denominator of the dependent variable, in equation (3) still using it as a proxy to control for firm size is inappropriate. Hence, we use $\ln(K)_{kjt}$ to control for firm size. However, in our empirical estimates we also report the result by using $\ln(\text{labor})_{kjt}$ as a supplementary in Table 1A.16 of Appendix Tables.

27 Other ownership variables are used as robustness checks. One proxy we used includes government share, foreign share and HMT share as one proxy, which represent the capital owned by local or central government, foreigners, Hong Kong, Macau and Taiwan respectively, and the other proxy includes two indicators, SOEs and foreign-invested firms (FIEs). Following Yu (2014), we construct the indicators based on firm registration status (*qiye dengji zhuce leixing*). A FIE is identified as a firm invested by other foreign countries. In particular, quite a lot of the Chinese firms are invested by Hong Kong, Macao and Taiwan and we also treat those firms as the FIEs. Specifically, FIEs include: HMT joint-stock corporations (code: 210), HMT joint venture enterprises (220), fully HMT-invested enterprises (230), HMT-invested limited corporations (240), foreign-invested joint-stock corporations (310), foreign-invested joint ventures (320), wholly-owned FIEs (330) and foreign-invested limited corporations (340). Additionally, Brant *et al.* (2012) also addressed that they utilize firm registration type to construct firm's ownership categories, but they have four categories:

than 0.5, and zero otherwise; the foreign-owned dummy is equal to one if a firm *k*'s foreign share is greater than 0.5, and zero otherwise; and the HMT dummy is defined as well as the foreign-owned dummy, equal to one if a firm *k*'s HMT share is greater than 0.5, and zero otherwise

Finally, we control for firm fixed effects, θ_k and firm-invariant location-year fixed effects, θ_{lt} , that the shocks over time may differ across different regions in China.[28] ε_{kjt} is the error term.

According to the theoretical predictions of Amiti and Davis (2011), the coefficients on our tariff variables in equation (3) should have the signs:

$$\begin{cases} \text{(i) } \alpha_1 > 0, \text{ denotes that if } OT_{jt-1} \downarrow, \text{ wages for non-exporters will } \downarrow; \\ \text{(ii) } \alpha_2 < 0, \text{ denotes that if } OT_{jt-1} \downarrow, \text{ relative to non-exporters, wages for exporters will } \uparrow; \\ \text{(iii) } \alpha_3 > 0, \text{ denotes that if } IT_{jt-1} \downarrow, \text{ wages for non-importers will } \downarrow; \\ \text{(iv) } \alpha_4 < 0, \text{ denotes that if } IT_{jt-1} \downarrow, \text{ relative to non-importers, wages for importers will } \uparrow. \end{cases}$$

In our estimation the interaction coefficient of lagged output (input) tariff rates and an exporter (importer) dummy indicates the differential effect between exporting (importing) firms and non-exporting (non-importing) firms. As a result, the net effect of output (input) tariff reductions on exporters (importers) is the sum of α_1 and α_2 (α_3 and α_4).

Since Amiti and Davis (2011) predicts that some marginal firms that shift from sourcing and serving the local market to exporting (importing) after falls in output (input) tariff rates will suffer decreases in both firm profits and wages if the profit loss induced

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SOEs, foreign firms, private firms and hybrid firms (local government owned, town-owned, village-owned, etc.). The results for such proxies are reported in Table 1A.16 of Appendix Tables.

[28] Following Kamal *et al.* (2012), we utilize information on a firm's region code to construct firm's location categories. Based on two-digit region code, which is equivalent to the province level, we group Chinese regions into five categories – (1) Costal: Beijing (code: 11), Tianjin (12), Hebei (13), Shanghai (31), Jiangsu (32), Zhejiang (33), Fujian (35), Shandong (37), Guangdong (44) and Hainan (46); (2)Inland: Shanxi (14), Anhui (34), Jiangxi (36), Henan (41); (3)Northeast: Hubei (42), Hunan (43); (4)Southwest: Liaoning (21), Jilin (22), Heilongjiang (23), Guangxi (45), Chongqing (50), Sichuan (51), Guizhou (52) and Yunnan (53); (5)Northwest: Inner Mongolia (15), Tibet (54), Shanxi (61), Gansu (62), Qinghai (63), Ningxia (64) and Xingjiang (65). So there are four location dummies: Costal, Inland, Northeast and Southwest. Thus, a Northwest dummy is omitted.

by stronger import competition cannot be balanced by profit gains from exporting (importing), and hence, these marginal firms need to make a great amount of exports (imports) for the benefit effects. To capture such effects, we further add-in the interaction term of lagged output (input) tariff rates and firm export (import) share instead of an exporter (importer) dummy, which may enable us to obtain the critical share of exporting (importing) to make the sum of coefficients on lagged output (input) tariffs and their interaction terms negative, implying a rise in wages by decreasing output (input) tariff rates.[29]

Alternatively, we exploit another approach to investigate the effects of trade reform on firm average wage by combining the impacts of output and input tariffs and use 3-digit industry ERP to estimate the following:

$$\ln(\text{wage})_{kjt} = \beta_1 \text{ERP}_{jt-1} + \beta_2 \text{ERP}_{jt-1} \times \text{FXX}_{kjt} + \beta_3 \text{ERP}_{jt-1} \times \text{FMM}_{kjt} + \beta_4 \text{ERP}_{jt-1} \times \text{FXM}_{kjt} + \gamma \text{Z}_{kjt} + \gamma_k + \gamma_{lt} + \omega_{kjt}. \quad (4)$$

Here ERP_{jt-1} describes the one-year lagged industry ERP at the 3-digit level and the interaction terms between the industry ERP and the firm's global status are also included. To capture the differential effect we interact the lagged industry ERP with three dummy variables. FXX_{kjt} is a pure exporter dummy that is equal to one if a firm *k* only has exports in year *t*, and zero otherwise; FMM_{kjt} is a pure importer dummy that is equal to one if a firm *k* only has imports in year *t*, and zero otherwise; and FXM_{kjt} is a both exporter-importer dummy that is equal to one if a firm *k* has non-zero exports and

[29] Note that the export share is defined as the total exports over total outputs and the import share is defined as the total imports over total inputs. In particular, Manova and Zhang (2012) document that the Chinese Customs records discriminate between "ordinary" trade and trade under the "processing-and-assembly" regime and they exploit information only on firm's imports in the latter category to ensure that they can correctly interpret such imports as inputs to the goods firms sell abroad. However, all of their results hold if they instead use data on all imported inputs and not only those under the processing-and-assembly regime. It seems that using all imports (both under the ordinary trade and the processing-and-assembly regimes) as inputs would not bias the results. Hence, following this we take all the imports as intermediate inputs used for production since our sample excludes processing firms (firms that with non-zero value of processing export or processing import) and all imports are under the ordinary trade.

non-zero imports in year *t*, and zero otherwise.[30]

The vector Z_{kjt} includes the firm's global status and other firm level characteristics as controls. Thus it contains the dummy variables FXX_{kjt}, FMM_{kjt} and FXM_{kjt} to indicate the firm's global status and other characteristics (firm size, firm performance, skill intensity and ownership variables). Finally, we include γ_k to control for un-observed and time-invariant firm fixed effects. γ_{lt} is included to control for firm-invariant location-year fixed effects and ω_{kjt} is the error term.

Based on the Amiti and Davis (2011) model, we predict the coefficient on lagged industry ERP in equation (4), $\beta_1 > 0$, which captures the joint effects of decreasing output and input tariff rates on firms serving only the domestic market, suggesting that a fall in ERP will decrease wages for domestic-oriented firms. Interaction terms of lagged industry ERP indicate the differential effects between globally engaged firms and domestic-oriented firms and these coefficients before interaction terms should be positive as predicted, suggesting that a fall in ERP will increase wages for globally engaged firms relative to domestic-oriented firms. Moreover, as firms that both export and import will benefit from the reductions of both output and input tariffs, therefore, β_4 should be greater than either β_2 or β_3. Thus, the net effects of industry ERP reductions on pure exporters, pure importers, and both exporters and importers are the value of $(\beta_1 + \beta_2)$, $(\beta_1 + \beta_3)$, and $(\beta_1 + \beta_4)$ respectively.

Similarly, we then interact lagged industry ERP with the trade shares rather than trade orientation dummy variables (FXX_{kjt}, FMM_{kjt} and FXM_{kjt}) in some specifications, which may enable us to get the critical trade shares to make the sum of coefficients on

[30] Since ERP combines the impacts of both output and input tariffs, we need to classify firms according to their activities in both intermediate and final goods sectors of production. In each sector, there are 2 possibilities to choose, either exporter (importer) or non-exporter (non-importer), and hence, we have 4 (2×2=4) various combination for firm global engagement in total and they are firms that only export, firms that only import, firms that export and import and firms that neither export nor import. Therefore, there are three dummy variables to denote a firm's trade orientation and a dummy of non-exporter and non-importer is omitted.

lagged industry ERP and their interaction terms negative, implying a rise in wages following a cut in industry ERP.

2.3.5 Endogeneity of Tariff Reduction

Before proceeding to the estimation of equation (3) and (4), one concern that we want to address is a possible endogeneity possible which may be caused by potential reverse causality between tariff reductions and firm income. However, quite a lot of researchers believe that tariff reductions are exogenous when considering the connection between tariff liberalization and firm performances. Topalova and Khandelwal (2011) argue that the narrow dispersion and the drastic reduction in tariffs after the 1991 trade reforms in India are exogenous as the reform was imposed externally, it can be assumed that lower trade protections cannot affect firm productivity or industry productivity. Hence, they treat the tariffs across industries between 1991 and 1997 as exogenous to the Indian firm-level productivity. Brandt *et al.* (2012) argue that in China the uniform import tariffs after trade reforms cannot be explained by policy endogeneity. It seems that changes in trade policy result in all tariffs shifting to a relative low or nearly the same level, which supports the argument that tariff endogeneity is not a big issue in China. As a result, they believe that tariff reductions are exogenous when exploiting the causality between trade reforms and productivity changes. Similarly, Kamal *et al.* (2012) take tariff reform as exogenous in their study of estimating the alteration of China's labor share in response to output and input reductions. Hence, we do not take the potential endogeneity of tariff reductions as a big concern in our study since the tariff reduction conducted in 2002 was negotiated with the WTO and such reduction under the external pressure is quite expected.

Note that although the reductions of tariff rates are under regulation, firms within low-income industries would still lobby or seek trade protection from the government (Grossman and Helpman, 1994), which could lead to the maintenance of tariffs at relatively high levels and protect the lower-profit firms from tougher import-competition.

This in turn causes a negative bias on the tariff coefficients. Thus, we address this potential endogeneity concern of tariffs in several ways. First, we examine to what extent tariff rates moved together following Topalova and Khandelwal (2011). The analysis of changing tariff rates of 4902 HS 6-digit products for 2000 to 2006 is reported in Figure 2.12. According to the difference between current tariff rate and the one-year lagged tariff rate, we group products into three categories: Lower Tariffs, if one-year change in tariffs are negative; Same Tariffs, if one-year change in tariffs is zero; and Higher Tariffs, if one-year change in tariffs in positive. Each bar in Figure 2.12 describes the percentage of each group in total HS products for each year and it reveals that movements in 6-digit product tariffs were remarkably uniform, with more than half of the products remaining the same tariff levels around the sample except in 2001 and 2002.[31] In 2001 and 2002, as before and immediately after China joining WTO, the majority of products experience a fall in tariffs.[32] It is noted that the majority of product tariff rates share a similar pattern of movement and they move down or remain constant each year. Hence, the power of policy-makers to set or control product-level tariff rates is restricted or limited in 2000-2006, and the potential endogeneity problem of tariff reductions becomes less pronounced.

[Figure 2.12 about here]

Alternatively, we plot the change in tariffs against the initial tariff levels. Following Brandt *et al.* (2012), we plot the change in 3-digit industry output tariffs in different

[31] Tariffs in 1999-2001 are based on HS1996 coding system whilst in 2002-2006 are based on HS2002 coding system. Before our analysis, we drop all products with missing tariff rates. We then map such products before 2002 with HS1996 codes into HS2002 codes and combine all the products with HS2002 codes by keeping only those appeared in the full sample, and finally we obtain a dataset full of yearly 6-digit product tariff rates for 2000-2006 with 4902 products in each year. As a robustness check, we also make an analysis of the tariff changes for 2000 to 2001 and for 2002 to 2006 as either of them based on the same coding system and report them in Figures 2A.1 and 2A.2 respectively. Here we do not require that the number of products appeared in each year of either sub-sample is the same and the HS product number in each year is different (for 1999-2001 using HS1996: 1999: 5090, 2000: 5090, 2001: 5089; for 2001-2006 using HS2002: 2001: 5201, 2002: 5201, 2003: 5224, 2004: 5224, 2005: 5225, 2006: 5205, and there is one additional year included for each sub-sample for first difference measurement). And hence if a product does not appear in last period making the change value of tariff is missing, we treat is as in the "same tariffs" group. Similarly, Figures 2A.1 and 2A.2 show the same pattern that the majority of product tariffs move together.

[32] The exact date of China to join WTO is 11th December 2001. As it is at the end of 2001, we treat 2001 as the year of pre-WTO and treat 2002 as the year of immediately post-WTO.

sample period, as a function of initial output tariff level in Figures 2.13-2.15.[33] [34] First, Figure 2.13 shows tariff changes in 2000-2006, which spans our full sample period, and demonstrates that almost all industries experienced a considerable reduction with a change in value between 0 to -30% and the industry with the highest initial output tariff tended to experience the largest reduction.[35] The alcohol industry experienced the largest cut in its output tariff, followed by the tobacco industry. Further, Figure 2.13 suggests a linear relationship between initial tariff rates and reductions in industry tariffs and from Figure 2.13 we observe that around the full sample period output tariffs decrease almost half of their initial protection levels, with a slope of -0.49 obtaining from simple regressing tariff changes on initial tariff rates. The dispersion of sector trade protection is not broad in 2000, with most of the sector protections ranging between zero percentage point and twenty percentage points, and only four sectors have protection of more than forty percentage points. Moreover, only three observations above the fitted line (slope=-0.49) on the right-hand side of Figure 2.13 are relative high protection sectors at the initial level that experience below average tariff reductions and only three observations below that fitted line on the right-hand side of the figure are relative high protection sectors at the initial level that experience above average tariff reductions. This figure implies that the trade reform decreased product-line tariff rates and their dispersion, also abandon tariff concessions and uniform the system. From the results in Figure 2.13, we conclude that over the sample period, tariff reductions are lack of heterogeneity, which is consistent with the findings in Brandt *et al.* (2012), as they argue that between 1992 and 2007 policy discretion is rarely concerned in tariff liberalization across sectors.

[Figure 2.13 about here]

In addition, we create sub-samples of "pre-WTO period" (2000-2001) and

[33] There are 117 industries in total at the 3-digit industry level.

[34] For robustness, we plot the relationship between output tariff changes and initial output tariff level at the adjusted 4-digit industry level in Figures 2A.4-2A.7 as well, and the results are robust to the conclusions made at the 3-digit industry level.

[35] The only one industry to experience an increase in its output tariffs was the fertilizer manufacturing industry (CIC: 262).

"post-WTO period" (2001-2006) to examine the relationship between tariff reductions and their initial levels, and report the results in Figure 2.14 and Figure 2.15 respectively.[36] Similarly, all the observations are plotted near the fitted regression line and there is less dispersion in tariff reduction across sectors, consistent with the suggestions in Brandt *et al.* (2012) that the decline in tariffs was almost entirely proportional and subject to little policy discretion.

[Figure 2.14 about here]

[Figure 2.15 about here]

We further look at the tariff reductions in the highest protected industries and the lowest protected industries to consider that industries with different degrees of protection may have different lobbying power and reflect various abilities to affect policymakers. And hence we follow Ahsan and Mitra (2014) to classify 3-digit industries into two categories, the highest or the most protected industry and the lowest or the least protected industry, according to the average industry output tariff rates for each industry around 2000-2006, and we list the 10 highest (most) protected industries and the 10 lowest (least) protected industries in Table 1.5.[37] Table 1.5 shows that the difference in tariffs between the lowest (least) protected industry (Manufacture of Ferroalloy Smelting, IO: 57) and the highest (most) protected industry (Manufacture of Sugar, IO: 16) is 30.74 percentage points. Then we graph the output tariff trends for that two groups of industries during the sample period in Figure 2.16 and Figure 2.17 respectively, and both figures demonstrate that the declines in output tariffs was very similar across industries

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[36] We also use 2002 as the initial year of post-WTO period in Figure 2A.3 as China joined WTO at the end of 2001. We treat 2002 to be the first year of post-WTO period as a robust check and the results seem to be more heterogeneity than that using 2001 as initial year. This leaves some scope for policy endogeneity to allow policymakers tailor the cuts for specific sectors but only in a sense that tariff cuts are being negotiated and fixed. It is not the dependency of policy on unobservable that we should worry about.

[37] Note that the 3-digit industry level is equivalent to the IO sector level, and hence we use the IO sector number to denote the industry code in Table 5. Moreover, we report the average output tariffs for each 3-digit industry around 2000-2006 in Table 1A.11 and show the rankings as well. We rank the 3-digit output tariffs from the highest to the lowest. Note that there are 122 IO sectors in 2002 China Input/ Output Table but only 69 of them belong to manufacturing industries.

with different degrees of trade protection. For instance, Manufacture of Alcohol and Alcoholic Beverages (IO: 20), one of the most protected industries, with output tariff of 53 percent in 2000 experiences a 32 percent drop in output tariff by 2006 whilst Manufacture of Electronic Component (IO: 77), one of the least protected industries, with initial output tariff of 12 percent experiences a 4 percent fall in output tariff by 2006. The results support the notion that tariffs decline by a same proportion of their initial levels, indicating that the dispersion in tariff reductions is driven by the initial tariff dispersions. As a result, an initially highly protected industry receives a largest cut and an initially lowly protected industry receives a smallest cut, consistent with the argument that tariff reform in China can be well described as tariff compression as in Brandt *et al.* (2012), with initially highly protected industries receiving the largest cuts.

[Table 1.5 about here]

[Figure 2.16 about here]

[Figure 2.17 about here]

In short, tariff reductions are already fixed as China signed the accession agreement in 2001 and under pressure from WTO, the tariff reductions could be predicted. Only some specific-sectors can make government to tailor their tariff reductions to maintain their performance and so on income, but in an expectation as achieving negotiated tariff cuts, and hence policymakers become less selective to determine trade protection, implying that in the sample we can treat tariffs as exogenous variables.

However, while we are confident that our trade protection measures are exogenous, we nonetheless seek to be doubly sure that trade protections are in fact exogenous to economic and political protection. Consequently, we seek to control for such potential endogeneity problem and address this by adapting the similar strategy used by Topalova and Khandelwal (2011); Brandt *et al.* (2012); Ahsan and Mitra (2014) in two ways: we first examine whether measures of trade protection (output tariffs, input tariffs and ERP) are correlated with industrial characteristics; then we investigate whether past wages predict current measures of trade protection.[38]

In Table 1.6 we report regression results of trade protection on characteristics at the industry level in variety measures of protection. We regress the 6-period change in output tariffs, input tariffs and ERP between 2000 and 2006 on various industrial characteristics in 2000 with control of industry fixed effect and the regressions are weighted by taking the square root of the quantity of firms within an industry.[39] We include several characteristics that may affect policymakers' decision, for instance, industry average wage and skill intensity (policy makers may protect industries which hire low skilled or vulnerable workers), industry employment (taken by its logarithm value, which captures the notion that a larger labor force may lead to more protection), industry output and value-added (used by their logarithm values to capture the ability to put pressure on policymakers for more lobbing powers), and the industry revenue and profits (measured in logarithm values which address the possibility that low-income industries may lobby the government for more protections).[40] There are four panels in Table 1.6, panels A and B report the regressions of change in 4-digit and 3-digit output tariffs on industry characteristics respectively, panel C reports the regressions of change in 3-digit input tariffs and panel D reports the regressions of change in ERP, and each cell presents one result of regressing a measure in trade protection on industry-specific characteristics. All of the estimated results show that industry-specific characteristics before trade reform are unable to affect changes in trade protection with the exception of regression of 6-period change in input tariffs against 2000 industry mean wage.

[Table 1.6 about here]

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[38] In Ahsan and Mitra (2014), they only check whether in India the past share of total wage over total revenue can determine current tariff rates.

[39] For robust checks, we use 2001 or 2002 as the initial year as well and examine whether 5-period change or 4-period change in trade protections are correlated with initial industry characteristics. The results are reported in Tables A12 and A13 and they are robust. There is no correlation between industry characteristics before trade reform and changes in trade protection with exceptions of regressing 6-period change in output (input) tariffs against 2001 (2002) industry mean wages.

[40] Note that skill intensity is measured by using China Annual Survey Data and is only available in 2004.

Our results are consistent with the findings in Brandt *et al.* (2012), as they find that by 2007, no characteristics at the Chinese industry level can predict tariff rates significantly. However, they also find that skill intensity is negatively and significantly correlated with tariff levels, which is in contrast to ours, since we find that initial industry skill intensity is uncorrelated with change in trade protections. Our results support the view that neither political nor economic factors can necessarily explain the changes of trade protection in China. A possible explanation of this is that import tariff rates were determined when China signed the agreement with WTO and the conclusion of the negotiations represents a commitment undertaken by China to remove trade protection (barriers) gradually and expand market access for foreign companies. Hence, it is suggested that tariff reduction across industries between 2000 and 2006 can be treated as exogenous.

Brandt *et al.* (2012) argue that in the post-WTO period higher-productive sectors had lower trade protection one or two year earlier and hence tariffs endogeneity may not be fully ruled out in the post-WTO period but the only possibility is on a basis of expectation in sector performance. However, we still doubt that tariff protections are endogenous to firm wages and we finally examine whether tariff rates can be tailored or set by government to adjust industry average wages. Hence, we aggregate firm wages into industry level, take their average values, and then regress our measures of current trade protections (output and input tariff rates, and ERP) against one lag of industrial average wages, where industry and year fixed effects are controlled. The regressions are weighted by the yearly quantity of firms within an industry and industry standard errors are clustered. We perform this analysis separately for the full sample period, the pre-WTO period and the post-WTO period, and present the results in Table 1.7. There is no significant correlation between past wages and current tariffs or ERPs for all concerns of different periods and all measures of tariffs used in our study except in regression of 3-digit output tariffs for the full sample and regression of 3-digit input tariffs for the pre-WTO period. For column (1) in panel B of 3-digit output tariffs, the coefficient on lagged industry mean wage is negative and significant at the 10% level, suggesting that if industry mean wage decreases the industry will get more lobbies on final products since lower income predicts higher output tariffs and hence higher trade protection. For column (2) in panel C of 3-digit input tariffs, the coefficient on lagged industry mean wage is positive and significant at the 10% level, suggesting an opposite mechanism compared to output tariffs, which is if industry mean wage decreases firms in that industry will become much easier to access to imported intermediate inputs since lower income predicts lower input tariffs and hence lower trade barriers. All of these suggest that policymakers may have adjusted tariff policies to industrial relative performances. However, in the post-WTO period, tariff protections are not driven by the industry average wage.

[Table 1.7 about here]

All tests above show that tariff policy endogeneity is not a big concern in our study as tariff reduction process has been set and committed with China's entry into WTO and policymakers liberalize all industry barriers although adjusted to some industries' relative performance under the fixed negotiated process. As a result, we restrict the sample to the period 2002-2006 and in each specification, we use lag tariff measures to consider that tariff reductions making an effect on firm wages is not instantaneous.[41]

Nonetheless, as robustness checks we further adopt an instrumental variables (IV) approach in some specifications for concern about the potential endogeneity problem of tariffs. Finding appropriate instrument for tariff changes is not a simple process. The majority of researchers choose instruments for tariff reductions that are not related to firm wages. Amiti and Davis (2011), who adopted the approach of Trefler (2004), use the initial proportion of production labor divided by total employment and the initial input tariff rates as instruments for changes in output and input tariff rates respectively, and try to block tariff liberalization in Indonesia. In the case of India, Ahsan and Mitra (2014) use five year lags of output tariff rates as the instrument for one year difference in tariff rates. For the empirical studies of China, in Hu and Liu (2014) Chinese output and input

[41] For the purpose of robustness checks, we use full sample for regression analysis as well and report the results in Tables A14-A23.

tariffs are instrumented by the Philippine tariffs.[42] Cheng (2015) uses changes in Albania and Lithuania's tariffs as instruments for China's tariff concessions, whilst Yu (2015) uses the one lagged firm output tariffs, one lagged firm input tariffs and interactions of lagged tariffs and fitted processing intensity as instruments.

Following Trefler (2004), Amiti and Davis (2011) and Yu (2015), we use lagged of one-period difference in our output (input) tariff term as the instrument for output (input) tariff term.[43] The economic rationale is that one year lag of one-period change in output (input) tariff term will affect the level of output (input) tariff term but it is not related to residuals. For example, if an industry *j* experiences a small reduction in the previous period, it means that it is difficult for government to remove its relative high protection in foreign trade as the industry has relative strong lobbing power. Thus, in the future period, this industry would still be expected to maintain a relative high level of output (input) tariff term. Moreover, the interaction between lagged of one-period difference in output (input) tariffs and exporter (importer) dummy is adopted as an additional instrument for output (input) tariffs.

We then turn to briefly introduce the data sources that we rely on for our empirical analysis in the next section.

2.4. Data

To explore how trade liberalization affects workers' wages, we draw on three main sources of micro-data: detailed industrial firm data, which provides production information at the firm level, comprehensive trade transaction data and tariff rate data, and the last two are at the product level. China's tariff rate data is from the World Integrated Trade Solution (WITS) database, also used by Kamal *et al.* (2012) and Hu

[42] For example, 2001 Chinese tariff rates are instrumented by 1995 Philippine tariff rates.

[43] Note that our output (input) tariff term is output (input) tariffs lagged by one-year period and hence, the instrument for output (input) tariff term is two-year lag of one period difference in current output (input) tariffs. We also include two-year lag of one-difference in current output (input) tariffs interacted with exporter (importer) as our additional instrument for output (input) tariff term.

(2014).[44] The detailed industrial firm production data are collected from the Chinese Annual Survey of Industrial Firms (CASIF), which is conducted by the National Bureau of Statistics of China (NBSC).[45] The comprehensive trade transaction data are obtained from the Chinese Customs Trade Statistics (CCTS) dataset which is recorded and collected by the General Administration of Customs of China (GACC). Data from all three sources cover the period from 2000-2006.

2.4.1 Tariff Data (WITS)

The tariff data are available at the 6-digit product level for our sample period and the product is coded by the Harmonised System (HS).[46] Our measure of tariffs is based on effectively applied tariffs, which means taking the tariff rate and weighting it by imports.

2.4.2 Firm-level Production Data (NBSC)

The industrial firm production data cover all state-owned enterprises (SOEs) and non-SOEs whose annual turnover is over 5 million RMB (commonly referred to as the "above-designated size" firms).[47] The dataset has broad sector coverage and includes the mining, manufacturing, production and supply of electric power, gas and water industries. The dataset provides rich information for each firm and includes not only the basic information but also financial variables from three statement of financial accounting standards, such as firm name, firm ID, total capital, annual sales, employment, and so on. Since the dataset does not include all Chinese manufacturing firms for each year, it is not reasonable to take a firm's exit from the dataset as its exit from the market due to no production. Hence, we rarely discuss the issue of firm entry and exit.

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[44] The WITS software provides access to international merchandise trade, tariffs and non-tariff measures (NTM) data.

[45] Each observation in the CASIF dataset is a plant and definitely we are not able to identify or trace a firm with multi-plants. To make it simple, we still call them "firm".

[46] The WITS covers China's tariff data for our sample period except for 2002. Following Yu (2015) we obtain the 2002 tariff data from the Trade Analysis and Information System (TRAINS).

[47] At 2014 an exchange rate of RMB=0.154 US dollar and the value of 5 million RMB is 770,000 US dollars.

2.4.3 Product-level Transaction Data (GACC)

The disaggregated trade transaction data is collected at the HS 8-digit product level and covers monthly trade records for all firms, starting from 1st January 2000 and ending on 31th December 2006. It records rich information for each trade transaction, including basic information such as firm name, firm ID code given by the Customs and also includes highly disaggregated information, such as 8-digit HS code, value, destination and mode of international trade. Most importantly, it records exports and imports so we can trace the effect of engagement in international trade separately for each type of trade. All values for each trade transaction are expressed in US dollars.

2.4.4 Matching the Production Data with the Transaction Data

To examine the relationship between firms' performance and engagement in international trade requires us to link indicators of firm performance from the NBSC with detailed trade data, this means therefore we need to combine the GACC and NBSC datasets.

However, in practice merging those two datasets is not a simple process. Although each firm in either the production or trade dataset has a registered ID, different coding systems are used for each dataset. Indeed, the firm ID in the production dataset is coded by the local administrative authorities and is a 9-digit code. In contrast, the firm ID in the trade dataset is coded by the Customs and is a 10-digit code. As a result, one cannot simply merge the two datasets using firm IDs.

As an alternative, we use firm name, contact person name, telephone number and postcode-common variables from both datasets to identify each and every unique firm. The process of data preparation for both data sources, matching and cleaning, is fully presented in Appendix 1A.[48] We therefore have an unbalanced panel with 953,609

[48] We combine the best of the matching methods from both Upward *et al.* (2013) and Yu (2015).

observations and 332,958 unique firms in 2000-2006 for estimation purpose.

2.5. Results

Our estimations are based on our uniquely merged dataset, an unbalanced panel from 2002-2006 (post-WTO period), the industrial output and input tariff rates and the industrial ERP are used.[49] For tariff variables, only the first are at the four-digit industry level and the last two are at the three-digit industry level. We control for two-digit industry fixed effects, year fixed effects and time-varying location-year fixed effects in all the regressions and we cluster errors by firm.[50]

2.5.1 Assumptions Identification

Using the post-WTO and full sample data we first estimate the following three assumptions as listed below before our main regressions and the results are reported in Tables 1.8 (Tables 1A.14 for full sample) and 1.9 (Table 1A.15 for full sample). The regressions in Tables 1.8 and 1.9 all include two-digit industry effects and year effects.

Ⅰ. Assumption 1: if trade barriers between countries become weaker, it may induce a stronger competition in markets and thus definitely affect firm profits. Hence, if we can prove that there is a positive relationship between firm profits and firm wages, then we can assume that firm wages will change by the changes of firm profits after tariff liberalization.

In column (1) and (2) of Table 1.8, we estimate the relationship between firm wages

[49] Amiti and Davis model (2011) did not address the issue of processing trade which is not a major concern for Indonesia. In China, however, processing trade plays an important role and processing firms enjoy a special tariff treatment. For our sample, nearly 7.5% of total observations are engaged in processing trade and processing trade contributes to almost 70% of total exports and 60% of total imports in China. So including firms involved in processing trade could bias our estimation, hence, we drop trade processing firms from our sample.

[50] Since we use industry-level tariffs and ERP for estimation, we should also cluster errors by industry or by industry-year group. However, when using fixed-effects linear model in STATA13, our panel spans more than one cluster if we do so. Hence, we only cluster errors by firm.

and firm profits and find there is a positive link between wages and profits, both in firm total profits and in firm operating profits. With a coefficient equal to 0.068 on the log of firm total profits, it shows that firm wages are positively and significantly connected to firm profits. With a significant coefficient equal to 0.069 on the log of firm operating profits, this positive relationship still holds. Hence, Assumption 1 is proved by using our data in post-WTO period.[51]

[Table 1.8 about here]

Ⅱ. Assumption 2: Following a huge reduction in both output and input tariff rates, foreign products (final goods or intermediates) become easier to enter the domestic market and domestic products with high quality also become easier to enter the foreign market. If local firms are only keen to the domestic, due to the tougher import completion, they may experience a profit loss and thus lower wages. But if local firms can export, then as they can access to more markets they may earn more profits and thus pay higher wages. In another direction, if local firms are available to import a vast variety of intermediates with high productivity, as a result of this, they produce high-quality final outputs and sell them at a higher price, which may raise their profits and thus wages. Since we have proved assumption one, we then hypothesis that firm wage may be dependent on firm's different engagement in globalization.

Despite within industry firm wages varying within a relative narrow range, firm wages vary greatly due to different market orientation. Comparing global oriented firms to domestic oriented firms in the last three columns of Table 1.8, from column (3) we observe that on average pure exporters pay 10.4% higher wages, exporting and importing firms pay the second highest wages (45.7%) and pure importers pay the highest wages (56.2%). In column (4) we use the log of firm capital as a control of firm size and find the conclusions obtained from column (3) still hold. With additional controls of industry

[51] Assumption 1 is proved by using our full sample data as well, since the coefficients on the log of firm total profits and the log of firm operating profits are 0.071 and 0.073 respectively in columns (1) and (2) of Table 1A.14 and both of them are highly significant.

skill intensity in column (5), firms that import only pay the highest wages, which is consistent with the results as before. However, our findings on firm wages differ from Amiti and Davis (2011) who found that the highest wages are paid by exporting and importing firms, wage heterogeneity arises by firm's different engagement in globalization and hence, we prove Assumption 2 as well.[52]

III. Assumption 3: There is a fixed cost for entry into each foreign market. If a local firm wants to enter foreign markets as much as possible in order to acquire higher profits and thus higher wages, it need to be larger, more powerful and high-efficient. Hence, we assume that there is a connection between firm ability and its global engagement.

In Table 1.9, from columns (1) and (2) we conclude that firms oriented to domestic market have the smallest employment and from columns (3) and (4) we see that domestic oriented firms are the least productive firms. Exporting and importing firms are the largest firms whilst pure importers are the most productive firms. In general, exporting and importing firms hire on average 79% more workers than domestic firms even with controls of industry skill intensity and the log of firm capital, and pure importers are on average around 45% more productive than domestic oriented firms. In addition, firms that both export and import have on average nearly 30% higher employment than pure importers, which are consistent with other studies in the heterogeneous firm such as Bernard *et al.* (2007), Amiti and Davis (2011), but on average exporting and importing firms are about 4% less productive than pure importers, which is in contrast to the finding in Amiti and Davis (2011) as they document that the most productive firms are those both exporting and importing firms. As a result, Assumption 3 is also made by our post-WTO dataset.[53]

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52 We also prove Assumption 2 by using our data in 2000-2006 and report the results in columns (3)-(5) of Table 1A.14, as the coefficients on trade dummy variables are all significantly positive, indicating there are wage differentials between firms that only serve domestic market and firms engaged in global markets. Besides, the ranking of firm wages is the same and can be concluded as: domestic< pure exporter< exporter and importer< pure importer.

53 Our full sample data perfectly fits Assumption 3 as well as shown in Table 1A.15 but with slight differences as following: in column (1), pure exporters hire slightly more than pure importers

[Table 1.9 about here]

After confirming that our data are perfectly fitting the assumptions stated in Amiti and Davis (2011) model, we start our main estimations in the following sections.

2.5.2 Trade Protections and Firm Wages: Baseline Results

2.5.2.1 Tariff Rates

In columns (1)-(5) of Table 1.10, we present the results from an OLS estimation of equation (3) with the one-year lagged of output and input tariffs. In columns (1) and (2) we investigate the impact of decreasing output tariff rates on firm wages. To address the importance of differential effects on exporting firms and non-exporting firms, we only regress the log mean wage on the one-year lagged output tariffs in column (1) and find industrial output tariffs have a negative and significant impact on firm wages, indicating that average wages increase with reductions in output tariffs. In column (2) an interaction of output tariffs and an exporter dummy is included. It shows that the output tariff coefficient is now a little higher and the interaction coefficient is significantly positive, suggesting that exporting firms pay lower wages than non-exporting firms after falls in output tariff rates. The negative sign on output tariffs and the positive sign on the interaction, which contrasts to predictions (i) and (ii) of equation (3) for our output tariff variables, could be explained by import-competition effects. For example, increased import-competition induced by a fall in output tariffs may force domestic producers to raise their productivity level to survive in the current market and hence those domestic producers attempt to become more productive producers. As a result, the wage of non-exporting firms goes up and the relative wage gap of exporting firms may be closed by non-exporting firms as they obtain a higher productivity level and the marginal exporting firms with lower productivity may become less profitable and thus pay less. In addition, the negative coefficient on output tariffs showed in both columns contrasts to

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and in column (4), firms that both export and import have the highest value-added, which is slightly higher than that in pure importers.

prediction (i) could also be explained by another possible explanation that non-exporting firms appeared in the sample might import intermediate inputs and benefit from accessing to a variety of cheap and high-quality imported inputs.

[Table 1.10 about here]

The net effect for exporting firms by falling output tariff rates is the sum of -0.143 and 0.096, which is equal to -0.047. However, we conduct the joint significance tests to test whether in general cutting output tariffs makes no effect on average exporters and hence, the null hypothesis of such test is that the sum of the output tariff coefficient and the interaction coefficient is equal to zero. As the sum of coefficients reported in column (2) for the joint significance test is insignificant, we can conclude that the net effect of cutting output tariff on exporters is zero, indicating wages for exporting firms unchanged following falls in output tariff rates.

In columns (3) and (4), we investigate the effects of a fall in input tariffs. Alternatively, to differentiate such effects on importing firms and no-importing firms, we only regress the log mean wage on the one lag of input tariffs in column (3) and find a negative sign on input tariffs at the 1% significance level, which is opposite to prediction (iii), indicating a higher wage in non-importing firms with a cut in input tariffs. In column (4) an interaction of input tariffs and an importer dummy is included. We still find a significantly negative sign on input tariffs, but an insignificantly positive sign on the interaction term. The significantly negative coefficient on input tariffs is opposite to prediction (iii) of equation (3) as well and indicates an increase in wages of non-importing firms after falls in input tariff rates. The potential explanation for this opposite sign on the input tariff coefficient is that similarly, domestic intermediate producers face stronger import-competition, which is induced by falling input tariffs, and such competition pressure forces them to decrease local prices, or to be more productive to meet a higher requirement and thus raise their profits and so on wages. This could also explain a part of the gains for non-exporting firms after a cut in output tariffs as they may use the much cheaper but good-quality domestic inputs as well.

In addition, the coefficients on exporter and importer dummies are insignificant in columns (1)-(4), showing that there is no significant beneficial gains obtained by firms from international trade through either exporting or importing.

Column (5) combines the specifications of columns (2) and (4) and includes lagged output tariff rates, lagged input tariff rates, and their interaction terms. For output tariff variables, the coefficient sign on output tariffs and the coefficient on output tariffs interacted with an exporter dummy remain the same significance levels but are with smaller magnitudes. In terms of our input tariff variables, the input tariff coefficient remains a significantly negative sign but is with a little smaller magnitude, and the interaction coefficient is still positive and significant. The coefficients on tariff variables in column (5) are broadly close to those in the previous specifications where output and input tariff variables are included individually, implying that we can clarify the differential impacts of tariff liberalization on firm wages by different types of tariffs.

Based on the results of the first four columns in Table 1.10, we argue that the impact of decreasing tariffs on firm wages in China are quite different from that in Indonesia as documented in Amiti and Davis (2011). Our empirical results using Chinese manufacturing firm data do not support the predictions derived from the model of Amiti and Davis (2011), which states that falling output (input) tariffs makes exporting (importing) firms pay higher wages but makes non-exporting (non-importing) firms pay lower wages. Our findings are totally in contrast with such predictions since we find that decreasing output (input) tariffs increases wages at domestic-serving (domestic-sourcing) firms, but decreasing output tariffs makes exporting firms pay lower wages than firms that face even stronger import-competition locally.

Since the theoretical model in Amiti and Davis (2011) also highlights a differential impact of decreasing tariffs on marginal firms, we further consider this issue. Those marginal firms, who switch their status form sourcing and serving local market to foreign market, may face stronger competition and thus have a decrease in firm profits and son on firm wages, if their export (import) share is not sufficiently large. To find out the critical value of such "sufficiently large" share, in column (6) we use the firm's exact trade shares instead of trade dummies to re-estimate equation (3) and report the results for share variables still in the cells for dummy variables. The result in column (6) shows that the output tariff coefficient is -0.116 and the input tariff coefficient is -0.360. Since we use output and input tariff rates as natural values in estimation and if we take the output tariff coefficient of -0.116 as an example, it implies that a 10% decrease in output tariff rates leads to a 0.0116 (0.116×0.1=0.0116) increase in the log mean wage in non-exporting firms and equivalently to increasing firm mean wage by 1.16%. Similarly, for the input tariff coefficient of -0.360, it implies that a 10% decrease in input tariff rates leads to a 0.0360 (0.360×0.1=0.0360) increase in the log mean wage in non-importing firms and equivalently to increasing firm mean wage by 3.6%. But the coefficient on interaction terms ($OT_{jt-1} \times \mathrm{ExportShare}_{kjt}$, $IT_{jt-1} \times \mathrm{ImportShare}_{kjt}$) are insignificant and thus we cannot calculate the critical values of export share and import share for marginal exporters and marginal importers respectively.[54]

To isolate the synergistic effects for trading firms, which are also predicted y Amiti and Davis (2011), we split global engaged firms into three categories: pure exporters ($\mathrm{FXX}_{kjt} = 1$), pure importer s ($\mathrm{FMM}_{kjt} = 1$), and both exporter-importers ($\mathrm{FXM}_{kjt} = 1$). Then we replace an exporter dummy with a pure exporter dummy and an exporter-importer dummy to multiply with output tariffs and replace an importer dummy with a pure importer dummy and an exporter-importer dummy to multiply with input tariffs. In column (7) we find that a drop in output (input) tariff rates increase wages for non-exporters (non-importers), and a drop in output tariff rates decrease wages for both exporting and importing firms relative to non-trading firms only. Comparing the result in column (7) with that in column (5), we notice that the magnitude for firms that both export and import are larger than that for exporters in column (5), which are not identified by their import status. Therefore, although the coefficient sign is inconsistent

54 Taking the marginal exporter as an example, if the output tariff coefficient (α_1) and its interaction coefficient (α_2) are both significant, the critical export share, for marginal exporters to avoid experiencing a wage loss following output tariff cuts, should be calculated as $(-\alpha_1/\alpha_2)$. The calculation approach is that $\alpha_1 + \alpha_2 \times \text{export share} \leq 0 \Rightarrow \text{hence, export share} \leq -\alpha_1/\alpha_2$.

with prediction in the Amiti and Davis (2011) model, the synergistic effects still works for firms that both export and import. For importers, the coefficient on interaction terms ($\mathrm{IT}_{\mathrm{jt-1}} \times \mathrm{FMM}_{kjt}$, $\mathrm{IT}_{\mathrm{jt-1}} \times \mathrm{FXM}_{kjt}$) are insignificant as well. As the joint significance test in column (7) for firms that both export and import seems to be insignificant by experiencing a cut in output tariff rates, the net effect for both exporting and importing firms is indifferent from zero and there is no impact on them after output tariff drops. Moreover, we estimate such effects by replacing trade dummies with trade shares in column (8) and produce the similar conclusions. The coefficient on export share of exporter-importers is reported in the former cell for FXM_{kjt} indicator whilst the coefficient on import share of exporter-importers is reported in the latter cell for FXM_{kjt} indicator in the last column of Table 1.10. But the joint significance test in the last column, for those exporter-importers experiencing a fall in output tariff rates, becomes significant now, suggesting that for them, the net effect of decreasing output tariffs is not zero.

All the results above point out that a firm's choice of different engagement in globalization is important, which may affect its profit and thus its wage. If we ignore this in our study, we only test the mean impact of decreasing tariff rates on wages for all firm types, without identifying a specific impact on each type of firms. In past reseatch, without mentioning tariff changes in intermediate inputs sector would overestimate the impact of such changes in final goods sector on firm performance. For robustness, we use the full sample (2000-2006) data to estimate all regressions in Table 1.10 as well and report the results in Table 1A.16. We see from Table 1A.16 that the conclusions are close to those in Table 1.10.[55]

2.5.2.2 Effective Rate of Protection

As discussed before, we want to link the combination effects of falls in output and input tariff rates on firm wages and present the results from an OLS estimation of equation (4)

[55] The interaction coefficient of output tariffs and export shares is significantly positive in the last column (6) of Table 1A.16. In addition, the net effect of decreasing output tariffs on exporters in that column is not zero according to the joint significance test.

with the one-year lagged of 3-digit industrial effective rate of protection in Table 1.11.

[Table 1.11 about here]

In columns (1) we only regress the log of firm average wage on the one lag of ERP to investigate the effects of a fall in ERP on firm wages and find industrial ERP is negatively and statistically significantly correlated with firm wages, indicating that average wages increase with reductions in ERP. The significantly negative coefficient on industry ERP is inconsistent with our hypothesis that we assume $\beta_1 > 0$, which is based on predictions from the Amiti and Davis (2011) model. To address the importance of differential effects on firms engaged in globalization, in column (2) we include the interaction term between industry ERP and three dummy variables to denote the different status of pure exporters (FXX_{kjt}), pure importers (FMM_{kjt}) and exporter-importers (FXM_{kjt}). It shows that the industry ERP coefficient is now a little higher and the interaction coefficient of industry ERP and an exporter-importer dummy is positive and significant, suggesting a decrease in wages of firms that both export and import relative to domestic firms when industry ERP becomes weaker. To find out the critical value of trade shares for trading firms to maintain a growth of wages with a lower ERP, we re-estimate equation (4) with trade shares in column (3) to replace of trade dummies (FXX_{kjt} and FMM_{kjt}) as included in column (2) and report the results for share variables still in the cells for dummy variables. However, the coefficient on industry ERP interacted with export share of exporter-importers and the coefficient on industry ERP interacted with import share of exporter-importers are reported in cells $\mathrm{ERP}_{jt-1} \times \mathrm{FXM\_ExportShare}_{kjt}$ and $\mathrm{ERP}_{jt-1} \times \mathrm{FXM\_ImportShare}_{kjt}$ respectively. Since the interaction coefficient of industry ERP and export share of exporter-importers is 0.309, both exporting and importing firms that do not export exceed 26% ($-(-0.081/0.309) \approx 0.26$, since the coefficient on industry ERP is significant and equal to -0.081) of their outputs could still benefit on wages from a decrease in industry ERP, or equivalent to a tougher import competition.

Comparing the coefficients on industry ERP in columns (1), (2) and (3) of Table 1.11

with the sum of output tariff coefficient and input tariff coefficient in columns (5), (7) and (8) of Table 1.10 respectively, we notice that the sum of output tariff coefficient and input tariff coefficient is always much larger than the coefficient on industry ERP, which satisfies our concern that the impact of weakening trade barriers in final goods sector can be offset by reducing trade barriers in intermediate inputs sector .

Furthermore, it is known that the sum of the industry ERP coefficient and its interaction coefficient represents the net effect of decreasing industry ERP on globalized firms and we conduct the joint significance tests and report the results in Table 1.11. Since the results imply that the net effects from decreasing industry ERP for both exporting and importing firms are always insignificantly different from zero.[56] We further use the full sample data to estimate all regressions in Table 1.11 and report the results in Table 1A.17. Nonetheless, the conclusions in Table 1.11 are also hold in Table 1A.17 but with slightly smaller magnitudes.

2.5.3 Additional Controls for Firm Characteristics

2.5.3.1 Tariff Rates

In Table 1.12 we report the empirical results of several robustness checks for our OLS estimations. To check whether the effects of tariff reductions on firm wages are sensitive to firm ownership structure, we include three dummy variables (SOE, foreign-owned and HMT) in column (1) of Table 1.12.[57] We can see our results for all tariff variables are robust and we find a significantly positive sign on the coefficient of a foreign-owned dummy, indicating that foreign-invested firms play a positive impact on firm wages in

[56] We only conduct the joint significance test for the situation that each coefficient is significant. In Table 1.11, only the industry ERP coefficient and the interaction coefficient for exporter-importers are both significant in column (2).

[57] In addition, we also include other variables (e.g. owner indicators or owner shares) to control for firm ownership and report those results in columns (1) and (2) of Table 1A.18 in Appendix Tables. In the following columns (3) and (4), we include owner shares as well. The conclusions for tariff variables are robust as well as those in joint significance tests for the net impact of tariff reductions on trading firms. The coefficients on a foreign indicator and foreign share are found to be significantly positive, the same sign as found for a foreign-owned dummy in column (1) of Table 1.12. Besides, the coefficient on HMT share is positive and significant.

China and hence workers in these firms get on average higher wages. Although the coefficient on SOE dummy is negative, it is insignificant and does not support plenty of conclusions based on the previous empirical work (Hsieh and Klenow, 2009; Brandt *et al.* 2012) where SOEs are found to be less efficient and most likely to pay lower wages but they may offer other sets of compensation.[58]

[Table 1.12 about here]

Another concern is that large firms usually have higher productivity, earn higher profits and hence pay higher wages. We want to be certain that the findings are driven by cuts in output and input tariff rates, not by picking up the role of firm size, so we include the firm's log capital as a proxy for controlling firm size in column (2).[59] After controlling for the firm size, the results are still robust and the coefficient on lnK is highly significant and positive, which demonstrates that larger firms pay higher wages. Then we include firm productivity and add in firm TFP in column (3).[60] The coefficient signs on our tariff variables remain unchanged and the labor productivity coefficient is significantly positive, demonstrating that firms with higher productivity pay higher wages to workers.

In column (4), we drop any firms that change their two-digit industry affiliation during our sample period, and we see that the coefficient signs on our tariff variables maintain the same but with higher magnitudes except for the coefficient on output tariff

58 Using the data from China and India, Hsieh and Klenow (2009) state that traditional SOEs are seen to be less productive and less efficient. Also in Brandt *et al.* (2012), they show that in China, on average SOEs are the least productive firms among all types of firms. Nonetheless, Elliott and Zhou (2013) point out that the performance of state-owned enterprises differ markedly between those that export and those that supply the domestic market only. However, when we go back to full sample data for analysis in Table 1A.19, we find a negative coefficient on SOE dummy at 10% significance level in column (2), which supports the negative impact of SOEs found in a lot of previous studies.

59 As an addition for the control of firm size, we include use the log employment instead of the lnK and report the result in column (3) of Table 1A.18. Still, the results for tariff variables are robust and the coefficient on the log of total employment is significantly negative as expected.

60 The log of value-added per worker that has been used as the supplementary for productivity control and the result based on this variable is reported in column (4) of Table 1A.18. The findings for tariff variables are consistent with those in column (3) of Table 1.12 and the significantly positive coefficient on the log of value-added per worker suggests a positive link between firm wages and firm productivity.

interaction term. Compared with those shown in column (3) of Table 1.12, such differential in magnitudes between the sample without industry switchers and the full sample results relates to the effect of tariff reductions to resources reallocation between industries. A similar finding is mentioned by Lu (2011) who finds that a reduction of trade frictions lead to a higher demand for goods with comparative advantage, thus labor moves to labor-intensive sectors in China.

The last two columns of Table 1.12 show the findings based on a balanced sample where we keep only the firms that appeared in the sample for all five years, and the former includes dummy variables to denote an exporter or an importer whilst the latter includes variables of trade shares instead. The coefficients on all tariff terms are robust to the previous analysis by using an unbalanced sample and additionally find the interaction coefficient of input tariff and an importer dummy is significantly positive in column (5). Hence, our results still hold even with controls of firm ownership, firm turnover and other characteristics.

The joint significance tests for net effects of decreasing tariffs on wages of trading firms are also reported in Table 1.12 and the results imply that the net effect for exporters (importers) by falls in output (input) tariffs is always insignificantly different from zero. Moreover, we re-estimate all regressions in Table 1.12 by using the full sample data for robustness and report the results in Table 1A.19. From Table 1A.19, we notice that the findings are broadly similar to those in Table 1.12.[61]

2.5.3.2 Effective Rate of Protection

For industry ERP, we then include several controls of firm characteristics as well and report the results of our robustness estimations for equation (4) in Table 1.13. First of all, we include three dummy variables (SOE, foreign-owned and HMT) in the first column and find the results for industry ERP and its interaction terms with trade dummy

[61] In the last two columns of Table 1A.19, the interaction coefficient of output tariff and an exporter dummy remains the same sign but becomes insignificant now as well as the coefficient on a foreign dummy.

variables are robust. A positive and significant coefficient on foreign-owned dummy is also found, indicating that foreign-invested firms and HMT-controlled firms play a positive impact on firm wages in China and hence workers in these firms get on average higher wages, which is consistent with those in the first column of Table 1.12 by using output and input tariffs.[62] However, the coefficient on SOE dummy is negative and insignificant.

[Table 1.13 about here]

Then we consider the role of firm size and include the log firm capital as a proxy for controlling firm size in column (2).[63] After controlling for the firm size, the results are still robust and the coefficient on lnK is highly significant and positive, which demonstrates that larger firms pay higher wages, and the coefficient on exporter-importer dummy is negative at the 5% significance level, suggesting a negative impact on firm wages with a firm status in both exporting and importing. After that we include firm productivity and add in firm TFP in column (3). In comparison with the results in column (2), the coefficient signs on our industry ERP variables and other variables remain unchanged and maintain the same significance level but the exporter-importer coefficient becomes highly significant now.[64] The labor productivity coefficient is significantly positive, which implies that firms with higher productivity pay higher wages to workers.

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62 In addition, we also include other variables (e.g. owner indicators or owner shares) to control for firm ownership and report the results in columns (5) and (6) of Table 1A.18. In the following columns (7) and (8), we include owner shares as well. The findings for industry ERP are robust as well as those in joint significance tests. The coefficients on a foreign indicator and foreign share are found to be significantly positive, the same sign as found in column (1) of Table 1.13. Additionally, we have a significantly positive sign of the HMT share coefficient

63 As an addition for the control of firm size, we include the log employment instead of the lnK and report the result in column (7) of Table 1A.18. Still, the results for industry ERP are robust as well as the finding in joint significance test. The coefficient on the log employment is significantly negative as expected.

64 The log of value-added per worker that has been used as the supplementary for productivity control and the result based on this variable is reported in column (8) of Table 1A.18. The findings for industry ERP are similar to those in column (3) of Table 1.13 as well as the conclusion for net effect of decreasing industry ERP on both exporting and importing firms. The significantly positive coefficient on the added-value variable suggests a positive link between firm wages and firm productivity.

In column (4), we drop any firms that switch their two-digit industry affiliation during our sample period, and we see that the coefficient signs on our industry ERP variables maintain the same but with a higher magnitude on industry ERP and a lower magnitude on interaction term between industry ERP and a exporter-importer dummy. Such differential magnitudes in industry ERP variables could be explained by the effect of resources reallocation between industries due to the change in trade protection across different sectors.

The results reported in the last two columns are using a balanced sample where we keep only the firms that are always found to appear in our sample, and the former includes exporter and importer dummy variables whilst the latter includes trade share variables instead of trade dummy variables. The coefficients on industry ERP, its interaction terms and all other firm control variables are robust to the previous analysis based on the full sample except for industry ERP interacted with import shares of exporter-importers and a foreign dummy. Besides, we find a significantly negative coefficient on exporter-importer dummy in column (5) and a significantly negative coefficient on export shares for both exporting and importing firms in column (6). So we conclude that our estimations of firm wages by using the industry ERP are robust after including additional controls of firm type, firm size and other heterogeneous characteristics.

The joint significance tests for net effects of industry ERP reductions on wages of exporter-importers are also reported in Table 1.13 and the results imply that such net effect is zero for all listed specifications. Besides, we re-estimate all specifications in Table 1.13 by using data in 2000-2006 instead of that in post-WTO period for robustness purpose and report the results in Table 1A.20. Observed from Table 1A.20, we conclude that the findings are broadly close to those in Table 1.13.[65]

[65] The coefficient on HMT dummy is significantly positive in all the specifications of Table 1A.20, but the export share coefficient for exporter-importers becomes insignificant now.

2.5.4 Robustness Checks

2.5.4.1 Endogeneity of Tariffs (IV)

As mentioned in section 3.5, we conduct an instrumental variables (IV) approach to re-estimate the specifications in Table 1.12 in order to control for the possible reverse causality caused by endogeneity of tariffs. Hence, we use one year lag of one-period difference in our output (input) tariff rates and such lagged difference interacted with exporter (importer) dummy as our instruments for output (input) tariff term, and report the results in Table 1.14.[66]

[Table 1.14 about here]

In comparison to those results reported in Table 1.12, for tariff variables, we still have a significantly negative sign on the output tariff coefficient and a significantly positive sign on the coefficient of output tariffs interacted with exporter dummy, but the input tariff coefficient becomes insignificant now. The magnitudes on the coefficients of output tariff variables in the IV specifications in Table 1.14 are larger than the magnitudes found in the OLS specifications in Table 1.12, suggesting that the possible endogeneity of tariffs may cause an under-estimate of impacts on firm wages by decreasing tariffs, but not change the main findings. Moreover, the coefficient signs on exporter dummy, log of firm capital and firm TFP remain the same.

We also report the results of several tests in the first-stage of IV estimation to verify the quality of instruments used in Table 1.14. For under-identification test, the null hypotheisi is that the model is under-identified. Using the Kleibergen-Paap LM statistics, we check whether the instrument set is relevant and reject the null hypothesis in all the IV estimates at 1% significance level and show that the instrument set is correlated with

[66] Specifically, the instruments in column (6) of Table 14 are one year lag of one-period difference in our output and input tariff terms and their interaction terms with export and import share respectively. Note that our output (input) tariff term is output (input) tariffs lagged by one-year period and hence, the instrument for output (input) tariff term is two-year lag of one period difference in current output (input) tariffs.

the endogenous variables. We use Kleibergen-Paap F-statistic to check the weak-identification tests and reject the null hypothesis that the excluded instruments are weakly correlated with the endogenous variables as the Kleibergen-Paap F-statistics are all greater than the Stock-Yogo critical values listed by STATA 13, and we can conclude that the IV estimates pass the weak-identification tests.[67] Further, we report Hansen J statistic and *p*-values for over-identification test. In all the columns the *p*-values for over-identification tests are above 0.1 which indicates that the instruments are valid.

The joint significance tests show that in all these specifications, the net effect for exporters by decreasing output tariff rates is always zero with the exception of the specification in column (5).

Observed from Table 1.14, we conclude that the findings are broadly close to those in Table 1.12 and hence, the endogeneity problem of tariffs does not seem to be a big issue in our study. Therefore, we go back to use OLS estimation instead of IV estimation for the rest of our empirical study.

2.5.4.2 Firm Heterogeneous Choices

2.5.4.2a Choices of Trade Status

In this section, we concern about a firm's choice to engage in international trade may be endogenous and such firm's switching into and out of international trade may bias our key results. Hence, in the next stage we fix the setting of an exporter dummy and an importer dummy in several ways to check whether our key results still hold. We only use the new setting of trade dummies in interactions between tariffs and trade dummies and we believe that our main conclusions on the interaction coefficients of tariffs and trade dummies may not change. Then we fix the set of trade dummies in several ways and

[67] STATA 13 reports both the Cragg-Donald statistic and the Kleibergen-Paap *rk* *F*-statistic for weak-identification test. As we cluster the robust errors at the firm-level, it is a sensible and clearly superior to the use of the latter *rk* Wald *F*-statistic as mentioned in Baum *et al.* (2007). Although we only report Kleibergen-Paap *F*-statistic in Table 14, we also check the Cragg-Donald statistics and find they are well above the Stock-Yogo critical values. To save pace, we do not report the Cragg-Donald statistics.

include the results in Table 1.15.

[Table 1.15 about here]

In the first column of Table 1.15, a firm that always exports (imports) in our sample is now defined as an exporter (importer). In the next column, a firm that exports (imports) in 2002 is defined as an exporter (importer) and in column (3), a firm that exports (imports) at its first entry is defined as an exporter (importer). The results reported in columns (1)-(3), are broadly similar to our key results before. Now in columns (2) and (3) the interaction coefficient of output tariff and an exporter dummy becomes insignificant although it remains the same magnitude as that in column (3) of Table 1.12. Nonetheless, the interaction coefficient of input tariff and an importer dummy becomes positive and significant at a high significance level, which suggests that importing firm lower their wages by a drop in input tariffs. The joint significance tests in these columns for the net effect of cutting tariffs on trading firms is again all zero.

Further, we continue to use an exporter (importer) as defined in column (3) to interact with our tariff variables, drop any firms that change global status in column (4). Hence, we do not report the coefficients on exporter and importer dummies in column (4) as these two dummy variables are dropped. The results are robust in column (5) but with a positive and insignificant coefficient on a foreign dummy. In the last two columns of Table 1.15 we go back to the sample without dropping any firms that change global status. In column (5) we use trade shares instead of trade status to interact with our tariff variables and fix the trade shares at entry. The results in column (5) broadly hold but with coefficient on output tariffs interacted with export shares positive and insignificant.

Another concern is that a firm's life cycle could also affect firm wages and hence bias out key results. As shown in the last two columns of Table 1.12 when using a balanced panel, the coefficients on tariffs variables in column (5) are slightly higher and the interaction coefficient of input tariff and an importer dummy becomes significantly positive now in a comparison with those in column (3) of Table 1.12. All of these imply that firm exit decision could account for some part of impact on firm wages after tariff reductions, since it is given that there is a higher possibility of less-productive firms to exit. Thus, in the final column we include an exit dummy and go back to use firm current trade status to calculate the interaction terms between tariffs and trade dummy variables. If a firm appears in current time *t* but exits in time *(t+1)*, then an exit dummy equals one.[68] We see that our key conclusions hold for the tariff coefficients, which shows that exit does not make a considerable effect on the findings. Nonetheless, the coefficient of an exit dummy is -0.004 but insignificant.

The joint significance test for column (4) shows that the net effect from decreasing output tariff rates on exporting firms is insignificantly different from zero. Moreover, we re-estimate all specifications in Table 1.15 by using data in 2000-2006 instead of that in post-WTO period for robustness purpose and report the results in Table 1A.21. Observed from Table 1A.21, we conclude that the findings are broadly close to those in Table 1.13.[69]

2.5.4.2b Exiting Firms

In this section, we investigate how exiting firms affect firm wages in details by using industry effective rate of protection in our estimations.

In the first column of Table 1.16, we include an exit dummy variable and find that the coefficient on industry ERP is a little lower and the interaction coefficient of industry ERP and a dummy of firms that both export and import remains the same when

[68] Note that the sample only includes firms selling at least 5 million RMB per year. Some firms that exit from the sample may not have been closed without production and may still be producing before they achieve this sales-threshold or before they are 'discovered' again. And hence, exit here means that firm leaves from such a large sales-threshold. Further, with the concern of exiting firms, we drop data in 2006 since we do not have data in 2007 to identify the business status of those firms appeared in 2006.

[69] In addition, the coefficient on HMT dummy is significantly positive in columns (1)-(3) and (5) of Table 1A.21 and the interaction coefficient of output tariff and export share in columns (5) and (6) are positive and significant. However, the coefficients on interaction terms of input tariffs are insignificant in all columns. Moreover, the net effect of decreasing output tariffs on exporters is in addition different from zero significantly in all specifications except in the last column when exit decision is considering.

comparing with those in column (3) of Table 1.13. There is a have a negative but insignificant sign on the coefficient of an exit dummy, which is the same as that in column (6) of Table 1.15 when output and input tariffs are including together. Then in the second column, we include the interaction term between industry ERP and the exit dummy instead of industry ERP interacted with trade dummy variables and it is noted that the coefficient on industry ERP is still negative and significant at a high significance level and its interaction coefficient is positive and also significant at a high significance level, indicating that relative to non-exiting firms, exiting firms pay lower wages following a weaker trade protection. Besides, the coefficient of an exit dummy now turn to be highly significant and negative, indicating that workers worked in firms making a decision to exit may experience a loss in their wages. Such a finding fits the prediction in Amiti and Davis (2011) that firm eventually exit if they pay lower wages and become the least efficient ones. The joint significance test in column (2) shows that the net effect from cutting industry trade protection on exiting firms is not significantly different from zero.

[Table 1.16 about here]

We first distinguish firms between four trade categories: pure exporters (FXX_{kjt}), pure importers (FMM_{kjt}), exporter-importers (FXM_{kjt}) and domestic-only firms (DOM_{kjt}) and we further use one exit dummy variable to identify firm-types: exiting firms and non-exiting firms. As a result, industry ERP reduction effects now vary across eight different firm types: for non-exiting firms, they are non-exiting pure exporters, non-exiting pure importers, non-exiting exporter-importers and non-exiting domestic-only firms; for exiting firm, they are exiting pure exporters, exiting pure importers, exiting exporter-importers and exiting domestic-only firms. And hence, we include seven dummy variables to denote firm types, where a dummy variable of non-exiting domestic-only firms is omitted, and use them to interact with industry ERP in column (3).

In column (3) the industry ERP is highly significant and negative, suggesting that a fall in industry ERP will increase wages for domestic firms that do not exit. With the exception of non-exiting pure exporters, non-exiting pure importers, exiting pure importers and exiting exporter-importers, the coefficients on interaction terms between industry ERP and firm types are all positive and significant, indicating that other than non-exiting pure domestic firms, other types of firms pay lower wages after a cut in industry ERP. The coefficient of an exit dummy remains unchanged. In the joint significance test of column (3), cutting industry ERP only has a non-zero net effect on exiting pure domestic firms and the sum of coefficients on industry ERP and its interaction term with exiting domestic firms is significantly negative, suggesting that an increase in wages of exiting domestic-only firms following a decrease in industry trade protection. Moreover, such a finding is consistent with that in column (1) of Table 1.16 as industry ERP has a significantly negative coefficient, which also suggests that firms only serve domestic market boost their wages after a fall in industry trade protection.

Then, in the rest columns of Table 1.16 we use a balanced panel to re-estimate the specifications in the first three columns and find the results are robust for industry ERP variables and the exit dummy.

In addition, we use full sample data instead of data in post-WTO period to re-estimate all specifications in Table 1.16 for robustness checks and report the results in Table 1A.22. It is concluded from Table 1A.22 that the findings are broadly close to those in Table 1.16 except for using a balanced sample.[70]

2.5.5 Channels

Our results so far provide vast evidence to support that falling tariff rates can increase wages in non-trading firms and also as a result of such falls in output tariff rates, exporting firms pay lower wages than non-exporting firms. Nonetheless, industry ERP

[70] None of the coefficients on industry ERP and its interactions is significant in columns (4)-(6). The interaction coefficient of industry ERP and an exit dummy in the second, the interaction coefficient of industry ERP and exiting pure exporter (domestic firms) in the third column all becomes insignificant now.

reductions have a positive impact on domestic oriented firms as well and the reductions in industry ERP lead to a lower wage in firms that both export and import relative to pure domestic firms.

A possible channel to affect firm wages after tariffs liberalization is that firms engaged in international trade attract different types of workers and hence adjust their demands on workers in response to changes in trade protection. Thus, in Table 1.17 we add-in one-year difference in the log employment in our regressions, where output and input tariffs are used in the first two columns whilst industry ERP is used in the last two columns. The results for output tariff variables still hold in column (1) and the input tariff coefficient remains negative but turns to be insignificant now. What's more, one-year difference in the log of total employment has a highly significant and negative coefficient, indicating that changing labordemand has a negative effect on firm wages and hence, if a globalized firm intends to hire more workers to expand its production, an increase demand of laborwill lower wages for workers at a globalized firm. Alternatively, if a domestic oriented firm tries to survive from an even tougher import-competition, it will cut the demand of laborand hence pay higher wages. Since the coefficient on one-year difference in the log of total employment is also significantly negative in column (3), the same mechanism works after a fall in industry trade protection.

[Table 1.17 about here]

Another potential channel to affect firm wages after trade protection reductions is straightforward to find out, as the weaker trade barriers will induce importers access a variety of intermediate inputs and cheaper inputs can help import-using firms to raise productivity via learning and a quality upgrading effect, and hence achieve higher profit leading to the payment of higher wages. Thus, another possible channel to boost firm wages is that firms would turn to purchase intermediate inputs with good quality and high productivity as discussed by Amiti and Konings (2007). Hence, we additionally include the log firm import scope to capture the variety effect and here import scope means the variety of inputs that a firm imports. In columns (2) and (4), we test the channel that the wage gains may be attributable to switching to multiple imported inputs, so we include the log firm import scope in both columns and find a positive coefficient on it but insignificant. It seems that importing more intermediate inputs is not helpful for raising firm wages. The results for tariff variables in column (2) are the same as those in column (1) and the results in both column (3) and column (4) are robust to such findings in our previous estimations.

Moreover, we use data in 2000-2006 instead of data in post-WTO period to re-estimate all specifications in Table 1.17 and report the results in Table 1A.23. From the results in Table 1A.23, it is concluded that the findings are similar to those in Table 1.17.[71]

2.6. Conclusion

In this paper we have investigated the effect of tariff falls in the wages of Chinese firms. Using an OLS approach our results show that decreasing output tariff rates can induce a higher wage for firms selling final outputs in the domestic market but induces a lower wage for exporting firms relative to non-exporters, whilst decreasing input tariff rates can induce a higher wage for firms sourcing intermediate inputs domestically

Specifically, based on the results in the fifth column of Table 1.10, the output tariff coefficient is -0.119, which can be interpreted as that a 10% decrease in output tariff rates can lead to a -0.0119 gain in the log mean wage of non-exporters and hence, a 1.19% growth in firm wages. Alternatively, the coefficient on input tariffs is -0.372, which can be interpreted as that a 10% decrease in input tariff rates can lead to a 0.0372 gain in the log mean wage of non-importers and hence, a 3.72 % growth in firm wages. Overall, falls in input tariff rates have a stronger effect on firm wages than that from output tariff falls,

[71] In addition, the coefficient on SOE dummy is significantly negative in Table 1A.23 and the input tariff coefficient turns to be significantly negative now in the first two columns when output and input tariffs are being used. Besides, the coefficient on log firm import scope becomes significantly positive now in columns (2) and (4), which implies that higher import-using firms are more likely to pay higher wages.

which is at least three times the wage growth by decreasing output tariff rates. However, cutting input tariffs in general has a zero net effect on import-using firms as well as that of cutting output tariff rates on exporting firms.

Our results are opposite to predictions arising from the Amiti and Davis (2011) model which is based on Indonesia but are quite close to those conclusions in Kamal *et al.* (2012), also a study in the case of China. Most importantly, our results imply that workers in firms that only source or only serve domestic market share part of the gains from China's WTO accession documented by Brandt *et al.* (2012), which suggests that the positive effect of trade liberalization can be profound for the local economy. Our findings also highlight the importance of trade policy in determining the outcomes for home country market.

In this study, we only focus on the impact of ordinary trade in China through trade liberalization. Since it is well known that processing trade becomes a significant part of international trade in China and contributes the majority of China's export, we leave this area for our future study.

Chapter 3. Trade Liberalization, Profits and Wages in China: Are Processing Firms Different?

Abstract

Since joining the WTO in 2001 it is well documented that China's economy benefited from lower tariff barriers and a massive increase in exports to the rest of the world. An important but little understood dimension of China's exports led growth is the role of processing firms that process imported intermediates within China for future export. Through processing trade, China has become an intrinsic part of the global value chains (GVC), which mainly locate firms in the production stage of the whole production process, producing final products from raw materials and exporting them, or processing imported intermediates for future exports to foreign buyers, and traditionally the whole production process includes product designing, producing, searching and serving the target markets. In this paper we examine the relationship between tariff reductions and wages for Chinese firms, paying attention to firms engaged in processing trade who can enjoy special treatment in tariff rates and are often located in China's numerous special economic zones (SEZs). Using a detailed dataset matching manufacturing data with custom trade data for the period 2002-2006 we find that during periods of tariff liberalization, a reduction in output tariffs increases the wages of workers in processing firms relative to non-processing firms, an effect that is greater, the greater a firm's intensity in the use of intermediate imports. For input tariffs we find that wages increase for workers in the more traditional non-processing firms only. However, falls in tariff rates have a more complex impact on firm profits. Output tariff reductions are found to decrease firm profits for non-processing firms.

3.1. Introduction

China is well known by its role of global export processers. Processing trade is also known as a scheme of tariff drawback, which documents that tariff rates should not be applied to firms importing certain amount of intermediate inputs as they are then assembled or processed for the manufacture of goods that are subsequently exported. Given China's large low-skilled labor market, China created a considerable export processing sector that has become an intrinsic part of the global value chain. The use of processing trade that employs vast numbers of workers has enabled China to become the factory of the world and the world's largest exporter. Estimates suggest that over 50% of China's entire international trade flows by 2006 are occupied by processing trade (Fernandes and Tang, 2012; Manova and Yu, 2014; Zhu, 2014; Yu, 2015; Brandt and Morrow, 2015).

In this paper we explore how processing trade affects firm wages since a firm is engaged in this specific part of the global value chain. Based on detailed Chinese manufacturing firm data and China's highly disaggregated customs transaction data we investigate how workers have been effected by China's engagement in the global value chain by which workers are employed at a stage of simply assembling or processing components imported from other foreign countries into final goods for re-exporting to developed countries, for example, the US or EU consumer markets. We also examine a related topic which is to what extent the profits from processing trade are shared with the workers and how this has changed with trade liberalization. Finally we examine the extent to which the intensity by which a firm engages in processing trade influences wage differentials between trading firms.

In the first stage in Figure 3.1, we present the trends in output and input tariffs, and average wage in both processing-import-using firms and trading firms without processing imports. As expected there is a downward trend in both types of tariffs following China's accession into the WTO and its commitment as part of the accession process to gradually reduce Chinese import duties. In contrast, average wages in processing and non-processing firms have increased with the mean wage for workers in processing firms being higher than that for workers in non-processing firms. In this paper, we explore the channels through which wages growth varies across firm type following tariff liberalization.

[Figure 3.1 about here]

A large number of studies have examined the impact of China's processing trade. Koopman *et al.* (2012) demonstrated that both foreign wholly-invested firms and Sino-foreign joint ventures are most likely to produce and export final products with a high proportion of imported processing inputs but with a low proportion of domestic inputs, which entails less added-value in domestic production. Manova and Yu (2014) state that credit constraints influence the design of international trade contracts, shifting firms to engage in the stage of producing or creating low added-value, which may in turn affect the patterns that firms and countries are located or engaged in GVCs. Their work also points out that the establishment of healthier financial markets in developing countries is a great help to boost added-value, revenue and profits. Most importantly, through GVCs more manufacturing firms in developing countries become capable to share part of trade gains.

Some of them try to find a connection between trade liberalization and processing trade. Based on firm-level tariffs, Yu (2015) found that decreasing output tariff rates has a positive impact on productivity of firms engaged in global trade and such impact is larger than that found in decreasing input tariff rates. However, those impacts induced by tariff reductions become smaller by increasing a firm's share in processing trade. Brandt and Morrow (2015) tend to examine the impact of Chinese tariff reductions on a firm's choice between traditional ordinary trade and processing trade and they address that cutting industry-level input tariff rates shifts or drives firms to participate more in a traditional trade pattern, with both the intensive and extensive margins playing roles. While Zhu (2015) shows how the presence of domestic trade costs alongside of the sheer magnitude of processing trade drastically affects how trade distributes its impact across firms of different types and it also shows that falling trade costs unequivocally deliver welfare gains in both countries.

Based on three major data sources (Chinese Industrial Firm dataset, Custom Trade dataset and Chinese applied tariffs data), we construct output tariff rates, input tariff rates and effective rates of protections (ERP) at the firm level, so we are able to shed light on how workers gain from international trade in the context of global production chains through tariff liberalization. Based on our empirical estimations, we argue that a cut in output tariffs causes firms with imported processing components to pay higher wages than non-processing firms and such wage differentials will become greater since a crease can only be found in non-processing firms who experience a cut in input tariffs. Such findings are partly consistent with those found previously for firm performance, such as productivity (Yu, 2015) or profits (Manova and Yu, 2014). Particularly, a 10% fall in output tariff rates leads to a 1.37% increase in average wage in processing firms relative to non-processing firms. We also highlight that cutting output tariffs in the years 2002-2006 contributes almost 0.49% to the wage gap between processers and non-processers covered in the sample after WTO and cutting input tariffs contributes overall nearly 0.23% wage gains for non-processers in the post-WTO period.

The rest of the paper is organized as follows. Section 2 introduces the background of processing trade in China. Section 3 illustrates our empirical estimation strategy and the measurement for firm-specific tariffs and ERP whilst section 4 describes our data sources. Section 5 presents our empirical estimated results and finally, in section 6 we conclude and make some policy implications.

3.2. Processing Trade in China

3.2.1 The Definition of Processing Trade and Two Major Types

Processing trade in China is defined as the activity of importing all or part of the raw materials and intermediate inputs from oversea enterprises to local enterprises for manufacturing procedure of assembling and processing those intermediate components into final goods. Local manufacturers then re-export them to the foreign buyers who are in charge of selling and marketing (Feenstra and Hanson, 2005).

In 2012, there are 16 specific types of processing trade are reported by China's General Administration of Customs.[72] Among them, two main types are frequently considered to be important: assembling and processing with imported intermediate inputs. They dominate the processing trade of China's manufacturing industries and account for 99% of total processing trade in manufacturing for the period 2000-2006.[73]

In terms of processing with assembly, commonly referred to assembling means that the foreign partner purchase and provide raw materials and intermediate components to local manufacturers, the local manufacturers get those inputs free from foreign partners and then assembly them into final goods. Since the foreign partner own those intermediate inputs, after assembling they also own the final goods, distribute and sell them in the markets, and hence, they can fully earn revenues from those products but the Chinese enterprises can only earn an assembly fee for each product through this type of processing trade.

The second processing type referred to processing with imported intermediate inputs means that the local manufacturers buy and import intermediate inputs from foreign

[72] Our data only contains 12 types of processing trade and are based on Customs 2-digit codes given by the General Administration of Customs: International aid (code: 12), Compensation trade (13), Assembly (14), Processing with imported inputs (15), Consigned goods (16), Border trade (19), Contracting projects (22), Goods on lease (23), Outward processing (27), Barter trade (30), Bonded warehousing (33) and Entrepot trade (34). In specific, international aid (12) is defined as financial aid (capital) or donations (goods/services) from governments or other organizations and outward processing (27) is defines as exporting raw materials, intermediate components for oversea assembly or processing and re-importing those finished goods after processing. Hence, we must pay special attention to this trade regime when we identify a firm's processing status or direction since it works in the opposite direction to what processing trade usually does. For the detail definition and description of other types of processing trade, it can be found in Upward *et al.* (2013).

[73] Our sample only includes manufacturing firms that are SOEs and non-SOEs with annual sales above 5 million RMB (commonly referred to as the "above-designated size" firms) and based on this sample nearly 47% of observations that engage in processing trade are foreign-owned and HMT-owned firms (the ownership is defined as foreign/HMT share greater than 50%). Based on this sample, the proportion of processing with assembly and inputs in total processing trade may be overestimated because of two concerns. One concern is that large and foreign-owned firms are more willing to become processers as found in Yu (2014), and the other concern is that many foreign companies are more willing to carry out processing trade in China in order to benefit from government concessions, cheaper labor and low expenses of land-use, and have more power to conduct processing with assembly and inputs in China. As a result, if we go back to the full sample of manufacturing firms which also includes small and medium-size firms, the proportion drops as small and medium-size firms have less ability to engage in processing trade.

partners, process such imported raw materials and intermediate components into final outputs and then re-export them to foreign markets. In contrast to assembling, the local manufacturers engaged in processing with imported intermediate inputs own such raw materials and intermediate components for future processing and are capable to sell the final goods abroad. Therefore, their profits are dependent on the sales of the exporting final goods.

3.2.2 The Role of Processing Trade

Over 2000-2006, processing trade plays an important role for the development of China's economy and we find that in total its trade volume accounts for approximately 66% of China's foreign trade. In particular, processing exports constitute 71% of total Chinese exports and processing imports accounts for 58% of total imports.[74] Our findings are consistent with previous research (J.P. Morgan, Koopman *et al*, 2008, 2012; Manova and Yu, 2014; Yu, 2015).[75] J.P. Morgan reported that in 2009, bonded processing accounted for 48.2% of China's export-import volume, a dramatic increase from 5.68% in 1981, and it has been pointed out by Koopman *et al* (2008, 2012) that since 1996 Chinese annual processing exports have contributed to more than a half of its total exports. Also Manova and Yu (2014) stated that by 2005, nearly one third of Chinese exporters chose to be processers and accounted for more than one half of China's total exports. Finally, Yu (2015) noted that in the early 1990s China experienced a huge growth in processing imports and in 1992 processing imports began to be the leading part of China's imports, while Chinese government adapted to a market economy. Afterwards, greater than one half of China's total imports was contributed by processing imports by 2006.

In Figures 3.2 and 3.3 we report China's processing trade versus ordinary trade where the former is for processing exports and the latter is for processing imports. Each year at least 70% of total exports are contributed by processing exports since 2000 as shown in

[74] The calculation of all percentages (66% of total, 71% of exports and 58% of imports) are based on our matched sample around 2000-2006.

[75] Our proportions are slightly higher, which may be due to using our matched sample only including SOEs and non-SOEs with annual sales above 5 million RMB (commonly referred to as the "above-designated size" firms), not using the entire customs data sample of firms which includes small and medium-sized firms as well. But the studies from others (J.P. Morgan, Koopman *et al*, 2008, 2012; Manova and Yu, 2014; Yu, 2015) are based on the entire customs sample.

Figure 3.2. Additionally, in contrast with ordinary exports, the volumes of processing exports are always greater and the gap between them is growing wider from almost 200 billion RMB increasing to more than 1,100 billion RMB in 2006, which is a near six fold increase in value over the period. However, its share in total exports has declined slightly from 76% in 2000 to 70% in 2006. From Figure 3.3 we observe that more than one half of annual total imports are contributed by processing imports since 2000. Similar to the findings of processing exports, the volumes of processing imports are always greater than that of ordinary imports except in 2001 and the gap between them is widening from the lowest of -19.5 billion RMB to a high of 331 billion RMB. Interestingly, in contrast to processing exports, the share of processing imports in total imports increased during our sample period.

[Figure 3.2 about here]

[Figure 3.3 about here]

Hence, it is clear that processing trade has become a major source of China's foreign trade activities and it has not only helped to deepen China's integration into the global economy, but also has contributed enormously to the booming domestic economy. However, under the regime of processing trade with assembly, the Chinese manufacturing firms have no right to decide what kind of intermediates to source since the categories of raw materials and intermediate inputs are set by foreign buyers and they could only charge an assembly processing fee. Under the regime of processing trade with imported inputs, although the Chinese manufacturing firms are free to decide what kind of intermediates to source and where to source, they could only get a part of total profits since they transact with a foreign buyer who covers any costs and hence under Nash equilibrium they take their contribution as bargaining power to split profits (Manova and Yu, 2014). Moreover, following a fall in tariffs due to trade liberalization, the comparative advantage of enjoying tariff exemption for firms engaged in processing trade becomes weaker gradually, and processing firms that are lack of financial supports and with higher credit constraints are in difficulty to improve their productivity level and hence become even less productive when comparing with firms engage in ordinary trade.[76] [77]

3.2.3 The Advantage in Custom Tariffs and Taxation

In China there is a special system for processing trade, called bonded system, which covers bonded areas, warehouses and factories, and under this system, firms engaged in processing trade can rebate tariffs and taxes relative to imports if part of the imported intermediate inputs is used for assembling or processing since such proportion of imported inputs can enjoy zero tariffs and zero taxes. However, if those processed final outputs are sold locally, local processing firms will be levied by Chinese customs for tariffs on those imported intermediate inputs used for processing such locally sold outputs, which are supposed to re-export after assembling and processing. Furthermore, for the purpose of processing trade, the foreign partners may provide and import equipments for local manufacturers and such equipments can also enjoy tariff exemptions and free from taxes of value-added.

Given manufacturing firms engaged in processing enjoy zero tariffs when importing intermediate inputs for processing trade thus will reduce production costs. The benefits from tariff exemptions may in turn encourage some traditional producers to become processing producers either partially or entirely.[78] If, for example, a firm is a partial processer then as only part of the imported raw materials are used for the processing exports of final outputs and hence be exempt from tariffs, for example, if a firm could not sell all of its processed products in foreign markets, then only the imported amount used for producing processing products will enjoy the advantage of zero tariffs. Hence, it is important to capture a firm's actual degree of participation in processing trade.

To accurately measure the extent of processing trade, we need to know the detailed information about each firm's production line. However, we do not have this information and hence to solve this problem, we assume that only a firm undertakes both processing

[76] Manova and Yu (2014) document that firms with higher financial constraints as well as low productive firms are more willing to become processers and they are especially to engage in assembling.

[77] Yu (2015) states that both types of output and input tariff reductions can increase firm productivity. However, such positive impacts become smaller if a firm imports a higher proportion of processing inputs.

[78] Here partially processing producers mean that manufacturing firms conduct both ordinary trade and processing trade. Pure processing producers only assemble and process goods.

exports and processing imports in the same period, it has engaged in the processing business. So only the firms that satisfy such requirements are treated as successful processing producers that receive tariff exemptions for the full volume of processing imports. Alternatively, firms that only have customs transactions of processing exports or processing imports are excluded from our sample because it is hard for us to judge the real tariff charges that are appeared to them. This is a strong assumption as the value and quantity of processing inputs may not be matched with the value and quantity of processing outputs although those trade activities occur in the same period or happen one after another. Due to data restrictions, we cannot trace those input-outputs of production directly. Once the clear production line data are available for China, this is can be explored in more detail. However, we roughly believe that if these processing imports appear with these processing exports in the same period t, such processing imports are all used to produce such processing exports and hence this amount of processing imports could entirely enjoy zero tariffs.

3.2.4 Defining a Processing Firm

Under the law, Chinese processers should be well-organized to prove their capability for processing which means ownership of factories, processing equipment and already having an established work force. In addition, the Chinese enterprise should have the authorized import and export licenses to operate trade activities. Additionally, they should obtain government granted certifications of capability in both manufacturing production and processing trade. If local manufacturers tend to begin an operation in processing trade, they must present to the Chinese customs both certificate of approving processing trade and the contracts related to processing trade and further apply for the registration handbook of processing trade.

Hence, even though firms might not be located in a bonded area, they are still able to execute processing business by holding the processing trade registration handbook. Hence, we define a firm as a processing firm not using its location information but its importing information. A processing firm is defined as a firm with non-zero processing imports, no matter if it is a pure processer or a mixed processer.[79]

3.2.5 Characteristics of Processing Firms

In this section, Table 2.1 summarizes the characteristics of processing firms including the number, the proportion, the distribution of ownership and performance. We also investigate in how the proportion of processing firms varies by 2-digit industry level with the result shown in Figure 3.4.[80]

[Table 2.1 about here]

Table 2.1 shows that although the quantity of processing firms in China grew rapidly, the proportion of processing firms in total exporting and importing firms decreased from nearly 50% in 2000 to less than 40% in 2006. Consistent with Yu (2015), we find that processing firms are mainly invested in and controlled by foreign and HMT owners and they dominate the processing business in China's local market, accounting for more than 65% of processing firms in China. On the other hand, state-owned enterprises are less likely to be processors.[81] In terms of size (total employment), we find that the average size of a processing firm increased year by year, and matches Yu (2015), where he noted that large and foreign-owned firms are more willing to self-select into being processers. In terms of performance, we find that since 2000 mean value-added per worker and the mean wage per worker in processing firms grew considerably, while the mean of total factor productivity (TFP) remained relatively stable. These trends may be explained by the simple assembly and processing work without technical development or improvement.

We then compare processors with ordinary traders through the use of the premium variables, which are equal to the average performance of processing firms over the average performance of firms engaged only in ordinary trade. The premiums of

[79] Pure processers are firms that only import raw materials and components for assembly and processing purpose, without any ordinary imports, and mixed processers are firms that have both processing and ordinary imports.

[80] The manufacturing industry names matched with the two-digit industry codes appeared in Figure 3.4 are stated in Table 2A.1 (Appendix Table).

[81] The conclusion is made based on the statistic summary shown in the ownership category of Table 2.1, where the SOE is defines as a firm with its government share no less than 50%, the foreign-owned is defined as a firm with its foreign share greater than 50%.

variables to describe firm performance are all greater than one except for the variable of value-added per worker. Premiums with a value greater than 1 show that the processing firms exhibit better performance when compare with ordinary trading firms. Hence, processors appear to pay higher wages and are more productive. However, the premium of value-added per worker is around 0.55 over our sample period, indicating that even though processing firms are more productive, they produce much lower value-added for each worker. This high level of average TFP may be driving by the issue of foreign ownership.[82] Hence, using value-added per worker to capture a trading firm's capability in manufacturing production may be a better indicator, as it excludes the value created by intermediate inputs and could reflect the true value created during manufacturing production.[83] The lower value-added level may also reflect a fact that processing firms lack motivation for technical innovation. Our results are again similar to other relative studies (Manova and Yu, 2014; Yu, 2015).[84]

Additionally, we show the trends of processing firms varying across time based on 2-digit Chinese industrial code (CIC) level classification in Figure 3.4, where the black line is representative of the share of processing firms in total number of manufacturing firms penetrating foreign markets within each industry, and the grey line is representative for the total number of processing firms within each industry.

[Figure 3.4 about here]

We find that processing firms are mainly concentrated in labor-intensive, high-pollution and high-energy-consumption industries.[85] [86] [87] These include: textiles

[82] Note that we only take simple average value of firm TFP here, not control for firm ownership structure. If we take a summary analysis only for the trading firms without any foreign ownership (we check both situations: the foreign share is equal to zero or the foreign-owned dummy is equal to zero), the mean value of TFP in non-processing firms then is slightly greater than that in processing firms, with a value of TFP premium around 1.001.

[83] Hence, we use value-added per worker to control for productivity for the two-stage Heckman selection model, which is following Amiti and Davis (2011) that they use the log of value-added per worker as the indicator to control for firm productivity.

[84] The former argues that firms with higher credit constraints as well as low productive firms are more likely to self-select to engage in processing trade, whilst the latter argues that firms with low productivity level are more willing to self-select to become processers and the negative productivity gap between processers and non-processers through tariff liberalization becomes even larger if firms engage more in process trade.

[85] Following Mckay and Song (2012), an industry with a higher ratio of labor inputs over capital inputs in production is defined as a labor-intensive industry and 12 industries are categorized as labor-intensive industries: textiles, garment and foot wear (18); leather products (19); wood and wood products (20); furniture manufacturing (21); entertainment products (24); plastic products and fur (30);

(CIC: 17), apparel and footwear (CIC: 18), leather products and fur (CIC: 19), furniture (CIC: 21), paper and paper products (CIC: 22), printing and re-production media (CIC: 23), cultural and entertainment products (CIC: 24), rubber products (CIC: 29), plastic products (CIC: 30), metal products (CIC: 34), electric machines and appliances (CIC: 39), electric equipment (CIC: 40), instruments and appliances(CIC: 41) industries, with the share of processing firms on average greater than 0.5. Overall, the proportion of processing firms in China is on a downward trend for all the manufacturing industries. However, in some industries the number of processing firms increased dramatically, including textiles, apparel and footwear, plastic products, electric machines and appliances, and electric equipment industries.

In the next section, we turn to introduce our measurements of trade protection and our empirical estimation strategy.

3.3. Estimation Strategy

3.3.1 Tariff Measures

Following Yu (2015), we construct firm-level output and input tariff rates using universal firm-product transaction records. In addition, we also calculate China's industry output and input tariffs following Amiti and Konings (2007). Appendix 2A provides a description of our methodology.

3.3.1.1 Firm-specific Output Tariff

The output tariff of a multi-product firm could be affected by multiple tariff lines. To compute a firm-specific output tariff, we use a product-sales weighted average of these product-level tariffs and we fix the product-sales share at the year in which the firm first enters the sample following Topalova and Khandelwal (2011), where

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metal products (34); universal equipment (35); special equipment (36); instruments and appliances (39); communications and computers (40); and appliances, electrical machines and equipment (41).

[86] Following Mani and Wheeler (1998), pollution-intensive industries include: Iron and Steel; Non-Ferrous Metal; Industrial Chemicals; Petroleum Refineries; Non-metallic Min Pro; Pulp and Paper; Other Chemicals; Rubber Products; Leather Products and Metal Products, which are listed and ranking in Table 1 of their paper.

[87] Following Li and Pan (2013), in China high energy-consumption sectors include oil and chemical industries.

$$output\ \ tariff_{kjt} = \sum_m \omega^m_{kj,t\_initial} \times tariff^m_t \qquad (1)$$

$$\omega^m_{kj,t\_initial} = \frac{v^m_{kj,t\_initial}}{Y_{kj,t\_initial}} = \frac{v^{mX}_{kj,t\_initial} + v^{mD}_{kj,t\_initial}}{\sum_m v^{mX}_{kj,t\_initial} + \sum_m v^{mD}_{kj,t\_initial}}$$

The $tariff^m_t$ is the effectively applied tariff of product *m* in year *t*, and the weight $\omega^m_{kj,t\_initial}$ for firm *k* within industry *j* is computed by the firm *k*'s sales of product *m* in the initial year it appeared in the sample, $v^m_{kj,t\_initial}$, divided by the firm's total sales in the same year, $Y_{kj,t\_initial}$. Of course, a product may be sold in both domestic and global markets. Hence, in the firm *k*'s first entry year $v^m_{kj,t\_initial}$ includes product *m*'s foreign sales $v^{mX}_{kj,t\_initial}$ and domestic sales $v^{mD}_{kj,t\_initial}$, and $Y_{kj,t\_initial}$ includes the firm *k*'s total export values $\sum_m v^{mX}_{kj,t\_initial}$ and total sales in domestic-oriented market, $\sum_m v^{mD}_{kj,t\_initial}$. We use the time-invariant shares to weight the firm output tariffs to avoid potential pitfall due to the possible reverse causality problem in firm wages.[88]

In a multi-product firm *k*, the share of product *m*, exported to foreign markets or sold in domestic market are defined in equations (2) and (3) respectively, and $\omega^{mX}_{kj,t\_initial}$ denotes the share of product *m* in total exports and $\omega^{mD}_{kj,t\_initial}$ denotes the share of

[88] A product with a high-profit margin must be sold more and hence its sales would take account of a larger share in a firm's total sales. Note that wages are positively related to profits. Hence, when we investigate the impact of decreasing tariff rates on firm wages, a bias on the output tariff coefficient could be caused by using the current product-sales share to measure the firm-specific output tariffs, since the direction of such a bias is determined by the change of tariff rate (higher/lower) on large-sale products. For example, if a high-profit product with a larger proportion in total sales incurs a higher tariff rate, then the output tariff effect on firm profits (wages) would face an upward bias. Alternatively, if a high-profit product incurs a lower tariff rate, a downward bias on the output tariff coefficient could be caused when investigating its impact on firm profits (wages). Therefore, to avoid this potential reverse causality, we fix the weight to measure firm output tariffs, and for each product we construct its time-invariant weight using data of firm's initial year in the sample by following Topalova and Khandelwal (2011). However, setting an invariant weight for tariff rates (output/input) calculation may possibly introduce a systematic measurement error. If in the following year, firms export (import) more share of products, we may under-report the value of firm output (input) tariff rates since we fix the weight as initial. In another case, if firms export (import) less share of products, we may over-report the value of firm output (input) tariff rates. Based on such under-report (over-report) tariff rates, we may further over-estimate (under-estimate) the effects caused by changing tariff rates.

product *m* in total domestic sales.

$$\omega^{mX}_{kj,t\_initial} = \frac{v^{mX}_{kj,t\_initial}}{\sum_m v^{mX}_{kj,t\_initial}} \Rightarrow v^{mX}_{kj,t\_initial} = \omega^{mX}_{kj,t\_initial} \times \sum_m v^{mX}_{kj,t\_initial} \tag{2}$$

$$\omega^{mD}_{kj,t\_initial} = \frac{v^{mD}_{kj,t\_initial}}{\sum_m v^{mD}_{kj,t\_initial}} \Rightarrow v^{mD}_{kj,t\_initial} = \omega^{mD}_{kj,t\_initial} \times \sum_m v^{mD}_{kj,t\_initial} \tag{3}$$

As pointed out by Melitz (2003), a high productive firm can sell final outputs in foreign markets as well as in local market. Hence, we assume that a product sold successfully in the foreign markets is also sold in the local market, and hence the product should be sold in the same share domestically and globally. Thus, we suppose $\omega^{mX}_{kj,t\_initial} = \omega^{mD}_{kj,t\_initial}$, which means equation (2) is equal to equation (3), and then we have:

$$v^{mD}_{kj,t\_initial} = \omega^{mX}_{kj,t\_initial} \times \sum_m v^{mD}_{kj,t\_initial} = \omega^{mX}_{kj,t\_initial} \times (Y_{kj,t\_initial} - \sum_m v^{mX}_{kj,t\_initial}) \tag{4}$$

After that, we insert (2), (4) into (1) and have:

$$\begin{aligned}
\omega^{m}_{kj,t_initial} &= \frac{v^{mX}_{kj,t_initial} + v^{mD}_{kj,t_initial}}{\sum_m v^{mX}_{kj,t_initial} + \sum_m v^{mD}_{kj,t_initial}} \\
&= \frac{v^{mX}_{kj,t_initial} + \omega^{mX}_{kj,t_initial} \times (Y_{kj,t_initial} - \sum_m v^{mX}_{kj,t_initial})}{\sum_m v^{mX}_{kj,t_initial} + (Y_{kj,t_initial} - \sum_m v^{mX}_{kj,t_initial})} \\
&= \frac{v^{mX}_{kj,t_initial} + \omega^{mX}_{kj,t_initial} Y_{kj,t_initial} - \omega^{mX}_{kj,t_initial} \sum_m v^{mX}_{kj,t_initial}}{Y_{kj,t_initial}} \\
&= \frac{v^{mX}_{kj,t_initial} + \omega^{mX}_{kj,t_initial} Y_{kj,t_initial} - v^{mX}_{kj,t_initial}}{Y_{kj,t_initial}} = \omega^{mX}_{kj,t_initial}
\end{aligned}$$

As a result, we have equation (1) = equation (3) and finally we obtain a measure of firm-specific output tariffs given by equation (5):

$$output\ \ tariff_{kjt} = \sum_m \omega^{mX}_{kj,t\_initial} \times tariff^m_t = \sum_m \left(\frac{v^{mX}_{kj,t\_initial}}{\sum_m v^{mX}_{kj,t\_initial}} \right) \times tariff^m_t \quad (5)$$

However, since we make the extremely strong assumption (Yu, 2014) that the proportion of a product sold domestically by trading firms is the same as that in the foreign markets, we should exclude the firms with zero domestic sales (pure exporting firms) and the firms with zero exports (pure domestic-sale firms), otherwise, either of them could bias our measure of firm output tariffs. In our sample, around 9.7% (20,926 observations) of firms are pure exporting firms and around 11.6% (25,032 observations) are pure domestic-sale firms.[89] To ensure our main estimation results are not biased by those two types of firms, we drop them from our sample in the following regressions which leaves 170,083 observations.[90]

3.3.1.2 Firm-specific Input Tariff

As mentioned in section 2.3., processing imports could enjoy tariff exemption in China and that part of imports is duty free for a processer. To compute a firm-specific input tariff, following Yu (2015) we take average of these product-level tariff rates by using the ordinary input-costs as weights and we fix the share at the year in which a firm first enters the sample to avoid potential endogeneity problems. Thus, we compute a firm input tariff as follows:

$$input\ \ tariff_{kjt} = \sum_m \omega^{mOM}_{kj,t\_initial} \times tariff^m_t = \sum_m \left(\frac{v^{mOM}_{kj,t\_initial}}{\sum_m v^{mTM}_{kj,t\_initial}} \right) \times tariff^m_t \quad (6)$$

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89 Theoretically, pure exporting firms should be defined as firms with 100% exporting share, which means that total sales is equal to total exports. Actually, due to the different requirement of reporting date, for example, if a firm receives a payment for exports in advance, this amount of exporting value should be recorded under the relative accounting entry according to Accounting Standards, even though the real exporting is not made. However, the customs could record this export value at the time of shipping exports or exporting done. Hence, there may appear a differential time node between the records of firm and that of customs even for the same trade transaction. As we use the merged firm-customs dataset, due to the different marking point caused by different system rules, even an actual pure exporter may not 100% match the value of its total sales with the value of its total exports, although in theory those two should be equal. Consequently, we roughly treat a firm as a pure exporting firm with its exporting share no less than 0.9, which is very close to one.

90 According to our assumption and calculation of firm output tariff rates, we believe that if a firm sells chocolate in the foreign market accounting for 30% of total exports, it also sells chocolate in the domestic market which accounts for 30% of total domestic sales as well. Hence, we give a 30% weight to the chocolate tariff when calculating a firm's output tariff. Based on this rule, such weight for pure exporting firms is 100% and for pure domestic firms it is 0%. As a result of this, including pure exporting firms may over-estimate the effects of falls in output tariff rates and including pure domestic firms may under-estimate the effects of such falls.

where $\sum_m v^{mTM}_{kj,t\_initial} = \sum_m v^{mOM}_{kj,t\_initial} + \sum_m v^{mPM}_{kj,t\_initial}$

The $tariff^m_t$ is the effectively applied tariff of product *m* in year *t*, and the weight $\omega^{mOM}_{kj,t\_initial}$ for firm *k* within industry *j* is computed by the firm *k*'s ordinary imports of product *m* in its initial year that it appeared in the sample, $v^{mOM}_{kj,t\_initial}$, divided by the firm's total imports in the same year., $\sum_m v^{mTM}_{kj,t\_initial}$. Certainly, a product *m* may be imported under two different regimes, both ordinary trade (OT^m) and processing trade (PT^m). Hence, in the firm *k*'s first entry year $\sum_m v^{mTM}_{kj,t\_initial}$ includes the firm *k*'s total ordinary import values, $\sum_m v^{mOM}_{kj,t\_initial}$ and total processing import values, $\sum_m v^{mPM}_{kj,t\_initial}$.

As previously noted, as that the part of imported inputs for processing and assembly are not subject to tariffs, we do not include the set of importing processing inputs in equation (6).

3.3.1.3 Firm-specific Effective Rate of Protection (ERP)

To test the robustness of our results we use several alternative measures of trade protection. Hence, we construct a measure of the firm-level effective rate of protection (ERP). At the firm level, the disciplining effect of decreasing output tariff rates might be balanced by decreasing input tariff rates, and so rather than include both measures in the same equation, we use the firm-specific ERP to capture the net effect of both types of protection on outputs and intermediate inputs. This was done following Corden (1966):

$$ERP_{kjt} = \frac{output\ tariff_{kjt} - input\ tariff_{kjt}}{1 - \alpha_{kjt}} \qquad (7)$$

where α_{kjt} are the input-value share of firm *k* in the production of its total outputs and α_{kjt} can be expressed as:

$$\alpha_{kjt} = \left(total\ input_{kjt} - \sum_{m} V_{kjt}^{mPM} \right) \Big/ total\ output_{kjt}$$

where the value of total processing imports is excluded from total intermediate inputs in firm *k*.[91]

3.3.1.4 Industry-level Trade Protection

To complement firm-level tariffs, we also calculate industrial output and input tariff rates at the Chinese Input-Output (IO) sector level following Amiti and Konings (2007), which is equivalent to 3-digit Chinese Industry Classification (CIC) level. We then further construct an ERP measure at the industry level to evaluate the level of trade protection in China. The measurement of industrial tariff rates and industry ERPs are explained in detail in Appendix 2A.

3.3.1.5 Summary of Tariffs

In Table 2.2 we present China's output and input tariff rates at three-digit industry level and at firm-level for each year from 2000-2006. Generally, output tariffs are greater than input tariffs; almost one and a half times the rate of the latter at industry level. At the firm level, output tariffs are nearly 4.5 times the rate of input tariffs. Obviously, input tariffs at the firm level are always much smaller than those at the industry level as the calculation of firm-level input tariff rates has taken into account the participation of processing trade, which may induce tariff exemptions for some part of intermediate inputs.

[Table 2.2 about here]

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[91] For robustness, we include another firm ERP measure in our estimations which is measured as: $ERP\_2_{kjt} = \dfrac{output\ \ tariff_{kjt} - input\ \ tariff_{kjt}}{1-\lambda_{kjt}}$, where $\lambda_{kjt} = total\ \ input_{kjt} / total\ \ output_{kjt}$ and we do not exclude the value of total processing imports from total intermediate inputs in firm k.

Both types of tariffs have experienced a reduction over the sample period. Specifically, industrial mean output tariff rates dropped from 18.49% in 2000 to 10.13% in 2006 while industrial mean input tariff rates dropped from 12.32% in 2000 to 6.59% in 2006. At the firm level, mean output tariff rates fell from 18.97% in 2000 to 9.39% in 2006 while mean input tariff rates fell from 4.05% in 2000 to 2.12% in 2006. A downward trend is also found for the dispersion of tariff rates as the standard deviations are decreasing. Table 2.2 illustrates that China had its highest output and input tariff rates in 2000 after which tariff rates began to fall, and more importantly, after the accession to the WTO in 2001 China began to reduce tariffs sharply in 2002 but the reduction slowed after 2002. On average, output and input tariffs experienced a sharp cut in 2002 and fell by approximately 25%, while in 2006 average output and input tariffs only declined by around 2.5% at both the industry and firm level, which support the finding in Brandt *et al.* (2010) and Kamal *et al.* (2012) that the sharpest fall in tariffs occurred immediately after accession to the WTO. What is clear is that, China joining the WTO led to a substantial reduction in tariff rates for the majority of manufacturing industries.

Finally, Table 2.3 reports the correlations of output and input tariffs at different levels of aggregation. It shows that 3-digit industrial output tariffs and 3-digit industrial input tariffs are highly correlated with a correlation coefficient of 0.763.[92] Yu (2015) also finds a strong positive correlation between the industrial output and input tariffs but at a lower level (*corr.* =0.578). In addition, in Table 2.3 we also check the correlation between firm output and input tariff rates and we find a weak correlation between firm output and input tariff rates with a correlation coefficient of 0.004, which is smaller than that in Yu (2015) who obtains a coefficient of 0.092.[93]

[Table 2.3 about here]

[92] Note that such correlation coefficient at the industry level is based on our unbalanced panel merged with the three-digit industry tariffs. The correlation coefficient between industry-level tariffs before merging is much smaller and equal to 0.71.

[93] Since our matching is better than Yu (2015) and hence we may merge more products within a firm than he does, therefore, the diversity of products may then weaken the correlation between firm-level output and input tariff rates.

3.3.2 Empirical Strategy

To investigate the effects of output and input tariff reductions on the average wage of trading firms, we consider the following empirical framework:

$$\begin{aligned}\ln(\text{wage})_{kjt} = {} & \alpha_1 \text{Output Tariff}_{kjt-1} + \alpha_2 \text{Output Tariff}_{kjt-1} \times \text{Processing}_{kjt} \\ & + \alpha_3 \text{Input Tariff}_{\text{kjt}-1} + \alpha_4 \text{Input Tariff}_{kjt-1} \times \text{Processing}_{kjt} \\ & + \alpha_5 \text{Processing}_{kjt} + \Pi \text{X}_{kjt} + \rho_k + \rho_{lt} \\ & + \varepsilon_{kjt}. \qquad (8)\end{aligned}$$

The dependent variable $\ln(\text{wage})_{kjt}$ is the logarithm of firm *k*'s average wage per worker in industry *j* in year *t*, defined as the total wage bill divided by total employment, measured by the number of employees.[94] $\text{Output Tariff}_{kjt}$ and $\text{Input Tariff}_{kjt}$ describe firm output and input tariff rates respectively, both of them are constructed by using the initial trading weights which are time-invariant, and hence the coefficient α_1 (α_3) gives the impact of decreasing output (input) tariffs on wages of ordinary trading firms. To capture the potential differential effects on wages between processing firms and ordinary trading firms induced by tariff reductions, we include an interaction of firm output (input) tariff rates and a processing dummy. Processing_{kjt} is a dummy variable that denotes the firm's processing status, which is equal to one if the processing import of firm *k* is non-zero in year *t*, and zero otherwise. The coefficient α_5 before the processing dummy is used to capture the impact of processing trade on firm wages.

The vector X_{kjt} includes other firm level characteristics as controls, such as the firm size (the logarithm of firm capital), the firm performance ($\text{TFP}^{dl}{}_{kjt}$, the total factor productivity of firm *k*) and ownership variables.[95] Following Yu (2015), we do not use the logarithm of firm *k*'s total employment as a traditional control for the firm size but

[94] Here the total wage bill only includes the standard payment to workers and does not include the welfare and unemployment insurance. For a robustness check, we include those extra wage components to construct a variable of total compensation, and the average of which is used as a dependent variable. The results are quantitatively similar.

[95] Our measure of TFP is estimated following the De Locker (2007) approach and the modification conducted by Elliott *et al.* (2015).

we use the variable $\ln(\mathrm{K})_{kjt}$, the logarithm of firm *k*'s capital as an proxy for firm size instead.[96] There are three dummy variables to describe the firm ownership structure: state-owned enterprise (SOE), foreign-owned, Hong Kong/Macao/Taiwan owned (HMT), and a dummy for other types of firms is omitted.[97] The SOE dummy is equal to one if a firm *k*'s government share is no less than 50%, and zero otherwise; the foreign-owned dummy is equal to one if a firm *k*'s foreign share is greater than 50%, and zero otherwise; and the HMT dummy is defined as well as the foreign-owned dummy, equal to one if a firm *k*'s HMT share is greater than 50% and zero otherwise

Finally, we include ρ_k to control for unobservable and time-invariant firm fixed effects. ρ_{lt} is to control for firm-invariant location-year fixed effects that the shocks over time may differ across different regions in China.[98] ε_{kjt} is the error term.

However, using a processing dummy to identify the role of processing trade in trade liberalization may face an over-estimation problem since the coefficient is likely to be over-estimated. For example, if a firm with a processing dummy equal to 1 is classified or

[96] In our estimates the dependent variable is the log of firm *k*'s average wage, which could be written as: $\ln(\text{wage})_{kjt} = \ln(\text{total wage bill/labor})_{kjt} = \ln(\text{total wage bill})_{kjt} - \ln(\text{labor})_{kjt}$. Since the logarithm of firm labor is used as the denominator of the dependent variable, in equation (8) still using it as a proxy to control for firm size is inappropriate. Hence, we use $\ln(\mathrm{K})_{kjt}$ to control for firm size.

[97] Other ownership variables are used as robustness checks. One proxy we used includes government share, foreign share and HMT share as one proxy, which represent the capital owned by local or central government, foreigners, Hong Kong, Macau and Taiwan respectively, and the other proxy includes two indicators, SOEs and foreign-invested enterprises (FIEs). Following Yu (2015), we construct the indicators based on a firm's registration type (*qiye dengji zhuce leixing*). The role of SOEs is simple to identify (including code: 110, 141, 143 and 151) and a FIE is identified as a firm invested by other foreign countries. In particular, quite a lot of the Chinese firms are invested by Hong Kong, Macao and Taiwan and we also treat those firms as the FIEs. Specifically, FIEs include: HMT joint-stock corporations (code: 210), HMT joint venture enterprises (220), fully HMT-invested enterprises (230), HMT-invested limited corporations (240), foreign-invested joint-stock corporations (310), foreign-invested joint ventures (320), wholly-owned FIEs (330) and foreign-invested limited corporations (340). Additionally, Brant *et al.* (2012) also addressed that they utilize firm registration type to construct firm's ownership categories, but they have four categories: SOEs, foreign firms, private firms and hybrid firms (local government owned, town-owned, village-owned, etc.).

[98] Following Kamal *et al.* (2012), we utilize information on a firm's region code to construct firm's location categories. Based on two-digit region code, which is equivalent to the province level, we group Chinese regions into five categories – (1) Costal: Beijing (code: 11), Tianjin (12), Hebei (13), Shanghai (31), Jiangsu (32), Zhejiang (33), Fujian (35), Shandong (37), Guangdong (44) and Hainan (46); (2)Inland: Shanxi (14), Anhui (34), Jiangxi (36), Henan (41); (3)Northeast: Hubei (42), Hunan (43); (4)Southwest: Liaoning (21), Jilin (22), Heilongjiang (23), Guangxi (45), Chongqing (50), Sichuan (51), Guizhou (52) and Yunnan (53); (5)Northwest: Inner Mongolia (15), Tibet (54), Shanxi (61), Gansu (62), Qinghai (63), Ningxia (64) and Xingjiang (65). So there are four location dummies: Costal, Inland, Northeast and Southwest, and a Northwest dummy is omitted.

treated as an entire processing firm, means that it will be one hundred percent or fully affected by processing activity, although it only has one percent processing imports. This may cause an over-estimation problem as we over-state the impact of processing trade on firm wages and actually such impact is mainly due to ordinary trade which accounts for 99% of total imports. From our sample, the proportion of processing imports in total imports for processing firms is around 78% on average and it has a wide distribution, ranging from slightly greater than zero up to 100 percent. As a result, it is necessary and appropriate to take processing intensity into account, not simply using a processing indicator to identify the status of processing trade. In equation (8), we replace the processing dummy Processing_{kjt} with the measure of processing intensity, which is defined as the share of firm *k*'s imports through processing trade over its total imports in year *t*. Unlike the discrete dichotomous dummy variable, this measure is continuous. We include an interaction term between firm output (input) tariff rates and its $\text{Processing Intensity}_{kjt}$ to capture the differential effect on firm wages between processers and non-processers following a fall in output (input) tariffs. Specifically, our main empirical estimations use the following framework:

$$
\begin{aligned}
\ln(\text{wage})_{kjt} = {} & \gamma_1 \text{Output Tariff}_{kjt-1} + \gamma_2 \text{Output Tariff}_{kjt-1} \times \text{Processing Intensity}_{kjt} \\
& + \gamma_3 \text{Input Tariff}_{\text{kjt}-1} + \gamma_4 \text{Input Tariff}_{kjt-1} \times \text{Processing Intensity}_{kjt} \\
& + \gamma_5 \text{Processing Intensity}_{kjt} + \Gamma X_{kjt} + \rho_k + \rho_{lt} \\
& + \mu_{kjt}. \qquad (9)
\end{aligned}
$$

Similar as before, the effect for ordinary trading firms following a fall in output (input) tariffs is equal to $\gamma_1(\gamma_3)$, the net effect for processing firms by decreasing output (input) tariff rates is the sum of γ_1 and γ_2 (the sum of γ_3 and γ_4), and the coefficient γ_5 before the variable of processing intensity is used to capture the other potential gains induced by a firm's engagement in processing trade besides tariff liberalization. Still, we include the vector X_{kjt} to control for other firm level characteristics, ρ_k to control for unobservable and time-invariant firm fixed effects and ρ_{lt} to control for firm-invariant location-year fixed effects, and μ_{kjt} is the error term.

Alternatively, we exploit another approach to investigate the effects of trade reform on firm average wage by combining the impacts of output and input tariffs and use either 3-digit industry ERP or firm ERP to estimate the following equations (10) and (11):

$$\ln(\text{wage})_{kjt} = \theta_1 \text{ERP}_{kjt-1} + \theta_2 \text{ERP}_{kjt-1} \times \text{Processing}_{kjt} + \theta_3 \text{Processing}_{kjt} + \Lambda X_{kjt} + \rho_k + \rho_{lt} + \tau_{kjt}. \quad (10)$$

$$\ln(\text{wage})_{kjt} = \lambda_1 \text{ERP}_{kjt-1} + \lambda_2 \text{ERP}_{kjt-1} \times \text{Processing Intensity}_{kjt} + \lambda_3 \text{Processing Intensity}_{kjt} + \Psi X_{kjt} + \rho_k + \rho_{lt} + \upsilon_{kjt}. \quad (11)$$

3.3.3 Self-selection into Processing Activities

A firm may self-select into processing trade and self-determine its processing intensity, or the depth of processing engagement, according to its productivity and any financial constraints (Yu, 2014; Manova and Yu, 2014). Hence, the processing variables, processing dummy and processing intensity are likely to be endogenous. To avoid this, we perform a Heckman two-stage selection procedure to predict the fitted processing intensity for each firm and use this predicted processing intensity to replace the actual processing intensity for our empirical estimation.

The Heckman selection procedure is specified as follows:

(i) In the first stage, the probability of being a processing firm, is estimated by using a probit regression,

$$\text{Prob}(\text{Processing}_{kjt} = 1|\text{Z}) = \Phi(\text{Z}\varpi) = \Phi(\beta_0 + \beta_1 \text{Firm Age}_{kj,t-1} + \beta_2 \text{ST Liability}_{kj,t-1} + \beta_3 \ln(\text{VA})_{kj,t-1} + \beta_4 \ln(\text{K})_{kj,t-1} + \beta_5 \textit{Govt share}_{kj,t-1} + \beta_6 \text{Foreign share}_{kj,t-1} + \beta_7 \text{HMT share}_{kj,t-1} + \delta_j + \delta_t), \quad (12)$$

where Processing_{kjt} indicates a firm's processing status (Processing_{kjt}=1 if a firm imports any processing inputs, $\text{Processing Intensity}_{kjt}$>0 and zero otherwise), Z is a vector of explanatory variables for self-selection mechanism, Φ is the cumulative distribution function of the standard normal distribution and ϖ is a vector of unknown parameters. Following Manova and Yu (2014) and Yu (2015), a firm's choice to become a processer is affected by its age (Firm Age_{kjt}, defined as current year *t* minus the firm *k*'s birth year), financial constraints ($\text{ST Liability}_{kjt}$, short-term liability, which is defined as the share of current liability over total assets), firm performance ($\ln(\text{VA})_{kjt}$, the log of firm *k*'s value-added per worker), firm size ($\ln(\text{K})_{kjt}$) and its ownership structure, which we use ownership shares to describe.[99] We use the one-period lag of all explanatory variables and include the controls for industry effects δ_j at the 3-digit level and year effects δ_t.

(ii) In the second stage, to quantify a firm's depth of engagement in processing trade, we estimate a linear function of the explanatory variables except for firm age and incorporate a transformation of predicted probabilities of being a processing firm as an additional explanatory variable.

3.3.4 Endogeneity Concerns

One concern with the empirical specification in equations (8) and (9) is possible endogeneity which may be caused by potential reverse causality between firm income and tariff reductions. This in turn causes a negative bias on the tariff coefficients. The argument is that, although the reduction of tariff rates are restricted after China joining WTO, firms within low-income industries would still lobby or seek trade protection from the government (Grossman and Helpman, 1994), which could lead to the maintenance of tariffs at relatively high levels and protect the low-profit firms from the tougher import-competition. If a firm in a low-income industry does not have the lobbing power to affect tariffs, facing tougher import competition induced by the lower tariffs, might

[99] The ownership shares include the capital share controlled by central or local government, the capital share invested by foreigners and the capital share invested by Hong Kong, Macau and Taiwan.

mean that it would exit the current market or cut costs and earn less to survive, which would certainly impact worker's wages. However, if a firm has lobbing power, it would not need to cut workers' wages.

However, there are two main reasons why we do not expect the endogeneity of tariffs to be primary concern in our estimations. First, as explained in greater detail in Brandt *et al.* (2012) and in chapter two, the tariff liberalization conducted in 2001 after China joining WTO was negotiated and in China the striking uniform import tariffs after trade reform cannot be explained by policy endogeneity. It seems that changes in trade policy result in all tariffs moving to a low (same) level, which supports the argument that tariff endogeneity is not a big issue in China. As a result, they believe that tariff reductions are exogenous when exploiting causality between productivity and policy reforms. However, in chapter two, we clearly discuss the endogeneity issue in multiple ways and conclude that while the immediate changes in tariffs after the accession to WTO are exogenous, the same cannot be said of tariffs before 2001.

Nonetheless, this does not necessarily imply that firm tariffs are exogenous to firm wages. And hence, we examine whether past firm average wages predict current firm tariff rates and ERPs. To do so, we then regress our measurement in trade protection at the firm level on the one-year lagged firm average wage as well as three-digit industry effects and year effects.[100] In Table 2.4 our estimated results rarely support the notion that firm-level trade protection is driven by firm average wages since firm tariffs are unlikely to be driven by firm average wages after 2001 and firm ERPs are unlikely to be driven by firm average wages for the period 2000-2006.[101] Hence, it is suggested that firm protection after 2001 can be treated as exogenous and as a result, we restrict the

[100] In chapter two of this thesis, we have already examined this relationship based on industry tariffs and industry ERP and found that industry protection is not driven by firm average wage in the post-WTO period. Hence, we only test on firm tariffs and firm ERP.

[101] For firm output tariffs, the coefficients on lagged firm average wages are insignificant for pre-WTO period and post-WTO period but significant for full sample. For firm input tariffs, the coefficients on lagged firm average wages are insignificant for full sample and post-WTO period but significant for pre-WTO period. For ERP, both at the industry level and at the firm level, the coefficients on lagged firm average wages are insignificant for all different periods. Due to the coefficients on lagged firm average wages for tariffs are very small, we keep the first 4 digits after the decimal point only in Table 4 whilst in other tables we always keep the first 3 digits.

sample to the period 2002-2006 and use one-year lagged trade protection in each specification because firm wages are unlikely to have adjusted instantaneously.

[Table 2.4 about here]

Moreover, as concluded in chapter two based on IV estimations, the endogeneity problem of tariffs does not seem to be a big issue in our study. Therefore, we treat firm-level trade protection as exogenous variables for firm wages and use OLS approach in all our specifications as reported in section 5. Then in the following section, we introduce three data sources that we used and data merging and cleaning as well.

3.4. Data

3.4.1 Data Sources

To examine the impact of decreasing tariff rates on wages of trading firms, and whether such impact is affected by the extent of firm's engagement in processing trade, we draw on three main sources of micro-data: detailed industrial firm data, comprehensive trade transaction data and tariff rate data.

China's tariff data available at the HS 6-digit product level for 2000-2006 are from the WITS database and are also used by Kamal *et al.* (2012) and Hu (2014).[102] For measurement, we use effectively applied tariffs which means taking the tariff rate and weighting it by imports.

The detailed industrial firm data that includes all SOEs and non-SOEs whose annual turnover is over 5 million RMB (commonly referred to as the "above-designated size" firms) are from the Chinese Annual Survey, which is officially conducted and collected by

[102] The WITS provides data of exports, imports, tariff and measures of non-tariff barriers and hence, we use it to access to China's tariff data for our sample period except for 2002. Following Yu (2015) we obtain the 2002 tariff data from the TRAINS.

the NBSC.[103,104] Our main interest is the manufacturing industries and hence we exclude the mining industry, industry of electric production and supply and industry of natural gas and water from this dataset. The dataset also provides rich information on three standard accounting statements and they are Balance Sheet, Cash Flow Statement and Income Statement.[105]

The detailed exports and imports are recorded at the HS 8-digit product level and are reported monthly for all trading firms and are from the Customs Trade database which is officially managed by the GACC. It reports the value of the universal trade transactions in US dollars and also indicates the trade regime for each transaction (i.e. ordinary trade and processing trade), which is one of the main interest variables for our research purpose.[106]

3.4.2 Data Merging and Cleaning

To find out the impact of processing trade on firm wages after tariff falls, we rely on the merged sample from the latter two data sources. Therefore, we combined the annual industrial firm data and the monthly trade data by using firm name, contact person name, telephone number and postcode-common variables from both datasets to identify each and every unique firm.[107]

Our research aims to investigate the differential impacts of tariff reductions on trading firms and hence we exclude the firms with no exports and no imports

[103] The value of 5 million RMB is a 770,000 US dollars in 2014 as the exchange rate is 1 RMB=0.154 US dollar.

[104] Each observation in the CASIF dataset is a plant and definitely we are not able to identify or trace a firm with multi-plants. To make it simple, we still call them "firm".

[105] We drop two sectors and three industries based on 2-digit industry codes. One is the mining sector, including codes 06, 07, 08, 09, 10 and 11; the other is the sector of energy production and supply, which includes the codes 44, 45 and 46; additionally, tobacco (16), arts and crafts (42) and resource renewable and recycling (43) industries are excluded.

[106] China's Customs specified the range of processing trade in 2012 and based on 2-digit regime codes, we listed the processing trade types in Table 1A.10.

[107] We combine aspects of the matching methods from both Upward et al. (2013) and Yu (2015) and we report the detailed matching process in Appendix 1A.3.

(non-trading firms) from our clean merged dataset.[108] As explained in section 3.1.1, to make sure our measurement of firm output tariffs are not biased, we should further exclude the firm with zero domestic sales (pure exporting firms) and the firms with zero exports (pure domestic firms). Intuitively, the latter are already excluded in the first step since we exclude the non-trading firms and hence we only need to further exclude the former. We therefore have an unbalanced panel with 135,793 observations and 56,765 unique firms for period 2000-2006 in total.

3.5. Empirical Results

3.5.1 Baseline

In this chapter, we aim to investigate how tariff liberalization affects firm wages and present our estimations starting with a comparison between industry tariff rates and firm tariff rates in Table 2.5. In these estimations we cluster errors by firm and control for several fixed effects, including invariant effects (3-digit industry effects, location effects and year effects) and time-varying effects (location-year effects) in all regressions.

[Table 2.5 about here]

The first three columns of Table 2.5 report the results with industry output and input tariffs and their interaction terms and the last three columns report the results with firm output and input tariffs and their interaction terms. First, we only use output and input tariffs as explanatory variables and include processing dummy as well in columns (1) and (4), and we find that for industry tariffs, reductions in both output and input tariffs do not affect firm wages, however, a different situation occurs for firm tariffs where we have

[108] The clean principle and process are also reported in Appendix 1A.4 and 1A.6. However, the data used for chapter two are already dropped processing firms in the cleaning step after merging. Hence, to satisfy our research purpose on processing firms for this chapter, we use the clean merged sample without dropping processing firms to exclude non-trading firms. Thus, the majority of the observations are excluded and such non-trading firms account for nearly 83% of the clean merged sample before excluding processing firms, and almost 17% of observations are trading firms, which is consistent with Bernard *et al.* (2007) that only a small proportion of firms are able to engage in international trade.

the output tariff coefficient positive and significant and the input tariff coefficient negative and significant in column (4), suggesting that decreasing firm output tariff rates induces a decrease in firm wages and decreasing firm input tariff rates induces an increase in wage payments to workers. However, the coefficient on processing dummy is insignificant in both column (1) and column (4).

One possible explanation for our unexpected finding is that when constructing our industry output and input tariffs, the weights used are at a more aggregated level and also take the products' information of consumption and sales for other non-trading firms. Hence, using industry tariffs may be too broad to capture an individual trading firm's reaction to the tariff changes.

An interaction of output tariff rates and a processing dummy and an interaction of input tariff rates and a processing dummy are included in columns (2) and (5), tariffs in the former column are at the industry level and in the latter they are at the firm level. In columns (3) and (6) we replace the processing dummy with each firm's processing intensity and also include its interactions with both tariff rates at different aggregated levels. For industry tariffs, the input tariff coefficient is always insignificant. However, in columns (2) and (3) the output tariff coefficient becomes significantly positive and additionally, the interaction coefficient of processing status (either processing dummy or processing intensity) and output (input) tariff is significantly negative (positive), which suggests that decreasing output (input) tariff rates increases (decreases) wages of processing firms, but decreasing output tariff rates also decrease wages of on-processing firms. For firm tariffs, we still have the output tariff coefficients positive and significant and the input tariff coefficients negative and significant in the last two columns. Only the coefficient on a processing dummy in column (2) is highly significant and negative, implying that firms engaged in processing trade pay lower wages.

Although the output tariff coefficients in both column (2) and (5) remain the same sign but are with different magnitudes, which implies that when calculating tariffs at a more disaggregated level, the effect of falling tariffs on firm wages is diminishing, form a number of 0.110 to 0.083, reducing by nearly 25%. Hence, such differences and the insignificant coefficients on tariffs in column (1) both suggest the pitfalls of using tariffs at the industry level. For instance, if product *m* in an industry experiences a fall in output tariffs, such reduction would not be directly relevant to a firm does not produce such a product. Hence, the pro-competition effect may be overestimated for a firm if industry output tariffs are used. Further, the input tariff coefficient in column (2) is insignificant but it becomes significantly negative in column (5), which indicates that if we ignore the fact that processing imports can enjoy tariff exemptions, as a result of this, a potential measurement error may be introduced during our estimation. Hence, using firm tariff rates are better at capturing the effect of tariff exemptions due to processing trade.

Moreover, even though a firm's processing status has been taken into account, the impact of firm-level tariff reductions on average wages indicates no statistically significant differential effects for processing firms, no matter using processing dummy or processing intensity. One possible explanation is that a firm's decision to become a processing trading firm or its decision to import the amount of processing inputs is endogenous and this would bias our estimation results. To avoid this potential problem, we do not use the current processing status for measurement. Hence, we use the two-stage Heckman selection procedure to model a firm's self-selecting into processing trade in section 5.2 and utilize the adjusted processing intensity obtained from Heckman estimation for the rest of specifications.[109] Further, the joint significance tests on output tariffs suggest that the net impact for processing firms by decreasing industry output tariff rates is none.

Additionally, we use industry level ERP and firm level ERP as a measure of trade protection for robustness checks and report the results in Table 2A.2. Only the coefficients on industry ERP are significantly positive, suggesting that falls in industry ERP lower wages for firms not engaged in processing trade.

[Table 2A.2 about here]

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[109] Processing intensity is a more accurate way than processing dummy to describe a firm's engagement in processing trade since processing intensity is a continuous measurement of firm's different engagement in processing trade. Using processing dummy may result in overestimating the role of processing firms. According to the definition of a processing dummy, if a firm's processing intensity is only 1% or even smaller, it would still be given processing dummy with value one and thus its processing intensity becomes 100% now, which may induce a measurement error.

As discussed before, we conduct Heckman Two-stage Selection model in the next section to control for the potential endogeneity that a less-productive firm may self-select into processing trade.

3.5.2 Heckman Self-selection Procedures

To avoid the potential endogeneity bias caused by firm's self-selection into processing activities, we conduct the Heckman two-stage procedures to obtain the adjusted processing intensity for our main estimations as follows.

As mentioned by Manova and Yu (2014) and Yu (2015), a firm's choice to become a processor is affected by many factors, like firm age, size, productivity, ownership structure and its ability to get financial support, so we use such factors as our explanatory variables to determine a firm's processing status. In the first stage, we use firm age to determine the choice of being processing firms but exclude such a age variable in the second stage, where a firms processing intensity is determined. The fact that firm age serves such purpose has been mentioned in Amiti and Davis (2011), which believes that older firms are seen to be more likely to export.

We report the results in Table 2.6, where industry and year effects are controlled. We control for three-digit industry specific effects and year fixed effects. From the first-stage probit estimation, firms established earlier are more likely to self-select into being processors, which is also concluded in Amiti and Davis (2011) also in Yu (2015). Similarly, large and foreign firms are more willing to become processors as well as low productive firms, which is also consistent with the conclusions in Yu (2015) although we use a different variable, the log value-added per worker, as a proxy for concerning firm productivity and the log capital as a proxy for firm size, while in Yu (2015) TFP and the log employment are used to measure the effect of firm productivity and size respectively. Finally, Manova and Yu (2014) predicted that firms with high-leverage, where the leverage is the ratio of short term debt to current asset, or tough financial constraints are more likely to turn to processing trade, whilst Yu (2015) predicted that firms mainly controlled by central government or local government are less likely to become processing firms. In our first-stage estimation, we obtain the predicted signs for such two variables and the coefficients of them are significant at the 1% significance level. Instead we use short-term liability, where the short term liability is defined as the share of current liability over total assets, to control for financial constraints that firms may face and we have a positive coefficient on it, which demonstrates that a firm with more debts is more likely to become a processing firm.

[Table 2.6 about here]

From the second-stage linear estimation for determining firms' share of processing imports, the estimated coefficients of explanatory variables have identical signs to those obtained in the first-stage probit estimation except for log firm capital where the coefficient on log firm capital becomes negative but insignificant. Our findings are partly consistent with the conclusions in Yu (2015) as he concluded that large and foreign firms have a higher proportion of processing imports. Additionally, the coefficients on the short term liability and the government share are positive and negative respectively and become marginally statistically significant at the 1% significance level, which implies that firms with low liquidity would engage more in processing trade and firms that are highly controlled by government seem to participate less in processing trade.

Hence, from Heckman model we have the adjusted processing intensity for each firm now and we use this instead of the original intensity for our following estimations, which has been discussed in our estimation strategy before.

3.5.3 Preliminary Estimates

As noted in the previous sections, we use the adjusted value of firm's processing intensity predicted by the Heckman selection procedure instead of the original or actual one for controlling the endogeneity caused by self-selection to become processing firms. The results in Table 2.7 are OLS panel estimations and all the results are based on the controls of three-digit industry specific effects, invariant location and year effects, year fixed effects and time-varying location-year effects.

[Table 2.7 about here]

We run the fixed effects model with the industry tariff variables and adjusted processing intensity in the first column and we then turn to using firm tariff variables and adjusted processing intensity in column (2). The interaction coefficient of industry output tariff rates and the adjusted processing intensity is significant and negative in column (1). Comparing such results for industry output tariffs with those in column (3) of Table 2.5, the interaction coefficient remains the same sign but is with a larger magnitude now, indicating that the endogeneity problem of self-selection may cause an under-estimate effect. In comparison with the results for industry input tariffs in column (3) of Table 2.5, the industry input tariff coefficient becomes significantly negative now which is insignificant before, whilst the interaction coefficient of industry input tariff rates and the adjusted processing intensity remains positive but becomes insignificant now which is significantly positive before.

Alternatively, in column (2) firm output tariffs interacted with adjusted processing intensity has a significant and negative coefficient now, and such coefficient in column (6) of Table 2.5 is negative but insignificant. Moreover, the firm output tariff coefficient is statistically significant and positive in column (6) of Table 2.5 but such coefficient becomes insignificant in column (2) of Table 2.7. For firm input tariff rats, in the last column of Table 2.5 and in the last column of Table 2.7, the input tariff coefficient remains statistically significant and negative. But the latter coefficient is greater than the former, more than twice of the former. Hence, we conclude that the endogeneity of self-selection into processing trade can bias our results and we should always use the adjusted value of firm's processing intensity predicted by the Heckman selection procedure in our rest estimations.

Additionally, with a comparison of the results in Table 2.7, we find that the magnitudes for firm tariff variables are slightly greater those in industry tariff variables, suggesting that it is much better or more accurate to choose firm tariffs as our indicators rather than industry tariffs. Since the interaction of output tariff rates (industry/firm) and the adjusted processing intensity is negative and significant, we can argue that falling output tariff rates makes processors pay higher wages than non-processors, and such positive impact becomes stronger as firm processing intensity grows, which is in contrast to the findings in Yu (2015) which states cuts in output tariff rates can lead to a growth in firm productivity but such growth will decrease if a firm increases its engagement in processing trade. The potential explanation is firms engaged in processing trade rarely sell products in the domestic markets, and hence they may bare less import competition caused by cutting output tariffs than non-processors when comparing with other trading firms. In our sample, the mean export share of non-processing firms is around 23% and hence nearly 80% of their outputs are sold locally. Thus, such majority of outputs which serves domestic market has to face even tougher import competition by dropping output tariff rates and hence earn less and pay lower wages relative to processing firms since their exports may not be sufficient large to outweigh the loss from domestic market. Therefore, if a firm engages more in processing trade, it will sell less in the domestic market and following a cut in output tariffs it would face less import competition than non-processing firms, and hence earn more and pay higher wages relative to non-processing firms.

As the input tariff coefficient (industry/firm) has a significantly negative sign, we can argue that non-processing firms experience a gain in firm wages following a fall in input tariff rates, similar to those in Yu (2015). Since a drop in input tariffs, firms become much easier to access to variety of imported inputs with high quality and hence increase productivity and pay higher wages.

As a robustness check, we then regeress the firm average wages with the ERP variables and adjusted processing intensity and report the results in Table 2A.3. The coefficients on the ERP variables themselves and their interaction terms are all insignificant although the firm adjusted processing intensity remains a significantly positive sign at the 1% significance level, indicating that the combination effect of output and input tariffs is close to zero.

[Table 2A.3 about here]

3.5.4 Additional Controls for Firm Characteristics

It is also worthwhile to check whether our findings above hold after including other firm characteristics. Thus, we further consider the role of firm ownership structure, productivity, size and financial variables. The results are provided in Table 2.8.

[Table 2.8 about here]

In column (1) of Table 2.8, we include three dummy variables to characterize a firm's ownership and they are SOE dummy, foreign-owned dummy and a dummy for HMT-owned. The coefficients on all the significant terms are exactly the same in terms of magnitudes as those in column (2) of Table 2.8, and we have a significantly positive coefficient on foreign-owned dummy, indicating that workers worked in foreign-owned firms get higher wages.

Another possibility that may drive our key results is upgrades in firm productivity induced by dropping tariff rates. According to Yu (2015), falling output (input) tariff rates can lead to a higher level of productivity but such a productivity growth may become smaller if a firm imports more in processing inputs. To check this, we include firm total factor productivity (TFP) in the second column of Table 2.8 and see that its coefficient is highly significant and positive, suggesting that a high productive firm pay a higher wage. But the coefficient on the adjusted processing intensity is now a little smaller as well as the interaction coefficient of output tariff rates and the adjusted processing intensity and the input tariff coefficient, but the latter still remain at the same significance level.

Here, we also include the log firm capital as the control for firm size in column (3) and obtain a highly significant and positive coefficient on it. Hence, firms with higher capital pay higher wages. We then include firm leverage in the following column as a proxy for controlling firm financing capability, where firm leverage is the ratio of current liability to current asset as described in Manova and Yu (2014), and find that it has a positive coefficient although insignificant. Thus, firms with lower leverage, being financially healthier and less constrained, do not tend to pay higher wages to workers, which is inconsistent with Manova and Yu (2014) that profits are affected by producers' financial health and firms with higher liquidity and less constraints are more free to choose opportunities to maximize their profits. But, more importantly, the inclusion of the firm size and leverage leaves the significant coefficients on tariffs unchanged and the coefficient of adjusted processing intensity is almost the same.

Additionally, we include the total debt ratio at the firm-level in column (5) as another alterative control for firm financing capability, where firm total debt ratio is the ratio of total debt to total asset, and find that it is significantly negative as expected in column (5). Thus, firms with higher debts are more financial constrained and hence pay lower wages to workers, supporting the views in Manova and Yu (2014).

Our conclusions for all these specifications in Table 2.8 remain consistent with the conclusion of column (2) in Table 2.7. Reductions in output tariff rates can increase wages of firms that have processing business relative to non-processing firms and such increases in wages by dropping output tariff rates will become larger by increasing firm's processing intensity. We also find that reductions in input tariff rates can induce non-processors to pay higher wages but can not cause wage differentials between non-processors and processors.

Finally, in Tables 2A.3 and 2A.4 we use two different measures of firm ERP to evaluate the impact of trade protection on firm average wages with several firm characteristic controls as robustness checks. The conclusions from both tables are clearly consistent with those in Table 2A.2, implying that a fall in firm ERP does not affect firm average wages but importing more processing inputs has a positive impact on firm average wages.

[Table 2A.3 about here]

[Table 2A.4 about here]

3.5.5 Channels

We have presented robust evidence that output tariff reductions boost the wages of processing firms and the impact becomes stronger as the share of processing imports increases whilst input tariff reductions boost the wages of non-processing firms. W can conclude that there is a connection between tariff reductions and firm wages, however, and we still need to assess the plausible channels to interpret the mechanism of such effects, as they are partly consistent with the findings of Manova and Yu (2014) and Yu (2015), who conclude that a firm boosts its productivity after experiencing a fall in output (input) tariff rates and such a positive impact may become weaker by an increase in firm's processing intensity(Yu, 2015) and compared with processing firms, ordinary trading firms are exposed to high risk due to contracts maybe imperfectly enforced and hence have more bargaining power to acquire more profits when they have access to international trade (Manova and Yu, 2014).

According to Amiti and Davis (2011), firm wages are dependent on firm performance and positively correlated with profits. We first detect the relationship between firm tariff changes and profits and report our findings in Table 2.9. Based on our panel sample, we first regress the log total profits as a proxy for denoting firm performance on output and input tariff rates as well as their interactions. We find that if firms are global engaged, they could obtain profit gains by decreasing tariff rates especially for output tariffs, but the coefficients on tariff interactions are insignificant which indicates that such a positive impact on firm profits is not affected by changes in firm processing intensity, which is consistent with Manova and Yu (2014) that once a firm can manage and occupy more stages of global supply chains, as a results of this, it can achieve higher added-value and thus higher profits. However, the requirement of high working capital and financial constraints prevent firms to jump from a low-productive stage to a high-productive stage freely.

[Table 2.9 about here]

As a result, in China the situation in terms of firm profits is quite different from that of firm wages and we try to figure out the reasonable explanations behind this. One possible channel is that lower input tariffs induces access to a vast variety of imported intermediates (Amiti and Konings, 2007; Helpern *et al.*, 2010) and this results in firms switching their usage of intermediate inputs form low to high-quality products, if switching allows them to increase variety and quality, then this action is likely to increase their TFP and thus enable them to pay higher wages. This is one prospect and another is that lower output tariffs induce tougher competitions as smaller barriers and weaker protections would allow more foreign goods to enter the local market. To occupy and explore the market, firms need to upgrade their products and still maintain their profits, and hence, it is desirable for them to use high-quality inputs for production. Specifically, if firms engaged in processing trade, they have little ability or power to choose and decide the variety of processing inputs, and hence we focus on firm's scope of ordinary imports which are more related to the dependence of a firm's own choice. As a result, we regress firm average wage bills additionally on the log of firm ordinary imported inputs in column (2) and expect the coefficient on it should be positive, but we observed that the log of firm ordinary imports has an insignificantly negative coefficient, showing that intermediates switching is not attributable to firm wages. Besides, the channel for processing firms to boost their wages after tariff reductions may be addressed through the structural changes of products from low-productivity to high-productivity and we hypothesis that multi-product firms can have more chance to acquire higher profit and thus pay more. So we also include the log of firm export scope as the measure for such effect in column (2) and see an insignificant and negative impact of export scope on firm wages, suggesting that workers do not benefit from firms that export multiple products. The possible explanation is that even though switching to such intermediate imports with high-quality, firms still lack technological experiences to adjust or find out an appropriate way for better usage of imported inputs, or firms have already purchased or obtained better returns in the short-run, but they would still like to keep the profits for future development and desire to have a sustainable profit growing ability, and hence they do not share part of their profits with workers.

As stated before, we should check the correlation between a firm's expenditure on research and development (R&D) and its wages. To consider that firms may earn higher profits from investing in technology development, we include the log firm R&D as our control in column (3) and find its coefficient is negative as expected but insignificant. This may be explained by lacking R&D data for full sample. We only ave the R&D information in year 2004-2006 and they just account for 34% of the observations around 2002-2006.[110] Thus, we only run a small sample regression and the effect of R&D expenditures or investment in new technologies is under-estimated. It is also hard for use to investigate the improvement or importance of technology upgrade or detect the gians from technology improvement.

We also detect such channels by using the measures of firm effective rate of protections in Table 2A.5 and find the same conclusions as those for firm tariffs.

[Table 2A.5 about here]

3.5.6 Discussion of results

Since our estimates are robust after all controls, we start to discuss the economic or policy implications of our findings. Based on the result of column (2) in Table 2.7, the interaction coefficient of firm output tariff rates and the adjusted processing intensity is -0.327, which is used to address the differential effects between processing firms and non-processing firms following a fall in output tariffs, and the firm output tsriff coefficient becomes insignificant, so on average, we can only conclude that the differential effect for processing firms by falling output tariff rates is -0.327×0.42= -0.13734, given that the mean of firm adjusted processing intensity is 0.42. This negative 0.13734 could be interpreted as saying that a 10% decrease in output tariff rates can lead to a 0.013734 growth in the log mean wage in processing firms and equivalently to a 1.37% growth in firm wages. Thus, in short processors pay 1.37% higher wages than non-processors by drops output tariff rates. From Table 2.2 we can see that average firm output tariffs are reduced by 3.55% points in our strict sample, from 19.97% in 2002 to

[110] Here we only include the observations with valid R&D information, which are without the observations with negative R&D expenses.

9.39% in 2006. Thus, we could predict that cutting output tariffs in the years 2002-2006 contributes almost 0.49% (-0.13734×3.55%=0.487557%) to the wage gap between processors and non-processors covered in our sample after WTO.

For firm input tariffs, its coefficient is -0.379, which is used to describe the impact on non-processing firms following a cut in input tariff rates. But the interaction coefficient of input tariff rates and the adjusted processing intensity is insignificant, so on average, we can only conclude that falling input tariff rates has a negative impact on non-processing firms and the number is -0.379, implying that a 10% decrease in input tariff rates can lead to a 3.79% increase in wages for non-processing firms. Moreover, from Table 2.2 we can see that average firm input tariffs are reduced 0.61% points, from 2.73% in 2002 to 2.12% in 2006. Thus, we could predict that cutting input tariffs contributes overall nearly 0.23% (-0.379 × 0.61% = 0.23119%) wage gains for non-processing firms in the sample.

3.6. Conclusion

The impact of tariff liberalization on firm wages has attracted a considerable interest from academics and policy makers. While some attention has been paid to the role of processing trade in global value chains (GVCs), no prior study has found how processing trade affect firm wages through tariffs liberalization in China. Our article aims to fill this gap and we tend to explore how reductions in both types of output and input tariffs affect wage payments for trading firms. Specifically, we try to figure out the role of processing trade: whether China has gained or lost in labor welfare after participating in processing trade through trade liberalization?

Based on our empirical results, we have examined the linkage between tariff reductions and wages for trading firms over 2002-2006. Specifically, taking the special tariff treatment into account for processing firms, we can conclude that during tariff liberalization in China, a fall in output tariff rates induces a higher wage for processors than non-processors, but such a fall in input tariff rates makes non-processors experience a wage gain. Such findings are partly consistent with those found previously for firm performance, such as productivity or profits.

One concern in our empirical practices is the firm heterogeneity, which could affect firm wages. Another concern to determine a firm's wage is the role of worker heterogeneity, which has been stressed its importance in early studies (Abowd *et al.*, 1999; Abowd *et al.*, 2002; Frias *et al.*, 2009). But the current data do not support us to address the latter issue and we may discuss the topic of changes in laborcomposition following tariff liberalization in our future work.

As highlighted in our estimates, a firm's switching in processing engagement could have influence on firm wages. It would be very interesting to investigate the role of changes in firm production structure or shifts in product composition as a response to a firm's different engagement in processing trade after tariff falls. All of these remain the directions for our future study.

Chapter 4. Export Status Switching and Wages

Abstract

This paper examines the impact of tariff reductions on the firm's decision of to switch between different modes of exporting. We find that a cut in output tariffs decreases the wages of pure processing exporters who do not switch and a cut in input tariffs increases the wages of pure processing exporters who switch to being pure ordinary exporters. In contrast, pure ordinary exporters who switch to being pure processing exporters pay lower wages when they experience a cut in input tariffs. We highlight that input tariff reduction at the firm level can determine the decision of the firms to switch between different modes of exporting and most importantly, such reduction on firm level input tariffs always encourage exporting firms switch to another export status to upgrade their productivity level.

4.1. Introduction

Between 1990 and 2009, China's share of world manufacturing exports grew from only two percent to thirteen percent (Hanson, 2012). An important dimension of this impressive growth has been the remarkable but declining role of processing exports in China. In 1999, processing exports represented 53.7 % of China's total exports, but by 2006 this had fallen to 53.6% and by 2012 it accounted for just 34.8%. Recent studies have argued that the composition trade matters for China and its trading partners. Koopman *et al.* (2012) and Kee and Tang (2015) find that ordinary exports comprise more than two times as much domestic value-added per USD as do processing exports. Recent work by Jarreau and Poncet (2012), and Yu (2015) also indicates that in comparison to processing trade the most traditional channel of ordinary trade entails substantially more technological upgrading and facilitates larger spillovers to the domestic economy.

In this paper we examine the impact of tariff reductions in China on the switching behavior of firms between different modes of exporting. The difference between ordinary trade and processing trade in China differs most prominently in terms of tariff treatment and hence the ability of processing firms to sell their final products to foreign markets free from import and export tariffs. Manufacturing firms engaged in processing business enjoy a zero tariff rate for all the import of intermediate inputs for processing trade which reduces production costs relative to non-processors. The benefits that processors experience from tariff exemptions may encourage other domestic producers to switch, either partly or entirely, from a domestic producer and ordinary exporter to an exporter processor.[111]

[111] Part processing producer means that manufacturing firms conduct both ordinary trade and processing trade. Processing producers that export all of their outputs are called are pure as

Based on three major data sources (Chinese Industrial Firm dataset, Custom Trade dataset and Chinese applied tariff data), we construct firm-level output and input tariffs and a firm level effective rate of protections (ERP) to investigate the impact of export mode on wages following a period of trade liberalization and explore the determinants of firm export switching. The rest of the paper is organized as follows. In section 2 we describe the data sources and section 3 introduces the different trade modes in China. In section 4 we describe our estimation strategy and our measures of firm-specific tariffs and ERP. Section 5 presents our results and section 6 concludes.

4.2. Data

4.2.1 Data Sources

To investigate the determinants of switching in different modes of exporting firms, we draw on three main sources of micro-data: tariff data, detailed firm-level production data and product-level transaction data.

China's tariff data available at the Harmonised Commodity and Description and Coding System (HS) 6-digit level for 2000-2006 are from the World Integrated Trade Solution (WITS) database, also used by Kamal *et al.* (2012) and Hu (2014).[112] Our measure of tariffs is based on effectively applied tariffs, which means taking the tariff rate and weighting it by imports.

The detailed firm-level production data are collected from the Chinese Annual Survey of Industrial Firms (CASIF), which is conducted by the National Bureau of Statistics of China (NBSC), and cover all state-owned enterprises (SOEs) and non-SOEs with annual

processors and are firms, that participate in enrolled in global markets only for the purpose of assembling and processing.

112 The WITS software provides access to international merchandise trade, tariffs and non-tariff measures (NTM) data, and it covers China's tariff data for our sample period except for 2002. Following Yu (2014) we obtain the 2002 tariff data from the WTO and the Trade Analysis and Information System (TRAINS).

sales above 5 million RMB (commonly referred to as the "large-size" firms).[113] [114] The dataset has broad sector coverage and includes the mining, manufacturing, production and supply of electric power, gas and water industries. Since our main interest is the manufacturing industries we exclude the mining, production and supply of electric power, gas and water industries from this dataset. also the dataset provides rich information on standard accounting statements The dataset provides rich information for each firm and includes not only the basic information but also financial variables listed in the main accounting statements (i.e. balance sheet, income statement and cash flow statement), such as firm name, firm ID, total capital, annual sales, employment, and so on.[115] Since the dataset is not a census of all manufacturing firms in China, it is not well suited to study the entry and exit of firms (if firms exit the dataset, it is unlikely that they have truly disappeared from the economy).

The product-level transaction data is from the database of the Chinese Customs Trade Statistics (CCTS) which is compiled and maintained by the General Administration of Customs of China (GACC). Data from all three sources cover the period from 2000-2006. The disaggregated trade transaction data is collected at the HS 8-digit product level and covers monthly trade records for all firms, starting from 1st January 2000 and ending on 31th December 2006. It records the value of the universal trade transactions in US dollars universal information for each trade transaction and also indicates the trade regime for each transaction (i.e. ordinary trade and processing trade), which is one of the main interest variables for our research purpose.[116] Moreover, each trade transaction includes basic information such as firm name, firm contact person,

113 5 million RMB is 770,000 US dollars in 2014 as the exchange rate is 1 RMB=0.154 US dollars.

114 The CASIF production data are at the plant level and it is not possible to identify multiple plants belonging to a firm. For convenience we use the word "firm".

115 For exclusion, we drop two sectors and three industries based on 2-digit industry code. One is the mining sector, including codes 06, 07, 08, 09, 10 and 11; the other is the sector of production and supply of electric power, gas and water, which includes the codes 44, 45 and 46; additionally, tobacco (code: 16), handicrafts (code:42) and recycling (code: 43) industries are excluded.

116 In 2012, there are 16 specific types of processing trade reported by China's General Administration of Customs which include: international aid (regime code: 12), compensation trade (13), processing with assembly (14), processing with imported materials (15), goods on consignment (16), border trade (19), contracting projects (20), goods on lease (23), outward processing (27), barter trade (30), warehousing trade (33) and entrepot trade by bonded area (34).

telephone number and firm postcode for location, which are useful for our merging process in the next section, and it also records trade types (i.e. exports and imports) and hence we can trace the effect of engagement in international trade separately for each type of trade.

4.2.2 Data Merging

Our empirical analysis critically relies on the merged data from the latter two data sources, NBSC and GACC datasets. However, in practice merging those two datasets is not a simple process. Although each firm in either the production or trade dataset has a registered ID, different coding systems are used for each dataset. Indeed, the firm ID in the production dataset is coded by the local administrative authorities and is a 9-digit code. In contrast, the firm ID in the trade dataset is coded by the Customs and is a 10-digit code. As a result, one cannot simply merge the two datasets using firm IDs.

As an alternative, we combined the firm-level production data and the product-level transaction data by using firm name, contact person name, telephone number and postcode-common variables from both datasets to identify each and every unique firm.[117] The comprehensive process of data preparation for both data sources, and the matching and basic cleaning process, is described in detail in Appendix 1B of chapter two. We therefore have an unbalanced panel with 1,026,728 observations and 350,699 unique firms for 2000-2006 in total.

To satisfy our research purpose, we further exclude some observations from our merged sample and we report the principle of data exclusion in Appendix 3A.

4.3. Firm Trade Status in China

4.3.1 Classification of Firm Trade Status

According to whether a firm chooses to engage in international trade, we can classify

[117] We combine aspects of the matching methods from both Upward *et al.* (2013) and Yu (2015).

firm as a trading firm or non-trading firm. For the latter, it means that firms do no export or import and they source intermediate inputs and sell their final products domestically. For the former, there are three different trade statuses: export only, import only, or both export and import. Specifically, in China firms can penetrate global markets through either ordinary trade or processing trade. Ordinary trade is a traditional and the most difficult route for firms to engage in international trade. The second is through processing trade which can be considered as an easier route into international markets. Therefore, if firms want to export (import), they can access this through ordinary exports (ordinary imports) or processing exports (processing imports). As a result, we classify Chinese manufacturing firms into eight groups, one group for non-trading firms and seven groups for trading firms. These categories are listed in Table 3.1.[118]

[Table 3.1 about here]

As our intention is to measure a firm's ability to export and to investigate the role of firm switching trade status on exports, we concentrate in those firm groups that include exporting. First, we define firms that do not export as type I, called non-exporters (NE), and hence, group 1 (firms with no exports and no imports) and group 3 (firms with ordinary imports only) are included in type I. For exporters, based on the composition of export status there are three types. First, Type II pure ordinary exporters (OE), Type III pure processing exporters (PE) and Type IV mixed exporters (ME). Type II pure ordinary exporters are those firms that only use the traditional route and sell products directly to foreign markets, and hence, include group 2 (firms with ordinary exports only) and group 4 (firms with ordinary exports and ordinary imports). Type III, mixed exporters, are those firms that export through both the ordinary trade channel and the processing trade channel, and include group 5 (firms with ordinary exports and engaged

118 Note that there are 4 groups for firms that both export and import. Because for either export or import there are 2 possible modes to choose, and according to mathematical principle, when combining trading activities of export and import, there should be 4 (2×2=4) possible combination groups to choose. However, for firms that export (import) only, there is only 1 group left. It is because that if firms engage in processing trade, they must import intermediate inputs from foreign suppliers and re-export final products to foreign buyers after processing process. Hence, processing export and processing import should appear together in a firm's trading volumes and for firms that export (import) only, they could only choose to export (import) through ordinary trade.

in processing trade) and group 6 (firms with ordinary exports, ordinary imports and engaged in processing trade). Finally, type IV are pure processing exporters which are firms that only export through the processing trade channel and include the final two groups from Table 3.1, which are group 7 (firms only engaged in processing trade) and group 8 (firms with ordinary imports and engaged in processing trade).

Theoretically, since pure ordinary exporters have no processing exports and the share of processing exports in total exports should be equal to 0. For pure processing exporters total processing exports should equal total exports, and hence, the share of processing exports in total exports should be equal to 1. To distinguish between our three types of exporting firm, we use a firm's processing export share (ProExp_share). ProExp_share is a firm's processing trade intensity and this is defined as the proportion of firm's total processing exports over total exports.[119]

Table 3.2 presents a summary of our firm groups based on our theoretical assumptions. Pure ordinary exporters are defined as firms with processing export share equal to zero, mixed exporters are defined as firms with processing export share greater than zero but smaller than 1, and pure processing exporters are defined as firms with processing export share equal to 1.

[Table 3.2 about here]

4.3.2 Firm Characteristics of Different Trade Types[120]

4.3.2.1 Firm Heterogeneity across Different Trade Types

[119] Note that in chapter three, we treat a firm as a processing firm if it has any processing imports, in order to distinguish firms engaged in processing trade from firms engaged in ordinary trade. Based on this, in this chapter we further to distinguish whether such a processing firm may also have ordinary exports. Hence, we use processing export share as an indicator to measure a firm's degree of exporting in processing trade.

[120] The summary statistics in this section are based on our merged unbalanced panel only excluding firms who do not have processing exports and processing imports at the same period and hence, our analysis relies on the sample with 1,014,429 observations.

We now investigate how firms that engage in different types of trade differ. Depending on a firm's decision of export or not, we group firms into four categories following Table 3.2: non-exporters (Type I), pure ordinary exporters (Type II), mixed exporters (Type III) and pure processing exporters (Type IV). As we show in Tables 3.3 and 3.4, non-exporters account for nearly 86% of manufacturing firms in China and contribute around 64% of total production respectively.

It is interesting to note that pure processors account for only 1.82% of firms but nearly 5% of outputs. Also, while the number of pure processors has fallen over our period, the output share remained fairly steady.

[Table 3.3 about here]

[Table 3.4 about here]

In Table 3.5, we summarize the proportion of exports by firm type. For exporters, during the sample period, pure ordinary exporters account for less than 9% of total firms (from Table 3.3) but contribute more than 16% of total production (from Table 3.4) and almost 20% of total exports in China (from Table 3.5). The largest proportion of exports are from mixed exporters who account for only 3.5% of total firms but contribute nearly 15% of total production and more than 56% of total exports. Given the importance of mixed exporters it is useful to investigate what factors determine a firm's decision to become a mixed exporter. The other type of exporting firm that plays an important role in China's exports and the pure processing exporters. Although they only account for one fifth of the pure ordinary exporters and produce less than one third the output of pure ordinary exporters, they contribute slightly more to exports than pure ordinary exports (nearly 1.24 times of the latter) and account for around a quarter of total exports in China.

[Table 3.5 about here]

For the period 2000-2006, the number of non-exporter firms and the quantity of output of non-exporters fell. However, pure ordinary exporters experienced an increase in both the quantity of firms, total production and total exports. For those firms engaged in processing trade, mixed exporters slightly increase in number and production and maintain their percentage of exports. Pure processing exporters experienced a slight decline in the number of firms but a large drop in their export values, decreasing by almost 5% of total exports. Hence, following Chin's period of trade liberalization the number of pure processors appeared to fall. In this paper we want to understand whether pure processors have exited the market or switched trade type.

4.3.2.2 Export Share of Exporters

In Table 3.6 we further calculate the export shares of all exporters, pure ordinary exporters, mixed exporters and pure processing exporters, based on exporting values from Custom dataset. Table 3.6 shows that around 46% of exporters sell less than 20% of their total outputs in foreign markets, although this propensity has been falling over time from over 52% in 2000 to 44% in 2006. At the other end of the table, we see that about 10% sell sell greater than 90% of their outputs abroad.[121]

[Table 3.6 about here]

When we compare the distribution shown in Table 3.6 with the situation in the US and Germany following Lu (2010) we find the pattern is partly consistent since 66% of US exporters export less than 10% of outputs and less than 5% of those exporters sell more than a half of outputs in foreign markets, while in Germany half of exporters export no more than 15% of their outputs and 12.6% of them export more than half of their

[121] It is worth noting that our results differ from Lu (2010), whose analysis is based on exporting values reported in the industrial firm dataset (NBSC). He finds that less than 20% of exporters export less than 10% of their outputs and about 37% of them export more than 90% of their outputs. One possible explanation is that a firm's exporting value reported by the Customs is the value actually conducted by the firm itself and realized in the current period, and a firm's exporting value reported in the balance sheet of industrial firms dataset is the delivery value of exports which also includes the value of products delivered to trading intermediaries and sold abroad by trading intermediates. That is why Lu (2010) argues that the distribution of China's exporting intensity is different from that of developed countries (the US and Germany). He finds that the majority of the exporters sell more percentage of total outputs in foreign markets and in his work more than half of exporters export larger than 60% of their final outputs.

outputs. It seems that the percentage for the first category (0<export share<10%) in China is smaller than those in the US and Germany, with less than 33.5% of exporters. However, around one half of Chinese exporters export less than 25% of their exports, which is similar to the findings for the US and Germany where the majority of the exporters sell less in the foreign markets, consistent with the argument in Bernard *et al.* (2007) that only a small proportion of firms can enter into foreign markets and serve those markets. The main difference is that the percentage for the latter category (export share>50%) is larger and accounts for around 32%. One possible concern is that the processing trade in China may be influencing the results. We find that nearly 17% of processing exporters (firms with processing exports greater than zero) with export shares greater than 50% belong to pure processing exporters, around 37% of them are mixed exporters and 46% are pure ordinary exporters. Moreover, the mean processing export share is around 42%. Since engaging in processing trade is an easier route for firms to enter into foreign markets it explains why in China a larger amount of exporters export more than half of their outputs when compared to the US and Germany.

In Table 3A.1, we further drop the exporters with non-zero processing export values or non-zero processing import values leaving only pure ordinary exporters with processing export share equal to zero.[122] From Table 3A.1 we find that nearly 44% of exporters export less than 10% of outputs, 57% of them export less than 20% and around 22% of them export more than 50%. Even then there are some differences between the distributions of developed countries (US, Germany) although the values for China are now much closer to those in developed countries. What is clear is that processing trade is an important element of China's trade.

[Table 3A.1 about here]

[122] A firm that imports processing inputs in the current period must re-export the outputs after assembly and processing to receive tariff exemptions for the full volume of processing imports. However, re-exporting may occur in the current period or the following periods. Hence, to avoid the bias of processing trade, in each year we exclude firms who do not undertake both processing imports and processing exports in the same period. Hence, we are left with a sub-group of OEs (with ProExp_share=0). This leaves 83,847 observations in total.

4.3.2.3 Summary

Table 3.7 summarizes firm performance according to different types (NE, OE, ME and PE). We find that on average, exporting firms produce more, hire more workers and pay higher wages than non-exporting firms. Consistent with other empirical studies on China, non-exporters are concentrated in private-owned firms, accounting for nearly 90%, and are older than firms engaged in processing trade but with the lowest productivity level among all firms. This finding is consistent with the argument in Melitz (2003) that only more productive firms are capable of selling products overseas.

[Table 3.7 about here]

Among exporting firms, we observe that mixed exporters hire the most workers, have the highest productivity levels, create the most value-added, earn the highest average profits and pay the highest average wages. Most of them are owned by foreigners or investors from Hong Kong, Macau and Taiwan (HMT), which account for more than 60% of total mixed exporters. For pure ordinary exporters, they have the second highest productivity level, produce the second most value-added and achieve the second highest average profit level but hire the least workers and pay the lowest average wages to their workers. For pure processing exporters, they have the lowest productivity level, create the least value-added and earn the lowest average profits but hire the second largest proportion of workers and pay the second highest average wages, which is in contrast with pure ordinary exporters but consistent with the previous studies who document that processing trade tend to concentrate in labor-intensive manufacturing industries.[123] It is not surprisingly that most of the pure ordinary exporters are privately-owned firms (up to nearly 70% of total) and most of the pure processing exporters are HMT-owned firms (reaching almost 60% of total).

4.3.3 Firm Switching Among Export Types

[123] The definition of labor-intensive industries is in footnote 14 of chapter three.

Table 3.8 reports the average transition of trade types over 2000-2006 among all firms including both non-exporting and exporting firms. The pattern figured out here highlights the importance of distinguishing between different modes of exporters in studying their performance and switching effects. Column (1) shows a firm's trade type in period *t*, and columns (2)-(4) show the three possible trade types of a firm in period (*t+1*).

[Table 3.8 about here]

Hence, we use exporter dummy variables as our indicator to judge whether a firm belongs to a switcher among variety of export modes. Specifically, we define a firm that switches from a pure processing exporter to a pure ordinary exporter (mixed exporter) as it is with PE dummy variable equal to one in period *t* and with OE (ME) dummy variable equal to one in the next period. Similarly, we define a firm that switches from a pure ordinary exporter to a pure processing exporter (mixed exporter) if the OE dummy variable is equal to one in period *t* and with a PE (ME) dummy variable equal to one in the next period. Then a firm is defined as a switcher switching from a ME to a PE if it belongs to ME in period *t*, and belongs to PE in period (*t+1*). Alternatively, a firm is defined as a switcher switching from a ME to an OE if it belongs to ME in period *t*, and belongs to OE in period (*t+1*). However, except for six kinds of switchers that switch among exporting firms (for PE: PE→OE and PE→ME; for OE: OE→PE and OE→NE; for ME: ME→PE and ME→OE) which we are mainly concerned about, there are other six kinds of switchers that switch between non-exporting firms and exporting firms (NE→PE, NE→OE, NE→ME, PE→NE, OE→NE and ME→NE).[124]

The results in row 1 of Table 3.8 show that non-exporters have a high persistence (96.25%) which suggests that the existence of relative high fixed costs for export

[124] Note that there are four types of firms and therefore we have 4× (4-1) =12 kinds of switchers. It is because if a firm maintains its status in the next period, it is not a switcher and hence, to become a switcher, a firm only has (4-1) types of possibilities to choose from in the next period. Excluding 6 kinds of switchers among exporters, there are 8 kinds of switchers left between non-exporters and exporters.

preclude non-trading firms from beginning to export. The fact that more non-exporters begin exporting through ordinary trade than processing trade implies that although starting to export by a traditional channel requires a higher fixed entry cost that firms at a lower productivity level may not wish to pay, greater learning effects from exporting through ordinary trade channel may provide a substantial incentive for non-exporters to become pure ordinary exporters even if they experience income losses in a short-run. Another possible explanation is that since processing trade are dominant by HMT investors who enjoy preferential policies and are encouraged by local government to conduct processing trade, and most of the non-exporters are privately-owned firms who do not be favoured by policies, it is even harder for them to enter into processing trade than ordinary trade.

The transition rates of pure processing exporters are reported in the second row. The much higher rate of switching into ordinary exports as mixed exporters than into pure ordinary exporters reflect different structure of fixed costs for these two export types. Another possible explanation is that processing trade may help less productive firms to learn more about foreign markets, decreasing the costs in investigation of foreign markets, increasing successful matching rate with potential trading partners and facilitating firms become much easier to entry into foreign markets through ordinary trade.

The third row states the transition rates for firms that are pure ordinary exporters in period *t*. The high exit rate from exporting and the high persistence in pure ordinary exporting reflect relative high fixed costs of entry into foreign markets through ordinary exports and the requirement for higher productivity levels. The final row shows the transition rates of mixed exporters. The much higher rate of switching into pure ordinary exporters from mixed exporters than from pure processing exporters is consistent with findings in Yu (2015) that less productive firms are more likely to self-select into processing trade and highlights that a firm's decision of switching from current trade mode to another trade mode may be correlated with its current productivity level and its expectation of productivity. Hence, firm productivity levels are helpful when we discuss firm switching into different types of export and we narrow our empirical study to those firms switching between exporting firms. Most importantly, according to the mean value of total factor productivity (TFP) for different types of exporters, we classify our 6 kinds of switchers into two groups, upward-switchers and downward-switchers. The former includes three kinds of switchers (PE→ME, PE→OE and OE→ME) and the latter includes three kinds of switchers (OE→PE, ME→PE and ME→OE).[125]

4.4. Methodology

4.4.1 Tariff Measures

Following Yu (2014), we construct output and input tariffs at the firm-level using detailed firm-product transaction records.[126]

4.4.1.1 Firm-specific Output Tariff

The output tariff of a multi-product firm could be affected by multiple tariff lines. To compute a firm-specific output tariff, we use a product-sales weighted average of these product-level tariffs and we fix the product-sales share at the year in which the firm first enters the sample by following Topalova and Khandelwal (2011), where

$$output\ \ tariff_{kjt} = \sum_m \omega^m_{kj,t\_initial} \times tariff^m_t \qquad (1)$$

$$\omega^m_{kj,t\_initial} = \frac{v^m_{kj,t\_initial}}{Y_{kj,t\_initial}} = \frac{v^{mX}_{kj,t\_initial} + v^{mD}_{kj,t\_initial}}{\sum_m v^{mX}_{kj,t\_initial} + \sum_m v^{mD}_{kj,t\_initial}}$$

125 According to the mean TFP in Table 7, the order from low to high among exporters is: $TFP_{PE} < TFP_{OE} < TFP_{ME}$, and hence, an upward-switcher is defined as a switcher that increases its TFP and a downward-switcher is defined as a switcher that decreases its TFP.

126 Our sample includes firms engaged in processing trade, which can enjoy tariff exemptions for their processing trade, and hence, to take into account of such tariff exemption, we need to measure output and input tariffs at the firm level to avoid possible bias as if we measure tariffs at the industry level.

The $tariff_t^m$ is the effectively applied tariff of product *m* in year *t*, and the weight $\omega_{kj,t\_initial}^m$ for firm *k* within industry *j* is computed by the firm *k*'s sales of product *m* in its initial year appeared in the sample, $v_{kj,t\_initial}^m$, divided by the firm's total sales in the same year., $Y_{kj,t\_initial}$. Certainly, a product may be sold in both domestic and global markets. Hence, in the firm *k*'s first entry year $v_{kj,t\_initial}^m$ includes product *m*'s foreign sales $v_{kj,t\_initial}^{mX}$ and domestic sales $v_{kj,t\_initial}^{mD}$, and $Y_{kj,t\_initial}$ includes the firm *k*'s total export values $\sum_m v_{kj,t\_initial}^{mX}$ and total sales in domestic-oriented market, $\sum_m v_{kj,t\_initial}^{mD}$. We use the time-invariant shares to weight the firm output tariffs to avoid potential pitfall due to the possible reverse causality problem in firm wages.[127]

Following Melitz (2003), a higher-productive firm is not only capable of serving the local market but also selling final goods in the foreign markets. Hence, we assume that if a product sold successfully in the foreign markets it must also be sold in the local market, and the product should be sold in the same share domestically and globally. Hence, we assume that $\frac{v_{kj,t\_initial}^{mX}}{\sum_m v_{kj,t\_initial}^{mX}} = \frac{v_{kj,t\_initial}^{mD}}{\sum_m v_{kj,t\_initial}^{mD}}$. According to the mathematical principle, we intuitively obtain $\frac{v_{kj,t\_initial}^{mX}}{\sum_m v_{kj,t\_initial}^{mX}} = \frac{v_{kj,t\_initial}^{mD}}{\sum_m v_{kj,t\_initial}^{mD}} = \frac{v_{kj,t\_initial}^{mX} + v_{kj,t\_initial}^{mD}}{\sum_m v_{kj,t\_initial}^{mX} + \sum_m v_{kj,t\_initial}^{mD}}$ (2).[128]

We then insert (2) into (1) and obtain a method to calculate firm-specific output tariffs in equation (3) given by:

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[127] A product with high-profit margin will be sold more and hence its sales would take account the larger share in a firm's total sales. Note that wages and profits are positively related. Hence, when we investigate the impact of tariffs on firm wages, a bias on the output tariff coefficient could be caused by using the current product-sales share to measure the firm-specific output tariffs, with the direction of the bias depending on whether tariffs were higher or lower on the products with a larger share in total sales. For example, if a high-profit product with a larger proportion in total sales incurs a higher tariff rate, then the output tariff effect on firm profits (wages) would face an upward bias. Alternatively, if a high-profit product incurs a lower tariff rate, a downward bias on the output tariff coefficient could be caused when investigating its impact on firm profits (wages). Therefore, to avoid this potential reverse causality, we fix the weight to measure firm output tariffs, and for each product we construct its time-invariant weight using data of firm's initial year in the sample by following Topalova and Khandelwal (2011).

[128] The mathematical principle is that if $\frac{a}{b} = \frac{c}{d} = \frac{e}{f} = \theta$, then $\frac{a+c+e}{b+d+f} = \theta$ as well and in equation (2) we use this principle directly. The detailed derivative process for equation (2) can be found in section 3.1.1 of chapter three, from equation (2) to equation (5).

$$output\ \ tariff_{kjt} = \sum_m \omega^{mX}_{kj,t\_initial} \times tariff^m_t = \sum_m (\frac{v^{mX}_{kj,t\_initial}}{\sum_m v^{mX}_{kj,t\_initial}}) \times tariff^m_t \qquad (3)$$

However, since we make a strong assumption following Yu (2015) that the proportion of a product sold domestically by trading firms is the same as that in the foreign markets, we should exclude the firms with zero domestic sales (pure exporting firms) and the firms with zero exports (pure domestic-sale firms), otherwise, either of them could bias our measure of firm output tariffs. In our sample, around 9.7% (20,926 observations) of firms are pure exporting firms and around 11.6% (25,032 observations) are pure domestic-sale firms.[129] To ensure our main estimation results are not biased by those two types of firms, we need to drop them from our clean sample in all following regressions.[130]

4.4.1.2 Firm-specific Input Tariff

As mentioned in section 2.3 of chapter three, processing imports could enjoy tariff exemptions in China and that part of imports is duty free for a firm engaged in processing trade. To compute a firm-specific input tariff, following Yu (2015) we use an ordinary input-cost weighted average of these product-level tariffs and we fix such shares at the year in which firm first entry into the sample to avoid potential endogeneity problem. Thus, we compute a firm input tariff as follows:

$$input\ \ tariff_{kjt} = \sum_m \omega^{mOM}_{kj,t\_initial} \times tariff^m_t = \sum_m (\frac{v^{mOM}_{kj,t\_initial}}{\sum_m v^{mTM}_{kj,t\_initial}}) \times tariff^m_t \qquad (4)$$

129 Theoretically, pure exporting firms should be defined as firms with 100% exporting share, which means that total sales are equal to total exports. Actually, due to the different requirement of reporting date, for example, if a firm receives a payment for exports in advance, this amount of exporting value should be recorded under the relative accounting entry according to Accounting Standards, even though the real exporting is not made. However, the customs could record this amount of exporting value just at the time of shipping exports or exporting done. Hence, there may appear a differential time node between the records of firm and that of customs even for the same trade transaction. As we use the merged firm-customs dataset, due to the different marking point caused by different system rules, even an actual pure exporter could not 100% match the value of its total sales with the value of its total exports, although in theory those two should be equal. Consequently, we roughly treat a firm as a pure exporting firm with its export share no less than 0.9, which is very close to one. The principle of choosing value of 0.9 is explained in footnote 151 of Appendix 3A.

130 Our clean sample is obtained after the process of merging and basic cleaning based on two datasets, the firm-level production data and the product-level transaction data, and such process is described in Appendix 1A of chapter two in detail.

where $\sum_m v^{mTM}_{kj,t\_initial} = \sum_m v^{mOM}_{kj,t\_initial} + \sum_m v^{mPM}_{kj,t\_initial}$

The $tariff^m_t$ is the effectively applied tariff of product *m* in year *t*, and the weight $\omega^{mOM}_{kj,t\_initial}$ for firm *k* within industry *j* is computed by the firm *k*'s ordinary imports of product *m* in its initial year that it appeared in the sample, $v^{mOM}_{kj,t\_initial}$, divided by the firm's total imports in the same year., $\sum_m v^{mTM}_{kj,t\_initial}$. Certainly, a product *m* may be imported under two different regimes, both ordinary trade (OT^m) and processing trade (PT^m). Hence, in the firm *k*'s first entry year $\sum_m v^{mTM}_{kj,t\_initial}$ includes the firm *k*'s total ordinary import values, $\sum_m v^{mOM}_{kj,t\_initial}$ and total processing import values, $\sum_m v^{mPM}_{kj,t\_initial}$.

As noted that the part of imported inputs for processing and assembly would not be charged for tariffs, we do not include the set of importing processing inputs in equation (4).

4.4.1.3 Firm-specific Effective Rate of Protection (ERP)

To test the robustness of our results we use several alternative measures of trade protections and further construct firm-level effective rate of protection (ERP). At the firm level, the disciplining effect of lowering output tariffs may be offset by lowering tariffs on intermediate inputs, rather than include both measures in the same equation, we use the firm-specific ERP to capture the net effect of both types of protection on outputs and intermediate inputs. Therefore, this was done using the following formula by following Corden (1966):

$$ERP_{kjt} = \frac{output\ \ tariff_{kjt} - input\ \ tariff_{kjt}}{1-\alpha_{kjt}} \qquad (5)$$

where α_{kjt} are the input-value share of firm *k* in the production of its total outputs and α_{kjt} can be expressed as:

$$\alpha_{kjt} = \left(total \quad input_{kjt} - \sum_m v_{kjt}^{mPM} \right) \Big/ total \quad output_{kjt}$$

where the value of total processing imports is excluded from total intermediate inputs in firm *k*.

4.4.2 Empirical Strategy

4.4.2.1 Firm Wages and Export Switching

To investigate the impact of firm switching between different export types on the average wage of exporting firms, we consider the following empirical framework:

$$\begin{aligned} \Delta \ln(\text{wage})_{kjt} = {} & \alpha_1 \Delta \text{Output Tariff}_{kjt-1} + \alpha_2 \Delta \text{Output Tariff}_{kjt-1} \times \text{Switcher}_{kjt} \\ & + \alpha_3 \Delta \text{Input Tariff}_{\text{kjt}-1} + \alpha_4 \Delta \text{Input Tariff}_{kjt-1} \times \text{Switcher}_{kjt} \\ & + \alpha_5 \text{Switcher}_{kjt} + \Pi \text{X}_{kjt} + \rho_k + \rho_{lt} \\ & + \varepsilon_{kjt}. \end{aligned} \quad (6)$$

The dependent variable $\Delta \ln(\text{wage})_{kjt}$ is the log difference in firm *k*'s average wage per worker in industry *j* between year *t* and year (*t-1*), where the average wage is defined as the total wage bill divided by the firm size, measured by the number of employees.[131] $\Delta \text{Output Tariff}_{kjt-1}$ and $\Delta \text{Input Tariff}_{kjt-1}$ describes the one-year difference in firm-level output and input tariffs respectively, both of which are constructed by using the time-invariant initial trading weights, and hence the coefficients α_1 and α_3 give the effect of output and input tariff reduction on wages of exporting firms without switching respectively. To capture the potential differential effects on the firm's wage

[131] Here the total wage bill only includes the standard payment to workers and does not include the welfare and unemployment insurance. For a robustness check, we include those extra wage components to construct a variable of total compensation payment, and the average of which is used as a dependent variable. The results are quantitatively similar and are available upon request.

payment between exporting switchers and exporting firms without switching induced by tariff reductions, we interact the firm output (input) tariff with switcher dummy variables and those interaction terms are also included. Switcher_{kjt} is a dummy variable denoting the firm's switching direction, which is equal to one if a firm *k* with exporting switching in year *t*, and zero otherwise and we have 6 kinds of switcher dummy variables in total.[132] The coefficient α_5 before the switcher dummy is used to capture the other possible gains from exporting switching besides tariff reductions caused by trade liberalization.

The vector X_{kjt} includes other firm level characteristics as controls, such as the firm size (the logarithm of firm capital), the firm performance (TFP_{kjt}, firm *k*'s total factor productivity level) and ownership variables. Following Yu (2015), we do not use the logarithm of firm *k*'s total employment to control for the firm size and we use the variable $\ln(K)_{kjt}$, the logarithm of firm *k*'s capital as an proxy for firm size instead.[133] There are three dummy variables to describe the firm ownership structure: state-owned enterprise (SOE), foreign-owned, Hong Kong/Macao/Taiwan owned (HMT), and a dummy for other types of firms which is the omitted category. The SOE dummy is equal to one if a firm *k*'s government share is no less than 50%, and zero otherwise; the foreign-owned dummy is equal to one if a firm *k*'s foreign share is greater than 50%, and zero otherwise; and the HMT dummy is defined as well as the foreign-owned dummy, equal to one if a firm *k*'s HMT share is greater than 50%, and zero otherwise.

Finally, we include ρ_k to control for time-invariant and unobservable firm fixed effects. ρ_{lt} is to control for firm-invariant location-year fixed effects that could affect wages across all industries but may vary across different regions in China.[134] ε_{kjt} is the

132 They are PE→ME, PE→OE, OE→PE, OE→ME, ME→PE and ME→OE.

133 In our estimates the dependent variable is the log of firm *k*'s average wage, which could be written as: $\ln(\text{wage})_{kjt} = \ln(\text{total wage bill/labor})_{kjt} = \ln(\text{total wage bill})_{kjt} - \ln(\text{labor})_{kjt}$. Since the log of firm employment is already used as the denominator of the dependent variable, it is inappropriate to use it as a proxy to control for firm size in equation (6). Hence, we use $\ln(K)_{kjt}$ to control for firm size.

134 Following Kamal *et al.* (2012), we utilize information on a firm's region code to construct firm's location categories. Based on two-digit region code, which is equivalent to the province level, we group Chinese regions into five categories – (1) Costal: Beijing (code: 11), Tianjin (12), Hebei (13), Shanghai (31), Jiangsu (32), Zhejiang (33), Fujian (35), Shandong (37), Guangdong (44) and Hainan

error term.

We further interact firm output and input tariffs with the change in processing export share of switchers rather than a switcher dummy in some of the specifications. Finally, we exploit another approach to investigate the effects of exporting switching after trade reform on firm average wage by combining the impacts of output and input tariffs and use firm ERP instead of firm output and input tariffs.

To avoid the potential endogeneity of tariff reductions, we restrict the sample to the period 2002-2006 and use one-year lagged trade protections in each specification because firm wages are unlikely to have adjusted instantaneously.

4.4.2.2 Determinants of Export Switching

We further investigate whether a firm's decision to switch between different modes of exporting is determined by the changes in output tariffs and input tariffs following a period of tariff liberalization. Hence, we conduct a Probit model as follows:

$$\text{Prob}(\text{Switcher} = 1|\text{Z}) = \Phi(\text{Z}\varpi)$$
$$= \Phi\big(\beta_0 + \beta_1 \Delta\text{Output Tariff}_{kjt-1} + \beta_2 \Delta\text{Input Tariff}_{kjt-1} + \beta_3 \Delta\text{TFP}_{kj,t} + \beta_4 \Delta\ln(\text{K})_{kj,t}$$
$$+ \beta_5 \Delta\text{SOE dummy}_{kj,t-1} + \beta_6 \Delta\text{Foreign dummy}_{kj,t-1} + \beta_7 \Delta\text{HMTdummy}_{kj,t-1} + \delta_j$$
$$+ \delta_t\big), \qquad (7)$$

where the dependent variable is Switcher_{kjt}, a dummy variable denoting the firm's switching direction, which is equal to one if a firm *k* with exporting switching in year *t*, and zero otherwise and we have 6 kinds of switcher dummy variables to denote an exporter's switching between different modes of exporting. We include firms output and input tariffs, firm performance ($\text{TFP}_{kj,t}$), firm size (log of firm capital) and firm ownership structure (include three dummy variables, SOE dummy, foreign-owned

(46); (2)Inland: Shanxi (14), Anhui (34), Jiangxi (36), Henan (41); (3)Northeast: Hubei (42), Hunan (43); (4)Southwest: Liaoning (21), Jilin (22), Heilongjiang (23), Guangxi (45), Chongqing (50), Sichuan (51), Guizhou (52) and Yunnan (53); (5)Northwest: Inner Mongolia (15), Tibet (54), Shanxi (61), Gansu (62), Qinghai (63), Ningxia (64) and Xingjiang (65). Hence, there are four location dummies: Costal, Inland, Northeast and Southwest, and Northwest is the omitted dummy.

dummy and HMT-owned dummy) as our explanatory variables in equation (7). Finally, Φ is the cumulative distribution function of the standard normal distribution and ϖ is a vector of unknown parameters.

To avoid time-invariant firm fixed effects that may be correlated with firm tariffs, we take one-period difference for every variable and then use them in our equation. Additionally, we control for location-year fixed effects in equation (7) and use the sample of post-WTO period (2002-2006).

5. Empirical Results

In order to investigate the impact of switching between exporters on firm wages, we conduct our empirical estimations based on equation (6) with controls of location-year fixed effects in all regressions.

5.1 Firm Wages and Export Switching

Table 3.9 reports the basic results of how exporter switching affect firm wages following a period of tariff liberalization, and we then use the change in firm output and input tariffs and those tariffs interacted with switcher dummy variables to investigate how tariff reductions affect firm wages by switching among different modes of exporting. We then use six switcher dummy variables in all the columns.

[Table 3.9 about here]

The results in columns (1) and (2) are based on the sub-sample of pure processing exporters in period (*t-1*), in column (1) we only include firm level output and input tariffs and in column (2) we further include their interaction terms with switcher dummies (PE→OE and PE→ME). We find that in column (1) only the coefficient on the change in firm output tariff is significant and positive, indicating that a decrease in firm output tariffs decreases wages of exporting firms, which is consistent with our findings in chapter two. In column (2) the positive coefficient on firm output tariffs remain the same and we further find a significantly negative coefficient on the change in firm input tariffs interacted with a switcher from PE to OE, which suggests that if a firm switches from a pure processing exporter into a pure ordinary exporter, it will pay higher wages for workers relative to those firms do not change their status since it experiences a decline in input tariffs. Such a growth in wages could be explained by a growth in productivity since the ranking of productivity is that pure ordinary exporters have higher productivity level than pure processing exporters. Or another possible explanation is that following a cut in input tariffs, firms become much easier to access to high-quality imported inputs and hence raise their productivity level and hence pay higher wages. As a result, the gain of higher productivity may be the motivation for PEs switching into OEs even if they need to bare the relatively high costs of conducting ordinary trade. However, we find no significant coefficients on either a switcher dummy from PE to OE or a switcher dummy from PE to ME.

The results in columns (3) and (4) are based on the sub-sample of pure ordinary exporters in period (*t-1*) and in column (3) we only find a significant and negative coefficient on the switcher dummy from OE to PE, implying that lower wages are paid for workers that work in a firm switching from a pure ordinary exporter to a pure processing firm. This may due to a decrease in firm profits as if a firm chooses to engage in processing trade, it has to share a part of their profits with foreign buyers. In column (4) we only find a find a significant and positive coefficient on the interaction term of firm input tariffs and the switcher from pure ordinary exporters to pure processing exporters, indicating that if a firm experiences a cut in input tariffs, it pay lower wages during its switching from OE to PE.

Moreover, the results in columns (5) and (6) are based on the sub-sample of mixed exporters in period (*t-1*). We only find a negative and significant coefficient on the switcher dummy from ME to OE in columns (5) and (6). The results suggest that although a firm switches from being a mixed exporter to a pure ordinary exporting and supposes to experience an increase in its productivity level, it will pay lower wages to workers relative to those firms that persist in their previous status. This could be explained by the fact that through ordinary trade channel it may cost firms a higher cost to enter into foreign markets and learn from exporting in a comparison to processing trade. Additionally, it is much easier for mixed exporters to find out and match with potential foreign markets for processing trade rather than ordinary trade. That is also why mixed exporters could not benefit from switching into pure ordinary exporters. However, firm wages are rarely affected by firm switching from mixed exporter to any other type of exporter status when experiencing a reduction on both output and input tariffs.

Based on the results of Table 3.9, we document that decreasing firm input tariffs can affect firm wages of those exporters that switch between pure processing exporters and pure ordinary exporters.

4.5.2 Additional Controls and Determinants of Export Switching

In Tables 3.10-3.12 we include additional controls, which include firm ownership structure, firm productivity level and firm size and we further investigate whether tariff liberalization can determine a firm's decision to switch between different modes of exporting. Additionally, we allocate firms to one of three groups: PEs in period (*t-1*), OEs in period (*t-1*) and MEs in period (*t-1*). We then report the empirical results for each group respectively.

4.5.2.1 Pure Processing Exporters

Table 3.10 reports the results based on the group of PEs in period (*t-1*). In columns (1)-(3) we include additional controls for firm characteristics and find that even after controls for firm ownership, firm productivity and firm size, our conclusions based on column (2) of Table 3.9 still hold. In addition, we find that workers worked who are employed in HMT-owned firms get higher wages.

[Table 3.10 about here]

Then, in columns (4)-(7) we detect the relationship between tariff reduction and firm switching from being pure processing exporter to any other type of export status. In column (4) we first examine the link between tariff liberalization and the firm's decision to switch from pure processing exporter to pure ordinary exporter and only include firm level output and input tariffs. For output tariff, we find no significant coefficient on them, and for input tariffs, we find a negative and significant coefficient on them, which suggests that a fall in firm level input tariffs will lead to a switch from PE to OE. We then in column (5) additionally include firm characteristic variables and find our conclusion based on column (4) hold. Moreover, the coefficient on the log of firm capital becomes negative and significant and the coefficient on SOE dummy is now negative and significant, suggesting that SOEs and firms with more capital are less likely to switch from being pure processor exporters to pure ordinary exporters.

Similarly, in columns (6) and (7) we investigate whether tariff reductions can determine the decision of a firm to switch from a pure processing exporter to a mixed exporter. We also find a negative and significant coefficient on firm level input tariffs in both column (6) and column (7), suggesting that a fall in firm level input tariffs will lead to a switch from PE to ME. Additionally, the coefficient on Foreign-owned dummy is positive and significant in column (7), which implies that firms owned by foreign investors are more likely to switch from being pure processor exporters to mixed exporters.

Hence, we can conclude that it can be explained by decreasing firm-level input tariffs that pure processing exporters switch to either pure ordinary exporters or mixed exporters, and such export switching improve a firm's productivity level. Therefore, pure processing exporters benefit from tariff liberalization, especially from cutting firm level input tariffs.

4.5.2.2 Pure Ordinary Exporters

Table 3.11 reports the results based on the group of PEs in period (*t-1*). In columns (1)-(3) we include additional controls for firm characteristics and find that even after controls for firm ownership, firm productivity and firm size, our conclusions based on column (4) of Table 3.9 still hold. We further find that workers worked in SOEs will get lower wages and workers worked in foreign-owned firms will get higher wages in column (3). In columns (4) and (5), we find a positive and significant coefficient on firm TFP, suggesting that high-productive firms pay higher wages.

[Table 3.11 about here]

Then, in columns (4)-(7) we detect the relationship between tariff reduction and firm switching from being pure ordinary exporter to any other mode of exporting. In columns (4) and (5) we first examine the link between tariff reduction and the firm's decision to switch from pure ordinary exporter to pure processing exporter and column (4) only includes firm level output and input tariffs and column (5) includes additional variables to control for firm characteristics. In both columns (4) and (5) we find no significant coefficient on firm level output tariffs, and for input tariffs, we find a positive and significant coefficient on them, which suggests that pure ordinary exporters are less likely to switch to export through processing trade only when experience a decline in firm level input tariffs. We then in column (5) additionally find that the coefficient on firm productivity level is positive and significant and the coefficient on foreign-owned dummy is negative and significant, suggesting that foreign-owned firms and low-productive firms are less likely to switch from being pure ordinary exporters to pure processing exporters.[135]

Similarly, in columns (6) and (7) we investigate whether tariff reductions can

[135] One explanation for this is that non-exporters with low productivity level are willing to self-select into processing trade. But if a firm used to be a pure ordinary exporter, even if it experiences a decline in its productivity level, it would not immediately switch into processing trade in the short-run. It would still try to survive as a pure ordinary exporter or maybe switch to being a mixed exporter shortly and temporally.

determine the decision of a firm to switch from a pure ordinary exporter to a mixed exporter and we find a negative and significant coefficient on firm level input tariffs in both columns (6) and (7), suggesting that a fall in firm level input tariffs will lead to a switch from OE to ME. Additionally, the coefficient on firm productivity level is positive and significant and the coefficient on the log of firm capital is also positive and significant in column (7), implying that high-productive firms and firms with high capital are more likely to switch from being pure ordinary exporters to mixed exporters.

Hence, we can conclude that cutting firm-level input tariffs encourage pure ordinary exporters to switch to mixed exporters, but prevent them to switch to pure processing exporters. Therefore, input tariff reductions encourage pure ordinary exporters to switch to a direction of higher productivity level since the ranking of productivity is that mixed exporters have higher productivity level than pure ordinary exporters, which is based on our summary analysis. However, output tariff reductions have no impact on the decision of pure ordinary exporters to switch into either pure processing exporters or mixed exporters.

4.5.2.3 Mixed Exporters

Finally, Table 3.12 reports the results based on the group of MEs in period (*t-1*) and we do not find any significant coefficients on tariff variables in columns (1)-(3). However, we find a negative and significant coefficient on the switcher dummy from ME to OE, which suggests that firms pay lower wages when it experience a export switching from being a mixed exporter to a pure ordinary exporter. With additional controls of firm size, productivity level, we further find a positive and significant coefficient on firm productivity level in columns (2) and (3), which implies that firms with higher productivity will pay higher wages.

[Table 3.12 about here]

Similarly, in columns (4)-(7) we detect the relationship between tariff reduction and firm switching from being mixed exporters to either pure processing exporters or pure ordinary exporters. In columns (4) and (5) we only find a positive and significant coefficient on firm level input tariffs, implying that mixed exporters are less likely to switch to engage in processing trade only following a fall in firm level input tariffs. In columns (6) and (7) we investigate whether tariff reductions can determine the decision of a firm to switch from a mixed exporter to a pure ordinary exporter and we find a negative and significant coefficient on firm level input tariffs in both columns (6) and (7), suggesting that a fall in firm level input tariffs will lead to a switch from ME to OE, but only find a negative and significant coefficient on firm level output tariffs in column (6), which suggests that a fall in firm level output tariffs may also lead to a switch from ME to OE. Additionally, the coefficient on firm productivity level is positive and significant and the coefficients on all dummy variables that indicate a firm's ownership structure are also positive and significant in column (7), implying that high-productive firms and firms that do not belong to privately-owned enterprises are more likely to switch from being mixed exporters to pure ordinary exporters.

Hence, we can conclude that cutting firm-level input tariffs encourage mixed exporters to switch to pure ordinary exporters, but prevent them to switch to pure processing exporters. Although based on the ranking productivity level of pure ordinary exporters is lower than that of mixed exporters, the willing of firms to become producers rather than processors becomes even stronger after a period of tariff liberalization. It may reflect a fact that firms desire to be independent in dealing with international trade and would not like to share profits with others in a long-run.

4.5.3 Robustness

4.5.3.1 Effective Rate of Protection

Then, in Tables 3A.2 we replace firm output and input tariffs with firm ERP and re-estimate the equation (6) as robustness check. We find a significantly negative coefficient on firm ERP in the first four columns and further find a significantly negative coefficient on firm ERP interacted with the switcher dummy from OE to PE, which implies that a fall in ERP will lead to an increase in wages for both PEs and OEs without switching and lead to an even greater increase in wages for OEs switching into PEs. Moreover, we find that the coefficients on the switcher dummy from OE to PE are negative and significant in columns (3) and (4), which is consistent with the finding in column (3) of Table 3.9. Such a negative and significant coefficient means that lower wages are paid for workers that work in a firm switching from a pure ordinary exporter to a pure processing firm.

[Table 3A.2 about here]

In the last two columns for the group of MEs in period (*t-1*), we find a positive and significant coefficient on firm ERP in both columns, a negative and significant coefficient on its interaction term with the switcher dummy from ME to PE and a positive and significant coefficient on its interaction term with the switcher dummy from ME to OE in column (6). Hence, a fall in firm level ERP lower firm wages of mixed exporters who persist their export status, increases firm wages of mixed exporters who switch to pure processing exporters and lower wages of mixed exporters who switch to pure ordinary exporters. Moreover, in the last column the coefficient on the switcher dummy from ME to OE is significantly negative, which is consistent with finding in column (6) of Table 3.9 and suggests that firms switching from being mixed exporters to pure ordinary exporters pay lower wages.

4.5.3.2 Determinants of Export Switching Among All Types

Following tariff liberalization, firms may have different choices according to their current business status. As a result of this, there must be more than two types of export switching and hence, we use multinomial logit model to detect the effect of decreasing firm tariff rates on determining a firm's export status and we report our findings in Table 3A.3.

[Table 3A.3 about here]

In the first six columns we only regress the switcher types on both output and input tariff reductions and in the last six columns we additionally controls for firm size, firm productivity and firm ownership structures. For a current pure processing exporter, no matter with or without firm characteristic controls, it is less likely to become a pure ordinary exporter after falls in input tariff rates, which supports our previous findings in columns (4) and (5) of Table 3.10. However, such a pure processing exporter is also less likely to become a mixed exporter after falls in output tariff rates which is contrast to those found in columns (6) and (7) of Table 3.10. For pure ordinary exporters, falling output and input tariffs rates has no impact on switching their status into pure processing exporters whilst such falls in both types of tariffs have a negative impact on firm's switching into mixed exporters and thus those tariff reductions do not encourage pure ordinary exporters to engage in processing trade. Further, for those are currently engaged in both ordinary and processing exports, the effects seem to be complicated as decreasing output tariff rates would decrease the possibility to become pure processors but decreasing input tariff rates would increase the possibility to become pure processors. But if mixed exporters are willing to switch into pure ordinary exporters, tariff liberalization only has a negative effect on such switching and may hurt their willing, which is the same conclusion as we concluded based on the last two columns of Table 3.12.

6. Conclusions

The effect of trade liberalization on wages has generated a vast literature in international economics. No previous study has investigated the role of export status switching and how switching status affect firm wages during a period of tariffs liberalization in China. This paper fills this gap and we explore how firm switching between exporting types affects wage payment for exporting firms and the determinants of firm switching between different modes of exporting. Specifically, we investigate the role of processing trade: whether China has learned from processing trade, which is another potential channel for penetrating foreign markets.

Our empirical analysis examines the relationship between tariff reductions and wages for export switching firms during the period 2002-2006, specifically taking the special tariff treatment into account for processing firms. We conclude that during tariffs liberalization, cutting firm output has affected wages for pure processing exporters who do not switch export status and cutting input tariffs has affected wages for pure processing exporters and pure ordinary exporters who switch export status. Tariff reductions appear to have little impact on mixed exporters.

Specifically, a cut in output tariffs decreases wages for pure processing exporters who do not switch and pure processing exporters who switch to being pure ordinary exporters pay higher wages when they experience a cut in input tariffs. In contrast, a fall in input tariffs decreases wages for pure ordinary exporters who switch to being pure processing exporters.

One concern in our empirical analysis is the determinants for firm exporting switching. Whether such switching is induced by tariff liberalization and we highlight that input tariff reduction at the firm level can determine the decision of the firms to switch between different modes of exporting, which is very important for us to understand a firm's exporting behavior. Most importantly, such reduction on firm level input tariffs always encourage exporting firms switch to another status to upgrade their productivity level.

In this chapter, we do not investigate the survival rates post switching which is an interesting question. The answer would depend on the link between export switching and changes in firm production or changes in unobserved product quality or technology. This remains an area for our future research.

Chapter 5. Conclusions

In this chapter we provide a brief summary of our results and then address some of the limitations with the thesis and finally provide some suggests for future research.

5.1 Summary of Results

To examine the relationship between firm performance and engagement in international trade we needed to combine data from the Chinese Annual Survey of Industrial Firms data with detailed Custom trade data. In practice merging those two datasets is not a simple process and the detailed matching process is reported in Appendix 1B of Chapter 2.

Using our merged unbalanced panel, Chapter 2 tests the theoretical model of Amiti and Davis (2011) and answers the question of how changes in trade protection affect wages of Chinese manufacturing firms. Using an OLS approach the results show that a decline in both output and input tariffs increases the wages of firms who source raw materials and intermediate inputs, and sell final products in the domestic market, and a fall in output tariffs decreases the wages of firms who export. Specifically, the findings can be interpreted as suggesting that on average, a 10% fall in output tariffs leads to a 1.19% wage gain for non-exporting firms and a 10 % fall in output tariffs leads to a 3.72% wage gain for non-importing firms. Overall, the impact of industry input tariff reductions on firm wages is stronger than that of industry output tariff reductions, at least three times as high as any gains from decreasing output tariffs. It is documented that such findings are not consistent with the predictions in Amiti and Davis (2011) which are based on Indonesian data are consistent with the results from Kamal *et al.* (2012).

Chapter 3 investigates the relationship between firm-level tariff reduction and the wages of trading firms for the period of 2002-2006 and try to figure out the role of processing trade in China. The results show that a cut in firm-level output tariffs increases wages for firms who use processing imports relative to those non-processing firms, although the same is true for firms who do not import processing inputs when experience a cut in firm-level input tariffs. Specifically, such findings predict that cutting output tariffs in the sample period contributes almost 0.49% to the wage gap between processing firms and non-processing firms after China joined the WTO in 2001.

Finally, Chapter 4 explores how firm switching between different export types affects the wage payments of exporting firms and examines whether tariff reductions at the firm-level can determine a firm's decision to switch between different modes of exporting. The results suggest that a cut in output tariffs affects wages of pure processing exporters who persist in their export status and a cut in input tariffs affects the wages of pure processing exporters and pure ordinary exporters both of who switch their export status. Moreover, it is highlighted that input tariff reductions at the firm-level can determine a firm's decision of switching export status and such reductions always encourage exporters to switch to another export status for acquiring higher productivity level.

5.2 Limitations and Future Research

One of the limitations of this thesis is the relatively short panel after China's entry into WTO and hence it is not enough to detect the impact of trade liberalization on Chinese manufacturing firms in a long run. We also lack information on the exact location of a firm (longitude and latitude which tells us where a firm is located). This prevents us investigating more closely the relationship between trade and geographic factors such as how geographical factors affect a firm's location choice relative to transportation costs and the role of networks and clusters. Ideally we would also have access to individual level data from laborforce surveys that we could merge into the data. Unfortunately this data is not available for China. Other extensions that we are considering include an analysis of firm survival and switching as well as examining issues relating to multi-product firms and the role of product quality and product upgrading.

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Tables

Table 1.1. Trade Protection in China, 2000-2006 (%)

	4-digit		3-digit					
	Output Tariff		Output Tariff		Input Tariff		Effective Rate of Protection	
Year	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
2000	18.09	12.88	12.66	11.96	10.88	4.76	9.49	29.01
2001	16.97	11.78	11.84	11.14	10.13	4.46	9.06	27.35
2002	13.04	9.37	9.00	8.59	7.51	3.39	7.55	21.49
2003	11.76	8.59	7.91	7.72	6.73	3.07	6.12	19.52
2004	10.82	8.13	7.33	7.11	6.26	2.80	5.55	18.24
2005	10.27	7.82	6.81	6.48	5.87	2.57	4.84	16.30
2006	10.15	7.74	6.78	6.58	5.83	2.62	4.98	17.07
All	13.01	10.11	8.86	8.97	7.57	3.94	6.77	21.69

Table 1.1 reports the mean and standard deviation of trade protection across 4-digit industries and IO sectors (equivalent to three-digit industry). Columns 1-2 report statistics for 4-digit industry output tariffs. Columns 3-4 report statistics for 3-digit industry output tariffs. Columns 5-6 report statistics for 3-digit industry input tariffs, measured in equation (1) of section 3.3.1, and input tariffs are constructed using the 2002 Input-Output Matrix Table for China. Columns 7-8 report statistics for the 3-digit industry effective rate of protection, measured in equation (2) of section 3.3.2.

Table 1.2. Output and Input Tariffs in China, 2000-2006 (%)

2-digit Industry		2000		2001		2002		2003		2004		2005		2006		6-period Change	
Code	Name	Output	Input	Output	Input	Output	Input	Output	Input	Output	Input	Output	Input	Output	Input	Output	Input
13	Manuf. agricultural products	29.77	17.59	28.18	16.72	20.74	12.52	18.81	11.58	17.52	10.93	15.30	10.00	16.61	10.44	-13.16	-7.15
14	Manuf. food products	26.47	17.49	24.94	16.67	20.14	12.19	18.48	11.47	16.89	10.82	16.52	9.47	16.66	10.01	-9.81	-7.48
15	Manuf. drink products	35.32	17.17	32.64	16.29	25.02	12.48	25.74	12.21	21.67	11.24	19.40	9.95	19.30	10.57	-16.02	-6.60
17	Manuf. textile products	21.83	16.19	20.17	15.16	16.41	11.62	14.05	10.11	12.14	8.77	10.65	7.77	10.70	7.88	-11.13	-8.30
18	Manuf. apparel, footwear etc.	27.06	16.30	24.08	15.11	21.76	11.91	19.68	10.27	17.65	8.81	16.38	7.75	16.40	7.82	-10.66	-8.49
19	Manuf. leather products, fur etc.	21.94	15.77	20.50	14.85	17.61	12.61	16.31	11.73	15.05	10.84	14.76	10.31	14.77	10.48	-7.17	-5.29
20	Manuf. wood and wood products	11.86	11.61	11.21	11.01	7.61	6.74	6.82	6.35	5.82	5.88	5.37	5.52	5.45	5.45	-6.41	-6.16
21	Furniture manufacturing	22.00	11.69	20.52	11.02	12.59	7.51	9.41	6.83	6.36	6.19	3.31	5.95	3.25	5.87	-18.75	-5.83
22	Manuf. paper, paper products	15.95	11.46	14.82	10.63	9.52	7.30	8.05	6.62	6.69	5.93	5.80	5.32	5.75	5.32	-10.20	-6.14
23	Printing and reproduction media	15.63	12.12	14.04	11.26	9.99	7.74	7.92	6.83	6.69	5.98	5.69	5.31	5.69	5.29	-9.93	-6.83
24	Manuf. cultural & entertainment products	19.96	12.91	19.20	12.08	15.20	8.91	14.52	8.03	13.53	7.24	12.02	6.84	11.60	6.71	-8.36	-6.20
25	Processing crude oil, nuclear fuel	6.76	5.20	6.17	4.79	5.56	3.62	5.50	3.52	5.54	3.17	5.52	3.13	5.03	3.01	-1.73	-2.20
26	Manuf. chemical raw materials	11.84	9.03	10.99	8.29	9.29	6.44	9.43	6.13	9.10	5.86	7.52	5.28	7.94	5.30	-3.90	-3.72
27	Manuf. pharmaceuticals	9.96	10.30	9.32	9.66	6.13	7.03	5.62	6.63	5.60	6.33	5.59	5.89	5.56	5.96	-4.40	-4.34
28	Manuf. chemical fibres	16.10	11.61	15.09	10.93	10.16	7.82	7.77	7.01	5.37	6.04	5.21	5.58	5.21	5.49	-10.89	-6.12
29	Manuf. rubber products	16.87	13.52	16.43	12.93	14.69	8.82	14.19	8.45	13.78	8.07	13.64	7.77	12.43	7.47	-4.45	-6.04
30	Manuf. plastic products	17.46	12.73	16.40	12.06	11.73	8.85	10.46	8.21	9.21	7.53	9.11	7.10	9.01	6.86	-8.45	-5.87
31	Manuf. non-metal products	12.50	7.68	12.31	7.12	10.59	5.62	11.39	5.42	11.20	5.21	11.09	5.06	10.94	4.95	-1.56	-2.73
32	Manuf. ferrous metal casting	8.19	6.26	7.41	5.69	5.65	4.46	4.71	4.07	4.76	4.00	4.69	3.91	4.63	3.79	-3.57	-2.47
33	Manuf. non-ferrous metal casting	6.57	5.09	5.53	4.40	4.53	3.57	4.50	3.51	4.53	3.49	4.51	3.40	4.33	3.28	-2.24	-1.82
34	Manuf. metal products	14.62	8.53	13.63	7.80	12.00	6.06	11.68	5.78	11.51	5.59	11.41	5.50	11.36	5.43	-3.25	-3.10
35	Manuf. universal equipment	14.12	10.41	13.79	9.80	10.00	7.20	9.16	6.67	8.56	6.29	8.49	6.18	8.44	6.05	-5.68	-4.36
36	Manuf. special equipment	13.17	10.25	12.78	9.54	9.30	7.00	8.32	6.51	8.13	6.14	8.08	6.01	8.00	5.88	-5.17	-4.36
37	Manuf. transportation equipment	22.84	10.63	20.71	9.77	15.91	7.46	14.70	7.90	13.14	7.30	11.89	6.70	10.51	6.11	-12.33	-4.51
39	Manuf. electric machines, appliances	15.42	10.03	14.84	9.30	10.49	6.94	9.90	6.55	9.26	6.16	9.21	6.00	9.06	5.88	-6.36	-4.15
40	Manuf. electronic equipment	16.82	12.35	15.77	11.56	9.60	7.45	8.11	6.69	7.23	6.32	6.69	6.01	6.43	5.87	-10.39	-6.48
41	Manuf. instruments, appliances	15.66	11.02	14.64	10.30	11.22	7.13	10.29	6.57	10.01	6.25	9.93	6.08	9.75	5.96	-5.90	-5.06
	All	17.29	11.66	16.15	10.92	12.35	8.04	11.32	7.47	10.26	6.90	9.55	6.44	9.44	6.41	-7.85	-5.25

Table 1.3. Correlations of China's Output Tariffs and Input Tariffs

Output Tariff	3-digit Input Tariff			
	Level	1-year lag	Level	1-year lag
	(1)	(2)	(3)	(4)
Panel A: 3-digit Output Tariff				
Level	0.79			
1-year lag		0.79		
Panel B: 4-digit Output Tariff				
Level			#	
1-year lag				0.52

Table 1.4. Firms in International Trade

Year	Percent of firms that export	Percent of firms that import	Percent of trading firms	Percent of export values	Percent of import values
2000	11.58	10.43	13.68	6.72	7.82
2001	11.58	10.06	13.81	6.45	7.59
2002	13.67	11.54	15.90	8.77	8.60
2003	14.38	11.51	16.40	9.30	9.09
2004	16.14	12.47	18.29	12.22	11.32
2005	16.84	12.42	18.72	12.19	9.71
2006	18.00	12.63	19.88	12.88	9.39
All	15.20	11.81	17.24	10.79	9.38

Table 1.5. Output Tariff Variations Across Three-digit Industries

The Ten Most Protected Industries			The Ten Least Protected Industries		
IO Sector Number	IO Sector Name	Mean Output Tariffs	IO Sector Number	IO Sector Name	Mean Output Tariffs
16	Manuf. sugar	33.45	57	Manuf.ferroalloy smelting	2.71
20	Manuf. alcohol and alcoholic beverages	32.85	54	Iron-making industry	3.14
13	Manuf. grain milling	30.57	66	Manuf. railway transport equipment	4.02
67	Manuf. automobile	23.88	75	Manuf. electronic computer	4.18
21	Manuf. other drink products	23.39	58	Manuf. Non-ferrous metal smelting	4.32
78	Manuf. household audiovisual equipment	21.30	59	Non-ferrous metal rolling processing	5.58
28	Manuf. apparel, footwear etc.	20.43	37	Coking industry	5.69
72	Manuf. home appliances	20.36	77	Manuf. electronic component	5.71
15	Processing vegetable oil	19.95	36	Processing crude oil, nuclear fuel	6.10
19	Manuf. food products and other food processing	19.83	49	Manuf. lime, plaster and cement	6.35

Notes: Industries are defined as the most or the least protected industries based on the average output tariff rate for each industry over the period 2000-2006.

Table 1.6. Reductions in Trade Protection and Pre-reform Industrial Characteristics (2000)

Dependent Variable: Change in Trade Protection	Ln(Wage) (1)	Ln(Output) (2)	Ln(Labour) (3)	Ln(Value-added) (4)	Ln(Total Profit) (5)	Ln(Revenue) (6)	Skill Intensity (7)
Panel A: Change in Output Tariff (4-digit)							
	-0.001	0.006	0.002	0.005	0.002	0.007	0.000
	(0.002)	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)	(0.000)
R^2	0.695	0.606	0.597	0.600	0.569	0.607	0.853
Observations	408	408	408	407	408	408	408
Panel B: Change in Output Tariff (3-digit)							
	-0.006	0.006	0.030	0.007	-0.011	0.004	0.001
	(0.007)	(0.035)	(0.032)	(0.037)	(0.045)	(0.035)	(0.001)
R^2	0.715	0.336	0.459	0.351	0.354	0.326	0.750
Observations	69	69	69	69	69	69	69
Panel C: Change in Input Tariff (3-digit)							
	-0.026**	-0.021	0.052	-0.018	-0.065	-0.026	-0.004
	(0.011)	(0.059)	(0.051)	(0.058)	(0.073)	(0.061)	(0.003)
R^2	0.732	0.337	0.453	0.351	0.363	0.328	0.755
Observations	69	69	69	69	69	69	69
Panel D: Change in Industry ERP (3-digit)							
	-0.001	-0.001	0.006	-0.000	-0.004	-0.002	0.000
	(0.003)	(0.011)	(0.011)	(0.011)	(0.013)	(0.011)	(0.001)
R^2	0.710	0.335	0.449	0.350	0.354	0.326	0.752
Observations	69	69	69	69	69	69	69

Notes: Robust standard errors are reported in parentheses; significant at *10%; **5%; ***1%. All regressions include industry fixed effects and 3-digit industry FEs are controlled in panel A whilst 2-digit industry FEs are controlled in the rest panels. The regressions are weighted by the square root of the number of firms within any one industry.

Table 1.7. Current Industry Wage and Subsequent Trade Protection

Dependent Variable: Current Trade Protection	Full sample (1)	Pre-WTO (2000-2001) (2)	Post-WTO (2002-2006) (3)
Panel A: Output Tariff (4-digit)			
Lagged Industry average wage	-0.004	0.003	-0.002
	(0.006)	(0.024)	(0.004)
R^2	0.312	0.738	0.295
Observations	2,451	407	2,044
Panel B: Output Tariff (3-digit)			
Lagged Industry average wage	-0.026*	0.068	-0.017
	(0.015)	(0.053)	(0.013)
R^2	0.608	0.637	0.493
Observations	414	69	345
Panel C: Input Tariff (3-digit)			
Lagged Industry average wage	-0.008	0.038**	-0.004
	(0.005)	(0.018)	(0.003)
R^2	0.790	0.767	0.679
Observations	414	69	345
Panel D: Industry ERP (3-digit)			
Lagged Industry average wage	-0.054	0.100	-0.030
	(0.034)	(0.188)	(0.031)
R^2	0.282	0.409	0.263
Observations	414	69	345

Notes: Robust standard errors are reported in parentheses and are clustered at 4-digit industry level; significant at *10%; **5%; ***1%. All regressions include 3-digit industry fixed effects and year fixed effects. The regressions are weighted by the number of firms within any one industry for each year.

Table 1.8. Estimation for Theoretical Assumptions (post-WTO)

Dependent Variable:	ln(wage) $_{k,j,t}$	ln(wage) $_{k,j,t}$	ln(wage) $_{k,j,t}$	ln(wage) $_{k,j,t}$	ln(wage) $_{k,j,t}$
	(1)	(2)	(3)	(4)	(5)
Ln(Total profit) $_{k,j,t}$	0.068***				
	(0.001)				
Ln(Operating profit) $_{k,j,t}$		0.069***			
		(0.001)			
FXX $_{k,j,t}$			0.104***	0.085***	0.090***
			(0.003)	(0.003)	(0.003)
FMM $_{k,j,t}$			0.562***	0.508***	0.491***
			(0.008)	(0.008)	(0.008)
FXM $_{k,j,t}$			0.457***	0.405***	0.398***
			(0.005)	(0.005)	(0.005)
LnK $_{k,j,t}$				0.035***	0.033***
				(0.001)	(0.001)
Skill intensity $_{j,t}$					1.168***
					(0.021)
Industry FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
Adjusted R^2	0.161	0.158	0.149	0.157	0.165
Observations	772,406	730,386	772,406	772,406	772,406

Notes: Firm-level robust standard errors are clustered and reported in parentheses; significant at *10%; **5%; ***1%. Industry fixed effects are controlled at the 2-digit industry level.

Table 1.9. Estimation for Theoretical Assumptions (post-WTO)

Dependent Variable:	Ln(Labour) $_{k,j,t}$	Ln(Labour) $_{k,j,t}$	Ln(Valu-added) $_{k,j,t}$	Ln(Value-added) $_{k,j,t}$	$TFP^{dl}_{k,j,t}$	$TFP^{dl}_{k,j,t}$
	(1)	(2)	(3)	(4)	(5)	(6)
FXX $_{k,j,t}$	0.475***	0.474***	0.420***	0.156***	0.251***	0.125***
	(0.007)	(0.007)	(0.008)	(0.006)	(0.006)	(0.006)
FMM $_{k,j,t}$	0.503***	0.509***	1.222***	0.444***	0.847***	0.459***
	(0.016)	(0.016)	(0.018)	(0.012)	(0.014)	(0.012)
FXM $_{k,j,t}$	0.792***	0.794***	1.187***	0.442***	0.780***	0.414***
	(0.011)	(0.011)	(0.013)	(0.008)	(0.010)	(0.009)
LnK $_{k,j,t}$				0.489***		0.238***
				(0.001)		(0.001)
Skill intensity $_{j,t}$		-0.371***		0.893***		1.030***
		(0.050)		(0.037)		(0.044)
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R^2	0.076	0.076	0.081	0.431	0.070	0.193
Observations	772,406	772,406	765,834	765,834	765,834	765,834

Notes: Firm-level robust standard errors are clustered and reported in parentheses; significant at *10%; **5%; ***1%. Industry fixed effects are controlled at the 2-digit industry level.

Table 1.10. Baseline Regressions for Tariffs and Wages (post-WTO)

Dependent Variable: ln(wage) $_{k,j,t}$	OT	OT × Exporter	IT	IT × Importer	Both	Trade shares	Identify FXM firms	
							Dummies	Shares
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Output tariff $_{j,t-1}$	-0.134***	-0.143***			-0.119***	-0.116***	-0.121***	-0.116***
	(0.022)	(0.0221)			(0.023)	(0.0222)	(0.023)	(0.022)
OT $_{j,t-1}$× FX (ExportShare)$_{k,j,t}$		0.096**			0.083**	0.241*		
		(0.041)			(0.041)	(0.125)		
OT $_{j,t-1}$× FXX (ExportShare)$_{k,j,t}$							0.057	0.152
							(0.048)	(0.141)
OT $_{j,t-1}$× FXM (ExportShare)$_{k,j,t}$							0.163***	0.448***
							(0.059)	(0.169)
Input tariff $_{j,t-1}$			-0.478***	-0.491***	-0.372***	-0.360***	-0.370***	-0.360***
			(0.087)	(0.0877)	(0.089)	(0.089)	(0.089)	(0.089)
IT $_{j,t-1}$× FM (ImportShare)$_{k,j,t}$				0.234*	0.193	-0.398		
				(0.136)	(0.137)	(0.816)		
IT $_{j,t-1}$× FMM (ImportShare)$_{k,j,t}$							0.398*	0.245
							(0.205)	(0.915)
IT $_{j,t-1}$× FMX (ImportShare)$_{k,j,t}$							-0.040	-1.406
							(0.176)	(1.323)
FX (ExportShare)$_{k,j,t}$	0.002	-0.009	0.002	0.002	-0.008	-0.043**		
	(0.004)	(0.006)	(0.004)	(0.004)	(0.006)	(0.019)		
FXX (ExportShare)$_{k,j,t}$							-0.005	-0.035
							(0.007)	(0.022)
FXM (ExportShare)$_{k,j,t}$							-0.008	-0.059**
							(0.014)	(0.025)
FM (ImportShare)$_{k,j,t}$	0.006	0.006	0.006	-0.012	-0.009	0.049		
	(0.004)	(0.004)	(0.004)	(0.011)	(0.011)	(0.067)		
FMM (ImportShare)$_{k,j,t}$							-0.026	0.015
							(0.018)	(0.082)
FMX_ImportShare $_{k,j,t}$								0.106
								(0.097)
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Location FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Location-year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R^2	0.111	0.111	0.110	0.111	0.111	0.111	0.111	0.111
Observations	516,799	516,799	516,799	516,799	516,799	516,799	516,799	516,799
Joint Significance tests for coefficients on tariffs and interaction terms								
OT for exporter		-0.047			-0.036			
		(0.042)			(0.043)			
OT for exporter-importer							0.042	0.332**
							(0.059)	(0.168)

Notes: Firm-level robust standard errors are clustered and reported in parentheses; significant at *10%; **5%; ***1%. Industry fixed effects are controlled at the 2-digit industry level.

Table 1.11. Baseline Regressions for ERP and Wages (post-WTO)

Dependent Variable: ln(wage) $_{k,j,t}$	ERP	ERP × global engagement dummies	Trade shares
	(1)	(2)	(3)
ERP $_{j,t-1}$	-0.079***	-0.085***	-0.081***
	(0.013)	(0.013)	(0.013)
ERP $_{j,t-1}$× FXX (ExportShare)$_{k,j,t}$		0.025	0.076
		(0.029)	(0.083)
ERP $_{j,t-1}$× FMM (ImportShare)$_{k,j,t}$		0.023	-0.082
		(0.048)	(0.195)
ERP $_{j,t-1}$× FXM $_{k,j,t}$		0.130***	
		(0.036)	
ERP $_{j,t-1}$× FXM_ExportShare $_{k,j,t}$			0.309***
			(0.099)
ERP $_{j,t-1}$× FXM_ImportShare $_{k,j,t}$			-0.078
			(0.226)
FXX (ExportShare)$_{k,j,t}$	0.002	-0.002	-0.028
	(0.004)	(0.006)	(0.018)
FMM (ImportShare)$_{k,j,t}$	0.006	0.002	0.044
	(0.007)	(0.010)	(0.042)
FXM $_{k,j,t}$	0.007	-0.011	
	(0.005)	(0.007)	
FXM_ExportSshare $_{k,j,t}$			-0.054**
			(0.021)
FXM_ImportShare $_{k,j,t}$			0.012
			(0.043)
Industry FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Location FE	Yes	Yes	Yes
Location-year FE	Yes	Yes	Yes
Adjusted R^2	0.111	0.111	0.111
Observations	516,799	516,799	516,799
Joint Significance tests for coefficients on ERP and interaction terms			
ERP for exporter- importer		0.045	
		(0.036)	

Notes: Firm-level robust standard errors are clustered and reported in parentheses; significant at *10%; **5%; ***1%. Industry fixed effects are controlled at the 2-digit industry level.

Table 1.12. Regressions for Tariffs and Wages - additional controls (post-WTO)

Dependent Variable: ln(wage) $_{k,j,t}$	Ownership	Size	Productivity	Drop switchers	Balanced	Trade shares
	(1)	(2)	(3)	(4)	(5)	(6)
Output tariff $_{j,t-1}$	-0.119***	-0.117***	-0.111***	-0.145***	-0.114***	-0.112***
	(0.023)	(0.023)	(0.022)	(0.027)	(0.029)	(0.028)
OT $_{j,t-1}$× FX (ExportShare)$_{k,j,t}$	0.084**	0.083**	0.083**	0.087*	0.086*	0.354**
	(0.041)	(0.041)	(0.041)	(0.047)	(0.051)	(0.160)
Input tariff $_{j,t-1}$	-0.371***	-0.351***	-0.406***	-0.513***	-0.482***	-0.459***
	(0.089)	(0.089)	(0.089)	(0.108)	(0.109)	(0.109)
IT $_{j,t-1}$× FM (ImportShare)$_{k,j,t}$	0.197	0.196	0.207	0.073	0.361**	-0.583
	(0.137)	(0.137)	(0.137)	(0.151)	(0.172)	(1.120)
FX (ExportShare)$_{k,j,t}$	-0.008	-0.011*	-0.014**	-0.016**	-0.017**	-0.073***
	(0.006)	(0.006)	(0.006)	(0.007)	(0.008)	(0.025)
FM (ImportShare)$_{k,j,t}$	-0.009	-0.012	-0.017	-0.009	-0.026*	0.037
	(0.011)	(0.011)	(0.011)	(0.012)	(0.014)	(0.093)
SOE dummy $_{k,j,t}$	-0.003	-0.005	-0.004	-0.007	-0.001	-0.001
	(0.007)	(0.007)	(0.007)	(0.007)	(0.009)	(0.009)
Foreign dummy $_{k,j,t}$	0.023**	0.021**	0.019**	0.027***	0.019	0.019
	(0.009)	(0.009)	(0.009)	(0.010)	(0.013)	(0.013)
HMT dummy $_{k,j,t}$	0.014*	0.013	0.011	0.012	0.011	0.010
	(0.008)	(0.008)	(0.008)	(0.009)	(0.012)	(0.012)
LnK $_{k,j,t}$		0.035***	0.035***	0.035***	0.038***	0.038***
		(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
TFP^{dl} $_{k,j,t}$			0.093***	0.097***	0.096***	0.096***
			(0.002)	(0.002)	(0.002)	(0.002)
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Location FE	Yes	Yes	Yes	Yes	Yes	Yes
Location-year FE	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R^2	0.111	0.113	0.128	0.127	0.155	0.155
Observations	516,799	516,799	513,449	445,818	211,312	211,312
Joint Significance tests for coefficients on tariffs and interaction terms						
OT for exporter	-0.035	-0.034	-0.028			0.242
	(0.043)	(0.042)	(0.042)			(0.159)
IT for importer					0.121	
					(0.192)	

Notes: Firm-level robust standard errors are clustered and reported in parentheses; significant at *10%; **5%; ***1%. Industry fixed effects are controlled at the 2-digit industry level.

Table 1.13. Regressions for ERP and Wages - additional controls (post-WTO)

Dependent Variable: ln(wage) $_{k,j,t}$	Ownership	Size	Productivity	Drop switchers	Balanced	Trade shares
	(1)	(2)	(3)	(4)	(5)	(6)
ERP $_{j,t-1}$	-0.085***	-0.081***	-0.078***	-0.085***	-0.091***	-0.087***
	(0.013)	(0.013)	(0.013)	(0.016)	(0.017)	(0.017)
ERP $_{j,t-1}$× FXX (ExportShare)$_{k,j,t}$	0.025	0.025	0.025	0.027	-0.009	0.010
	(0.029)	(0.029)	(0.029)	(0.034)	(0.036)	(0.106)
ERP $_{j,t-1}$× FMM (ImportShare)$_{k,j,t}$	0.024	0.023	0.032	0.012	0.034	-0.021
	(0.048)	(0.048)	(0.049)	(0.054)	(0.062)	(0.266)
ERP $_{j,t-1}$× FXM $_{k,j,t}$	0.131***	0.129***	0.122***	0.104***	0.132***	
	(0.036)	(0.036)	(0.036)	(0.040)	(0.043)	
ERP $_{j,t-1}$× FXM_ExportShare $_{k,j,t}$						0.348***
						(0.128)
ERP $_{j,t-1}$× FXM_ImportShare $_{k,j,t}$						-0.225
						(0.318)
FXX (ExportShare)$_{k,j,t}$	-0.002	-0.005	-0.009	-0.011	-0.008	-0.037
	(0.006)	(0.006)	(0.006)	(0.007)	(0.007)	(0.025)
FMM (ImportShare)$_{k,j,t}$	0.002	-0.001	-0.008	-0.008	-0.011	0.008
	(0.010)	(0.010)	(0.010)	(0.011)	(0.013)	(0.057)
FXM $_{k,j,t}$	-0.011	-0.017**	-0.023***	-0.023***	-0.023**	
	(0.007)	(0.007)	(0.007)	(0.008)	(0.009)	
FXM_ExportSshare $_{k,j,t}$						-0.066**
						(0.027)
FXM_ImportShare $_{k,j,t}$						-0.005
						(0.065)
SOE dummy $_{k,j,t}$	-0.003	-0.005	-0.004	-0.007	-0.001	-0.001
	(0.007)	(0.007)	(0.007)	(0.007)	(0.009)	(0.009)
Foreign dummy $_{k,j,t}$	0.023**	0.021**	0.019**	0.027***	0.019	0.019
	(0.009)	(0.009)	(0.009)	(0.010)	(0.013)	(0.013)
HMT dummy $_{k,j,t}$	0.014*	0.013	0.011	0.012	0.011	0.011
	(0.008)	(0.008)	(0.008)	(0.009)	(0.012)	(0.012)
LnK $_{k,j,t}$		0.035***	0.035***	0.035***	0.038***	0.038***
		(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
TFP^{dl} $_{k,j,t}$			0.093***	0.096***	0.096***	0.096***
			(0.002)	(0.002)	(0.002)	(0.002)
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Location FE	Yes	Yes	Yes	Yes	Yes	Yes
Location-year FE	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R^2	0.111	0.113	0.128	0.127	0.155	0.155
Observations	516,799	516,799	513,449	445,818	211,312	211,312
Joint Significance tests for coefficients on tariffs and interaction terms						
ERP for exporter-importer	0.046	0.048	0.043	0.019	0.041	
	(0.036)	(0.036)	(0.036)	(0.040)	(0.043)	

Notes: Firm-level robust standard errors are clustered and reported in parentheses; significant at *10%; **5%; ***1%. Industry fixed effects are controlled at the 2-digit industry level.

Table 1.14. IV Regressions for Tariffs and Wages (post-WTO)

Dependent Variable: ln(wage) $_{k,j,t}$	Ownership	Size	Productivity	Drop switchers	Balanced	Trade shares
	(1)	(2)	(3)	(4)	(5)	(6)
Output tariff $_{j,t-1}$	-0.533**	-0.530**	-0.527**	-0.738**	-0.537***	-0.512***
	(0.215)	(0.215)	(0.213)	(0.324)	(0.203)	(0.197)
OT $_{j,t-1}$× FX (ExportShare)$_{k,j,t}$	0.268**	0.264**	0.273***	0.286**	0.255**	0.418
	(0.106)	(0.106)	(0.105)	(0.119)	(0.103)	(0.284)
Input tariff $_{j,t-1}$	0.262	0.268	0.053	-0.039	0.209	0.308
	(0.804)	(0.804)	(0.802)	(1.182)	(0.849)	(0.870)
IT $_{j,t-1}$× FM (ImportShare)$_{k,j,t}$	0.408	0.420	0.528*	0.156	0.212	2.245
	(0.318)	(0.317)	(0.314)	(0.341)	(0.333)	(1.550)
FX (ExportShare)$_{k,j,t}$	-0.028**	-0.030**	-0.033**	-0.035**	-0.030**	-0.043
	(0.013)	(0.013)	(0.013)	(0.015)	(0.013)	(0.040)
FM (ImportShare)$_{k,j,t}$	-0.017	-0.020	-0.030	-0.009	-0.010	-0.146
	(0.022)	(0.022)	(0.022)	(0.024)	(0.023)	(0.120)
SOE dummy $_{k,j,t}$	-0.002	-0.003	-0.001	-0.000	0.008	0.008
	(0.010)	(0.010)	(0.010)	(0.011)	(0.010)	(0.010)
Foreign dummy $_{k,j,t}$	-0.000	-0.002	0.002	0.018	-0.000	-0.001
	(0.014)	(0.014)	(0.014)	(0.015)	(0.015)	(0.015)
HMT dummy $_{k,j,t}$	0.011	0.011	0.012	0.017	0.011	0.011
	(0.013)	(0.013)	(0.013)	(0.014)	(0.014)	(0.014)
LnK $_{k,j,t}$		0.038***	0.038***	0.038***	0.041***	0.041***
		(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
TFP^{dl} $_{k,j,t}$			0.088***	0.092***	0.090***	0.090***
			(0.003)	(0.003)	(0.003)	(0.003)
Panel A: Instruments tests						
Kleibergen-Paap rk LM statistic	917.293†	917.327†	912.106†	598.401†	759.377†	610.27†
Kleibergen-Paap rk statistic	267.47	267.50	265.91	164.45	245.99	208.15
Stock-Yogo critical values (5%)	11.04	11.04	11.04	11.04	11.04	11.04
Hansen J statistic	0.19	0.26	0.12	2.52	1.76	2.34
p-value	0.91	0.88	0.94	0.28	0.42	0.31
Panel B: Joint Significance tests for coefficients on tariffs and interaction terms						
OT for exporter	-0.265*	-0.266*	-0.254*	-0.451*	-0.282**	
	(0.141)	(0.141)	(0.140)	(0.240)	(0.136)	
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Location FE	Yes	Yes	Yes	Yes	Yes	Yes
Location-year FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	165,658	165,658	164,608	135,295	145,183	145,183

Notes: Firm-level robust standard errors are clustered and reported in parentheses; significant at *10%; **5%; ***1%. † indicates significance of the *p*-value at the 1% level. Industry fixed effects are controlled at the 2-digit industry level. Output and input tariffs are instrumented by lagged one-year difference in output and input tariffs and their interaction terms with exporter dummy and importer dummy (interacted with export share and import share in the last column).

Table 1.15. Regressions for Tariffs and Wages - Heterogeneous Choices (post-WTO)

Dependent Variable: ln(wage) $_{k,j,t}$	Always trade (1)	Trade in 2002 (2)	Trade at entry (3)	Drop switchers (4)	Trade shares (5)	Identify exit (6)
Output tariff $_{j,t-1}$	-0.114***	-0.109***	-0.110***	-0.111***	-0.107***	-0.101***
	(0.022)	(0.022)	(0.023)	(0.025)	(0.022)	(0.026)
OT $_{j,t-1}$× FX (ExportShare)$_{k,j,t}$	0.252***	0.083	0.084	0.203**	0.266	0.095*
	(0.078)	(0.075)	(0.070)	(0.100)	(0.214)	(0.050)
Input tariff $_{j,t-1}$	-0.399***	-0.423***	-0.427***	-0.433***	-0.401***	-0.236**
	(0.088)	(0.089)	(0.089)	(0.098)	(0.088)	(0.100)
IT $_{j,t-1}$× FM (ImportShare)$_{k,j,t}$	0.106	0.506**	0.552***	0.032	0.444	0.0237
	(0.299)	(0.202)	(0.198)	(0.370)	(1.056)	(0.155)
FX (ExportShare)$_{k,j,t}$	-0.005	-0.005	-0.005		-0.013	-0.020**
	(0.004)	(0.004)	(0.004)		(0.011)	(0.008)
FM (ExportShare)$_{k,j,t}$	-0.001	-0.004	-0.004		-0.001	0.002
	(0.004)	(0.004)	(0.004)		(0.026)	(0.013)
SOE dummy $_{k,j,t}$	-0.004	-0.004	-0.004	-0.003	-0.004	-0.007
	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.008)
Foreign dummy $_{k,j,t}$	0.019**	0.019**	0.019**	0.015	0.019**	0.004
	(0.009)	(0.009)	(0.009)	(0.011)	(0.009)	(0.012)
HMT dummy $_{k,j,t}$	0.011	0.011	0.011	0.003	0.011	0.002
	(0.008)	(0.008)	(0.008)	(0.010)	(0.008)	(0.011)
LnK $_{k,j,t}$	0.035***	0.035***	0.035***	0.036***	0.035***	0.035***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
$TFP^{dl}_{k,j,t}$	0.093***	0.093***	0.093***	0.093***	0.093***	0.090***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Exit$_{k,j,t}$						-0.006*
						(0.003)
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Location FE	Yes	Yes	Yes	Yes	Yes	Yes
Location-year FE	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R^2	0.128	0.128	0.128	0.126	0.128	0.086
Observations	513,449	513,449	513,449	441,878	513,449	366,441
Joint Significance tests for coefficients on tariffs and interaction terms						
OT for exporter	0.138*			0.091		
	(0.077)			(0.098)		
IT for importer		0.083	0.125			
		(0.209)	(0.205)			

Notes: Firm-level robust standard errors are clustered and reported in parentheses; significant at *10%; **5%; ***1%. Industry fixed effects are controlled at the 2-digit industry level.

Table 1.16. Regressions for ERP and Wages - exiting firms (post-WTO)

Dependent Variable: ln(wage) $_{k,j,t}$	Post-WTO			Balanced		
	Exit	ERP × Exit	ERP × Types	Exit	ERP × Exit	ERP × Types
	(1)	(2)	(3)	(4)	(5)	(6)
$ERP_{j,t-1}$	-0.064***	-0.057***	-0.063***	-0.071***	-0.066***	-0.072***
	(0.016)	(0.015)	(0.016)	(0.018)	(0.018)	(0.018)
$ERP_{j,t-1} \times FXX_{k,j,t}$	0.041		0.033	0.019		0.017
	(0.035)		(0.035)	(0.039)		(0.039)
$ERP_{j,t-1} \times FMM_{k,j,t}$	0.006		0.003	0.038		0.039
	(0.059)		(0.059)	(0.067)		(0.067)
$ERP_{j,t-1} \times FXM_{k,j,t}$	0.122***		0.119***	0.145***		0.138***
	(0.043)		(0.042)	(0.047)		(0.047)
$ERP_{j,t-1} \times Exit_{k,j,t}$		0.055***			0.093**	
		(0.020)			(0.042)	
$ERP_{j,t-1} \times FXX_{k,j,t} \times Exit_{k,j,t}$			0.141**			0.195**
			(0.065)			(0.097)
$ERP_{j,t-1} \times FMM_{k,j,t} \times Exit_{k,j,t}$			0.067			-0.037
			(0.122)			(0.311)
$ERP_{j,t-1} \times FXM_{k,j,t} \times Exit_{k,j,t}$			0.169*			0.461***
			(0.093)			(0.126)
$ERP_{j,t-1} \times DOM_{k,j,t} \times Exit_{k,j,t}$			0.050**			0.076*
			(0.020)			(0.044)
$FXX_{k,j,t}$	-0.017**	-0.010*	-0.017**	-0.013	-0.010	-0.013
	(0.008)	(0.006)	(0.008)	(0.008)	(0.006)	(0.008)
$FMM_{k,j,t}$	-0.005	-0.004	-0.005	-0.009	-0.003	-0.009
	(0.013)	(0.010)	(0.013)	(0.015)	(0.011)	(0.015)
$FXM_{k,j,t}$	-0.022**	-0.003	-0.021**	-0.021**	0.001	-0.021**
	(0.009)	(0.007)	(0.009)	(0.011)	(0.008)	(0.011)
$Exit_{k,j,t}$	-0.006*	-0.015***	-0.015***	-0.019***	-0.032***	-0.032***
	(0.003)	(0.004)	(0.004)	(0.006)	(0.009)	(0.009)
SOE dummy $_{k,j,t}$	-0.007	-0.007	-0.007	-0.006	-0.006	-0.006
	(0.008)	(0.008)	(0.008)	(0.009)	(0.009)	(0.009)
Foreign dummy $_{k,j,t}$	0.004	0.004	0.004	0.019	0.019	0.019
	(0.012)	(0.012)	(0.012)	(0.014)	(0.014)	(0.014)
HMT dummy $_{k,j,t}$	0.002	0.002	0.002	0.007	0.006	0.007
	(0.011)	(0.011)	(0.011)	(0.013)	(0.013)	(0.013)
$LnK_{k,j,t}$	0.035***	0.035***	0.035***	0.035***	0.036***	0.035***
	(0.002)	(0.002)	(0.002)	(0.003)	(0.003)	(0.003)
$TFP^{dl}_{k,j,t}$	0.090***	0.090***	0.090***	0.090***	0.090***	0.090***
	(0.002)	(0.002)	(0.002)	(0.003)	(0.003)	(0.003)
Adjusted R^2	0.086	0.086	0.086	0.102	0.102	0.102
Observations	366,441	366,441	366,441	188,632	188,632	188,632
Joint Significance tests for coefficients on tariffs and interaction terms						
ERP for exporter-importer	0.058			0.074		0.455***
	(0.043)			(0.047)		(0.148)
ERP for exiting firm		-0.002			0.028	
		(0.025)			(0.045)	
ERP for pure domestic firm			-0.075**			
			(0.037)			

Notes: Firm-level robust standard errors are clustered and reported in parentheses; significant at *10%; **5%; ***1%. 2-digit industry FE, year FE, location FE and location-year FE are controlled.

Table 1.17. Channels (post-WTO)

Regressand: ln(wage) $_{k,j,t}$	Change in labordemand	Import scope	Change in labordemand	Import scope
	(1)	(2)	(3)	(4)
Output tariff $_{j,t-1}$	-0.104***	-0.104***		
	(0.025)	(0.025)		
OT $_{j,t-1}$× FX $_{k,j,t}$	0.114**	0.115**		
	(0.049)	(0.049)		
Input tariff $_{j,t-1}$	-0.158	-0.157		
	(0.099)	(0.099)		
IT $_{j,t-1}$× FM $_{k,j,t}$	0.073	0.075		
	(0.151)	(0.151)		
ERP $_{j,t-1}$			-0.062***	-0.062***
			(0.016)	(0.016)
ERP $_{j,t-1}$× FXX $_{k,j,t}$			0.055	0.056
			(0.035)	(0.035)
ERP $_{j,t-1}$× FMM $_{k,j,t}$			0.003	0.002
			(0.056)	(0.056)
ERP $_{j,t-1}$× FXM $_{k,j,t}$			0.140***	0.141***
			(0.043)	(0.043)
Ln(Import scope) $_{k,j,t}$		0.008*		0.008*
		(0.004)		(0.004)
D1. Ln(Labour) $_{k,j,t}$	-0.177***	-0.177***	-0.177***	-0.177***
	(0.003)	(0.003)	(0.003)	(0.003)
Exit $_{k,j,t}$	-0.012***	-0.012***	-0.012***	-0.012***
	(0.003)	(0.003)	(0.003)	(0.003)
SOE dummy $_{k,j,t}$	-0.009	-0.009	-0.009	-0.009
	(0.008)	(0.008)	(0.008)	(0.008)
Foreign dummy $_{k,j,t}$	0.006	0.006	0.006	0.006
	(0.011)	(0.011)	(0.011)	(0.011)
HMT dummy $_{k,j,t}$	0.003	0.003	0.003	0.003
	(0.011)	(0.011)	(0.011)	(0.011)

(Continued)

Table 1.17. Continued

Regressand: ln(wage) $_{k,j,t}$	Change in labordemand (1)	Import scope (2)	Change in labordemand (3)	Import scope (4)
LnK $_{k,j,t}$	0.048***	0.048***	0.048***	0.048***
	(0.002)	(0.002)	(0.002)	(0.002)
TFP^{dl} $_{k,j,t}$	0.094***	0.094***	0.094***	0.094***
	(0.002)	(0.002)	(0.002)	(0.002)
FX $_{k,j,t}$	-0.023***	-0.024***		
	(0.008)	(0.008)		
FM $_{k,j,t}$	-0.001	-0.008		
	(0.013)	(0.014)		
FXX $_{k,j,t}$			-0.020***	-0.021***
			(0.008)	(0.008)
FMM $_{k,j,t}$			-0.004	-0.011
			(0.013)	(0.013)
FXM $_{k,j,t}$			-0.023**	-0.030***
			(0.009)	(0.010)
Joint Significance tests for coefficients on tariffs and interaction terms				
OT for exporter	0.010	0.011		
	(0.050)	(0.050)		
ERP for exporter-importer			0.078*	0.079*
			(0.044)	(0.044)
Observations	366,441	366,441	366,441	366,441

Notes: Firm-level robust standard errors are clustered and reported in parentheses; significant at *10%; **5%; ***1%. 2-digit industry FE, year FE, location FE and location-year FE are controlled. Adjusted R^2 are all equal to 0.123 and to save space, we do not report them here.

Table 2.1. Summary of Processing Firms in China, 2000-2006

Variable	2000	2001	2002	2003	2004	2005	2006
Basic:							
Number	8,164	7,482	9,485	10,378	15,400	15,890	18,549
Proportion of processing firms (P/P+O)	0.48	0.42	0.42	0.40	0.38	0.38	0.37
Ownership structure:							
SOE	0.06	0.06	0.04	0.03	0.02	0.02	0.01
Foreign	0.29	0.28	0.32	0.32	0.30	0.34	0.35
HMT	0.36	0.36	0.35	0.36	0.40	0.35	0.35
Others	0.29	0.30	0.28	0.29	0.28	0.29	0.29
Performance:							
Size	569	587	570	574	544	579	591
Size premium	0.93	1.05	1.15	1.29	1.62	1.69	1.84
Value-added per worker (1,000 RMB)	71.55	79.97	82.97	91.09	87.62	97.50	116.71
VA premium	0.49	0.55	0.54	0.57	0.57	0.57	0.61
TFP	6.36	6.47	6.47	6.60	6.26	6.63	6.83
TFP premium	1.01	1.01	1.01	1.01	0.98	1.01	1.03
Wage (1,000 RMB)	14.21	14.98	15.39	15.90	16.91	18.30	21.75
Wage premium	1.04	1.04	1.02	1.03	1.02	1.05	1.15

Notes: Here P denotes processing firms, O denotes ordinary trading firms, size denotes the number of employees and wage denotes the unit wage for each worker. Hence, wage=total wage bill/total employment; *Variable* premium=mean value of the *Variable* for processing firms/mean value of the *Variable* for ordinary trading firms.

Table 2.2. China's Output and Input Tariffs by Year (%)

	Firm output tariffs		Firm input tariffs		Industry output tariffs		Industry input tariffs	
	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.
Year	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
2000	18.97	8.76	4.05	7.21	18.49	6.50	12.32	3.56
2001	17.05	8.69	4.07	6.92	17.08	5.92	11.40	3.43
2002	12.94	7.78	2.73	4.63	13.43	5.45	8.58	2.70
2003	11.61	7.28	2.51	4.31	12.18	4.92	7.84	2.28
2004	10.35	6.86	2.36	4.10	10.89	4.29	7.15	1.91
2005	9.63	6.56	2.24	3.80	10.29	4.04	6.67	1.63
2006	9.39	6.67	2.12	3.72	10.13	4.04	6.59	1.68
All	11.61	7.84	2.61	4.69	12.10	5.45	7.90	2.92

Notes: Industry-level output and input tariffs are calculated at IO-sector level, which is equivalent to 3-digit industry level.

Table 2.3. Correlations of China's Output and Input Tariffs

	Firm output tariffs	Firm input tariffs	Industry output tariffs	Industry input tariffs
Firm output tariffs	1.000			
Firm input tariffs	0.004	1.000		
Industry output tariffs	0.623	0.065	1.000	
Industry input tariffs	0.515	0.074	0.763	1.000

Notes: Industry-level output and input tariffs are calculated at IO-sector level, which is equivalent to 3-digit industry level.

Table 2.4. Firm Average Wage and Subsequent Trade Protection

Dependent Variable: Firm-level Trade Protection	Full sample (1)	Pre-WTO (2000-2001) (2)	Post-WTO (2002-2006) (3)
Panel A: Firm Output Tariff			
Lagged firm average wage	0.0006*	0.0001	0.0000
	(0.0003)	(0.0013)	(0.0002)
R^2	0.491	0.496	0.321
Observations	65,097	5,333	59,764
Panel B: Firm Input Tariff			
Lagged firm average wage	-0.0002	0.0170***	0.0000
	(0.0002)	(0.0013)	(0.0001)
R^2	0.183	0.155	0.098
Observations	65,097	5,333	59,764
Panel C: Firm ERP			
Lagged firm average wage	0.1610	0.8330	0.0231
	(0.2390)	(1.2050)	(0.2090)
R^2	0.001	0.046	0.008
Observations	65,097	5,333	59,764
Panel D: Firm ERP_2			
Lagged firm average wage	0.0993	0.8200	-0.0898
	(0.3210)	(1.2080)	(0.3340)
R^2	0.000	0.047	0.000
Observations	65,097	5,333	59,764

Notes: Firm-level robust standard errors are clustered and reported in parentheses; significant at *10%; **5%; ***1%. All regressions include 3-digit industry fixed effects and year fixed effects.

Table 2.5. Regressions for Tariffs and Wages (post-WTO)

Dependent Variable: ln(wage) $_{k,j,t}$	Industry level			Firm level		
	Tariffs	Tariff × Dummy	Tariff × Intensity	Tariffs	Tariff × Dummy	Tariff × Intensity
	(1)	(2)	(3)	(4)	(5)	(6)
Output tariff (OT) $_{j,t-1}$	0.033	0.110***	0.089**	0.096***	0.083***	0.097***
	(0.036)	(0.042)	(0.041)	(0.025)	(0.031)	(0.030)
OT $_{j,t-1}$× Processing Dummy (Intensity)$_{k,j,t}$		-0.209***	-0.214**		0.029	-0.010
		(0.068)	(0.084)		(0.047)	(0.053)
Input tariff (IT) $_{j,t-1}$	0.092	-0.120	-0.057	-0.136**	-0.163**	-0.157**
	(0.068)	(0.082)	(0.079)	(0.062)	(0.068)	(0.065)
IT $_{j,t-1}$× Processing Dummy (Intensity)$_{k,j,t}$		0.551***	0.520***		0.119	0.164
		(0.130)	(0.160)		(0.113)	(0.169)
Processing Dummy (Intensity) $_{k,j,t}$	-0.008	-0.020***	-0.011	-0.008	-0.013*	-0.002
	(0.007)	(0.008)	(0.009)	(0.007)	(0.008)	(0.009)
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Location FE	Yes	Yes	Yes	Yes	Yes	Yes
Location-year FE	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R^2	0.120	0.120	0.120	0.120	0.120	0.120
Observations	115,179	115,179	115,179	115,179	115,179	115,179
Joint Significance tests for coefficients on tariffs and interaction terms						
Output Tariff		-0.099*	-0.125*		0.112***	0.087**
		(0.058)	(0.073)		(0.038)	(0.044)

Notes: Firm-level robust standard errors are clustered and reported in parentheses; significant at *10%; **5%; ***1%. Industry fixed effects are controlled at the 3-digit industry level.

Table 2.6. Heckman Two-Stage Selection Estimates

Dependent Variable:	1st Stage Processing Dummy $_{k,j,t}$		2nd Stage Processing Intensity $_{k,j,t}$	
Lagged Firm age $_{k,j,t}$	0.001**	(0.001)		
Lagged ST liability $_{k,j,t}$	0.094***	(0.024)	0.064***	(0.009)
Lagged Ln(Value added per worker) $_{k,j,t}$	-0.046***	(0.006)	-0.061***	(0.002)
Lagged LnK $_{k,j,t}$	0.200***	(0.004)	-0.002	(0.004)
Lagged Govt share $_{k,j,t}$	-0.119***	(0.032)	-0.056***	(0.012)
Lagged Foreign share $_{k,j,t}$	1.176***	(0.017)	0.169***	(0.021)
Lagged HMT share $_{k,j,t}$	1.266***	(0.016)	0.250***	(0.022)
Inverse mills ratio	-		0.320***	(0.028)
Industry FE	Yes		Yes	
Year FE	Yes		Yes	
Observations	69,098		69,098	

Notes: Standard errors in parentheses; * significant at 10%, ** at 5% and *** at 1%. The 3-digit industry fixed effects and year fixed effect are controlled in the regression.

Table 2.7. Preliminary Regressions for Tariffs and Wages (post-WTO)

Dependent Variable: ln(wage) $_{k,j,t}$	Industry Tariffs (1)	Firm Tariffs (2)
Industry Output tariff $_{j,t-1}$	0.127*	
	(0.066)	
Industry OT $_{j,t-1}$× Predicted Processing Intensity $_{k,j,t}$	-0.311**	
	(0.152)	
Industry Input tariff $_{j,t-1}$	-0.330**	
	(0.134)	
Industry IT $_{j,t-1}$× Predicted Processing Intensity $_{k,j,t}$	0.039	
	(0.362)	
Firm Output tariff $_{k,j,t-1}$		0.070
		(0.054)
Firm OT $_{k,j,t-1}$× Predicted Processing Intensity $_{k,j,t}$		-0.327***
		(0.122)
Firm Input tariff $_{k,j,t-1}$		-0.379***
		(0.122)
Firm IT $_{k,j,t-1}$× Predicted Processing Intensity $_{k,j,t}$		0.438
		(0.309)
Predicted Processing Intensity $_{k,j,t}$	0.100***	0.075***
	(0.021)	(0.013)
Industry FE	Yes	Yes
Year FE	Yes	Yes
Location FE	Yes	Yes
Location-year FE	Yes	Yes
Adjusted R^2	0.121	0.121
Observations	115,179	115,179

Notes: Firm-level robust standard errors are clustered and reported in parentheses; * significant at 10%, ** at 5% and *** at 1%. All regressions use adjusted processing intensity predicted by Heckman two-stage selection model and firm output and input tariffs are lagged by one period. Industry fixed effects are controlled at the 3-digit industry level.

Table 2.8. Regressions for Tariffs and Wages with Additional Controls (post-WTO)

Dependent Variable: ln(wage) $_{k,j,t}$	With ownership (1)	With TFP (2)	With size (3)	With leverage (4)	With debt (5)
Firm Output tariff $_{k,j,t-1}$	0.068	0.053	0.036	0.030	0.104*
	(0.054)	(0.054)	(0.054)	(0.056)	(0.061)
Firm OT $_{k,j,t-1}$× Predicted Processing Intensity $_{k,j,t}$	-0.327***	-0.285**	-0.274**	-0.264**	-0.390***
	(0.122)	(0.123)	(0.123)	(0.124)	(0.131)
Firm Input tariff $_{k,j,t-1}$	-0.379***	-0.371***	-0.380***	-0.383***	-0.339***
	(0.122)	(0.123)	(0.123)	(0.123)	(0.123)
Firm IT $_{k,j,t-1}$× Predicted Processing Intensity $_{k,j,t}$	0.436	0.430	0.445	0.451	0.367
	(0.310)	(0.315)	(0.314)	(0.314)	(0.315)
Predicted Processing Intensity $_{k,j,t}$	0.076***	0.060***	0.059***	0.057***	0.084***
	(0.013)	(0.013)	(0.013)	(0.014)	(0.016)
TFP^{dl} $_{k,j,t}$		0.071***	0.071***	0.071***	0.071***
		(0.003)	(0.003)	(0.003)	(0.003)
Ln K $_{k,j,t}$			0.032***	0.032***	0.032***
			(0.004)	(0.004)	(0.004)
Leverage $_{k,j,t-1}$				0.001	
				(0.002)	
Total debt ratio $_{k,j,t-1}$					-0.026***
					(0.009)
SOE $_{k,j,t}$	-0.010	-0.006	-0.007	-0.007	-0.008
	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)
Foreign owned $_{k,j,t}$	0.022**	0.022**	0.021**	0.021**	0.021**
	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)
HMT owned $_{k,j,t}$	0.018*	0.018*	0.017	0.017	0.017
	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)
Industry FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
Location FE	Yes	Yes	Yes	Yes	Yes
Location-year FE	Yes	Yes	Yes	Yes	Yes
Adjusted R^2	0.121	0.132	0.133	0.133	0.133
Observations	115,179	114,230	114,230	114,230	114,230

Notes: Firm-level robust standard errors are clustered and reported in parentheses; * significant at 10%, ** at 5% and *** at 1%. All regressions use adjusted processing intensity predicted by Heckman two-stage selection model and firm output and input tariffs are lagged by one period. Industry fixed effects are controlled at the 3-digit industry level.

Table 2.9. Channels (Post-WTO)

Dependent Variable:	ln(total profit) $_{k,j,t}$	ln(wage) $_{k,j,t}$ With Multi-products	ln(wage) $_{k,j,t}$ With firm R&D
	(1)	(2)	(3)
Firm Output tariff $_{k,j,t-1}$	0.385**	0.105*	0.157**
	(0.153)	(0.061)	(0.073)
Firm OT $_{k,j,t-1}$ × Predicted Processing Intensity $_{k,j,t}$	-0.492	-0.390***	-0.437***
	(0.344)	(0.131)	(0.154)
Firm Input tariff $_{k,j,t-1}$	0.0287	-0.339***	-0.480***
	(0.292)	(0.123)	(0.159)
Firm IT $_{k,j,t-1}$ × Predicted Processing Intensity $_{k,j,t}$	0.231	0.363	0.631
	(0.653)	(0.315)	(0.401)
Predicted Processing Intensity $_{k,j,t}$	-0.133***	0.083***	0.071***
	(0.041)	(0.016)	(0.017)
Ln (Export scope) $_{k,j,t}$		-0.002	
		(0.003)	
Ln (Ordinary import scope) $_{k,j,t}$		-0.003	
		(0.003)	
Ln (R_D) $_{k,j,t}$			-0.000
			(0.001)
$TFP^{dl}_{k,j,t}$	0.506***	0.071***	0.071***
	(0.010)	(0.003)	(0.004)
Ln K $_{k,j,t}$	0.275***	0.033***	0.035***
	(0.010)	(0.004)	(0.004)
Total debt ratio $_{k,j,t-1}$	0.244***	-0.026***	-0.017*
	(0.024)	(0.009)	(0.010)
SOE $_{k,j,t}$	-0.107***	-0.007	0.000
	(0.041)	(0.0133)	(0.016)
Foreign owned $_{k,j,t}$	0.0121	0.021**	0.012
	(0.025)	(0.011)	(0.011)
HMT owned $_{k,j,t}$	0.031	0.017	0.013
	(0.025)	(0.011)	(0.011)
Adjusted R^2	0.145	0.133	0.127
Observations	114,230	114,230	100,840
Joint Significance tests for coefficients on trade protections and interaction terms			
Firm Output Tariff	-0.106	-0.285***	-0.280***
	(0.247)	(0.092)	(0.107)

Notes: Firm-level robust standard errors are clustered and reported in parentheses; * significant at 10%, ** at 5% and *** at 1%. All regressions use adjusted processing intensity predicted by Heckman two-stage selection model. Three-digit industry FE, year FE, location FE and location-year FE are controlled.

Table 3.1. Firm Trade Modes in China

Trade Status	Trade Status	Firm Group No.	Firm Group Description	Type	Type Name
Non-trading Firms	Domestic sourcing and selling only	①	Firms with no exports and no imports	I	Non-Exporter (NE)
Trading Firms	Exporter only	②	Firms with ordinary exports only	II	Pure Ordinary Exporter (OE)
	Importer only	③	Firms with ordinary imports only	I	Non-Exporter (NE)
	Both exporter and importer	④	Firms with ordinary exports and ordinary imports	II	Pure Ordinary Exporter (OE)
		⑤	Firms with ordinary exports, processing exports and processing imports	III	Mixed Exporter (ME)
		⑥	Firm with ordinary exports, ordinary imports, processing exports and processing imports	III	Mixed Exporter (ME)
		⑦	Firms with processing exports and processing imports	IV	Pure Processing Exporter (PE)
		⑧	Firms with ordinary imports, processing exports and processing imports	IV	Pure Processing Exporter (PE)

Table 3.2. Definition of Firm Types

Type	Type Name	Definition
I	Non-Exporter (NE)	Total Exports=0
II	Ordinary Exporter (OE)	ProExp_share=0
III	Mixed Exporter (ME)	0 < ProExp_share < 1
IV	Processing Exporter (PE)	ProExp_share=1

Note: Total Exports=Ordinary Exports+Processing Exports, and the share of processing exports in total exports (ProExp_share)=Processing Exports/Total Exports=Processing Exports/(Ordinary Exports+Processing Exports).

Table 3.3. The Percentage of Firms Across Trade Types (%)

Trade Mode	Year							
	2000	2001	2002	2003	2004	2005	2006	All
Non-Exporter	88.99	88.98	87.15	86.45	85.10	84.40	83.37	85.74
Ordinary Exporter	5.28	6.18	7.30	8.31	9.53	10.17	11.32	8.91
Mixed Exporter	3.50	3.12	3.69	3.49	3.51	3.60	3.63	3.53
Processing Exporter	2.23	1.72	1.86	1.74	1.86	1.83	1.68	1.82
Total Observations	93,039	99,209	111,979	130,241	177,009	187,785	215,167	1,014,429

Table 3.4. The Percentage of Total Outputs Across Trade Types (%)

Trade Mode	Year							
	2000	2001	2002	2003	2004	2005	2006	All
Non-Exporter	70.37	69.19	66.85	66.21	61.56	63.35	60.47	63.97
Ordinary Exporter	12.27	13.68	14.96	16.02	17.65	16.14	18.4	16.37
Mixed Exporter	12.59	13.53	14.04	13.64	15.31	14.71	15.9	14.67
Processing Exporter	4.77	3.59	4.16	4.12	5.48	5.81	5.22	4.98
Total Outputs	545,443	594,308	755,740	997,001	1,270,124	1,563,768	1,981,051	7,707,435

Notes: Total outputs are in a unit of 10 million RMB.

Table 3.5. The Percentage of Total Exports Across Trade Types (%)

Export Mode	Year							
	2000	2001	2002	2003	2004	2005	2006	All
Ordinary Exporter	12.78	17.37	16.63	18.72	19.36	19.09	22.16	19.45
Mixed Exporter	59.49	59.61	60.12	60.26	56.60	54.73	54.37	56.46
Processing Exporter	27.73	23.01	23.25	21.03	24.04	26.19	23.47	24.08
Total Exports	387,929	398,976	666,935	931,066	1,536,172	1,921,790	2,522,553	8,365,420

Notes: Total exports are in a unit of 1 million RMB.

Table 3.6. Percentage of Exporters according to Share of Exports in Outputs

	Percentage of Exporters							
Export Share	2000	2001	2002	2003	2004	2005	2006	All
below 10%	39.83	40.67	35.78	34.13	31.02	30.80	32.08	33.44
10% - 20%	11.63	12.74	11.90	12.01	12.27	12.40	12.11	12.18
20% - 30%	7.49	8.42	8.47	9.19	8.80	8.77	9.06	8.75
30% - 40%	6.26	6.96	6.41	6.79	7.09	7.50	7.60	7.13
40% - 50%	5.09	5.71	5.72	6.12	6.06	6.57	6.22	6.08
50% - 60%	5.02	5.59	5.44	5.33	5.43	5.85	5.64	5.54
60% - 70%	4.61	4.64	4.74	4.93	5.45	5.65	5.60	5.27
70% - 80%	4.66	4.43	5.23	5.33	5.41	5.60	5.66	5.36
80% - 90%	5.18	4.81	5.83	5.78	6.16	6.49	6.48	6.06
above 90%	10.25	6.04	10.47	10.39	12.31	10.37	9.57	10.20
Observations	10,245	10,937	14,389	17,643	26,379	29,293	35,781	144,667

Table 3.7. Summary of Different Trade Modes of Firms

Variable	NE		OE		ME		PE	
	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.
Output	56.69	466.95	139.63	873.76	315.73	1848.13	207.87	1086.52
Age	9.23	10.58	9.34	10.57	9.08	8.76	8.29	5.48
Employment	213.75	931.06	411.76	1127.54	680.53	1598.84	587.11	1062.21
TFP^{dl}	6.29	1.11	6.74	1.13	7.01	1.17	6.64	1.17
Value-added per worker	87.35	222.45	100.68	202.44	117.11	243.70	88.95	534.45
Profit per worker	17.89	79.22	26.57	84.78	35.10	98.01	23.03	157.68
Wage per worker	11.50	26.65	15.68	14.43	18.69	16.83	16.59	16.97
SOE	0.07	0.25	0.05	0.21	0.03	0.18	0.02	0.13
Foreign	0.03	0.16	0.15	0.36	0.36	0.48	0.27	0.44
HMT	0.04	0.19	0.12	0.32	0.27	0.45	0.57	0.50
Others	0.87	0.34	0.69	0.46	0.33	0.47	0.15	0.36
Exit	0.18	0.38	0.14	0.35	0.22	0.41	0.27	0.45
Total exports	-	-	18.00	119.09	131.88	1202.93	109.13	803.38
Export scope	-	-	5.55	8.12	9.41	12.34	5.07	6.69
Total Imports	-	-	8.50	153.30	84.85	877.35	73.99	519.83
Import scope	-	-	5.34	17.87	32.45	50.09	23.93	29.88

Notes: All value variables are in a unit of 1 million RMB except for average value-added/profit/wage which are in a unit of 1,000 RMB.

Table 3.8. Transitions of Trade Modes

Trade Modes	Period *(t+1)*			
Period *t*	NE	PE	OE	ME
NE	96.25	0.20	3.11	0.44
PE	8.78	76.08	0.75	3.20
OE	13.97	0.08	82.24	1.28
ME	7.00	0.63	3.26	79.55

Notes: trade modes are ordered by mean TFP level (low to high).

Table 3.9. Firm Wages and Export Switching

Dependent Variable: D1.ln(wage) $_{k,j,t}$	PE		OE		ME	
	Tariffs	Tariff Interactions	Tariffs	Tariff Interactions	Tariffs	Tariff Interactions
	(1)	(2)	(3)	(4)	(5)	(6)
D1.Output tariff $_{,j,t-1}$	1.950*	2.139*	-0.001	-0.032	-0.288	-0.204
	(1.101)	(1.126)	(0.318)	(0.317)	(0.481)	(0.486)
D1.OT $_{k,j,t-1}$×PE_to_OE		-0.456				
		(7.958)				
D1.OT $_{k,j,t-1}$×PE_to_ME		-2.809				
		(2.965)				
D1.OT $_{k,j,t-1}$×OE_to_PE				3.544		
				(5.909)		
D1.OT $_{k,j,t-1}$×OE_to_ME				2.577		
				(2.715)		
D1.OT $_{k,j,t-1}$×ME_to_PE						-6.606
						(5.072)
D1.OT $_{k,j,t-1}$×ME_to_OE						-0.766
						(2.009)
D1.Input tariff $_{,j,t-1}$	-1.073	1.757	-1.539	-0.674	-0.125	-0.242
	(2.810)	(3.685)	(2.858)	(0.586)	(0.321)	(0.322)
D1.IT $_{k,j,t-1}$×PE_to_OE		-173.600***				
		(51.650)				
D1.IT $_{k,j,t-1}$×PE_to_ME		-8.826				
		(6.987)				
D1.IT $_{k,j,t-1}$×OE_to_PE				49.420***		
				(16.990)		
D1.IT $_{k,j,t-1}$×OE_to_ME				-1.235		
				(2.116)		
D1.IT $_{k,j,t-1}$×ME_to_PE						4.850
						(4.127)
D1.IT $_{k,j,t-1}$×ME_to_OE						4.694
						(7.694)
PE_to_OE	0.127	-0.115				
	(0.148)	(0.101)				
PE_to_ME	0.011	-0.088				
	-0.07	(0.089)				
OE_to_PE			-0.259***	-0.144		
			(0.076)	(0.109)		
OE_to_ME			-0.017	0.0145		
			(0.042)	(0.048)		
ME_to_PE					-0.001	-0.083
					(0.105)	(0.149)
ME_to_OE					-0.140***	-0.125*
					(0.054)	(0.072)
R^2	0.019	0.023	0.004	0.004	0.010	0.011
Observations	2,047	2,047	10,883	10,883	5,253	5,253

Notes: Firm-level robust standard errors are clustered and reported in parentheses; significant at *10%; **5%; ***1%. Year fixed effects, location fixed effects and location-year fixed effects are controlled in all regressions.

Table 3.10. Firm Wages and Export Switching of Pure Processing Exporters

Dependent Variable:	D1.ln(wage) $_{k,j,t}$			PE_to_OE		PE_to_ME	
	With ownership	With productivity	With size	Tariffs	Firm controls	Tariffs	Firm controls
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
D1.Output tariff $_{,j,t-1}$	2.057*	1.943*	1.856*	7.424	6.892	1.824	1.666
	(1.127)	(1.144)	(1.125)	(4.532)	(4.533)	(1.554)	(1.560)
D1.OT $_{k,j,t-1}$×PE_to_OE	-0.399	0.452	0.733				
	(8.238)	(8.968)	(9.777)				
D1.OT $_{k,j,t-1}$×PE_to_ME	-2.660	-2.457	-2.553				
	(2.952)	(3.005)	(3.000)				
D1.Input tariff $_{,j,t-1}$	1.842	2.253	2.334	-17.820***	-21.210***	-11.400***	-13.150***
	(3.693)	(3.735)	(3.737)	(4.560)	(4.785)	(3.189)	(3.285)
D1.IT $_{k,j,t-1}$×PE_to_OE	-181.500***	-175.300***	-167.800***				
	(51.160)	(55.500)	(58.670)				
D1.IT $_{k,j,t-1}$×PE_to_ME	-8.721	-9.322	-9.407				
	(6.878)	(6.920)	(6.927)				
PE_to_OE	-0.147	-0.136	-0.116				
	(0.114)	(0.124)	(0.134)				
PE_to_ME	-0.087	-0.091	-0.092				
	(0.089)	(0.091)	(0.091)				
D1.TFP^{dl} $_{k,j,t}$		0.008	0.013		-0.096		-0.014
		(0.021)	(0.021)		(0.127)		(0.032)
D1.Ln K $_{k,j,t}$			0.068		-0.199***		0.003
			(0.046)		(0.074)		(0.053)
D1.SOE $_{k,j,t}$	0.048	0.019	0.029		-1.096**		0.243
	(0.050)	(0.061)	(0.060)		(0.469)		(0.282)
D1.Foreign owned $_{k,j,t}$	0.141	0.154	0.156		0.422		0.260**
	(0.100)	(0.108)	(0.107)		(0.278)		(0.127)
D1.HMT owned $_{k,j,t}$	0.167**	0.183**	0.187**		0.500		0.085
	(0.085)	(0.091)	(0.090)		(0.341)		(0.118)
Observations	3,557	3,485	3,485	4,659	4,491	4,749	4,580

Notes: Firm-level robust standard errors are clustered and reported in parentheses; significant at *10%; **5%; ***1%. Year fixed effects, location fixed effects and location-year fixed effects are controlled in all regressions.

Table 3.11. Firm Wages and Export Switching of Pure Ordinary Exporters

Dependent Variable:	D1.ln(wage) $_{k,j,t}$			OE_to_PE		OE_to_ME	
	With ownership	With productivity	With size	Tariffs	Firm controls	Tariffs	Firm controls
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
D1.Output tariff $_{,j,t-1}$	-0.032	-0.017	-0.024	2.281	2.292	0.806	0.867
	(0.319)	(0.326)	(0.325)	(1.990)	(1.987)	(0.676)	(0.684)
D1.OT $_{k,j,t-1}$×OE_to_PE	3.573	-0.288	0.333				
	(5.914)	(5.713)	(5.675)				
D1.OT $_{k,j,t-1}$×OE_to_ME	2.700	2.639	2.611				
	(2.714)	(2.712)	(2.715)				
D1.Input tariff $_{,j,t-1}$	-0.664	-0.632	-0.639	5.507*	6.017**	-1.310*	-1.334*
	(0.596)	(0.602)	(0.602)	(2.865)	(2.451)	(0.701)	(0.704)
D1.IT $_{k,j,t-1}$×OE_to_PE	49.490***	42.140***	43.240***				
	(16.980)	(14.990)	(14.730)				
D1.IT $_{k,j,t-1}$×OE_to_ME	-1.302	-1.274	-1.254				
	(2.119)	(2.097)	(2.100)				
OE_to_PE	-0.143	-0.220**	-0.207**				
	(0.109)	(0.097)	(0.096)				
OE_to_ME	0.016	0.007	0.008				
	(0.048)	(0.048)	(0.048)				
D1.TFP^{dl} $_{k,j,t}$		0.064***	0.065***		0.191***		0.063***
		(0.009)	(0.009)		(0.056)		(0.024)
D1.Ln K $_{k,j,t}$			0.018		0.048		0.064**
			(0.012)		(0.144)		(0.026)
D1.SOE $_{k,j,t}$	-0.049*	-0.036	-0.036		0.022		-0.012
	(0.029)	(0.030)	(0.030)		(0.029)		(0.083)
D1.Foreign owned $_{k,j,t}$	0.044*	0.045*	0.043		-0.312**		0.021
	(0.027)	(0.027)	(0.027)		(0.153)		(0.092)
D1.HMT owned $_{k,j,t}$	0.033	0.030	0.028		0.234		0.064
	(0.026)	(0.025)	(0.025)		(0.157)		(0.101)
Observations	20,006	19,848	19,848	20,872	20,675	24,985	24,735

Notes: Firm-level robust standard errors are clustered and reported in parentheses; significant at *10%; **5%; ***1%. Year fixed effects, location fixed effects and location-year fixed effects are controlled in all regressions.

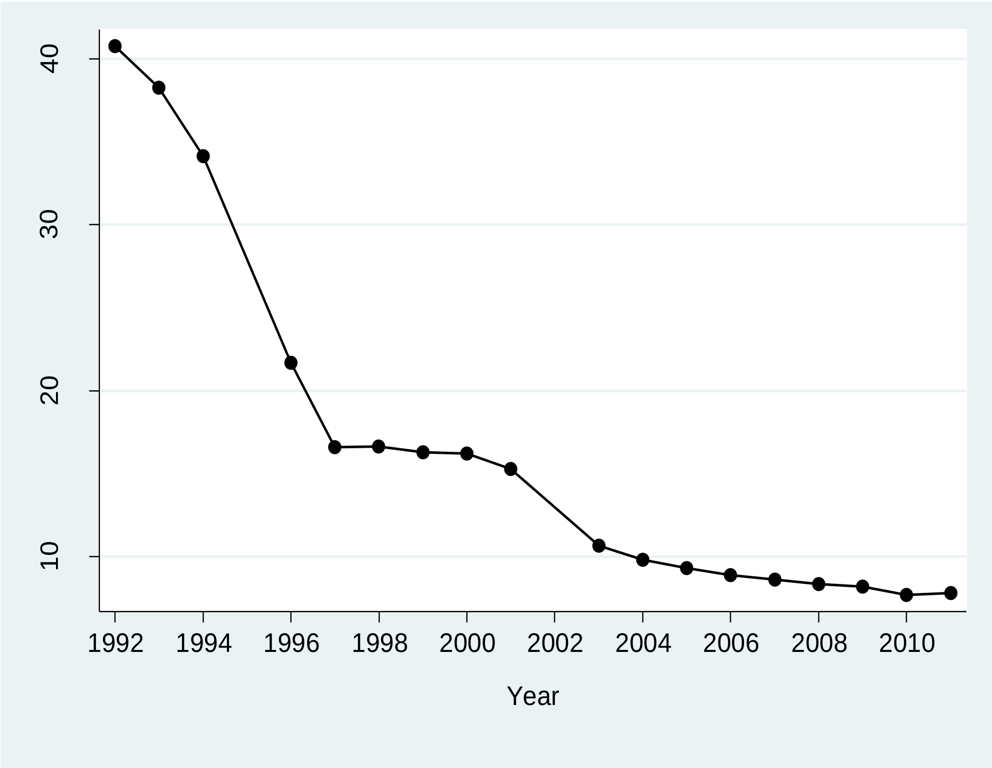
Table 3.12. Firm Wages and Export Switching of Mixed Exporters

Dependent Variable:	D1.ln(wage) $_{k,j,t}$			ME_to_PE		ME_to_OE	
	With ownership	With productivity	With size	Tariffs	Firm controls	Tariffs	Firm controls
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
D1.Output tariff $_{,j,t-1}$	-0.209	-0.231	-0.230	0.220	0.172	-1.703*	-1.611
	(0.486)	(0.498)	(0.496)	(1.485)	(1.482)	(1.018)	(1.013)
D1.OT $_{k,j,t-1}$×ME_to_PE	-6.540	-6.578	-6.377				
	(5.079)	(5.491)	(5.575)				
D1.OT $_{k,j,t-1}$×ME_to_OE	-0.738	-0.850	-0.751				
	(2.006)	(1.995)	(1.976)				
D1.Input tariff $_{,j,t-1}$	-0.244	-0.250	-0.256	9.587***	9.657***	-1.644*	-1.767*
	(0.322)	(0.333)	(0.333)	(2.807)	(2.819)	(0.973)	(0.998)
D1.IT $_{k,j,t-1}$×ME_to_PE	4.724	5.334	5.361				
	(4.146)	(4.145)	(4.127)				
D1.IT $_{k,j,t-1}$×ME_to_OE	4.630	4.506	4.378				
	(7.696)	(7.747)	(7.726)				
ME_to_PE	-0.083	-0.080	-0.075				
	(0.149)	(0.153)	(0.152)				
ME_to_OE	-0.124*	-0.135*	-0.133*				
	(0.072)	(0.072)	(0.072)				
D1.TFP^{dl} $_{k,j,t}$		0.052***	0.053***		0.004		0.054*
		(0.012)	(0.012)		(0.041)		(0.032)
D1.Ln K $_{k,j,t}$			0.035		0.055		-0.064
			(0.022)		(0.069)		(0.044)
D1.SOE $_{k,j,t}$	-0.009	-0.003	-0.003		-0.288		0.388**
	(0.055)	(0.056)	(0.056)		(0.186)		(0.164)
D1.Foreign owned $_{k,j,t}$	0.007	0.010	0.011		-0.157		0.198*
	(0.044)	(0.045)	(0.045)		(0.156)		(0.110)
D1.HMT owned $_{k,j,t}$	-0.017	-0.017	-0.015		0.010		0.195*
	(0.045)	(0.045)	(0.045)		(0.153)		(0.110)
Observations	10,168	10,065	10,065	11,145	10,999	11,347	11,198

Notes: Firm-level robust standard errors are clustered and reported in parentheses; significant at *10%; **5%; ***1%. Year fixed effects, location fixed effects and location-year fixed effects are controlled in all regressions.

Figures

Figure 1.1: Trend of Chinese Applied Tariff Rates (%), 1992-2011



Source: World Bank staff estimates using the World Integrated Trade Solution system, based on data from United Nations Conference on Trade and Development's Trade Analysis and Information System (TRAINS) database and the World Trade Organization's (WTO) Integrated Data Base (IDB) and Consolidated Tariff Schedules (CTS) database.

Figure 2.1. Trends of Output Tariff, Input Tariff, ERP and Firm Average Wage

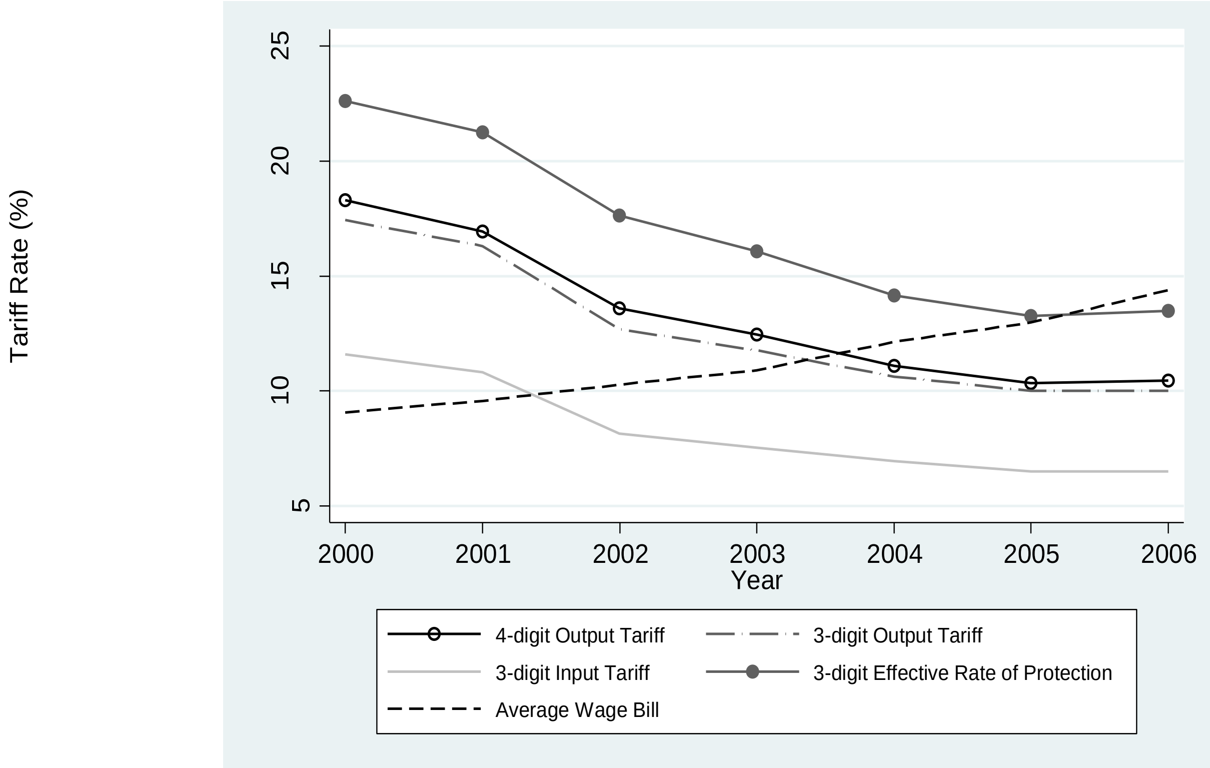


Figure 2.2. Trends of Chinese 2-digit Industrial Output Tariffs, 2000-2006

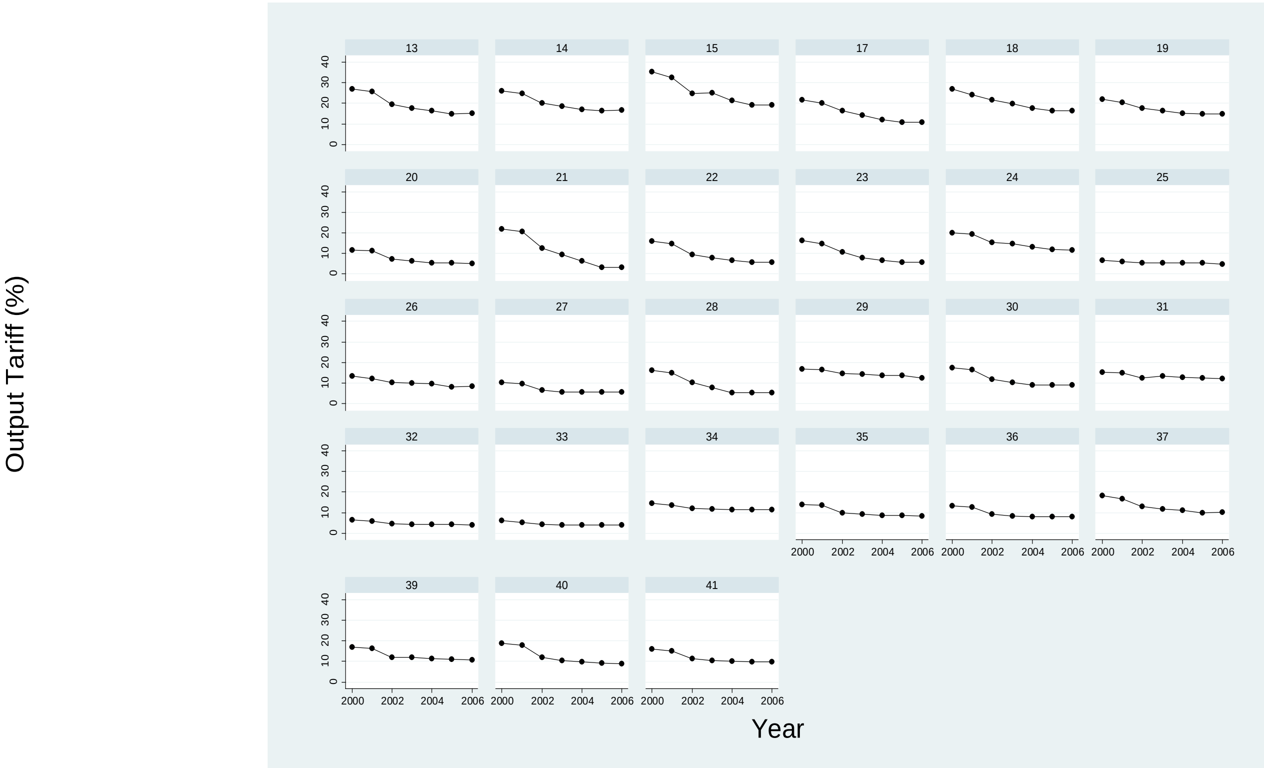


Figure 2.3. Trends of Chinese 2-digit Industrial Input Tariffs, 2000-2006

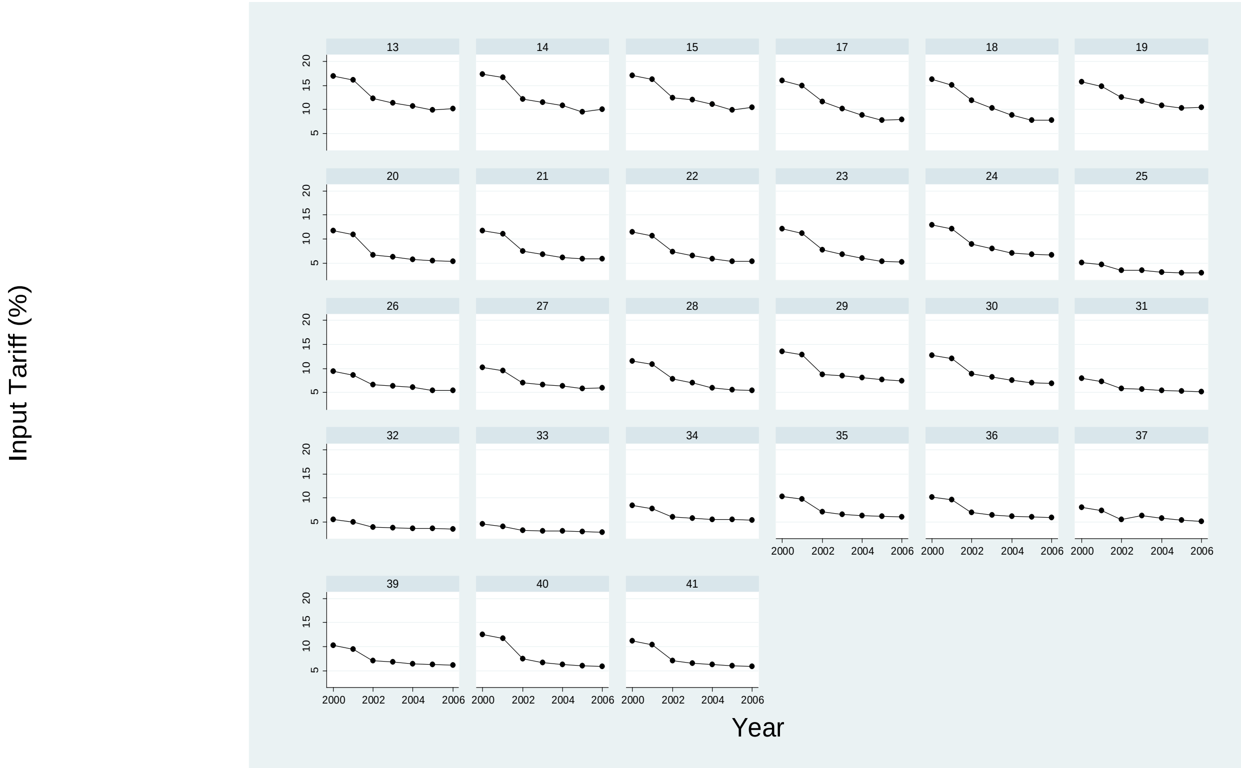


Figure 2.4. Trends of Chinese 2-digit Industrial ERP, 2000-2006

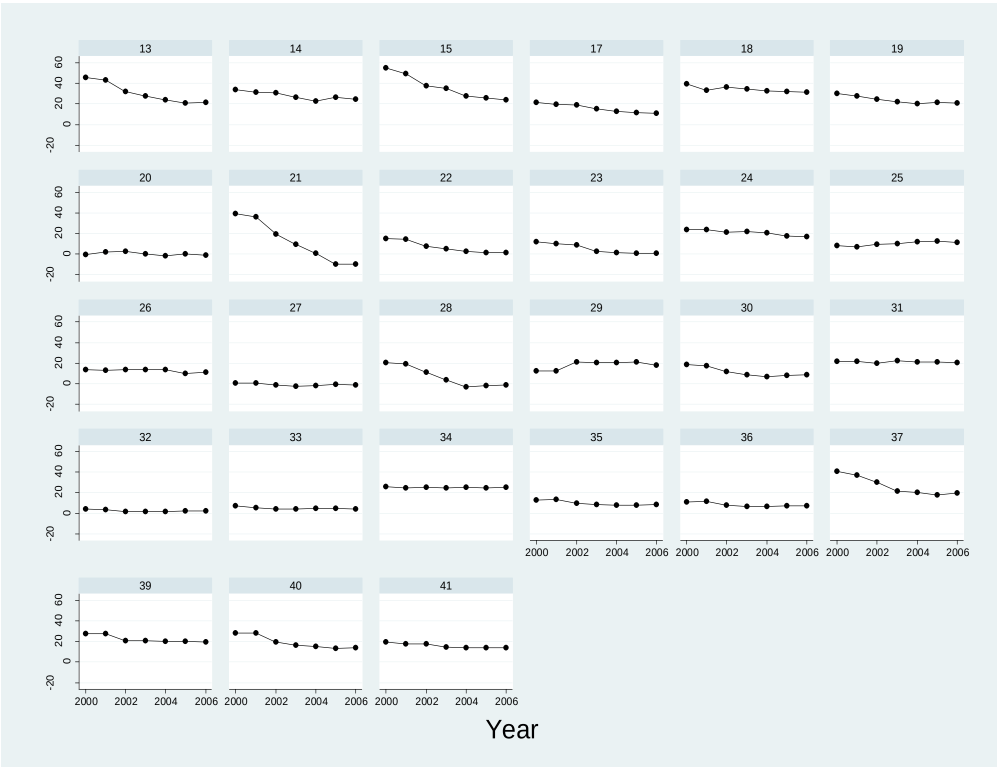


Figure 2.5. Output Tariffs Vary Across 3-digit Industries, 2000-2006

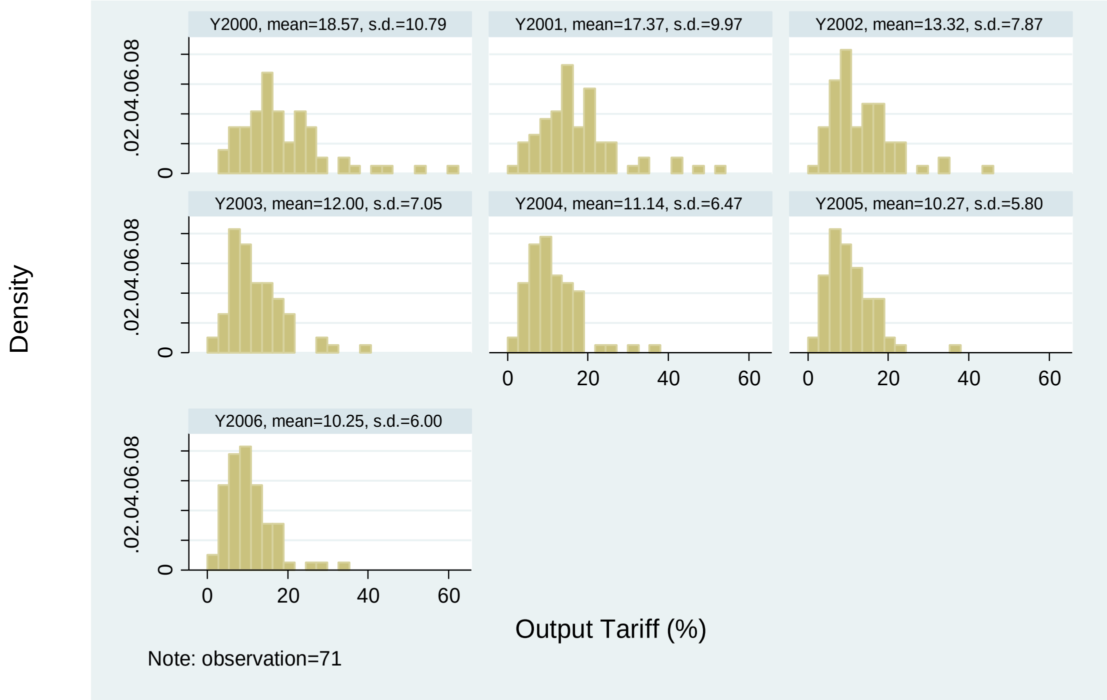


Figure 2.6. Input Tariffs Vary Across 3-digit Industries, 2000-2006

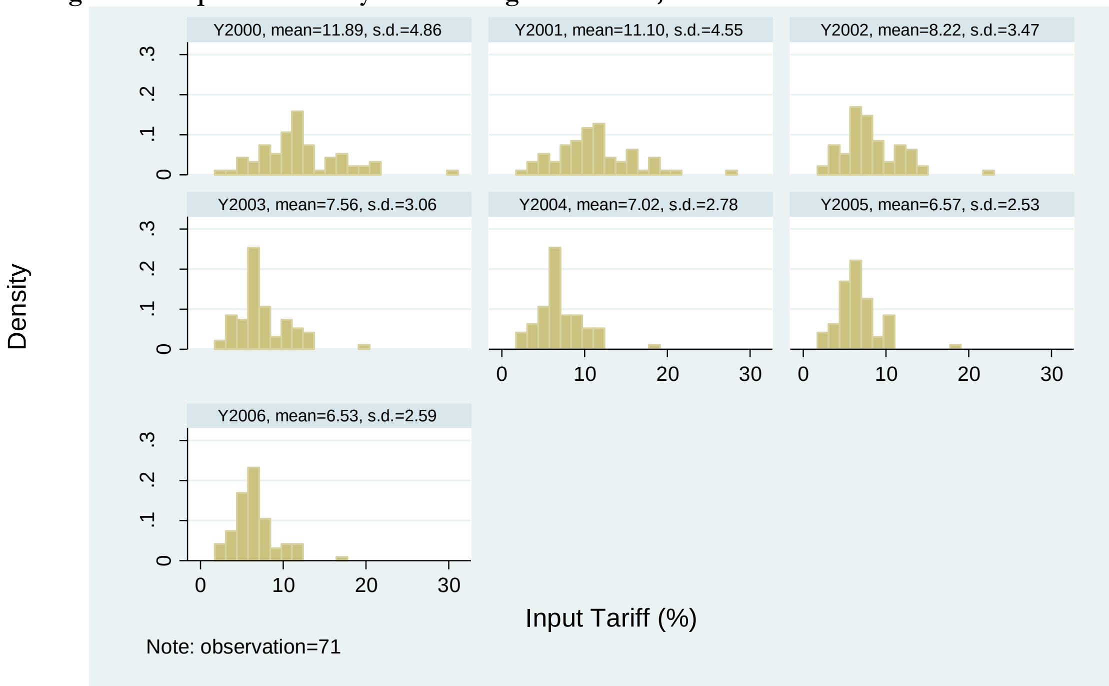


Figure 2.7. ERP Vary Across 3-digit Industries, 2000-2006

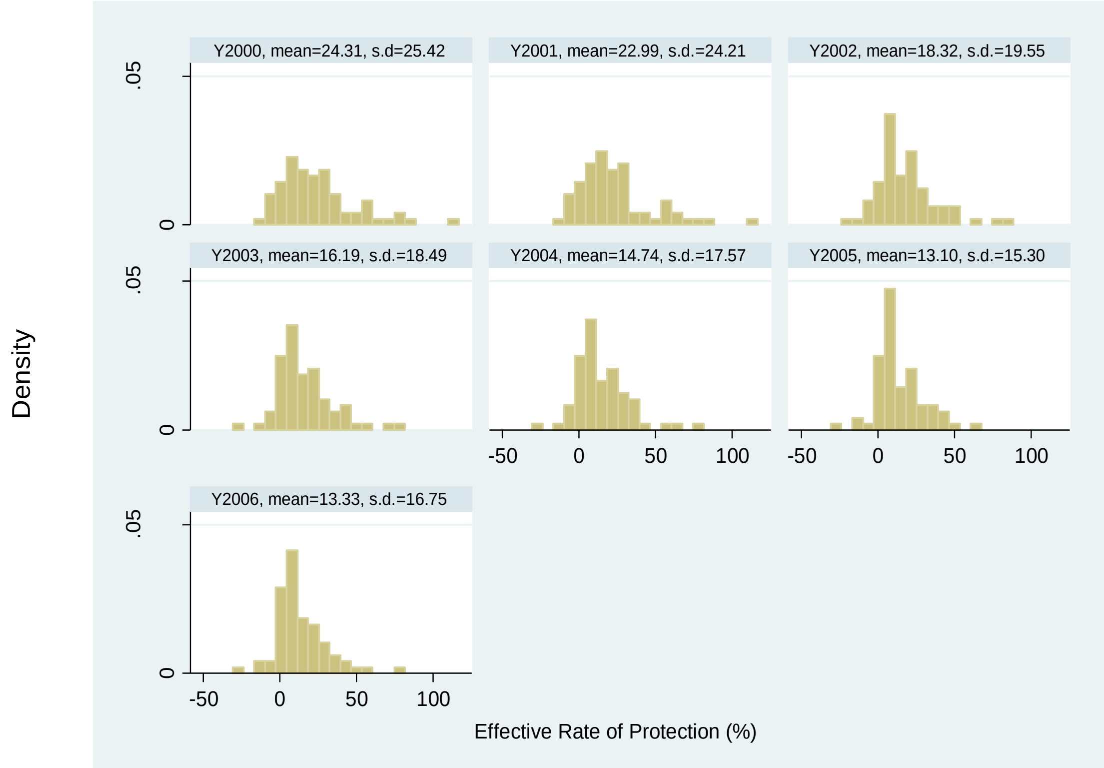


Figure 2.8. Correlation between Output Tariffs and Input Tariffs, 2000-2006

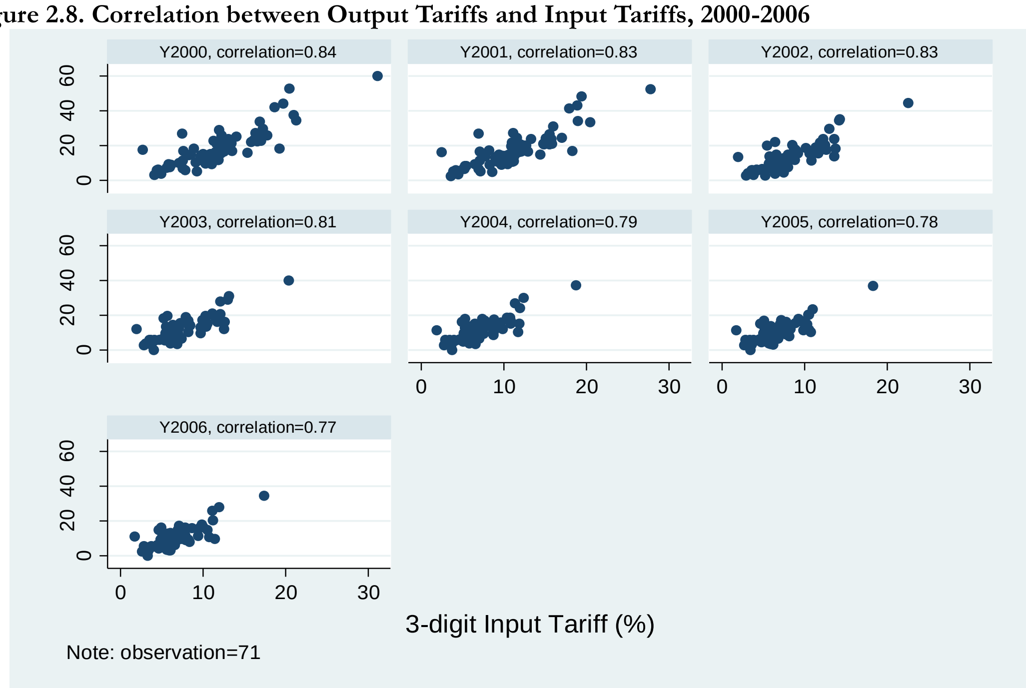


Figure 2.9. Share of Firms

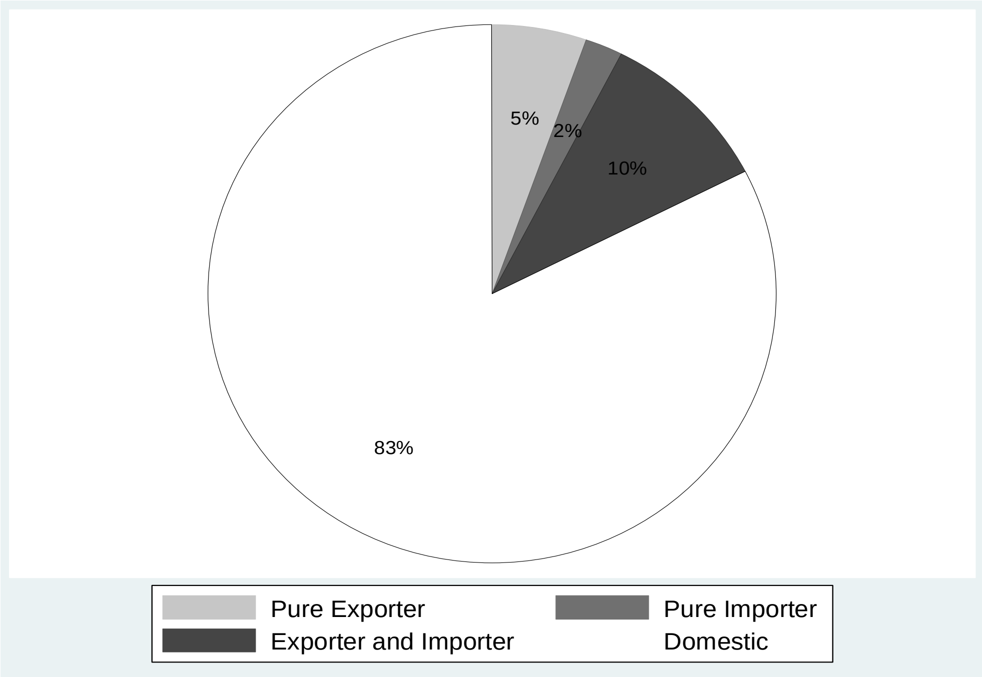


Figure 2.10.Employment Share

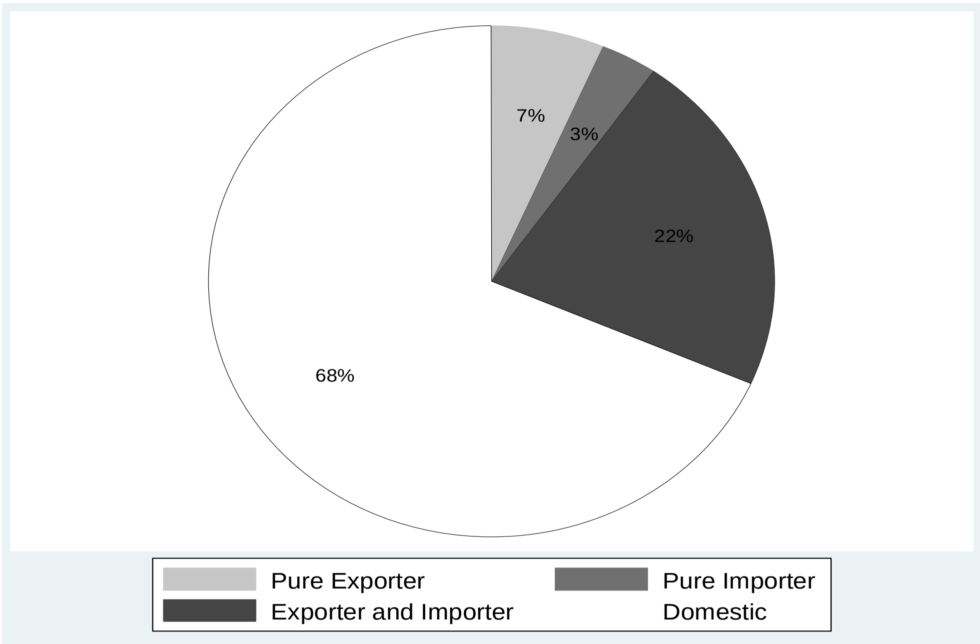


Figure 2.11.Value Added Share

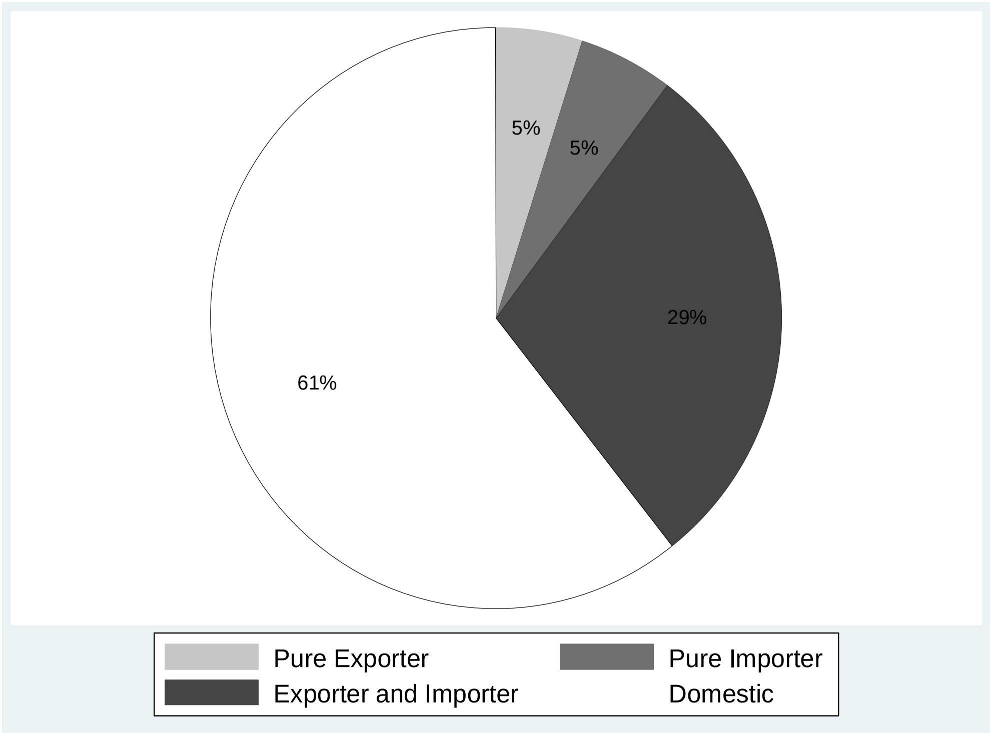


Figure 2.12. Tariff Changes in Percentage of HS Products, 2000-2006

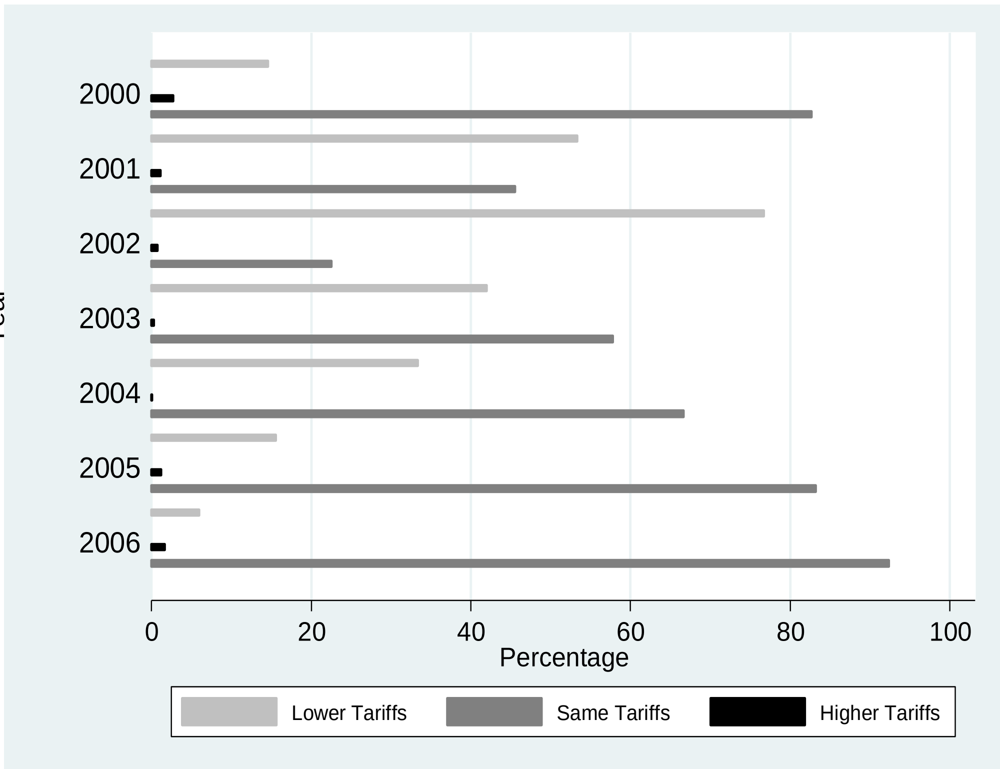


Figure 2.13. Change in Output Tariffs Relative to Initial Levels, 2000-2006 (3-digit Industry)

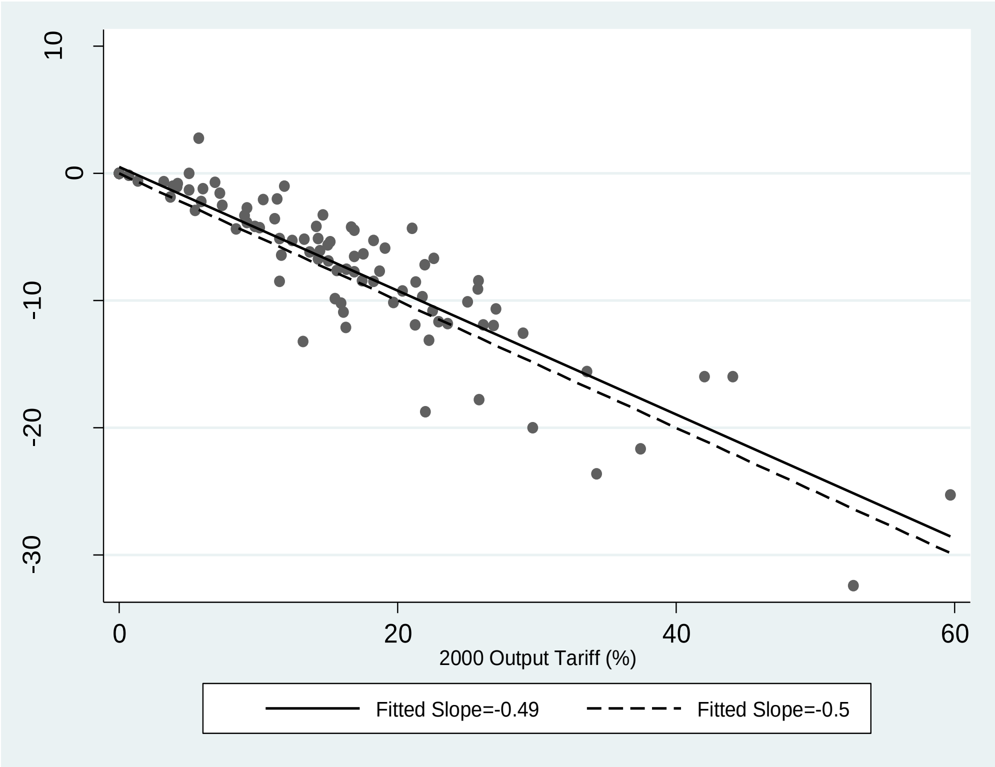


Figure 2.14. Change in Output Tariffs Relative to Initial Levels, pre-WTO (3-digit Industry)

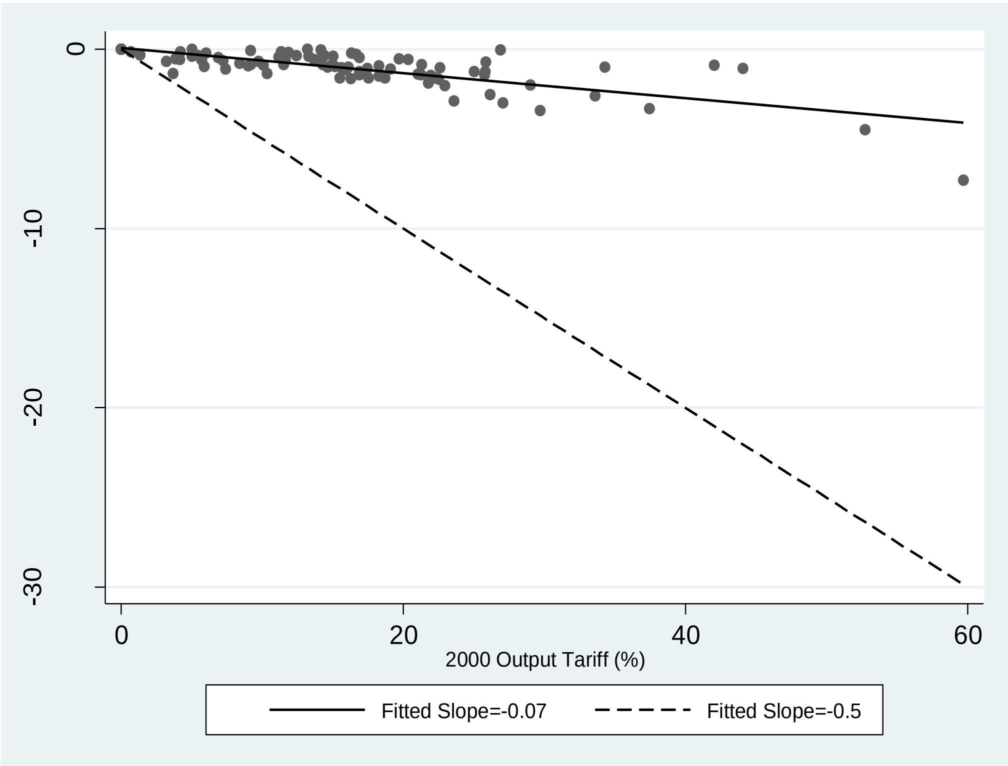


Figure 2.15. Change in Output Tariffs Relative to Initial Levels (2001), post-WTO (3-digit Industry)

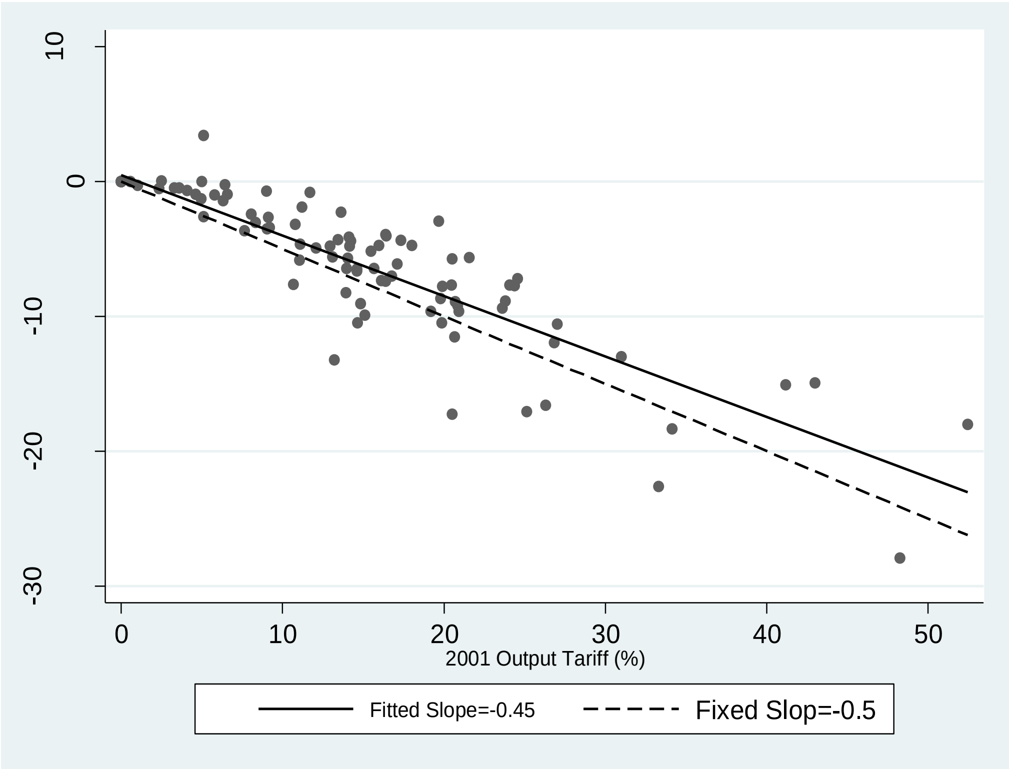


Figure 2.16. Trends in Tariffs for the Most Protected Industries, 2000-2006

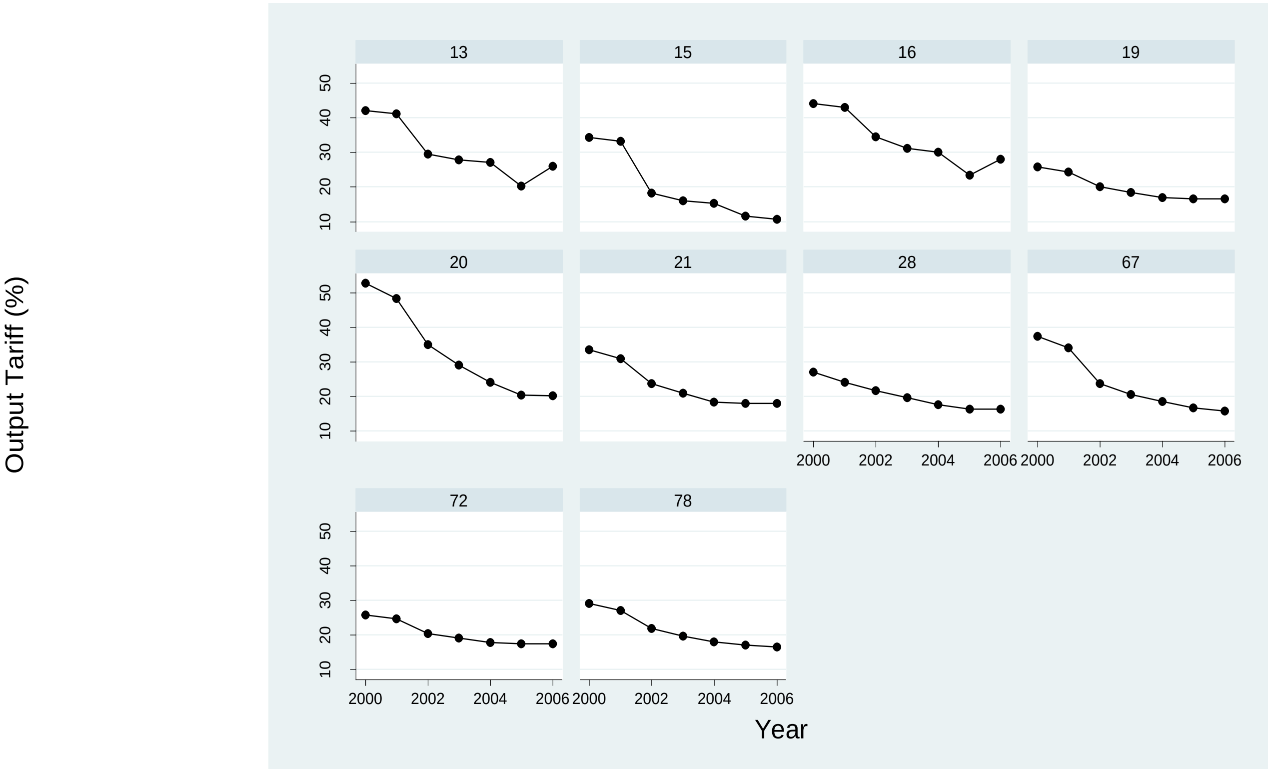


Figure 2.17. Trends in Tariffs for the Least Protected Industries, 2000-2006

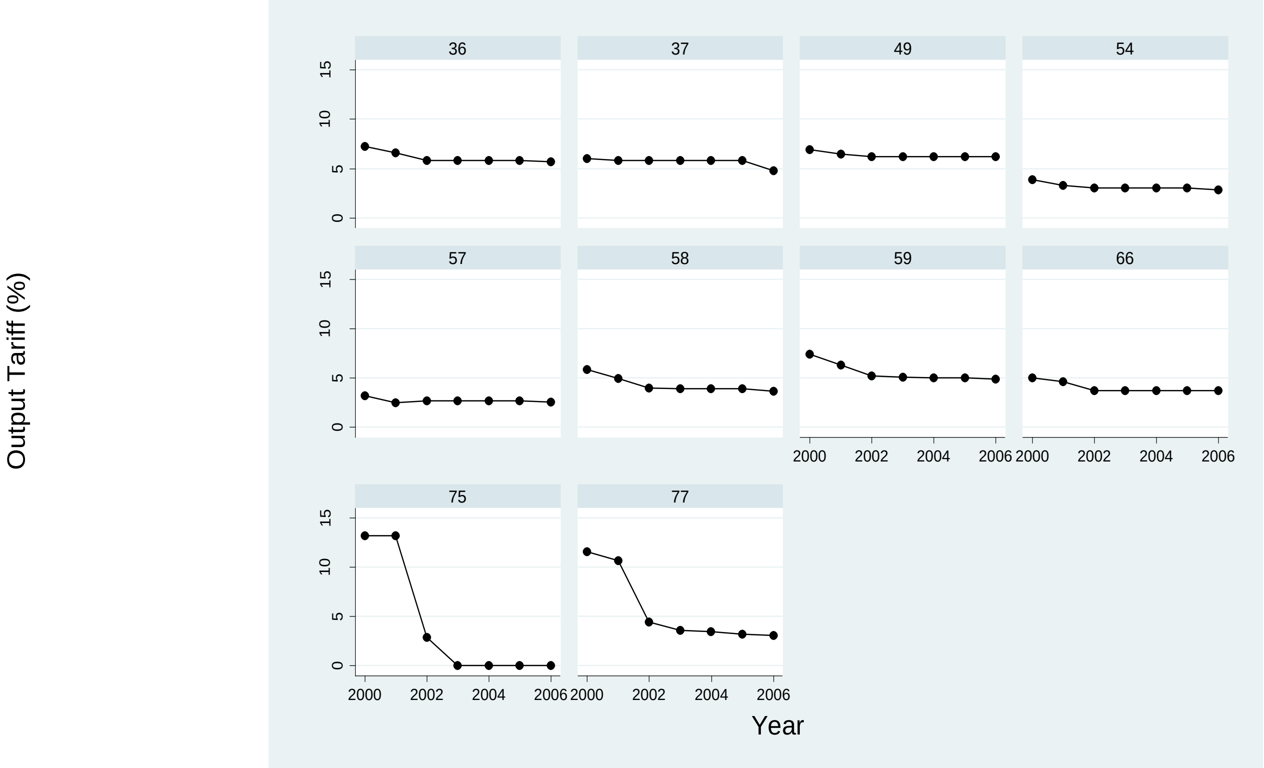


Figure 3.1. The Trends of Firm Wages and Firm Tariffs, 2000-2006

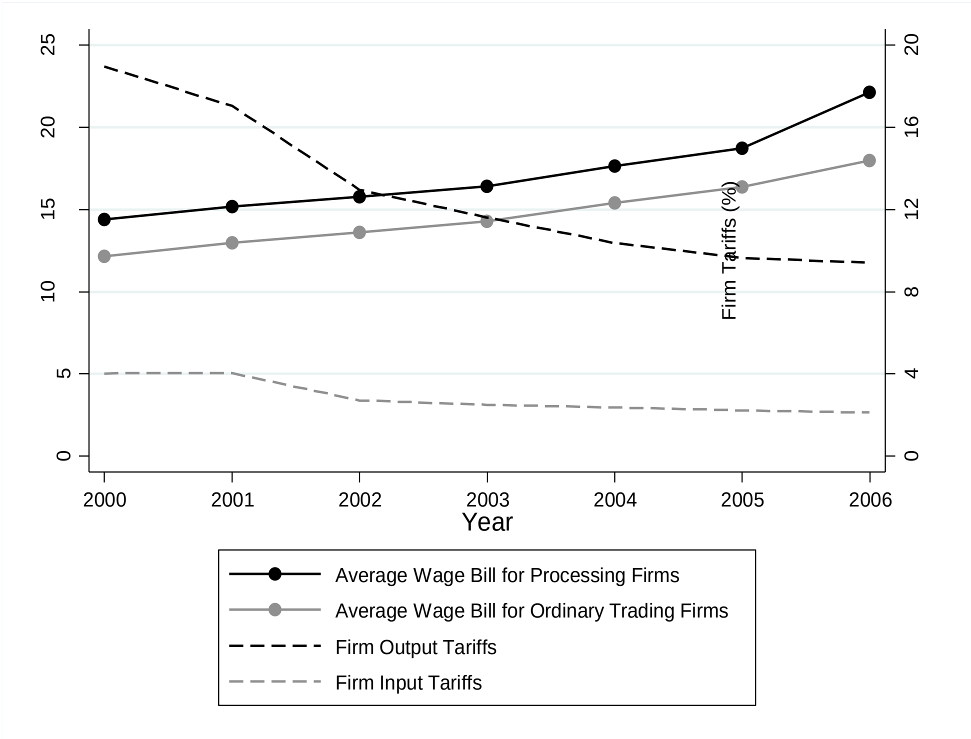


Figure 3.2. Processing Exports in China

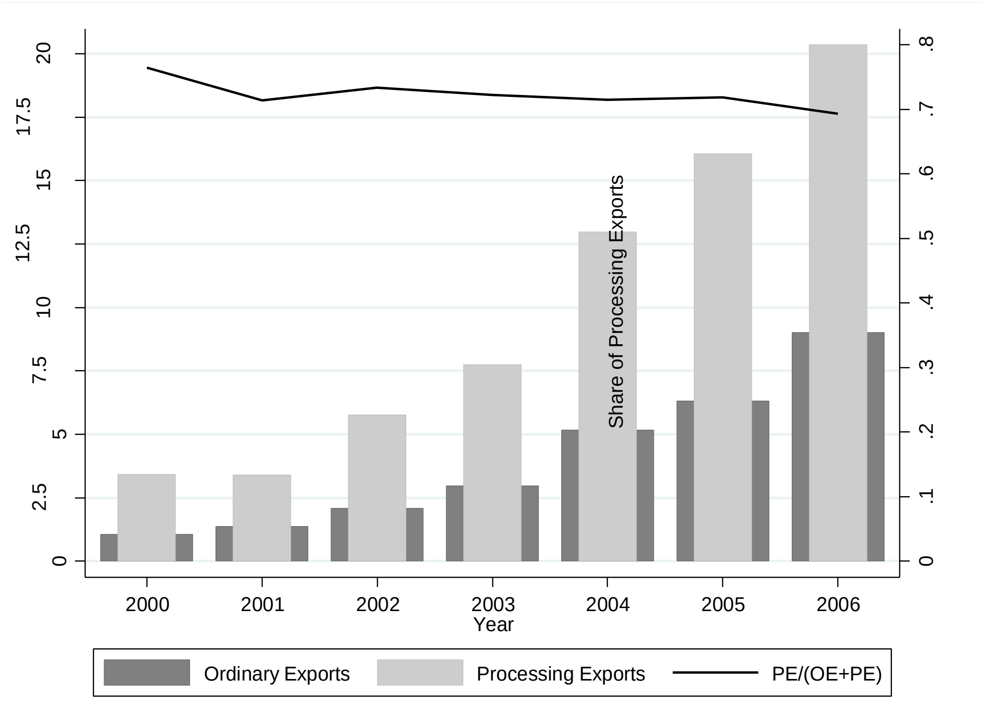


Figure 3.3 Processing Imports in China

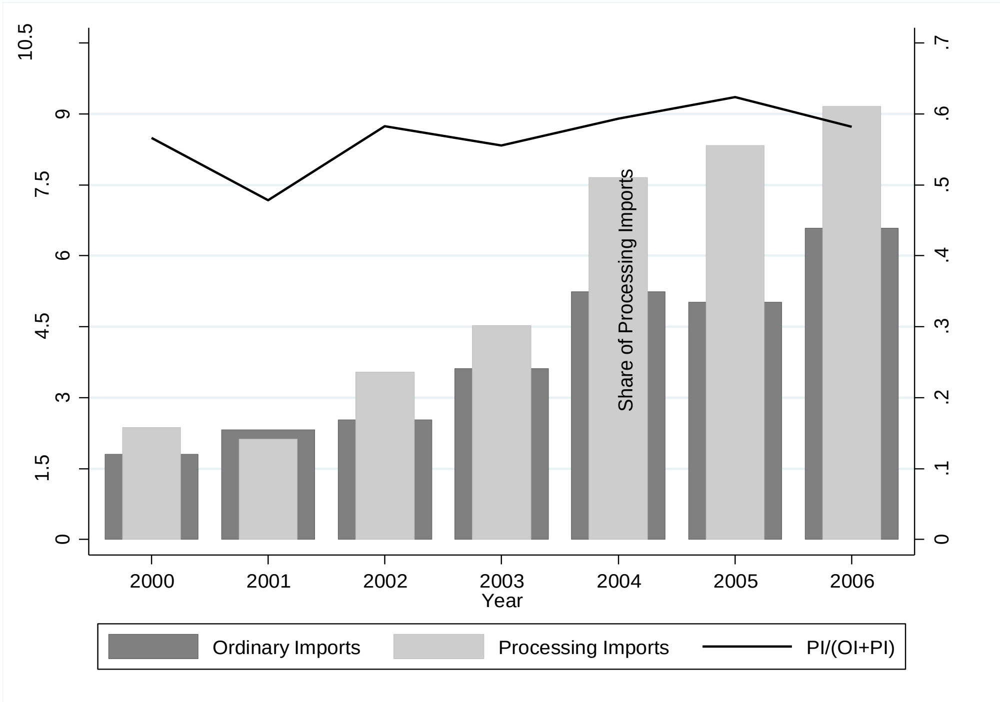
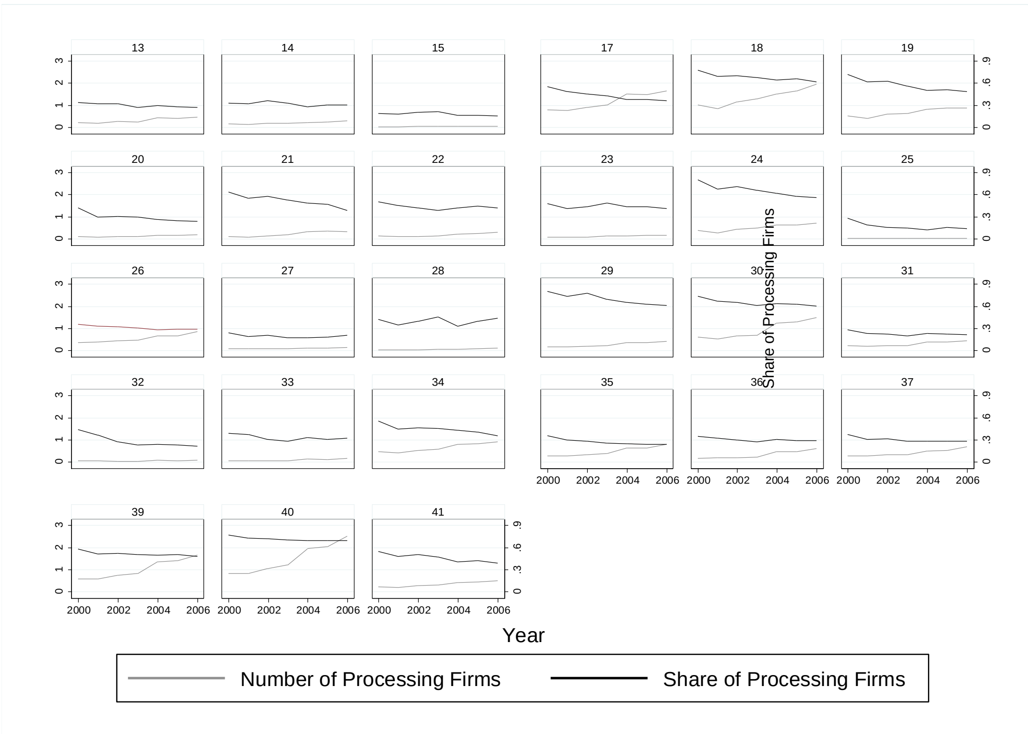


Figure 3.4. Chinese Processing Firms in Two-digit Industry, 2000-2006



Appendix 1A Data Preparation

1A.1 Firm-level Production Data (CASIF)

Table 1A.1 shows the number of industrial firms and the number of valid variables in this Chinese Annual Survey of Industrial Firms (CASIF).[136] It is clear that the quantity of above-scale firms is growing through 2000 to 2006, rising from 162,885 to 301,961. In 2006, the number of firms is almost double that of 2000. In this firm-level production dataset, each firm is required to report its main industry and all the industries are coded by a unique coding system which is under the National Standards of China (GB/T). Under this coding system, each industry is identified by a 4-digit Chinese Industry Classification (CIC) code.

[Table 1A.1 about here]

For our research purposes we only focus on manufacturing firms. This means some data cleaning is required. First, based on the two-digit industry code (the industry is coded within 4-digit in the sample), we exclude several industries and two sectors from this sample.[137] One is the mining sector, including codes 06, 07, 08, 09, 10 and 11; the other is the sector of production and supply of electric power, gas and water, which includes the codes 44, 45 and 46; in addition, tobacco (CIC: 16), handicrafts (CIC:42) and recycling (CIC: 43) industries are excluded.[138] Secondly, a change has occurred in the coding rule since 2003 and a new 4-digit GB/T code is used for coding industries from 2003 onwards As a result, the industry codes in our sample period are not consistent. This means we need to adjust the industry codes by using the industry concordance table constructed by Brandt *et al.* (2012). The adjusted industry codes are still 4-digit in length. After this adjustment, industries 1711, 1712, 1713, 1714, 2220, 3648, 3783, 4183 and 4280 that appeared before 2003 are further excluded, because industries with those codes above were re-classified as service industries in 2003, and hence do not belong to the

[136] The valid variable is a variable with values. If a variable is full of missing values, we consider it to be invalid.

[137] The two-digit industry codes are derived from the adjusted four-digit industry code.

[138] Followed by Upward *et al.* (2013), the production and sales of tobacco is still highly regulated by the Chinese government, the product values of the handicrafts are extremely heterogeneous across the industry as some of them are incredible artworks, and after 2003 recycling industry are divided into many other four-digit industries.

manufacturing sector. The final result is a sample of 424 adjusted industries.[139]

1A.2 Product-level Transaction Data (GACC)

Table 1A.2 shows the number of firms and the number of valid variables in the product-level trade dataset. Table 1A.2 also shows that extremely strong growth in the quantity of firms engaged in international trade between 2000 and 2006. As shown, the number of exporting or importing firms in 2000 is 82,064 but is 2.5 times higher in 2006, at 208,418.[140] The last two rows report the number of repeated firms; the firms with the same Customs ID but are different in all other characteristics. To match as many firms with the production data as possible we keep these repeated firms in the next part of the matching process.

[Table 1A.2 about here]

Before we take the next step of matching the Customs data with the Industrial data, we first clean the customs data and aggregate it from monthly records into yearly records in order to match with the industrial data which is collected annually. First, we exclude the service trade from the raw CCTS data. This means dropping the transaction records containing the two-digit HS codes 98 and 99 following Upward *et al.* (2013). Next, according to the unique 10-digit firm ID code, we aggregate each firm's yearly export values and import values. Because we subsequently use the firm's name as a link to match its trade information with its financial information in the industrial dataset, we drop the repeated aggregated values not only by firm code set by CCTS, but also by firm's name.[141] In such a situation, we make sure that the clean CCTS dataset includes all the names that each firm uses. Sometimes, in the transaction records, even though two records have the same firm code, they may have different firm names. Keeping all the used names of firms increases the matching success rate.

1A.3 Matching the Production Data with the Transaction Data

Combining the suggestions from Upward *et al.* (2013) and Yu (2015), we use common

[139] In the original data we had 535 industries for 2000-2002 based on GB/T 4754-1994 coding system and 480 industries for 2003-2006 based on GB/T 4754-2002 coding system.

[140] In Table 1A.2 we report two different numbers of firms for year 2005 and 2006. For comparison, we use the quantity of non-repeated firms in 2006.

[141] In certain years, there are repeated firms as mentioned before. We keep the different names to provide a better chance to match firms in CASIF. However, this would not cause a problem that a firm in CASIF may merge with repeated firm IDs in CCTS due to the names, because in each year a unique firm in CASIF only reports one name.

variables such as firm's name, contact person's name, telephone number and postcode, to identify a unique firm. Our matching process is described below.

1A.3.1 Matching Method I: by exact firm name

In the first step, a firm is matched if and only if it has the identified name in both datasets for a given year. This is the simplest and most direct way of matching. The matching result for each year is shown in Table 1A.3. However, the matched firms for each year account for just one fourth of the quantity of firms in the Trade dataset, and even fewer for the industrial firm dataset, with only around one fifth of the total number of firms for each year matched. Next, we check the location consistent for those matched firms using two indices, province consistency and postcode consistency, which are variables included in both datasets. The administrative region code in the CASIF is a 6-digit code (but for years 2004 and 2005, the region code is 12-digit) and we take the first two digits to check with the first two digits of firm code in the CCTS.[142] Under the label "Province/Postcode Inconsistency", the number 0 means that the location information in both are the same, while the number 1 means the location information is not consistent.

[Table 1A.3 about here]

Using this matching approach, approximately 19% of the observations in CASIF are matched during our sample period. The success rate of matching in 2000-2002 is around 13% rising to 21% in 2003-2006. At the firm-level the matched observations account for almost 31% of the total observations in CCTS, whereas the success rate of matching in 2000-2003 is around 25% and the rate in 2004-2006 is around 33%.

1A.3.2a Matching Method IIA: by the last 7-digit telephone number combined with the name of the contact person

In order to increase the number of matched firms further, we utilize a firm's contact telephone number combined with the value of the firm's contact person as our second matching approach. During our sample period the telephone number in some provinces had one more digit added at the beginning of the number to extend its length from 7-digits to 8-digits. Hence we use the last 7-digits of the telephone number to identify the

[142] As mentioned in Upward *et al.* (2013), the location information from those two data sources, CASIF and CCTS, are only consistent at the province level. The first two digits of a region code in CASIF represents for a province and the first two digits of a firm ID code in CCTS represents for a province.

firms that appear in both datasets.

To ensure that this second matching method is accurate, we use the combination of the last 7-digit telephone number and the contact person's name in part A. We report this matching result and the location check in Table 1A.4. For comparison we also use the combination of the full-length telephone number and the contact person's name in part B which is the next stage of the process.

[Table 1A.4 about here]

This part of the matching process accounts for approximately 5% of the total observations in CASIF in our sample period and in each year the success rate of matching is also around 5%. Further, the matched observations account for nearly 8% of the total observations in CCTS at the firm-level, whereas the yearly success rate of matching is around 8% (6% in 2003). The success rate of matching based on two datasets is much lower than the rate of the previous matching approach.

1A.3.2b Matching Method IIB: by full telephone number combined with the contact person's name

We also check another matching method in the second step of this part of the matching process. Now we use the full telephone number instead of last 7-digit telephone number combined with the contact person's name. However, the matched result based on this method is relatively small. The number of matched firms in each year is smaller than the one shown in Table 1A.4. To save space we do not provide the table of matching result here.

The result of having fewer matched firms following matching method IIB, satisfies our assumption that using the last 7-digit length of the telephone number is more accurate to identify the same firms common in both datasets, compared to the full length of the phone number.

1A.3.3a Matching Method IIIA: by the last 7-digit telephone number combined with postcode

The next stage in our effort to match as many firms as possible was to try to match firms in the two datasets by the set of last 7-digit telephone number plus postcode as part A of our third matching approach. The result is described in Table 1A.5. Using postcode as one of the keys in the third matching approach means each matched firm must have consistent postcodes. Hence values of the dummy variable "postcode inconsistency" for matched firms in each year are certainly all equal to zero as reported in Table 1A.5.

[Table 1A.5 about here]

In this part, the matched observations account for approximately 6% of the total observations in CASIF in our sample period and in each year the success rate of matching is also around 6%. Further, the matched observations account for nearly 10% of the total observations in CCTS at the firm-level, whereas the yearly success rate of matching is also around 10%. Both success rates of matching based on two datasets here are equivalent to the rates reported in part A of the second matching approach, but much lower than the rates of the first matching approach again.

1A.3.3b Matching Method IIIB: by full telephone number combined with postcode

Similarly, in the third matching step we use the full length of the telephone number, not just the last 7-digit of telephone number and combine with postcode as our matching method IIIB for comparison. Again, the quantity of matched firms based on this part B is smaller than the one based on part A in each year.

1A.3.4 Final Matched Result

Finally, we sum the matched results in each matching step, and then drop the repeated firms to get a more comprehensive matched result. We use the combination of firm ID in CCTS, 4-digit CIC industry code and the region code as our condition to drop the repeated firms in each year. The reason we do not use the firm ID in CASIF as the key to drop repeated firms is that we have found that firms with the same ID in CASIF may have different firm IDs in CCTS. Using the firm ID in CASIF as a hint to drop repeated firms may be erroneous as we may drop unrepeated firms. Hence we choose the firm ID in CCTS as the key to drop repeated firms.

Since the previous matching methods from part A gets a larger number of matched firms compared with part B, we choose the matched firms that appeared in part A to generate our final result. We report the final matched result in Table 1A.6 and check the location consistency again. Further, we calculate the consistency rate and get a value that is nearly 99 percent accurate for province consistency, while in another location index; the rate of postcode consistency is about 80 percent of the total. The consistency rates are both high and this finding convinces us of the success of our matching process.

[Table 1A.6 about here]

Finally, we make a comparison between our matching methods with others and report the results in Table 1A.7. Column (1) reports the yearly and total quantity of matched observations, whereas column (2) and (4) report the quantity of matched observations from Upward *et al.* (2013) and Yu (2015) separately.[143] We also calculate the comparison rates based on our matching results and others and report in both column (3) and (5). Although in some certain years matched observations in Upward *et al.* (2013) are greater than ours, in total we obtain a slightly larger matched sample, with a positive comparison rate of 1.26%, whether yearly or total we obtain a greater sample than Yu (2015), with an additional 42,971 matched observations in total. Finally, our matched sample contains approximately one fifth of observations in CASIF and nearly one third of observations in CCTS. Thus is close to Upward *et al.* (2013) who find 17% of firms in CASIF and 20% of registered firms in CCTS are included in their matched data. These findings convince us of the success of our matching process.

[Table 1A.7 about here]

1A.4 Exclusion of Trading Agents

As mentioned by Manova and Zhang (2009, 2012), there exist some firms whose principal business is not based on production, but mostly provide various kinds of trading services, such as exporting or importing products for other firms, or services like temporarily storing or shipping products for other firms. These firms are referred to as trading agents, or intermediary firms by Ahn *et al.* (2011), and are not engaged in production but involved in the international trade sector. It is the reaction of production firms in the manufacturing sector to tariff changes as a result of trade liberalization that we aim to observe. Hence, we need to exclude these trading agent firms from our sample.

There are no official indicators to identify these trading agents. In practice, Ahn *et al.* (2011) used four key words to identify trading agents while Upward *et al.* (2013) provide a more comprehensive list of key words which are typically used by various kinds of trading agents in their work. We follow their method and combine their lists to identify

[143] In Yu (2014), the author reports his different matching results in two columns, as one is based on raw firms and the other is based on filtered firms. Here we choose the result based on raw firms for comparison because our matching results are without deep cleaning at this stage.

Chinese trading agents then drop these trading agent firms from our sample.

In both industrial firms' dataset and customs trade dataset, the Chinese manufacturing firms report their names in Chinese words. Hence, we exclude the firms in both datasets whose names include such Chinese key words as shown in Table 1A.8, which provides 23 key words in total. Besides, we report the quantity of trading agents identified by our rules in Table 1A.9 and find that 1497 observations have been excluded from our sample in this stage.[144]

[Table 1A.8 about here]

[Table 1A.9 about here]

1A.5 Processing Trade Identification

Processing trade plays an important role in the international trade of China and firms engaged in processing trade enjoy special tariff treatment, which is different from that of other firms engaged in trade. To avoid our empirical results being biased by this type of trade we need to identify those firms involved in processing trade.

In the Customs trade data, there exists a variable to describe the trade types and each type is a 2-digit code. In 2012, the General Administration of Customs reports 16 specific types of processing trade in China. Our clean sample only contains just 12 and we list them in Table 1A.10. Hence, if a matched firm contains trading information including any of these types of processing trade in Table 1A.10, we treat it as a processing firm.

[Table 1A.10 about here]

1A.6 Data Cleaning

In order to obtain a more suitable sample for our analysis, we further clean the matched data. Firms with variables exhibiting the characteristics listed as below are also excluded from our sample:

1. Firms with missing location information, specifically without region code.

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[144] The number of trading agents is lower than the number reported in Upward *et al.* (2013) as the identification is based on different datasets. Ours is based on the matched sample, which is a small part of entire CCTS, whereas his is based on full set of CCTS. We also check the identification number based on full CCTS and find the same result as his work provided.

2. Firms report missing, zero or negative values for any of the financial variables related to final outputs, intermediate inputs, sales, revenue, profits, total capital and wage payment.
3. Firms report missing or negative values for any of the financial variables related to a firm's ownership structure, e.g. a firm with a negative value for its foreign capital is invalid, but a firm with zero foreign capital is valid, which could be explained by the lack of foreign investment. However, as mentioned in rule 2, a firm with zero total capital should not be treated as valid.
4. Firms with missing or negative values of exporting final outputs and importing intermediate inputs.
5. Firms whose production sales are less than the export value.
6. Firms whose total values of inputs used in production are less than the import value of intermediate inputs.
7. Firms with missing values of employment and have less than eight employees.
8. Firms who report missing values for any of the financial variables related to assets.
9. Firms whose liquid assets are higher than total assets; or firms whose total fixed assets are higher than total assets; or firms whose net fixed assets are higher than total assets.
10. Firms whose birth year or established year is missing and invalid.
11. Firms ID based on the industrial dataset system is missing.
12. Processing firms with non-zero values of processing export or processing import.

After this exhaustive data matching and cleaning exercise we are left with 953,609 observations in total.

1A.7 Deflators and Identification of Unique Firms

We use output and input deflators from Brandt *et al.* (2012), which are based on the 4-digit industry level, to deflate the values of all monetary variables in our sample.[145] In addition, we use their method to track the firms across time as we will discuss a firm's change in performance over time. According to the tracking approach, we provide each unique firm with a new identification code so we can recognize them across time. In the end we have an unbalanced panel with 953,609 observations and 332,958 unique firms for 2000-2006.

[145] Brandt et al. (2012) first construct output deflators by using "reference price" which is from China's Statistical Yearbook and then construct input deflators by using the 2002 IO table for China and their measured output deflators.

Appendix 1B Estimation of Total Factor Productivity (TFP)

Total factor productivity (TFP) is measured by following the De Loecker (2007) method and the modification conducted by Elliott *et al.* (2015). De Loecker (2007) extends the model of Olley and Pakes (1996) by introducing two key elements into the production function: one is a firm's export status and the other is different market structures conditional on firm's engagement in foreign trade.

Following De Loecker (2007), Elliott *et al.* (2015) modify and extend the structural model by further adding a firm's import status. introducing firm activities of both exporting and importing into this structural model. A vast of literature document that selling final outputs oversea and sourcing raw materials and intermediate inputs from foreign markets are equally important for firm productivity, and high-productive firms are more willing to self-select into global markets (Van Biesebroeck, 2005; Das *et al.*, 2007; Kasahara and Lapham, 2013), therefore, when measuring or calculating a firm's productivity level, taking its choice of exporting or importing into account is necessary but those trade activates should be treated as endogenous variables.

Since Olley and Pakes (1996) assume that firms are risk-neutral and always expect to maximize their profits in period *t* and period *(t+1)*, their production function is built as belows:

$$y_{it} = \beta_0 + \beta_k k_{it} + \beta_l l_{it} + \omega_{it} + \eta_{it} \qquad \text{(B. 1)}$$

y, *k*, and *l* are the natural logarithm value of firm added-value, firm total capital and firm total employment respectively. Here *i* denotes a firm and *t* denotes a specific year, ω controls for productivity shock which may affect a firm's choice into global engagement and η is an i.i.d component which may not affect a firm's choice of inputs used for manufacturing production.

In each period *t*, firm *i* need to make a series of decisions as follows at the starting point of production: (1) exit or continue to produce final products, which is determined by comparing the continuation value with the currently sell-off value. If the former is higher than the latter, firm *i* keeps producing, otherwise it exits; (2) the unit of labor and the amount of investment used in current production after firm *i* chooses to stay. Since $k_{it} = (1-\delta)k_{it} + i_{it}$, it is well believed that accumulated capital can make current investment become productive in the next time period.

The investment demand function includes considerations of firm capital *k*, its productivity level ω and two trading dummies but only considering in one-direction, exporting FX_{it} or importing FM_{it}:

$$i_{it} = i_t(k_{it}, \omega_{it}, FX_{it}, FM_{it}) \qquad \text{(B.2)}$$

It is hard to have available and appropriate investment data at the firm level and in empirical studies a large quantity of firms are lack of information on investments or occur zero-investment. To solve the problem of firms who have zero-investment, a modification approach introduced by Levinsohn and Petrin (2003) can be used by taking each firm's total intermediates (m) as a proxy for investment and hence, equation (B.2) turns to be:

$$m_{it} = m_t(k_{it}, \omega_{it}, FX_{it}, FM_{it}) \qquad \text{(B.3)}$$

Elliott *et al.* (2015) then obtain the function of productivity shock ω_{it} by inverting the demand function:

$$\omega_{it} = \omega_t(k_{it}, m_{it}, FX_{it}, FM_{it}) \qquad \text{(B.4)}$$

After substituting equation (B.4) into equation (B.1), the production function now turns to be:

$$y_{it} = \beta_0 + \beta_l l_{it} + \phi_t(k_{it}, m_{it}, FX_{it}, FM_{it}) + \eta_{it} \qquad \text{(B.5)}$$

where $\phi_t(k_{it}, m_{it}, FX_{it}, FM_{it}) = \beta_k k_{it} + \omega_t(k_{it}, m_{it}, FX_{it}, FM_{it})$.

Then, by substituting a third-order polynomial in four variables, k_{it}, m_{it}, FX_{it} and FM_{it} to approximate $\phi_t(.)$, β_l can be estimated from equation (B.5) by using OLS approach in the first stage and it is consistent. To capture the effects of firm ownership and year fixed effects, dummy variables to describe firm ownership structure and year dummy variables are additional included and the estimation is based on 4-digit CIC industry level. In the second stage, the coefficient on capital β_k is estimated in the following description.

The decision for surviving is dependent on firm trading status of exporting and importing through two channels: productivity shocks and the accumulated process of capital, in order to avoid the bias of selection. If the function of indicator χ_{it} is defined to be equal to 1, for example, if firm *i* stays in production at *t* and zero otherwise, then the probability of surviving is determined by the information set *J* at time *t* as follows:

$$\begin{aligned} Pr\{\chi_{i(t+1)} = 1|J_{it}\} &= Pr\left\{\omega_{i(t+1)} \geq \underline{\omega_{i(t+1)}}(k_{i(t+1)}, FX_{it}, FM_{it})\left|\underline{\omega_{i(t+1)}}(k_{i(t+1)}, FX_{it}, FM_{it}), \omega_{it}\right.\right\} \\ &= \psi\left\{\underline{\omega_{i(t+1)}}(k_{i(t+1)}, FX_{it}, FM_{it}), \omega_{it}\right\} = \psi\{k_{it}, m_{it}, FX_{it}, FM_{it}\} \\ &\equiv P_{it} \qquad \text{(B.6)} \end{aligned}$$

Then productivity is assumed to follow a first order Markov process:

$$\omega_{i(t+1)} = E\left[\omega_{i(t+1)}|\omega_{it}, FX_{it}, FM_{it}, \chi_{i(t+1)} = 1\right] + \xi_{i(t+1)} \qquad \text{(B.7)}$$

where $\xi_{i(t+1)}$ is the innovation on productivity in period (*t+1*) that is dependent on these variables, productivity in the current period *t*, trading status (export and import) and survival in the next period (*t+1*).

Let us consider the expectation of $y_{i(t+1)} - \beta_l l_{i(t+1)}$ conditional on survival and information at time *t*:

$$\begin{aligned} E\left[y_{i(t+1)} - \beta_l l_{i(t+1)}|k_{i(t+1)}, \chi_{i(t+1)} = 1\right] &= \beta_0 + \beta_k k_{i(t+1)} + E\left[\omega_{i(t+1)}|\omega_{it}, FX_{it}, FM_{it}, \chi_{i(t+1)} = 1\right] \\ &\equiv \beta_k k_{i(t+1)} + g(\omega_{i(t+1)}, \underline{\omega_{it}}) \qquad \text{(B.8)} \end{aligned}$$

Given the density of $\omega_{i(t+1)}$ conditional on ω_{it} is positive in each region, $\omega_{i(t+1)}$ can be expressed as a function of P_{it} and ω_{it} from equation (B.6). Hence, $g(.)$ can be written as a function of P_{it} and ω_{it}.

The equation (B.9) could be derived from equation (B.1) by substituting P_{it} and ω_{it} into $g(.)$ as follows:

$$\begin{aligned} y_{i(t+1)} - \beta_l l_{i(t+1)} &= \beta_0 + \beta_k k_{i(t+1)} + E\left[\omega_{i(t+1)}|\omega_{it}, FX_{it}, FM_{it}, \chi_{i(t+1)} = 1\right] + \xi_{i(t+1)} + \eta_{it} \\ &= +\beta_k k_{i(t+1)} + g(P_{it}, \omega_{it}) + \xi_{i(t+1)} \\ &\quad + \eta_{it} \qquad \text{(B.9)} \end{aligned}$$

Using $\omega_{it} = \phi_t(k_{it}, m_{it}, FX_{it}, FM_{it}) - \beta_k k_{it}$ from equation (B.5), on the right-hand side in equation (B.9) the first three terms can be re-written as a function of $(\phi_t - \beta_k k_{it})$ and P_{it} as follows:

$$y_{i(t+1)} - \beta_l l_{i(t+1)} = \beta_0 + \beta_k k_{i(t+1)} + g(P_{it}, \phi_t - \beta_k k_{it}) + \xi_{i(t+1)} + \eta_{it} \quad (B.10)$$

Similarly, β_k can be estimated from equation (B.10) by using nonlinear least squares approach and substituting the coefficient on laborβ_l that is estimated in the first stage and the probability of surviving P_{it} that is estimated in equation (B.6). Since in the first stage, $g(P_{it}, \phi_t - \beta_k k_{it})$ is a approximated function by using a higher order polynomial expansion in P_{it} and $(\phi_t - \beta_k k_{it})$.

Appendix 2A Measures of Industrial Trade Protections in China

2A.1 Industry-level Tariffs

We follow Amiti and Konings (2007) for the measurement of tariff rates. To do this we construct output and input tariffs in China using IO (Input/Output) sector categories, which are equivalent to the 3-digit Chinese Industry Classification (CIC) level. Output tariffs are constructed by taking the simple average of the tariffs at the Harmonized System (HS) six-digit code level within each IO sector. For each IO sector, the input tariff is measured by using an input-cost share as the weight to aggregate those IO sector output tariffs. The measurement is as follows:

$$input\ tariff_{jt} = \sum_{j} s_{ij,2002} \times output\ tariff_{jt}$$

$$where \quad s_{ij,2002} = \frac{\sum_{k} input_{kij}^{2002}}{\sum_{kj} input_{kij}^{2002}}$$

We use the shares from the input-output table of China in 2002 as the weights $s_{ij,2002}$, which are the input-cost proportions of industry *i* in producing total outputs in industry *j*, based on 2002 firm-level data, sum up to the 3-digit industry level (IO sector-level) by National Bureau of Statistics of China (NBSC).[146] Here, *i* or *j* denotes an industry, *t* denotes a different year and *k* denotes a firm. The measurement of input tariffs is such that if for example, industry *j* incurs 80% of its cost in cotton and 20% in wool, then cotton tariffs get a 80% weight and wool tariffs a 20% weight, and the input tariff for industry *j* is calculated as the sum of output tariffs on both cotton and wool, with a 70% weight giving to output tariff in cotton and a 30% weight giving to output tariff in wool.

To measure the IO sector output tariff rates, we first need to know the product line for each sector. However, the direct connection between IO sectors and HS codes is not

[146] Firm's inputs/outputs and compilation of the input-output tables for China is conducted by NBSC every five years. There are five IO tables for China, 1987, 1992, 1997, 2002 and 2007. Since our sample period is 2000 to 2006, we choose the 2002 IO table and use its input-cost shares as the weights to calculate our 3-digit industry input tariffs during the sample period.

readily available. There are two possible methods to address this problem: one is to rely on the linkage between the International Standard Industrial Classification (ISIC) coding system and CIC coding system and to utilize multiple concordance tables to indirectly obtain an IO-HS concordance table.[147] The other possible solution is to rely on the 2007 IO-HS concordance table as China Customs reports the product line within each IO sector directly. However, both products and sectors are based on the China's new coding system, HS2007 and IO2007. For our sample period, some additional adjustment is needed.[148] Our strategy is to combine both approaches to drop the repeated products of each sector to derive our comprehensive IO-HS concordance table, which is based on the HS 6-digit product level.

As a first step for method 1, we adjust the IO sectors with the 4-digit CIC industry codes. Specifically, we match 122 IO sectors with 861 CIC industries (2000-2002) and with 913 CIC industries (2003-2006) separately.[149] Secondly, we convert the CIC coding system into the ISIC coding system and further connect our IO sectors with ISIC industries.[150] Then using the ISIC/Rev.3-HS concordance tables we link the ISIC industry codes with China's HS 6-digit products.[151] Finally we find the correspondence between the IO sectors and the HS 6-digit products according to method 1. Later we convert the 2007 IO-HS concordance table into a new version to correspond to our time period as outlined in method 2. Eventually, by integrating the results from methods 1 and 2, we acquire our own IO-HS concordance tables, which cover almost 7,000 HS 6-digit

[147] These multiple concordance tables we utilized are: ISIC/Rev.3-HS1996, ISIC/Rev.3-HS2002, GB/T4754-2002-ISIC/Rev.3, GB/T4754-2002-IO2002 and GB/T-4754-2002- GB/T4754-1994.

[148] Here we need concordance tables HS1996-HS2007, HS2002-HS2007 and IO2002-IO2007.

[149] During the sample period there are two versions of industry classification, so we adjust the IO sectors with both of them separately. In 2000-2002 the industry classification is based on old coding system, GB/T4754-1994, therefore there are 861 industries in total. After 2002 the new coding system, GB/T4754-2002, is introduced to classify industry, hence there are 913 industries in total. As in Brandt *et al.* (2012), they only concordance the manufacturing industries with the IO sectors therefore 71 IO sectors are reported in their IO-CIC concordance table. Based on their work, we extend the adjustment as our IO-CIC concordance table including all 122 sectors appeared in 2002 input-output table, which includes all the industries not only manufacturing industries.

[150] NBSC report the concordance table between GB/T4754-2002 and ISIC/Rev.3. In practice a CIC code may correspond to three ISIC codes. For example, Manufacture of Stationery (CIC: 2411) is concorded with Manufacture of Plastic Products (ISIC: 2520), Manufacture of Other Metal Products (ISIC: 2899) and Manufacture of Others (ISIC: 3699). In this case we give a 1/3 weight to each ISIC industry and sum up those 3 ISIC output tariffs if we would like to get the CIC output tariff in Manufacture of Stationery. Later when we calculate the IO sector output tariffs, we treat each product's tariff under each ISIC industry equally.

[151] The tariffs of 6-digit products obtained from the WITS around our sample are based on different HS versions. Tariffs in 2000 and 2001 use the HS1996 coding system while tariffs in 2002-2006 use the HS2002 coding system. So we use two concordance tables: ISIC/Rev.3-HS1996 and ISIC/Rev.3-HS2002.

products within 122 IO sectors.[152]

With our own IO-HS table, we use China's HS 6-digit effectively applied tariffs and take a simple average to obtain IO sector output tariff rates.[153] Based on IO sector output tariffs, we turn to calculating IO sector input tariff rates. To measure IO sector input tariffs we use the input-cost shares from the 2002 input-output table as a weight to average the IO sector output tariffs as calculated previously. Since we assume in our sample period each IO sector does not change its cost distribution for each production line, we fix the input-cost shares. That is, we implicitly assume that technology remains constant. Further, since we use industry input-shares for input tariff rate calculations, which is at a more aggregated level, our measurement for input tariffs would not be biased by a single firm's own input choices.

2A.2 Industry-level Effective Rate of Protection (IERP)

We further also construct effective rate of protection (ERP) to evaluate the trade reform in China. Two forces drive this additional measurement. First, if the tariff structure across industries experiences a huge change, the disciplining effect of decreasing tariffs on final goods may be offset by decreasing input tariffs. Second, given the high correlation between output and input tariff rates at the 3-digit industry level (as seen in Table 2 of section 2.1), rather than include both measures in the same equation, we use the 3-digit industry level ERP to account for both types of protection.

Following Corden (1966), we therefore measure IERP to capture the net effect of tariff reductions on outputs and intermediate inputs,

$$IERP_{jt} = \frac{output\ tariff_{jt} - input\ tariff_{jt}}{1 - \sum_{j} \alpha_{ij,2002}}$$

where $\alpha_{ij,2002}$ are the input-value shares of industry i in the production of total

[152] We generate two concordance tables, IO2002-HS1996 and IO2002-HS2002. The former covers 6,886 HS 6-digit products within 122 sectors and the latter covers 7,031 HS 6-digit products within 122 sectors.

[153] Some IO sectors do not report the HS 6-digit outputs and hence their output tariff rates are missing. This is because that those 122 IO sectors include all the industries, not only manufacturing industries but also service industries, such service industries do not produce products and hence they would not induce tariffs. Therefore, it is reasonable that we treat those missing ISIC output tariffs as zero.

outputs in industry *j*, also derived from the input-output table of China in 2002. It is noted that the weights $\alpha_{ij,2002}$ to measure IERP are different from the weights $s_{ij,2002}$ to measure input tariffs in section A.1. The former is the share of inputs from industry *i* in the total input costs occurred in the production of total outputs in industry *j*, and the latter is the share of inputs from industry *i* in the total value of outputs in industry *j*. Hence, $(1-\sum_j \alpha_{ij,2002})$ can be expressed as:

$$1-\sum_j \alpha_{ij,2002} = 1-\frac{total\ input_{jt}}{total\ output_{jt}} = \frac{total\ output_{jt} - total\ input_{jt}}{total\ output_{jt}} = \frac{total\ value\text{-}added_{jt}}{total\ output_{jt}}$$

which is equivalent to the share of value-added in the value of outputs in industry *j*.

Appendix 3A Data Exclusion

Since our research aims to investigate the determinants of switching among different exporters, additional exclusions from our merged unbalanced panel data are needed. Based on the definition of processing exporters as defined in section 3.1.1, we first exclude the firms who have processing exports but no processing imports at period *t*, which include 4,936 observations and are around 0.48% (4,936/1,026,728≈0.00481) of our unbalanced merged sample, and the firms who have processing imports but no processing exports at period *t*, which include 7,363 observations and are around 0.72% (7,363/1,026,728≈0.00717) of our unbalanced merged sample in period *t*, and consequently we have 1,014,429 observations in current panel. Then, to satisfy our motivation to investigate firm switching among different export types, we exclude the firms without any exports and such non-exporting firms include pure domestic-oriented firms (group 1 in Table 1) and pure importing firms (group 3 in Table 1). Therefore, 869,762 observations are excluded, whilst among these the former accounts for 98% (852,437 observations) of them and the latter only accounts for 1.99% (17,325 observations). After such two additional exclusion rules, we are left with 144,667 observations. Finally, based on the assumption used for calculating firm output tariffs as mentioned in section .1.1 we need to drop those firms with zero domestic sales (pure exporting firms) and firms with zero exports (pure domestic-sale firms) to avoid either of them bias our empirical tests. Since we have already dropped pure domestic-sale firms as a last step, we only need to further drop pure exporting firms. According to the distribution of export shares, we define pure exporting firms to be those firms whose export share exceeds that of the 90th percentile within our current sample, and hence, we have 14,760 observations, around 10.2% (14,760/144,667≈0.1020), belonging to pure exporting firms in total.[154] As a result, there are 129,907 observations and 55,217 unique firms left for our main estimations.

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[154] Note that we only have firms with exports in our sample now and hence, their export shares are always greater than zero. As mentioned in footnote 7, due to the different accounting principles, even an actual pure exporter could not always 100% match the value of its total sales with the value of its total exports in period *t* in fact. Hence, we rely on the distribution of export shares to classify whether a firm is a pure exporting firm or not and we believe that taking those firms whose export shares drop in the range of top 10th percentile as pure exporting firms is credible and makes sense. Most importantly, the 90th percentile export share is equal to 0.9030679 and the 89th percentile export share is 0.8881256, so we decide to use the value of 0.9 as the cut-off, which is stated in footnote 23 as well, and define firms with their export shares greater than 0.9 to be pure exporting firms.

Appendix Tables

Table 1A.1. Number of Firms in the Industrial Firms Dataset

Year	Number of firms	Number of valid variables
2000	162,885	105
2001	171,256	97
2002	181,557	94
2003	196,222	80
2004	269,792	91
2005	271,835	95
2006	301,961	107
Total obs.	1,555,508	77*

Notes: * indicates the number of valid variables that appear in each year of our sample.

Table 1A.2. Number of Firms in the Trade Transaction Dataset

Year	Number of trading firms	Number of valid variables
2000	82,064	37
2001	89,660	37
2002	104,245	29
2003	124,299	29
2004	153,779	29
2005	179,665	29
2006	208,418	28
2005[r]	239,220	29
2006[r]	284,218	28
Total obs.[n]	942,130	28*

Notes: [n] indicates total observations only include non-repeated firms. [r] indicates the repeated firms would appear as firms which hold the same ID but have different information (e.g. firm name/telephone number/contact person/postcode). * indicates the number of valid variables that appear for each year in the sample.

Table 1A.3. Number of Matched Firms

Matching Method I--by exact firm name

Year	Province Inconsistency 0	Province Inconsistency 1	Postcode Inconsistency 0	Postcode Inconsistency 1	Total
2000	19,498	143	16,034	3,607	19,641
2001	23,596	138	19,238	4,496	23,734
2002	27,056	7	22,350	4,713	27,063
2003	31,536	13	26,600	4,949	31,549
2004	49,647	18	39,107	10,558	49,665
2005[r]	55,915	9	43,479	12,445	55,924
2006[r]	80,660	17	65,742	14,935	80,677
Total obs.	287,908	345	232,550	55,703	288,253

Notes: [r] indicates the repeated firms would appear as firms which hold the same ID but have different information (e.g. firm name/telephone number/contact person/postcode). Here 1 denotes inconsistency and 0 otherwise.

Table 1A.4. Number of Matched Firms

Matching Method IIA--by the last 7-digit telephone number combined with contact person

Year	Province Inconsistency 0	Province Inconsistency 1	Postcode Inconsistency 0	Postcode Inconsistency 1	Total
2000	7,917	41	6,645	1,313	7,958
2001	8,664	40	7,211	1,493	8,704
2002	8,426	10	6,992	1,444	8,436
2003	7,393	10	6,048	1,355	7,403
2004	12,681	52	10,267	2,466	12,733
2005[r]	13,745	49	10,939	2,855	13,794
2006[r]	15,651	85	12,115	3,621	15,736
Total obs.	74,477	287	60,217	14,547	74,764

Notes: [r] indicates the repeated firms would appear as firms which hold the same ID but have different information (e.g. firm name/telephone number/contact person/postcode). Here 1 denotes inconsistency and 0 otherwise.

Table 1A.5. Number of Matched Firms
Matching Method IIIA--by the last 7-digit telephone number combined with postcode

Year	Province Inconsistency 0	Province Inconsistency 1	Postcode Inconsistency 0	Postcode Inconsistency 1	Total
2000	11,033	39	11,072	0	11,072
2001	11,352	6	11,388	0	11,358
2002	10,960	1	10,961	0	10,961
2003	9,817	2	9,819	0	9,819
2004	14,830	10	14,840	0	14,840
2005[r]	16,085	11	16,096	0	16,096
2006[r]	19,226	11	19,237	0	19,237
Total obs.	93,303	110	93,413	0	93,413

Notes: [r] indicates the repeated firms would appear as firms which hold the same ID but have different information (e.g. firm name/telephone number/contact person/postcode). Here 1 denotes inconsistency and 0 otherwise.

Table 1A.6. Number Of Matched Firms
M1+M2a+M3a-Repeated Firms

Year	Province Inconsistency 0	Province Inconsistency 1	Consistency Rate	Postcode Inconsistency 0	Postcode Inconsistency 1	Consistency Rate
2000	25,163	167	99.34%	21,179	4,151	83.61%
2001	29,031	160	99.45%	24,105	5,086	82.58%
2002	32,074	18	99.94%	26,844	5,248	83.65%
2003	35,974	23	99.94%	30,542	5,455	84.85%
2004	55,687	75	99.87%	44,400	11,362	79.62%
2005	56,478	63	99.89%	44,028	12,513	77.87%
2006	66,466	98	99.85%	55,102	11,462	82.78%
Total obs.	300,873	604	99.80%	246,200	55,277	81.66%

Notes: Here 1 denotes inconsistency and 0 otherwise.

Table 1A.7. Comparison of Final Matched Firms

Year	Our work	Upward (2013)	Comparison Rate (Ours-Upward/Upward)	Yu (2015)	Comparison Rate (Ours-Yu/Yu)
	(1)	(2)	(3)	(4)	(5)
2000	25,330	23,740	6.70%	21,425	18.23%
2001	29,191	27,829	4.89%	24,959	16.96%
2002	32,092	32,782	-2.10%	28,759	11.59%
2003	35,997	38,802	-7.23%	33,901	6.18%
2004	55,762	56,078	-0.56%	49,891	11.77%
2005	56,541	56,864	-0.57%	49,891	13.33%
2006	66,564	61,628	8.01%	49,680	33.99%
Total obs.	301,477	297,723	1.26%	258,506	16.62%

Table 1A.8. Identification of Trading Agent

No.	Chinese Name	English Name
1	进出口	Import and Export
2	经贸	Business and Economics
3	贸易	Trade
4	科贸	Technology and Trade
5	服务	Service
6	投资	Investment
7	经发	Economic Development
8	经济发展	Economic Development
9	运储	Transportation and Storage
10	储运	Storage and Transportation
11	仓储	Storage
12	运输	Transportation
13	物资	Materials
14	资运	Materials and Transportation
15	代理	Agency/ Agent
16	进口	Import
17	出口	Export
18	物流	Logistics
19	合作	Corporation/ International Cooperation
20	外贸	Foreign Trade/ International Business
21	商社	Trading Enterprise/ Trading Co. ltd
22	供销	Supply and Marketing/ Supply and Sales
23	外经	Foreign Trade/ Foreign Trade and Economic Cooperation

Table 1A.9. Number of Trading Agents in the Matched Sample

Year	Number of firms
2000	145
2001	175
2002	157
2003	175
2004	265
2005	287
2006	364
Total obs.	1,568

Table 1A.10. Types of Chinese Processing Trade

No.	Code	Trade Type
1	12	International aid
2	13	Compensation trade
3	14	Processing with assembly
4	15	Processing with imported materials
5	16	Goods on consignment
6	19	Border trade
7	22	Contracting projects
8	23	Goods on lease
9	27	Outward processing
10	30	Barter trade
11	33	Warehousing trade
12	34	Entrepot trade by bonded area

Table 1A.11. Ranking of Output Tariffs for IO Sectors (%)

IO Code	Mean Output Tariffs	Ranking	IO Code	Mean Output Tariffs	Ranking
16	33.45	1	62	11.28	36
20	32.85	2	31	11.06	37
13	30.57	3	25	10.84	38
67	23.88	4	71	10.63	39
21	23.39	5	63	10.40	40
78	21.30	6	42	10.32	41
28	20.43	7	52	10.03	42
72	20.36	8	65	9.81	43
15	19.95	9	32	9.51	44
19	19.83	10	73	9.46	45
51	19.75	11	33	9.32	46
27	18.98	12	46	9.27	47
74	18.51	13	61	9.19	48
17	18.21	14	41	8.74	49
68	18.13	15	40	8.69	50
83	17.95	16	76	8.29	51
29	17.28	17	64	8.08	52
44	16.28	18	30	7.46	53
26	16.08	19	69	7.37	54
34	15.38	20	39	7.32	55
18	15.36	21	56	7.04	56
35	15.17	22	45	6.72	57
50	15.06	23	38	6.66	58
47	14.58	24	55	6.40	59
23	14.39	25	49	6.35	60
24	14.14	26	36	6.10	61
53	14.04	27	77	5.71	62
70	13.27	28	37	5.69	63
14	13.04	29	59	5.58	64
60	12.32	30	58	4.32	65
81	12.06	31	75	4.18	66
48	11.91	32	66	4.02	67
43	11.50	33	54	3.14	68
80	11.45	34	57	2.71	69
79	11.37	35			

Table 1A.12. Reductions in Trade Protection and Pre-reform Industrial Characteristics (2001)

Dependent Variable: Change in Protection	Ln(Wage)	Ln(Output)	Ln(Labour)	Ln(Added-Value)	Ln(Total Profit)	Ln(Revenue)	Skill Intensity
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Panel A: Change in Output Tariff (4-digit)							
	-0.003*	0.009	0.007	0.007	0.006	0.009	0.000
	(0.002)	(0.013)	(0.012)	(0.012)	(0.013)	(0.013)	(0.000)
R^2	0.738	0.606	0.602	0.600	0.575	0.606	0.848
Observations	408	408	408	408	408	408	408
Panel B: Change in Output Tariff (3-digit)							
	-0.004	0.002	0.029	0.000	-0.011	-0.001	0.001
	(0.007)	(0.038)	(0.033)	(0.039)	(0.047)	(0.038)	(0.001)
R^2	0.727	0.352	0.484	0.367	0.375	0.344	0.747
Observations	69	69	69	69	69	69	69
Panel C: Change in Input Tariff (3-digit)							
	-0.020	-0.039	0.060	-0.040	-0.091	-0.043	-0.005
	(0.017)	(0.069)	(0.058)	(0.067)	(0.081)	(0.071)	(0.003)
R^2	0.736	0.356	0.481	0.371	0.389	0.348	0.752
Observations	69	69	69	69	69	69	69
Panel D: Change in Industry ERP (3-digit)							
	-0.000	-0.002	0.005	-0.002	-0.002	-0.002	0.000
	(0.003)	(0.011)	(0.010)	(0.011)	(0.013)	(0.011)	(0.001)
R^2	0.725	0.352	0.476	0.367	0.374	0.344	0.749
Observations	69	69	69	69	69	69	69

Notes: Robust standard errors are reported in parentheses; significant at *10%; **5%; ***1%. All regressions include industry fixed effects and 3-digit industry FEs are controlled in panel A whilst 2-digit industry FEs are controlled in the rest panels. The regressions are weighted by the square root of the number of firms within each industry.

Table 1A.13. Reductions in Trade Protection and Pre-reform Industrial Characteristics (2002)

Dependent Variable: Change in Proteciton	Ln(Wage)	Ln(Output)	Ln(Labour)	Ln(Added-Value)	Ln(Total Profit)	Ln(Revenue)	Skill Intensity
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Panel A: Change in Output Tariff (4-digit)							
	-0.004	-0.026	-0.024	-0.023	-0.029	-0.026	0.000
	(0.005)	(0.031)	(0.031)	(0.032)	(0.033)	(0.031)	(0.001)
R^2	0.738	0.610	0.599	0.606	0.589	0.611	0.840
Observations	409	409	409	409	409	409	409
Panel B: Change in Output Tariff (3-digit)							
	-0.015	0.005	0.061	0.006	-0.041	0.001	0.000
	(0.016)	(0.087)	(0.076)	(0.092)	(0.113)	(0.088)	(0.003)
R^2	0.683	0.349	0.489	0.363	0.358	0.343	0.742
Observations	69	69	69	69	69	69	69
Panel C: Change in Input Tariff (3-digit)							
	-0.079**	-0.149	0.042	-0.166	-0.315	-0.154	-0.006
	(0.036)	(0.154)	(0.134)	(0.146)	(0.190)	(0.160)	(0.006)
R^2	0.706	0.361	0.477	0.377	0.394	0.355	0.743
Observations	69	69	69	69	69	69	69
Panel D: Change in Industry ERP (3-digit)							
	-0.002	-0.002	0.017	0.001	-0.011	-0.004	0.000
	(0.005)	(0.029)	(0.026)	(0.030)	(0.036)	(0.029)	(0.001)
R^2	0.676	0.349	0.483	0.363	0.356	0.343	0.742
Observations	69	69	69	69	69	69	69

Notes: Robust standard errors are reported in parentheses; significant at *10%; **5%; ***1%. All regressions include industry fixed effects and 3-digit industry FEs are controlled in panel A whilst 2-digit industry FEs are controlled in the rest panels. The regressions are weighted by the square root of the number of firms within each industry.

Table 1A.14. Estimation for Theoretical Assumptions (Full)

Dependent Variable:	ln(wage) $_{k,j,t}$	ln(wage) $_{k,j,t}$	ln(wage) $_{k,j,t}$	ln(wage) $_{k,j,t}$	ln(wage) $_{k,j,t}$
	(1)	(2)	(3)	(4)	(5)
Ln(Total profit) $_{k,j,t}$	0.071***				
	(0.001)				
Ln(Operating profit) $_{k,j,t}$		0.073***			
		(0.001)			
FXX $_{k,j,t}$			0.114***	0.092***	0.097***
			(0.003)	(0.003)	(0.003)
FMM $_{k,j,t}$			0.580***	0.521***	0.505***
			(0.007)	(0.007)	(0.007)
FXM $_{k,j,t}$			0.478***	0.419***	0.413***
			(0.006)	(0.006)	(0.005)
LnK $_{k,j,t}$				0.038***	0.036***
				(0.001)	(0.001)
Skill intensity $_{j,t}$					1.162***
					(0.020)
Industry FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
Adjusted R^2	0.186	0.183	0.172	0.180	0.188
Observations	953,609	893,920	953,609	953,609	953,609

Notes: Firm-level robust standard errors are clustered and reported in parentheses; significant at *10%; **5%; ***1%. Industry fixed effects are controlled at the 2-digit industry level.

Table 1A.15. Estimation for Theoretical Assumptions (Full)

Dependent Variable:	Ln(Labour)$_{k,j,t}$	Ln(Labour)$_{k,j,t}$	Ln(Valu-added)$_{k,j,t}$	Ln(Value-added)$_{k,j,t}$	TFP$^{dl}_{k,j,t}$	TFP$^{dl}_{k,j,t}$
	(1)	(2)	(3)	(4)	(5)	(6)
FXX $_{k,j,t}$	0.492***	0.491***	0.448***	0.166***	0.269***	0.134***
	(0.007)	(0.007)	(0.008)	(0.006)	(0.006)	(0.006)
FMM $_{k,j,t}$	0.489***	0.493***	1.236***	0.445***	0.862***	0.469***
	(0.015)	(0.015)	(0.017)	(0.011)	(0.013)	(0.011)
FXM $_{k,j,t}$	0.802***	0.804***	1.229***	0.458***	0.812***	0.434***
	(0.012)	(0.012)	(0.013)	(0.008)	(0.010)	(0.009)
LnK $_{k,j,t}$				0.491***		0.238***
				(0.001)		(0.001)
Skill intensity $_{j,t}$		-0.261***		0.860***		0.987***
		(0.050)		(0.036)		(0.043)
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R^2	0.078	0.078	0.081	0.436	0.074	0.198
Observations	953,609	953,609	945,433	945,433	945,433	945,433

Notes: Firm-level robust standard errors are clustered and reported in parentheses; significant at *10%; **5%; ***1%. Industry fixed effects are controlled at the 2-digit industry level.

Table 1A.16. Baseline Regressions for Tariffs and Wages (Full)

Dependent Variable: ln(wage) $_{k,j,t}$	OT	OT × Exporter	IT	IT × Importer	Both	Trade shares	Identify FXM firms	
							Dummies	Shares
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Output tariff $_{j,t-1}$	-0.117***	-0.125***			-0.099***	-0.097***	-0.100***	-0.097***
	(0.020)	(0.020)			(0.021)	(0.021)	(0.021)	(0.021)
OT $_{j,t-1}$× FX (ExportShare)$_{k,j,t}$		0.093**			0.086**	0.303***		
		(0.037)			(0.038)	(0.115)		
OT $_{j,t-1}$× FXX (ExportShare)$_{k,j,t}$							0.059	0.233*
							(0.043)	(0.131)
OT $_{j,t-1}$× FXM (ExportShare)$_{k,j,t}$							0.147**	0.467***
							(0.057)	(0.155)
Input tariff $_{j,t-1}$			-0.472***	-0.477***	-0.375***	-0.371***	-0.373***	-0.371***
			(0.078)	(0.079)	(0.080)	(0.080)	(0.080)	(0.080)
IT $_{j,t-1}$× FM (ImportShare)$_{k,j,t}$				0.093	0.053	-0.258		
				(0.117)	(0.119)	(0.647)		
IT $_{j,t-1}$× FMM (ImportShare)$_{k,j,t}$							0.086	-0.420
							(0.172)	(0.865)
IT $_{j,t-1}$× FMX (ImportShare)$_{k,j,t}$							-0.046	-0.127
							(0.157)	(0.856)
FX (ExportShare)$_{k,j,t}$	0.004	-0.008	0.004	0.004	-0.007	-0.046**		
	(0.004)	(0.006)	(0.004)	(0.004)	(0.006)	(0.018)		
FXX (ExportShare)$_{k,j,t}$							-0.004	-0.042**
							(0.007)	(0.021)
FXM (ExportShare)$_{k,j,t}$							-0.004	-0.054**
							(0.012)	(0.024)
FM (ImportShare)$_{k,j,t}$	0.006	0.006	0.006	-0.001	0.002	0.057		
	(0.004)	(0.004)	(0.004)	(0.010)	(0.010)	(0.057)		
FMM (ImportShare)$_{k,j,t}$							-0.001	0.073
							(0.016)	(0.080)
FMX_ImportShare $_{k,j,t}$								0.041
								(0.071)
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Location FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Location-year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R^2	0.117	0.117	0.117	0.117	0.117	0.117	0.117	0.117
Observations	579,501	579,501	579,501	579,501	579,501	579,501	579,501	579,501
Joint Significance tests for coefficients on tariffs and interaction terms								
OT for exporter		-0.031			-0.013	0.207*		
		(0.039)			(0.039)	(0.114)		
OT for exporter-importer							0.047	0.371**
							(0.057)	(0.155)

Notes: Firm-level robust standard errors are clustered and reported in parentheses; significant at *10%; **5%; ***1%. Industry fixed effects are controlled at the 2-digit industry level.

Table 1A.17. Baseline Regressions for ERP and Wages (Full)

Dependent Variable: ln(wage) $_{k,j,t}$	ERP	ERP × global engagement dummies	Trade shares
	(1)	(2)	(3)
ERP $_{j,t-1}$	-0.072***	-0.077***	-0.073***
	(0.012)	(0.012)	(0.012)
ERP $_{j,t-1}$× FXX (ExportShare)$_{k,j,t}$		0.019	0.037
		(0.027)	(0.080)
ERP $_{j,t-1}$× FMM (ImportShare)$_{k,j,t}$		0.016	-0.062
		(0.040)	(0.179)
ERP $_{j,t-1}$× FXM $_{k,j,t}$		0.113***	
		(0.034)	
ERP $_{j,t-1}$× FXM_ExportShare $_{k,j,t}$			0.273***
			(0.094)
ERP $_{j,t-1}$× FXM_ImportShare $_{k,j,t}$			-0.173
			(0.195)
FXX (ExportShare)$_{k,j,t}$	0.004	0.001	-0.017
	(0.004)	(0.006)	(0.018)
FMM (ImportShare)$_{k,j,t}$	0.006	0.004	0.044
	(0.007)	(0.009)	(0.039)
FXM $_{k,j,t}$	0.009*	-0.007	
	(0.005)	(0.007)	
FXM_ExportSshare $_{k,j,t}$			-0.040**
			(0.020)
FXM_ImportShare $_{k,j,t}$			0.056
			(0.041)
Industry FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Location FE	Yes	Yes	Yes
Location-year FE	Yes	Yes	Yes
Adjusted R^2	0.117	0.117	0.117
Observations	579,501	579,501	579,501
Joint Significance tests for coefficients on ERP and interaction terms			
ERP for exporter- importer		0.036	0.026
		(0.034)	(0.206)

Notes: Firm-level robust standard errors are clustered and reported in parentheses; significant at *10%; **5%; ***1%. Industry fixed effects are controlled at the 2-digit industry level.

Table 1A.18. Regressions for Tariffs and Wages - supplementary controls (post-WTO)

Dependent Variable: ln(wage) $_{k,j,t}$	Output and Input Tariffs				Industry ERP			
	Owner indicators	Owner shares	Size	Productivity	Owner indicators	Owner shares	Size	Productivity
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Output tariff $_{j,t-1}$	-0.119***	-0.119***	-0.125***	-0.116***				
	(0.023)	(0.023)	(0.022)	(0.022)				
OT $_{j,t-1}$× FX $_{k,j,t}$	0.084**	0.084**	0.083**	0.082**				
	(0.041)	(0.041)	(0.041)	(0.040)				
Input tariff $_{j,t-1}$	-0.369***	-0.370***	-0.357***	-0.413***				
	(0.089)	(0.089)	(0.089)	(0.087)				
IT $_{j,t-1}$× FM $_{k,j,t}$	0.193	0.199	-0.053	-0.081				
	(0.137)	(0.137)	(0.135)	(0.133)				
FX $_{k,j,t}$	-0.008	-0.008	0.009	0.005				
	(0.006)	(0.006)	(0.006)	(0.006)				
FM $_{k,j,t}$	-0.009	-0.009	0.019*	0.014				
	(0.011)	(0.011)	(0.011)	(0.011)				
ERP $_{j,t-1}$					-0.085***	-0.085***	-0.101***	-0.095***
					(0.013)	(0.013)	(0.013)	(0.013)
ERP $_{j,t-1}$× FXX $_{k,j,t}$					0.025	0.025	0.031	0.033
					(0.029)	(0.029)	(0.028)	(0.028)
ERP $_{j,t-1}$× FMM $_{k,j,t}$					0.023	0.024	-0.012	-0.012
					(0.048)	(0.048)	(0.046)	(0.047)
ERP $_{j,t-1}$× FXM $_{k,j,t}$					0.130***	0.131***	0.120***	0.110***
					(0.036)	(0.036)	(0.036)	(0.035)
FXX $_{k,j,t}$					-0.002	-0.002	0.014**	0.009
					(0.006)	(0.006)	(0.006)	(0.006)
FMM $_{k,j,t}$					0.002	0.002	0.017*	0.007
					(0.010)	(0.010)	(0.010)	(0.010)
FXM $_{k,j,t}$					-0.012	-0.012	0.015**	0.007
					(0.007)	(0.007)	(0.007)	(0.007)

(Continued)

Table 1A.18. Continued

Dependent Variable: ln(wage) $_{k,j,t}$	Output and Input Tariffs				Industry ERP			
	Owner indicators	Owner shares	Size	Productivity	Owner indicators	Owner shares	Size	Productivity
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
SOE indicator $_{k,j,t}$	0.013				0.013			
	(0.010)				(0.010)			
Foreign indicator $_{k,j,t}$	0.021**				0.021**			
	(0.009)				(0.009)			
Govt share $_{k,j,t}$		-0.004	0.007	0.008		-0.004	0.006	0.008
		(0.008)	(0.008)	(0.007)		(0.008)	(0.008)	(0.007)
Foreign share $_{k,j,t}$		0.039***	0.049***	0.042***		0.039***	0.049***	0.042***
		(0.011)	(0.011)	(0.011)		(0.011)	(0.011)	(0.011)
HMT share $_{k,j,t}$		0.029***	0.040***	0.035***		0.030***	0.040***	0.036***
		(0.010)	(0.010)	(0.010)		(0.010)	(0.010)	(0.010)
Ln(Labour) $_{k,j,t}$			-0.215***	-0.145***			-0.215***	-0.145***
			(0.004)	(0.003)			(0.004)	(0.003)
Ln(VA per worker) $_{k,j,t}$				0.126***				0.126***
				(0.002)				(0.002)
Joint Significance tests for coefficients on trade protections and interaction terms								
OT for exporter	-0.035	-0.035	-0.043	-0.034				
	(0.043)	(0.043)	(0.042)	(0.041)				
ERP for exporter-importer					0.045	0.046	0.019	0.015
					(0.036)	(0.036)	0.036	(0.035)
Observations	516,799	516,799	516,799	513,449	516,799	516,799	516,799	513,449

Notes: Firm-level robust standard errors are clustered and reported in parentheses; significant at *10%; **5%; ***1%. 2-digit industry FE, year FE, location FE and location-year FE are controlled. Adjusted R^2 are all above 0.111 and to save space, we do not report them here.

Table 1A.19. Regressions for Tariffs and Wages - additional controls (Full)

Dependent Variable: ln(wage) $_{k,j,t}$	Ownership	Size	Productivity	Drop switchers	Balanced	Trade shares
	(1)	(2)	(3)	(4)	(5)	(6)
Output tariff $_{j,t-1}$	-0.099***	-0.097***	-0.096***	-0.114***	-0.121***	-0.117***
	(0.021)	(0.021)	(0.021)	(0.026)	(0.033)	(0.032)
OT $_{j,t-1}$× FX (ExportShare)$_{k,j,t}$	0.086**	0.087**	0.092**	0.091**	0.091	0.309
	(0.038)	(0.038)	(0.037)	(0.044)	(0.058)	(0.199)
Input tariff $_{j,t-1}$	-0.374***	-0.352***	-0.405***	-0.586***	-0.439***	-0.430***
	(0.080)	(0.080)	(0.080)	(0.102)	(0.119)	(0.119)
IT $_{j,t-1}$× FM (ImportShare)$_{k,j,t}$	0.057	0.055	0.059	0.052	0.177	0.190
	(0.118)	(0.118)	(0.117)	(0.129)	(0.176)	(1.050)
FX (ExportShare)$_{k,j,t}$	-0.007	-0.011*	-0.015***	-0.018**	-0.020**	-0.063*
	(0.006)	(0.006)	(0.006)	(0.007)	(0.009)	(0.033)
FM (ImportShare)$_{k,j,t}$	0.002	-0.002	-0.007	-0.007	-0.012	-0.066
	(0.010)	(0.010)	(0.010)	(0.011)	(0.015)	(0.093)
SOE dummy $_{k,j,t}$	-0.008	-0.010*	-0.009	-0.010	0.000	0.000
	(0.006)	(0.006)	(0.006)	(0.006)	(0.009)	(0.009)
Foreign dummy $_{k,j,t}$	0.026***	0.024***	0.021**	0.030***	0.024	0.023
	(0.009)	(0.009)	(0.008)	(0.009)	(0.015)	(0.015)
HMT dummy $_{k,j,t}$	0.021***	0.019**	0.016**	0.018**	0.035**	0.035**
	(0.008)	(0.008)	(0.008)	(0.009)	(0.014)	(0.014)
LnK $_{k,j,t}$		0.035***	0.034***	0.035***	0.034***	0.034***
		(0.002)	(0.002)	(0.002)	(0.003)	(0.003)
TFP^{dl} $_{k,j,t}$			0.098***	0.102***	0.097***	0.097***
			(0.002)	(0.002)	(0.003)	(0.003)
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Location FE	Yes	Yes	Yes	Yes	Yes	Yes
Location-year FE	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R^2	0.117	0.120	0.136	0.136	0.186	0.186
Observations	579,501	579,501	575,800	485,392	139,300	139,300
Joint Significance tests for coefficients on tariffs and interaction terms						
OT for exporter	-0.012	-0.010	-0.004	-0.023		
	(0.039)	(0.039)	(0.039)	(0.047)		

Notes: Firm-level robust standard errors are clustered and reported in parentheses; significant at *10%; **5%; ***1%. Industry fixed effects are controlled at the 2-digit industry level.

Table 1A.20. Regressions for ERP and Wages - additional controls (Full)

Dependent Variable: ln(wage) $_{k,j,t}$	Ownership	Size	Productivity	Drop switchers	Balanced	Trade shares
	(1)	(2)	(3)	(4)	(5)	(6)
ERP $_{j,t-1}$	-0.077***	-0.074***	-0.072***	-0.084***	-0.055***	-0.051***
	(0.012)	(0.012)	(0.012)	(0.016)	(0.020)	-0.005
ERP $_{j,t-1}$× FXX (ExportShare)$_{k,j,t}$	0.019	0.020	0.025	0.023	0.011	(0.148)
	(0.027)	(0.027)	(0.027)	(0.032)	(0.045)	(0.124)
ERP $_{j,t-1}$× FMM (ImportShare)$_{k,j,t}$	0.017	0.016	0.026	0.023	0.026	0.179
	(0.040)	(0.040)	(0.041)	(0.046)	(0.061)	(0.322)
ERP $_{j,t-1}$× FXM $_{k,j,t}$	0.114***	0.113***	0.108***	0.102***	0.113**	
	(0.034)	(0.033)	(0.033)	(0.037)	(0.050)	
ERP $_{j,t-1}$× FXM_ExportShare $_{k,j,t}$						0.196
						(0.171)
ERP $_{j,t-1}$× FXM_ImportShare $_{k,j,t}$						-0.034
						(0.344)
FXX (ExportShare)$_{k,j,t}$	0.001	-0.003	-0.008	-0.011	-0.009	-0.029
	(0.006)	(0.006)	(0.006)	(0.006)	(0.009)	(0.035)
FMM (ImportShare)$_{k,j,t}$	0.004	-0.001	-0.008	-0.010	0.006	-0.072
	(0.009)	(0.009)	(0.009)	(0.010)	(0.014)	(0.061)
FXM $_{k,j,t}$	-0.008	-0.014**	-0.023***	-0.023***	-0.027**	
	(0.007)	(0.007)	(0.007)	(0.008)	(0.011)	
FXM_ExportSshare $_{k,j,t}$						-0.045
						(0.037)
FXM_ImportShare $_{k,j,t}$						-0.054
						(0.071)
SOE dummy $_{k,j,t}$	-0.008	-0.011*	-0.009	-0.010	0.000	0.000
	(0.006)	(0.006)	(0.006)	(0.006)	(0.009)	(0.009)
Foreign dummy $_{k,j,t}$	0.026***	0.024***	0.021**	0.031***	0.024	0.024
	(0.009)	(0.009)	(0.008)	(0.009)	(0.015)	(0.015)
HMT dummy $_{k,j,t}$	0.021***	0.019**	0.017**	0.018**	0.036**	0.035**
	(0.008)	(0.008)	(0.008)	(0.009)	(0.014)	(0.014)
LnK $_{k,j,t}$		0.035***	0.034***	0.035***	0.034***	0.034***
		(0.002)	(0.002)	(0.002)	(0.003)	(0.003)
TFP^{dl} $_{k,j,t}$			0.098***	0.102***	0.097***	0.097***
			(0.002)	(0.002)	(0.003)	(0.003)
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Location FE	Yes	Yes	Yes	Yes	Yes	Yes
Location-year FE	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R^2	0.117	0.120	0.136	0.136	0.186	0.186
Observations	579,501	579,501	575,800	485,392	139,300	139,300
Joint Significance tests for coefficients on tariffs and interaction terms						
ERP for exporter-importer	0.037	0.040	0.036	0.017	0.059	
	(0.034)	(0.034)	(0.033)	(0.038)	(0.051)	

Notes: Firm-level robust standard errors are clustered and reported in parentheses; significant at *10%; **5%; ***1%. Industry fixed effects are controlled at the 2-digit industry level.

Table 1A.21. Regressions for Tariffs and Wages - Heterogeneous Choices (Full)

Dependent Variable: ln(wage) $_{k,j,t}$	Always trade (1)	Trade in 2002 (2)	Trade at entry (3)	Drop switchers (4)	Trade shares (5)	Identify exit (6)
Output tariff $_{j,t-1}$	-0.094***	-0.094***	-0.097***	-0.094***	-0.092***	-0.081***
	(0.020)	(0.021)	(0.020)	(0.023)	(0.020)	(0.023)
OT $_{j,t-1}$× FX (ExportShare)$_{k,j,t}$	0.277***	0.090	0.169**	0.346***	0.441**	0.094**
	(0.093)	(0.069)	(0.077)	(0.124)	(0.199)	(0.043)
Input tariff $_{j,t-1}$	-0.400***	-0.419***	-0.407***	-0.416***	-0.407***	-0.261***
	(0.079)	(0.080)	(0.080)	(0.090)	(0.079)	(0.088)
IT $_{j,t-1}$× FM (ImportShare)$_{k,j,t}$	-0.287	0.277	0.051	-0.339	0.473	-0.106
	(0.278)	(0.171)	(0.181)	(0.393)	(0.778)	(0.129)
FX (ExportShare)$_{k,j,t}$	-0.004	-0.004	-0.004		-0.010	-0.019**
	(0.004)	(0.004)	(0.004)		(0.011)	(0.007)
FM (ExportShare)$_{k,j,t}$	-0.003	-0.004	-0.002		0.013	0.010
	(0.004)	(0.004)	(0.004)		(0.024)	(0.012)
SOE dummy $_{k,j,t}$	-0.009	-0.009	-0.009	-0.007	-0.009	-0.013*
	(0.006)	(0.006)	(0.006)	(0.007)	(0.006)	(0.007)
Foreign dummy $_{k,j,t}$	0.021**	0.021**	0.021**	0.022*	0.021**	0.008
	(0.008)	(0.008)	(0.008)	(0.011)	(0.008)	(0.011)
HMT dummy $_{k,j,t}$	0.016**	0.016**	0.016**	0.015	0.016**	0.010
	(0.008)	(0.008)	(0.008)	(0.010)	(0.008)	(0.010)
LnK $_{k,j,t}$	0.034***	0.034***	0.034***	0.036***	0.034***	0.034***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
TFP^{dl} $_{k,j,t}$	0.098***	0.098***	0.098***	0.099***	0.098***	0.096***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Exit $_{k,j,t}$						-0.013***
						(0.003)
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Location FE	Yes	Yes	Yes	Yes	Yes	Yes
Location-year FE	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R^2	0.136	0.136	0.136	0.132	0.136	0.095
Observations	575,800	575,800	575,800	485,552	575,800	428,792
Joint Significance tests for coefficients on tariffs and interaction terms						
OT for exporter	0.183**	-0.004	0.072	0.251**	0.349*	0.013
	(0.092)	(0.068)	(0.076)	(0.122)	(0.197)	(0.045)

Notes: Firm-level robust standard errors are clustered and reported in parentheses; significant at *10%; **5%; ***1%. Industry fixed effects are controlled at the 2-digit industry level.

Table 1A.22. Regressions for ERP and Wages - exiting firms (Full)

Dependent Variable: ln(wage) $_{k,j,t}$	Post-WTO			Balanced		
	Exit	ERP × Exit	ERP × Types	Exit	ERP × Exit	ERP × Types
	(1)	(2)	(3)	(4)	(5)	(6)
ERP $_{j,t-1}$	-0.053***	-0.048***	-0.053***	-0.036*	-0.033	-0.036*
	(0.014)	(0.014)	(0.014)	(0.021)	(0.020)	(0.021)
ERP $_{j,t-1}$× FXX $_{k,j,t}$	0.023		0.017	-0.016		-0.015
	(0.032)		(0.032)	(0.046)		(0.046)
ERP $_{j,t-1}$× FMM $_{k,j,t}$	0.010		0.007	0.054		0.054
	(0.047)		(0.048)	(0.064)		(0.064)
ERP $_{j,t-1}$× FXM $_{k,j,t}$	0.094**		0.086**	0.085		0.083
	(0.038)		(0.038)	(0.052)		(0.052)
ERP $_{j,t-1}$× Exit $_{k,j,t}$		0.005			0.032	
		(0.016)			(0.059)	
ERP $_{j,t-1}$× FXX $_{k,j,t}$ × Exit $_{k,j,t}$			0.100*			-0.152
			(0.057)			(0.139)
ERP $_{j,t-1}$× FMM $_{k,j,t}$ × Exit $_{k,j,t}$			0.062			-0.284
			(0.094)			(0.626)
ERP $_{j,t-1}$× FXM $_{k,j,t}$ × Exit $_{k,j,t}$			0.175**			0.202
			(0.076)			(0.180)
ERP $_{j,t-1}$× DOM $_{k,j,t}$ × Exit $_{k,j,t}$			-0.001			0.037
			(0.016)			(0.061)
FXX $_{k,j,t}$	-0.012*	-0.008*	-0.013*	-0.001	-0.003	-0.000
	(0.007)	(0.005)	(0.007)	(0.010)	(0.007)	(0.010)
FMM $_{k,j,t}$	-0.008	-0.006	-0.008	-0.004	0.005	-0.004
	(0.012)	(0.008)	(0.012)	(0.015)	(0.012)	(0.015)
FXM $_{k,j,t}$	-0.019**	-0.004	-0.019**	-0.018	-0.005	-0.018
	(0.009)	(0.006)	(0.009)	(0.012)	(0.009)	(0.012)
Exit $_{k,j,t}$	-0.013***	-0.014***	-0.015***	-0.017*	-0.021*	-0.020*
	(0.003)	(0.004)	(0.004)	(0.009)	(0.012)	(0.012)
SOE dummy $_{k,j,t}$	-0.013*	-0.013*	-0.013*	-0.009	-0.009	-0.009
	(0.007)	(0.007)	(0.007)	(0.010)	(0.010)	(0.010)
Foreign dummy $_{k,j,t}$	0.009	0.009	0.009	0.014	0.013	0.013
	(0.011)	(0.011)	(0.011)	(0.016)	(0.016)	(0.016)
HMT dummy $_{k,j,t}$	0.010	0.010	0.010	0.030*	0.030*	0.030*
	(0.010)	(0.010)	(0.010)	(0.015)	(0.015)	(0.015)
LnK $_{k,j,t}$	0.034***	0.034***	0.034***	0.029***	0.029***	0.029***
	(0.002)	(0.002)	(0.002)	(0.003)	(0.003)	(0.003)
TFP^{dl} $_{k,j,t}$	0.096***	0.096***	0.096***	0.092***	0.092***	0.092***
	(0.002)	(0.002)	(0.002)	(0.003)	(0.003)	(0.003)
Adjusted R^2	0.095	0.095	0.095	0.130	0.130	0.130
Observations	428,792	428,792	428,792	131,313	131,313	131,313
Joint Significance tests for coefficients on tariffs and interaction terms						
ERP for exporter-importer	0.041		0.156	0.049		0.213
	(0.038)		(0.100)	(0.052)		(0.201)

Notes: Firm-level robust standard errors are clustered and reported in parentheses; significant at *10%; **5%; ***1%. 2-digit industry FE, year FE, location FE and location-year FE are controlled.

Table 1A.23. Channels (Full)

Regressand: ln(wage) $_{k,j,t}$	Change in labordemand	Import scope	Change in labordemand	Import scope
	(1)	(2)	(3)	(4)
Output tariff $_{j,t-1}$	-0.085***	-0.085***		
	(0.023)	(0.023)		
OT $_{j,t-1}$× FX $_{k,j,t}$	0.107**	0.108**		
	(0.043)	(0.043)		
Input tariff $_{j,t-1}$	-0.190**	-0.190**		
	(0.086)	(0.086)		
IT $_{j,t-1}$× FM $_{k,j,t}$	-0.062	-0.056		
	(0.127)	(0.127)		
ERP $_{j,t-1}$			-0.051***	-0.051***
			(0.014)	(0.014)
ERP $_{j,t-1}$× FXX $_{k,j,t}$			0.031	0.032
			(0.031)	(0.031)
ERP $_{j,t-1}$× FMM $_{k,j,t}$			0.014	0.014
			(0.045)	(0.045)
ERP $_{j,t-1}$× FXM $_{k,j,t}$			0.103***	0.104***
			(0.038)	(0.038)
Ln(Import scope) $_{k,j,t}$		0.010**		0.010**
		(0.004)		(0.004)
D1. Ln(Labour) $_{k,j,t}$	-0.188***	-0.188***	-0.188***	-0.188***
	(0.003)	(0.003)	(0.003)	(0.003)
Exit $_{k,j,t}$	-0.020***	-0.020***	-0.020***	-0.020***
	(0.003)	(0.003)	(0.003)	(0.003)
SOE dummy $_{k,j,t}$	-0.014**	-0.014**	-0.015**	-0.015**
	(0.007)	(0.007)	(0.007)	(0.007)
Foreign dummy $_{k,j,t}$	0.009	0.010	0.010	0.010
	(0.011)	(0.011)	(0.011)	(0.011)
HMT dummy $_{k,j,t}$	0.010	0.010	0.010	0.010
	(0.010)	(0.010)	(0.010)	(0.010)

(Continued)

Table 1A.23. Continued

Regressand: ln(wage) $_{k,j,t}$	Change in labordemand (1)	Import scope (2)	Change in labordemand (3)	Import scope (4)
LnK $_{k,j,t}$	0.046***	0.046***	0.046***	0.046***
	(0.002)	(0.002)	(0.002)	(0.002)
TFP^{dl} $_{k,j,t}$	0.101***	0.101***	0.101***	0.101***
	(0.002)	(0.002)	(0.002)	(0.002)
FX $_{k,j,t}$	-0.022***	-0.022***		
	(0.007)	(0.007)		
FM $_{k,j,t}$	0.007	-0.001		
	(0.012)	(0.012)		
FXX $_{k,j,t}$			-0.015**	-0.016**
			(0.007)	(0.007)
FMM $_{k,j,t}$			-0.008	-0.016
			(0.011)	(0.012)
FXM $_{k,j,t}$			-0.020**	-0.029***
			(0.009)	(0.009)
Joint Significance tests for coefficients on tariffs and interaction terms				
OT for exporter	0.022	0.023		
	(0.044)	(0.044)		
ERP for exporter-importer			0.052	0.053
			0.039	(0.038)
Observations	516,799	516,799	516,799	513,449

Notes: Firm-level robust standard errors are clustered and reported in parentheses; significant at *10%; **5%; ***1%. 2-digit industry FE, year FE, location FE and location-year FE are controlled. Adjusted R^2 are equal to 0.132 and to save space, we do not report them here.

Table 1A.24. Summary of Chinese Two-digit Industry

Industry Code	Industry Name
13	Manuf. agricultural products
14	Manuf. food products
15	Manuf. drink products
17	Manuf. textile products
18	Manuf. apparel , footwear etc.
19	Manuf. leather products, fur etc.
20	Manuf. wood and wood products
21	Furniture manufacturing
22	Manuf. paper, paper products
23	Printing and re-production media
24	Manuf. cultural & entertainment products
25	Processing crude oil, nuclear fuel
26	Manuf. chemical raw materials
27	Manuf. pharmaceuticals
28	Manuf. chemical fibres
29	Manuf. rubber products
30	Manuf. plastic products
31	Manuf. non-metal products
32	Manuf. ferrous metal casting
33	Manuf. non-ferrous metal casting
34	Manuf. metal products
35	Manuf. universal equipment
36	Manuf. special equipment
37	Manuf. transportation equipment
39	Manuf. electric machines, appliances
40	Manuf. electronic equipment
41	Manuf. instruments, appliances

Table 2A.1. Regressions for ERP and Wages (post-WTO)

Dependent Variable: ln(wage) $_{k,j,t}$	Industry level			Firm level					
	ERP	ERP × Dummy	ERP × Intensity	ERP	ERP × Dummy	ERP × Intensity	ERP_2	ERP_2 × Dummy	ERP_2 × Intensity
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
ERP $_{j,t-1}$	0.043***	0.038**	0.043**	-0.000	-0.000	-0.000			
	(0.014)	(0.018)	(0.017)	(0.000)	(0.000)	(0.000)			
ERP $_{j,t-1}$× Processing Dummy (Intensity)$_{k,j,t}$		0.011	-0.001		-0.000	-0.000			
		(0.027)	(0.030)		(0.000)	(0.000)			
ERP_2 $_{j,t-1}$							-0.000	-0.000	-0.000
							(0.000)	(0.000)	(0.000)
ERP_2 $_{j,t-1}$× Processing Dummy (Intensity)$_{k,j,t}$								0.000	0.000
								(0.000)	(0.000)
PI $_{k,j,t}$	-0.008	-0.009	-0.000	-0.008	-0.008	0.000	-0.008	-0.008	-0.000
	(0.007)	(0.007)	(0.008)	(0.007)	(0.007)	(0.008)	(0.007)	(0.007)	(0.008)
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Location FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Location-year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R^2	0.120	0.120	0.120	0.120	0.120	0.120	0.120	0.120	0.120
Observations	115,179	115,179	115,179	115,179	115,179	115,179	115,179	115,179	115,179

Notes: Firm-level robust standard errors are clustered and reported in parentheses; significant at *10%; **5%; ***1%. Industry fixed effects are controlled at the 3-digit industry level.

Table 2A.2. Preliminary Regressions for ERP and Wages (post-WTO)

Dependent Variable: ln(wage) $_{k,j,t}$	Industry ERP (1)	Firm ERP (2)	Firm ERP_2 (3)
Industry ERP $_{,j,t-1}$	-0.005		
	(0.032)		
Industry ERP $_{j,t-1}$× Predicted Processing Intensity $_{k,j,t}$	-0.035		
	(0.063)		
Firm ERP $_{k,j,t-1}$		-0.000	
		(0.000)	
Firm ERP $_{k,j,t-1}$× Predicted Processing Intensity $_{k,j,t}$		0.000	
		(0.001)	
Firm ERP_2 $_{k,j,t-1}$			0.000
			(0.000)
Firm ERP_2 $_{k,j,t-1}$× Predicted Processing Intensity $_{k,j,t}$			-0.000
			(0.001)
Predicted Processing Intensity $_{k,j,t}$	0.050***	0.042***	0.042***
	(0.009)	(0.007)	(0.007)
Industry FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Location FE	Yes	Yes	Yes
Location-year FE	Yes	Yes	Yes
Adjusted R^2	0.121	0.121	0.121
Observations	115,179	115,179	115,179

Notes: Firm-level robust standard errors are clustered and reported in parentheses; * significant at 10%, ** at 5% and *** at 1%. All regressions use adjusted processing intensity predicted by Heckman two-stage selection model and firm output and input tariffs are lagged by one period. Industry fixed effects are controlled at the 3-digit industry level.

Table 2A.3. Regressions for Firm ERP and Wages with Additional Controls (Post-WTO)

Dependent Variable: ln(wage) $_{k,j,t}$	With ownership	With productivity	With size	With leverage	With debt ratio
	(1)	(2)	(3)	(4)	(5)
Firm ERP $_{k,j,t-1}$	-0.000	-0.000	-0.000	-0.000	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Firm ERP $_{k,j,t-1}$ × Predicted Processing Intensity $_{k,j,t}$	0.000	0.000	0.000	0.000	0.000
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Predicted Processing Intensity $_{k,j,t}$	0.042***	0.029***	0.026***	0.025***	0.049***
	(0.007)	(0.007)	(0.007)	(0.008)	(0.010)
$TFP^{dl}_{k,j,t}$		0.071***	0.071***	0.071***	0.071***
		(0.003)	(0.003)	(0.003)	(0.003)
Ln K $_{k,j,t}$			0.032***	0.032***	0.032***
			(0.004)	(0.004)	(0.004)
Leverage $_{k,j,t-1}$				0.000	
				(0.002)	
Total debt ratio $_{k,j,t-1}$					-0.025***
					(0.008)
SOE $_{k,j,t}$	-0.009	-0.00558	-0.007	-0.007	-0.007
	(0.013)	(0.0134)	(0.013)	(0.013)	(0.013)
Foreign owned $_{k,j,t}$	0.022**	0.0215**	0.020*	0.020*	0.021**
	(0.011)	(0.0105)	(0.011)	(0.011)	(0.011)
HMT owned $_{k,j,t}$	0.018*	0.0173	0.016	0.016	0.017
	(0.011)	(0.0106)	(0.011)	(0.011)	(0.011)
Industry FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
Location FE	Yes	Yes	Yes	Yes	Yes
Location-year FE	Yes	Yes	Yes	Yes	Yes
Adjusted R^2	0.121	0.131	0.133	0.133	0.133
Observations	115,179	114,230	114,230	114,230	114,230

Notes: Firm-level robust standard errors are clustered and reported in parentheses; * significant at 10%, ** at 5% and *** at 1%. All regressions use adjusted processing intensity predicted by Heckman two-stage selection model. Industry fixed effects are controlled at the 3-digit industry level.

Table 2A.4. Regressions for Firm ERP_2 and Wages with Additional Controls (Post-WTO)

Dependent Variable: ln(wage) $_{k,j,t}$	With ownership	With productivity	With size	With leverage	With debt ratio
	(1)	(2)	(3)	(4)	(5)
Firm ERP_2 $_{k,j,t-1}$	0.000	0.000	0.000	0.000	0.000
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Firm ERP_2 $_{k,j,t-1}$× Predicted Processing Intensity $_{k,j,t}$	-0.000	-0.000	-0.000	-0.000	-0.000
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Predicted Processing Intensity $_{k,j,t}$	0.042***	0.029***	0.026***	0.025***	0.049***
	(0.007)	(0.007)	(0.007)	(0.008)	(0.010)
$TFP^{dl}_{k,j,t}$		0.071***	0.071***	0.071***	0.071***
		(0.003)	(0.003)	(0.003)	(0.003)
Ln K $_{k,j,t}$			0.032***	0.032***	0.032***
			(0.004)	(0.004)	(0.004)
Leverage $_{k,j,t-1}$				0.000	
				(0.002)	
Total debt ratio $_{k,j,t-1}$					-0.025***
					(0.008)
SOE $_{k,j,t}$	-0.009	-0.006	-0.007	-0.007	-0.007
	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)
Foreign owned $_{k,j,t}$	0.022**	0.022**	0.020*	0.020*	0.021**
	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)
HMT owned $_{k,j,t}$	0.018*	0.017	0.016	0.016	0.017
	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)
Industry FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
Location FE	Yes	Yes	Yes	Yes	Yes
Location-year FE	Yes	Yes	Yes	Yes	Yes
Adjusted R^2	0.121	0.131	0.133	0.133	0.133
Observations	115,179	114,230	114,230	114,230	114,230

Notes: Firm-level robust standard errors are clustered and reported in parentheses; * significant at 10%, ** at 5% and *** at 1%. All regressions use adjusted processing intensity predicted by Heckman two-stage selection model. Industry fixed effects are controlled at the 3-digit industry level.

Table 2A.5. Channels (Post-WTO)

Dependent Variable:	ln(total profit) $_{k,j,t}$		ln(wage) $_{k,j,t}$			
			With Multi-products		With firm R&D	
	ERP	ERP_2	ERP	ERP_2	ERP	ERP_2
	(1)	(2)	(3)	(4)	(5)	(6)
Firm ERP $_{k,j,t-1}$	-0.001		-0.000		-0.000	
	(0.001)		(0.000)		(0.000)	
Firm ERP $_{k,j,t-1}$× Predicted Processing Intensity$_{k,j,t}$	0.001		0.000		-0.000	
	(0.001)		(0.001)		(0.001)	
Firm ERP_2 $_{k,j,t-1}$		-0.000		0.000		-0.000
		(0.001)		(0.000)		(0.000)
Firm ERP_2$_{k,j,t-1}$× Predicted Processing Intensity$_{k,j,t}$		0.000		-0.000		-0.000
		(0.001)		(0.001)		(0.001)
Predicted Processing Intensity $_{k,j,t}$	-0.137***	-0.137***	0.049***	0.049***	0.043***	0.043***
	(0.027)	(0.027)	(0.010)	(0.010)	(0.011)	(0.011)
Ln (Export scope) $_{k,j,t}$			-0.002	-0.002		
			(0.003)	(0.003)		
Ln (Ordinary import scope) $_{k,j,t}$			-0.003	-0.003		
			(0.003)	(0.003)		
Ln (R_D) $_{k,j,t}$					-0.000	-0.000
					(0.001)	(0.001)
TFP^{dl} $_{k,j,t}$	0.506***	0.506***	0.071***	0.071***	0.071***	0.071***
	(0.010)	(0.010)	(0.003)	(0.003)	(0.004)	(0.004)
Ln K $_{k,j,t}$	0.275***	0.275***	0.033***	0.033***	0.035***	0.035***
	(0.010)	(0.010)	(0.004)	(0.004)	(0.004)	(0.004)
Total debt ratio $_{k,j,t-1}$	0.276***	0.276***	-0.025***	-0.025***	-0.015*	-0.015*
	(0.021)	(0.021)	(0.008)	(0.008)	(0.009)	(0.009)
SOE $_{k,j,t}$	-0.105**	-0.105**	-0.007	-0.007	0.000	0.000
	(0.041)	(0.041)	(0.013)	(0.013)	(0.016)	(0.016)
Foreign owned $_{k,j,t}$	0.013	0.013	0.021*	0.021*	0.012	0.012
	(0.025)	(0.025)	(0.011)	(0.011)	(0.011)	(0.011)
HMT owned $_{k,j,t}$	0.032	0.032	0.017	0.017	0.013	0.013
	(0.025)	(0.025)	(0.011)	(0.011)	(0.011)	(0.011)
Adjusted R^2	0.145	0.145	0.133	0.133	0.127	0.127
Observations	114,230	114,230	114,230	114,230	100,840	100,840

Notes: Firm-level robust standard errors are clustered and reported in parentheses; * significant at 10%, ** at 5% and *** at 1%. All regressions use adjusted processing intensity predicted by Heckman two-stage selection model. Three-digit industry FE, year FE, location FE and location-year FE are controlled.

Table 3A.1. Percentage of Exporters according to Share of Exports in Outputs

	Percentage of Exporters							
Export Share	2000	2001	2002	2003	2004	2005	2006	All
below 10%	61.36	56.77	50.12	45.70	40.01	38.92	40.09	43.65
10% - 20%	11.70	12.76	13.44	13.48	13.73	13.81	13.37	13.42
20% - 30%	6.24	7.16	8.22	9.28	9.41	9.28	9.50	8.96
30% - 40%	4.65	5.59	5.76	6.28	6.99	7.38	7.27	6.73
40% - 50%	3.22	3.74	4.58	5.46	5.57	6.07	5.89	5.41
50% - 60%	2.91	3.83	4.27	4.25	4.58	5.13	4.90	4.58
60% - 70%	2.30	2.70	2.86	3.61	4.50	4.65	4.61	4.07
70% - 80%	2.15	2.42	3.08	3.58	4.15	4.35	4.25	3.83
80% - 90%	2.15	2.38	3.14	3.32	4.18	4.44	4.36	3.86
above 90%	3.31	2.65	4.54	5.06	6.87	5.99	5.76	5.48
Observations	4,470	5,667	7,494	9,983	15,698	17,761	22,774	83,847

Table 3A.2. Firm Wages and Export Switching

	PE		OE		ME	
Dependent Variable: D1.ln(wage) $_{k,j,t}$	Tariffs	Tariff Interactions	Tariffs	Tariff Interactions	Tariffs	Tariff Interactions
	(1)	(2)	(3)	(4)	(5)	(6)
D1.ERP $_{,j,t-1}$	-0.003**	-0.003***	-0.000***	-0.000***	0.001**	0.001**
	(0.001)	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)
D1.ERP $_{k,j,t-1}$× PE_to_OE		0.162				
		(0.336)				
D1.ERP $_{k,j,t-1}$× PE_to_ME		-0.024				
		(0.078)				
D1.ERP $_{k,j,t-1}$× OE_to_PE				-0.438***		
				(0.111)		
D1.ERP $_{k,j,t-1}$× OE_to_ME				0.001		
				(0.001)		
D1.ERP $_{k,j,t-1}$× ME_to_PE						-0.117*
						(0.060)
D1.ERP $_{k,j,t-1}$× ME_to_OE						0.025**
						(0.010)
PE_to_OE	0.147	0.135				
	(0.149)	(0.171)				
PE_to_ME	0.008	0.007				
	(0.070)	(0.070)				
OE_to_PE			-0.263***	-0.355***		
			(0.076)	(0.054)		
OE_to_ME			-0.016	-0.017		
			(0.042)	(0.042)		
ME_to_PE					-0.000	0.002
					(0.105)	(0.104)
ME_to_OE					-0.141***	-0.140***
					(0.054)	(0.054)
Observations	3,557	3,557	20,006	20,006	10,168	10,168

Notes: Firm-level robust standard errors are clustered and reported in parentheses; significant at *10%; **5%; ***1%. Year fixed effects, location fixed effects and location-year fixed effects are controlled in all regressions.

Table 3A.3. Determinants of Export Switching

Dependent Variable: Switcher $_{k,j,t}$	Only Tariffs						With Controls					
	PE→OE	PE→ME	OE→PE	OE→ME	ME→PE	ME→OE	PE→OE	PE→ME	OE→PE	OE→ME	ME→PE	ME→OE
	(1)	(2)	(3)	(4)	(5)	(6)	(1)	(2)	(3)	(4)	(5)	(6)
D1.Output tariff $_{,j,t-1}$	2.156	-9.264***	4.564	-5.357***	-7.763***	-8.861***	2.783	-9.364***	4.368	-5.571***	-7.817***	-8.955***
	(8.217)	(1.242)	(9.026)	(1.128)	(1.461)	(1.095)	(8.317)	(1.286)	(9.997)	(1.142)	(1.494)	(1.097)
D1.Input tariff $_{,j,t-1}$	-5.184**	2.975	3.348	-3.935***	10.750***	-3.439***	-5.210**	2.919	3.767	-4.051***	10.76***	-3.735***
	(2.531)	(2.996)	(12.710)	(1.263)	(2.916)	(1.200)	(2.587)	(3.067)	-13.77	(1.275)	(2.998)	(1.232)
D1.TFP^{dl} $_{k,j,t}$							-0.418	0.030	0.599***	0.126**	0.084	0.171***
							(0.289)	-0.079	(0.109)	-0.051	(0.080)	-0.063
D1.Ln K $_{k,j,t}$							-0.312	-0.160*	0.497	0.230***	-0.107	-0.059
							(0.209)	-0.088	(0.395)	-0.055	(0.124)	-0.072
D1.SOE $_{k,j,t}$							-2.550***	0.188	0.173***	-0.097	-0.613	0.675**
							(0.765)	(0.262)	(0.0445)	(0.204)	(0.399)	(0.268)
D1.Foreign owned $_{k,j,t}$							0.419	0.303	-0.562	0.170	-0.378	0.354*
							(0.571)	(0.242)	(0.364)	(0.177)	(0.342)	(0.213)
D1.HMT owned $_{k,j,t}$							0.844	-0.060	0.505	0.151	0.046	0.270
							(0.886)	(0.268)	(0.441)	(0.183)	(0.301)	(0.220)
R^2	0.007	0.007	0.007	0.007	0.007	0.007	0.010	0.010	0.010	0.010	0.010	0.010
Observations	59,771	59,771	59,771	59,771	59,771	59,771	59,008	59,008	59,008	59,008	59,008	59,008

Notes: Robust standard errors are clustered at the firm level and are reported in parentheses; significant at *10%; **5%; ***1%. Location-year fixed effects are controlled in all regressions.

Appendix Figures

Figure 2A.1. Tariff Changes in Percentage of HS Products (pre-WTO)

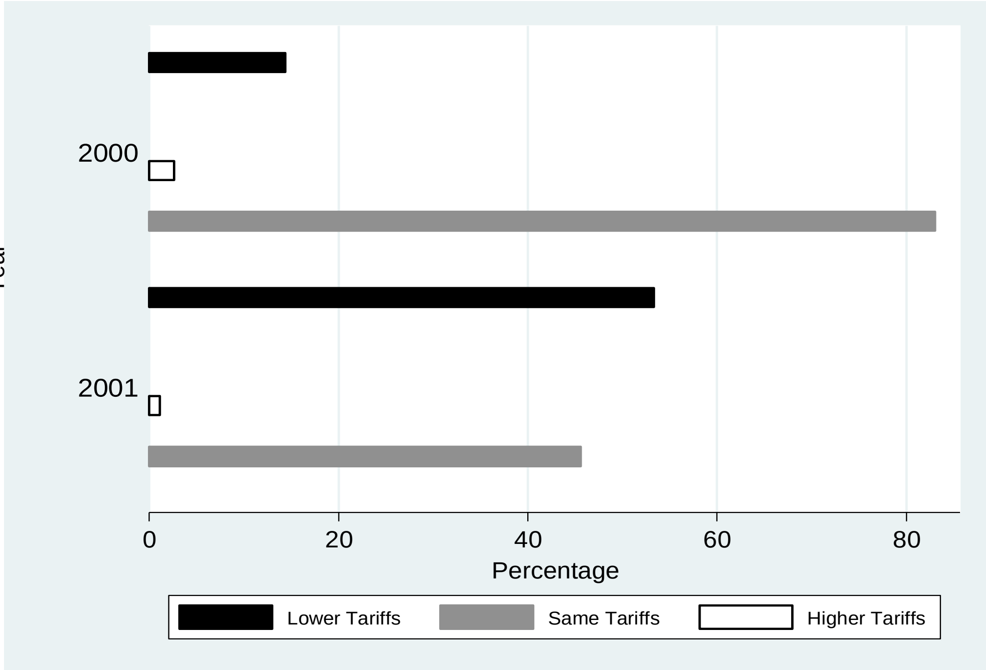

Figure 2A.2. Tariff Changes in Percentage of HS Products (post-WTO)

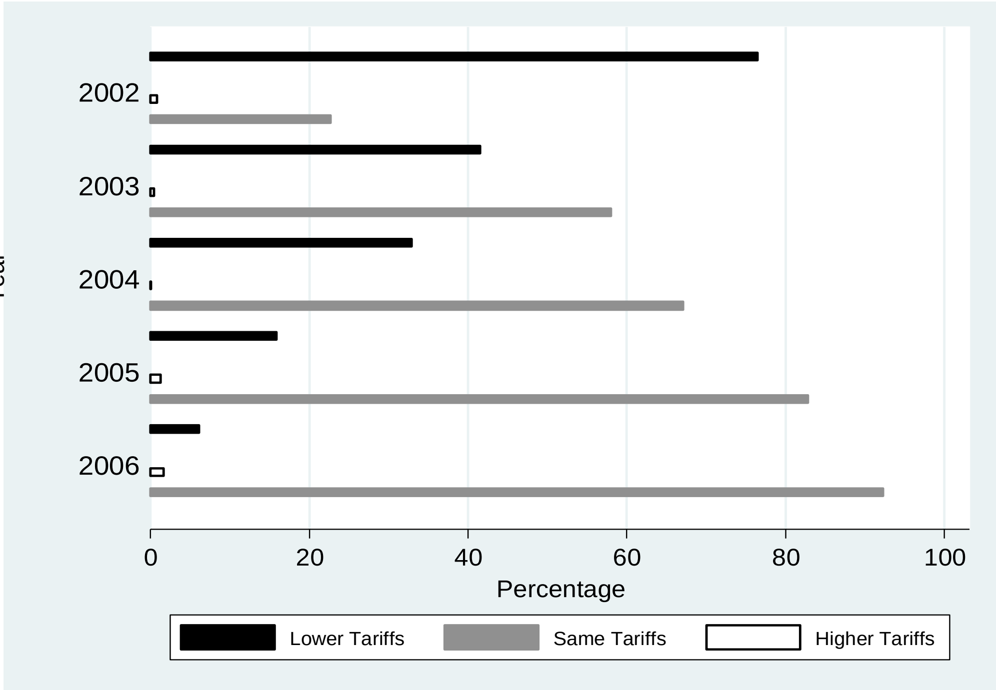

Figure 2A.3. Change in Output Tariffs Relative to Initial Levels (2002), post-WTO (3-digit Industry)

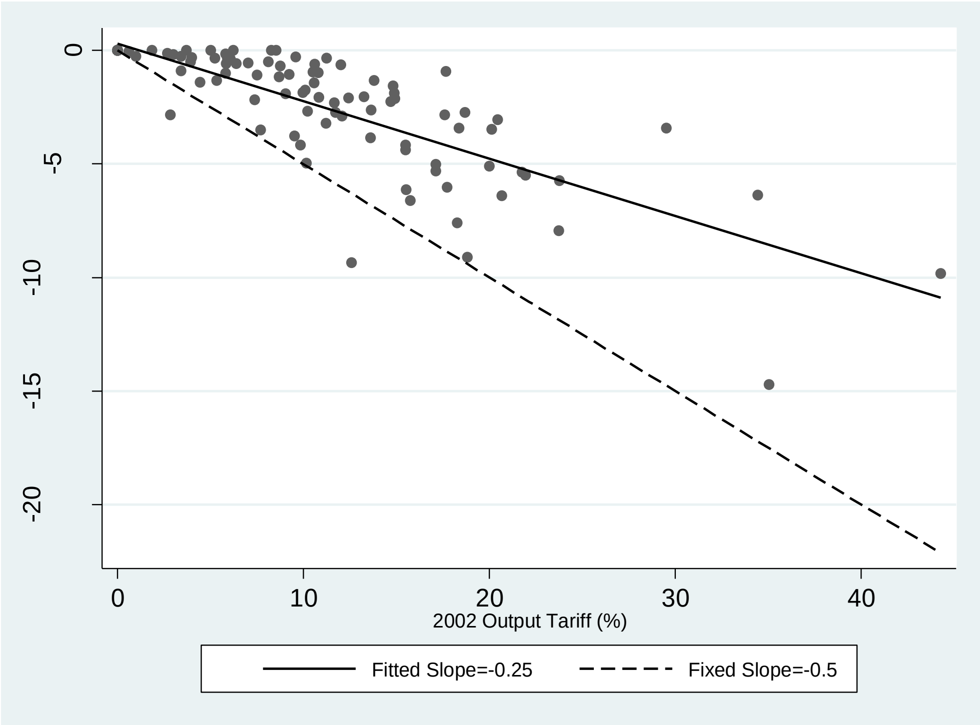

Figure 2A.4. Change in Output Tariffs Relative to Initial Levels, 2000-2006 (4-digit Industry)

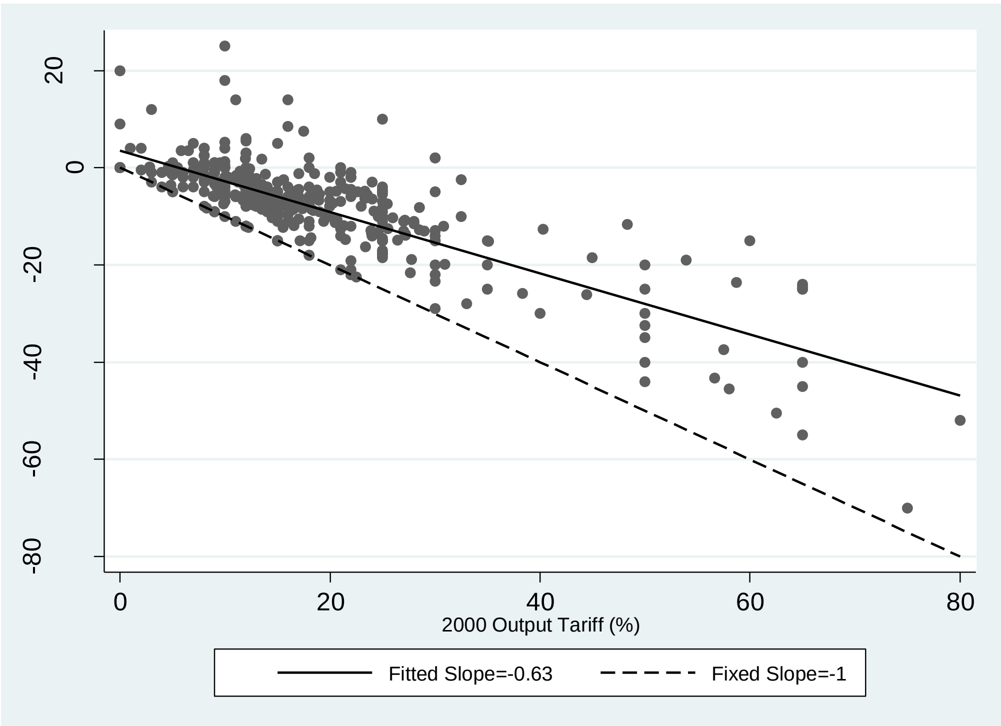

Figure 2A.5. Change in Output Tariffs Relative to Initial Levels, pre-WTO (4-digit Industry)

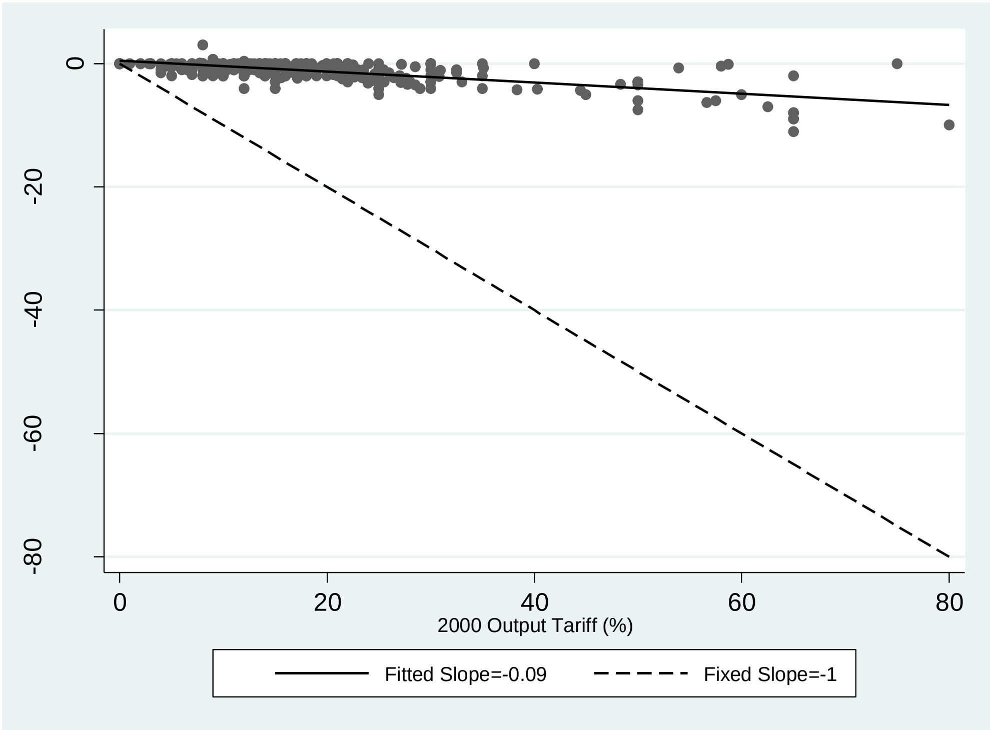

Figure 2A.6. Change in Output Tariffs Relative to Initial Levels (2001), post-WTO (4-digit Industry)

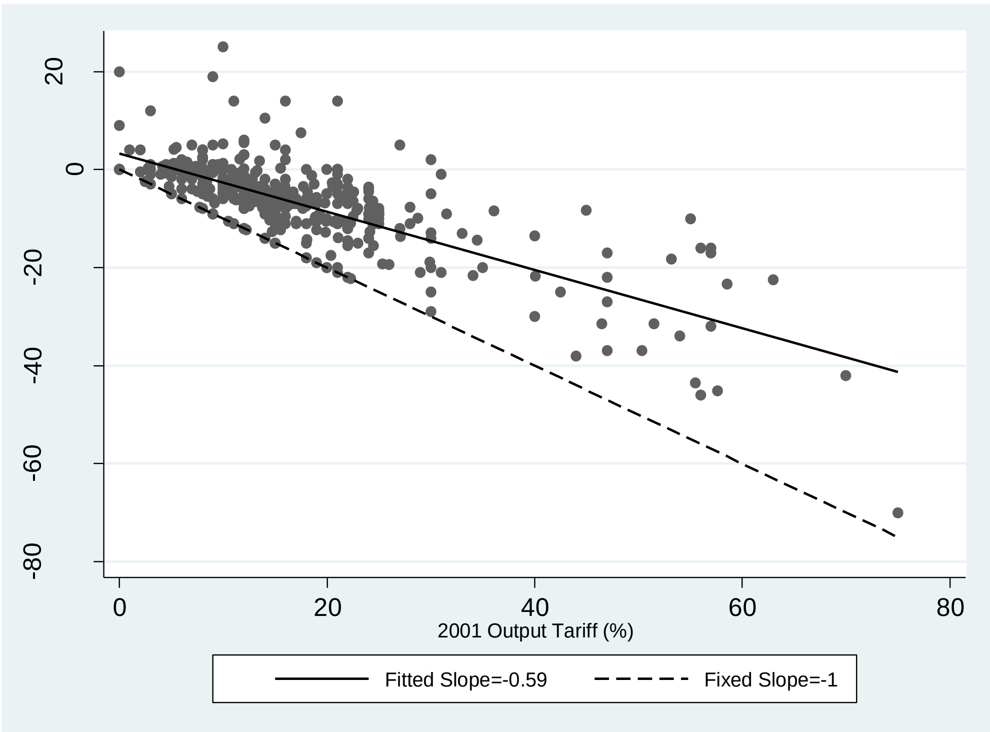

Figure 2A.7. Change in Output Tariffs Relative to Initial Levels (2002), post-WTO (4-digit Industry)