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China's Processing Trade and Value Chains*

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Abstract: *We investigate how trade liberalisation affects the performance of Chinese manufacturing firms. To better understand China's role in global value chains, we examine Chinese firms with a significant import share from Indonesia, one of its largest processing source countries. We find that Chinese firms with a greater import share from Indonesia perform better in productivity, export, and sales, and they are more likely to engage in processing exports. Moreover, the impact of foreign trade liberalisation on China's export scope is more pronounced for firms with a larger import share from Indonesia because of their greater extent of engagement in global value chains.*

Keywords: trade liberalisation, firm performance, processing trade

JEL Classification: F1, F13, F14

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1. Introduction

How much can a country expand its exports? It could either export more in terms of the quantity of goods (intensive margins), more in terms of the variety of goods (extensive margins), or move to a higher quality of goods (Hummels and Klenow, 2005). The conventional trade theorem predicts that a country will export goods that use its abundant factor intensively. In the North–South trade framework, this implies that developed countries will export capital-intensive goods, while developing countries will export labour-intensive goods. However, as tariffs decline, trade grows not only between countries with different levels of intensity of factors of production, but also between countries with similar levels. The Linder hypothesis claims that countries of similar incomes per capita should trade more intensively with one another (Linder, 1961). Furthermore, as suggested by Bernard et al. (2003), the increase of North–South trade generates more trade between developing countries as countries in different developing stages engage in different stages of global value chains.

This paper investigates the impact of Chinese trade liberalisation on imports from the Association of Southeast Asian Nations (ASEAN) countries. ASEAN is the most important processing source region for China. Since the ASEAN–China Free Trade Area launched in 2010, tariffs have been reduced significantly and trade has increased significantly. Taking the two largest developing countries in the ASEAN+1 trade bloc, according to National Bureau of Statistics of China, China and Indonesia, as an example, exports excluding oil and gas from China to Indonesia increased thirteenfold, from US$2.8 billion in 2000 to US$36.9 billion in 2014, and exports excluding oil and gas from Indonesia to China increased eightfold from 2000–2014, rising from US$1.7 billion to US$14.5 billion over the same period, with China's average purchasing power parity-based income per capita of US$7,200 being comparable to Indonesia's at US$7,224 .

China has become Indonesia's second largest trading partner and the largest importing country of non-fuel goods. Most of China's imports from Indonesia are raw materials and natural sources, including products from mining, oils, and rubber. The five largest imported goods in 2015 were fossil fuels, natural oil, wood pulp and other fibre, electronic products, and woodwork, amounting to US$13.12 billion and accounting for 66.2% of China's total imports from Indonesia (according to Comtrade data, 2017). Thus, trade between China and Indonesia is a good example for studying the impact of trade liberalisation and how South–South trade matters in global value chains.

Our paper focuses on how South–South trade has been affected by trade liberalisation and the interaction of South–North countries intensively and extensively, to illustrate how ongoing trade liberalisation strengthens a country's comparative advantage in the global value chains.

To fully capture the impact of trade liberalisation and fit with related empirical literature, we consider the following three dimensions of trade liberalisation: (i) home (i.e. China) tariff cuts in final products such as textiles and garments in China; (ii) tariff cuts of a foreign destination country (e.g. United States); and (iii) China's tariff cuts on its intermediate inputs imported from Indonesia (e.g. cotton). The first two types of tariffs are bilateral trade liberalisation on final goods. The last type is trade liberalisation on intermediate inputs, as noted in Goldberg et al. (2010) and Topalova and Khandelwal (2011).

The main findings of this paper are threefold. First, Chinese manufacturing firms with a significant import share from Indonesia perform better in terms of productivity, export value, number of employees, and sales, and they are more likely to engage in processing exports. Second, all aspects of trade liberalisation foster firm export value, and the impact is stronger for firms with less import from Indonesia.

Last but not least, we investigate how trade liberalisation affects export and import scope differently for firms with a different extent of imports from Indonesia. The empirical study shows that the impact of foreign trade liberalisation on Chinese export scope is more pronounced for firms with a larger import share from Indonesia because of the greater extent of involvement in the global value chains. However, on the contrary, the impact of tariff reductions from all three sources on import scope is less pronounced, while the impact of firm ownership is more pronounced.

The asymmetric findings of the effects on import scope and those on export scope can be understood for three possible reasons. First, imports from Indonesia are mostly raw materials with low demand elasticity, and the more competitive market discourages Indonesian firms to expand product lines. Second, the import price from Indonesia is not prohibitively high even before tariff cuts, which enables firms to import most of the varieties they need without the help of trade liberalisation. Last but not least, insufficient new product innovation in Indonesia provides few new varieties after trade liberalisation.

Our paper contributes to the literature in two ways. First, similar to previous work, we find that input tariff reductions increase exports through tougher import competition. The main value added of our work is that the magnitude is *uneven* across firms with different import intensity. Firms with a greater import share from Indonesia tend to increase exports with a lower value as import tariffs fall.

Second, we find that South–North and South–South tariff reductions influence trade differently by an extensive margin: South–North trade liberalisation reduces export scope but increases import scope, whereas South–South liberalisation increases export scope but decreases import scope from Indonesia. This result suggests that trade liberalisation could change the import and export structure with developing countries.

The literature most related to our paper is on multi-product firms. It was found that firms will reduce product scope in response to trade liberalisation (Feenstra and Ma, 2008; Arkolakis and Muendler, 2011; Baldwin and Gu, 2009; Bernard et al., 2011; Dhingra, 2013; Eckel and Neary, 2010). Recently, Qiu and Zhou (2013) argued that firms may increase product scope with increasing product-specific fixed costs. Furthermore, Mayer et al. (2014) showed that under one-sided trade liberalisation, firms reduce product scope and accordingly production is concentrated on a core competitive product. Qiu and Yu (2017) showed that home market liberalisation increases domestic competition and consequently leads to firm product scope reduction. On the one hand foreign market liberalisation increases foreign market competition, while on the other hand it makes exporters more profitable with lower tariffs. Accordingly, the net effect depends on firms' managerial efficiencies.

Empirically, Dhingra (2013) used Thailand data to show that during the one-side tariff cuts in 2003 to 2006, firms exported less and increased product varieties, while exporting firms decreased product scope. Iacovone and Javorcik (2010) found that product churning took place in Mexican firms in response to more liberalised foreign markets. Goldberg et al. (2010) found that Indian firms introduced more product varieties than they stopped when tariffs reduced between 1989 and 2003. Baldwin and Gu (2009), Bernard et al. (2011), and Berthou and Fontagne (2013) studied the impact of multilateral trade liberalisation but their results were inconclusive. By using Chinese data, Qiu and Yu (2017) showed that, parallel to the productive efficiency which is usually measured by total factor productivity (TFP), managerial efficiency is an important factor in determining the extent to which firms adjust their export product scope.

Different from the literature, our paper pays more attention to the impact of trade liberalisation between South and North (i.e. China and high-income countries) trade, and

between South and South (China and ASEAN countries) trade. Specifically, we study the three types of tariff reductions related to Chinese firms and how they change China's trade with Indonesia. We use the generated firm-level input tariffs to measure the tariffs between China and the South, and the constructed industry-level output tariffs and foreign tariff reductions as a measurement of trade liberalisation between China and the North.

The rest of the paper is organised as follows. Section 2 introduces the details of data and data sources. Section 3 presents econometric specifications and reports empirical findings. Section 4 concludes.

2. Data and Measurement

This paper uses three disaggregated data sets: Chinese firm-level production data which are obtained from annual survey manufacturing data, China's trade data which are from Customs data at the HS 8-digit level and tariff data are from the HS 8-digit level tariff data. Our data set is constructed by merging these three data sets with China's customs data (imports of China by products from Indonesia). We now briefly introduce these three data sets.

2.1. Chinese firm-level production data

The sample is derived from a rich firm-level panel data set that covers 162,885 firms (in 2000) and 301,961 firms (in 2006). The data are collected and maintained by China's National Bureau of Statistics in an annual survey of manufacturing enterprises. Complete information on the three major accounting statements (i.e. balance sheets, profit and loss accounts, and cash flow statements) is available. In brief, the data set covers two types of manufacturing firms – all state-owned enterprises (SOEs) and non-SOEs whose annual sales exceed CNY5 million (US$830,000). The data set includes more than 100 financial variables listed in the main accounting statements of these firms.

Although the data set contains rich information, some samples are still noisy and are therefore misleading, largely because of misreporting by some firms. Following Feenstra, Li, and Yu (2014), we clean the sample and omit outliers by using the following criteria. First,

observations with missing key financial variables (such as total assets, net value of fixed assets, sales, and gross value of the firm's output productivity) are excluded. Second, we drop firms with fewer than eight workers since they fall under a different legal regime, as mentioned in Brandt et al. (2012).

We remove observations according to the basic rules of the generally accepted accounting principles if any of the following are true: (i) liquid assets are greater than total assets, (ii) total fixed assets are greater than total assets, (iii) the net value of fixed assets is greater than total assets, (iv) the firm's identification number is missing, or (v) an invalid established time exists (e.g. the opening month is later than December or earlier than January). After applying such stringent filters to guarantee the quality of the production data, the filtered firm data are reduced by about 50% for each year.

To ensure the preciseness of the estimates, we exclude some trading companies from the sample in all estimates. In particular, we excluded from the sample firms with names including any Chinese characters for their trading company or importing and exporting company.

2.2. Chinese trade data

The Chinese trade data are obtained from the extremely disaggregated product-level trade transaction data of China's General Administration of Customs. The data provide information on each trading firm's product list, including trading price, quantity, and value at the HS 8-digit level. More importantly, the data include not only both import and export data, but also break down the data into several specific types of processing trade, such as processing with assembly and processing with inputs.

Overall, when focusing on the highly disaggregated HS 8-digit level, approximately 35% of the 18,599,507 transaction-level observations are ordinary trade, and 65% refer to processing trade. Similar proportions are obtained when measuring by trade volume: around 43% of trade volume comprises ordinary trade. Processing with inputs accounts for around 30%, whereas processing with assembly only is around 10%. The remaining 17% represents other types of processing trade, aside from assembly and processing with inputs.

Last, to calculate and estimate a firms' TFP, we need to merge manufacturing firm data and customs data. The detailed approach has been introduced in Tian and Yu (2012) and Yu (2015). In particular, we use the Chinese firm's name-year, zip code, and the last seven digits of the telephone number to merge the two data sets. As discussed in Yu (2015), our merged data skew towards larger trading firms as the matched sample has more exports, more sales, and even larger numbers of employees.

2.3. Measurement of firm-level tariffs

The measurement of average intermediate input tariffs faced by a single firm is constructed in Yu (2015). Since processing imports are duty-free in China, we construct a firm-specific input tariff index based on its non-processing imports (*O*), as follows:

$$FIT_{it} = \sum_{k \in O} \frac{m^k_{i,initial\_year}}{\sum_{k \in M} m^k_{i,initial\_year}} \tau^k_t$$

where $m^k_{i,initial_year}$is firm *i*'s imports of product *k* in the first year the firm appears in the sample. *M* is the set of the firm's total imports. The set of processing imports does not appear because processing imports are duty-free. Since imports are negatively affected by tariffs, and the imports of products with prohibitive tariffs would be zero, if the import weight is measured in the current period, the measure of firm tariffs would generate a downward bias. Following Topalova and Khandelwal (2011), we use the import weight for each product at the firm's first year in the sample, which is time-invariant weights to avoid such endogeneity.

We measure the output tariffs and tariffs charged by third countries (so called foreign tariffs) at 2-digit Chinese industry classification (CIC) level, according to Amiti and Konings (2007), by averaging the tariffs of HS 6-digit industries within each 2-digit CIC industry code.

China is the largest developing country and contributes most to world trade, so to study the impact of trade liberalisation between South and North, we choose trade liberalisation between China and the rest of the world as a sample. We use the generated firm-level input tariffs to measure the tariffs between China and the South, and the constructed industry-level

output tariffs and foreign tariff reductions to measure trade liberalisation between China and the North. This is because most Chinese trade between other developing countries are imports of intermediate input or raw materials, and between developed countries are basically final goods. This proxy will not generate much bias to our study, although we do not distinguish whether the partner is a developed or developing country, and both country groups are important trading partners of China.[1] First, as most of China's trading partners are members of the World Trade Organization, the tariffs are almost the same amongst different partners. Second, the weight used in the industry-output tariffs and foreign tariffs is constructed according to the domestic input–output table, which is irrelevant to the trading partner.

3. Empirical Findings

Before examining the nexus between trade liberalisation and firm exports, Table 1 shows the performance of overall exporters and exporters with a large import share from Indonesia. By comparing all Chinese exporting firms, those exporting firms with a significant import share from Indonesia (i.e. imports from Indonesia as a proportion of their total imports) tend to perform better in terms of export value, number of employees, and sales. In particular, of the total 70,369 Chinese exporting firms during 2000–2006, 1,387 exporting firms had more than a 5% import share from Indonesia and 995 firms had more than a 10 % import share from Indonesia. Although firms with significant imports from Indonesia perform better than those without, this does not imply that the larger the import share from Indonesia, the better the firm's performance will be. For example, Chinese firms with more than 10% import share from Indonesia apparently export less to other countries than those with more than a 5% import share, suggesting that firm performance has no simple linear relationship with its import share from Indonesia.

[1] According to the *China International Trade Report* in 2015 by the Minister of Commerce, international trade between China and developed countries is around 60% of the total.

Table 1: Overall Exporters and Exporters with Large Import Shares from Indonesia

	All Exporting Firms		>5% Import Share from Indonesia		>10% Import Share from Indonesia	
Variable	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
Log Exports	9.664	1.694	10.515	1.683	10.466	1.720
Log Number of Employees	5.456	1.167	5.876	1.249	5.853	1.283
Log Sales	10.802	1.337	11.504	1.564	11.465	1.584
Number of Firms		70,369	1,387			995

Note: Chinese exporters reported in this table are large exporters by matching Chinese firm-level data and customs data from 2000 to 2006.
Std. Dev. = standard deviation.
Source: compiled by authors.

Table 2 presents the summary statistics for some key variables used in the estimates. We report simple-average CIC 2-digit industry-level output import tariffs, and external tariffs imposed by China's trading partners. The external tariffs are smaller than output tariffs, as China's major trading partners are developed countries that tend to have lower import tariffs due partly to the World Trade Organization's discipline and partly to international trade agreements. We measure input tariffs at the firm level to capture the feature of zero import tariffs of processing imports. It is important to stress that firm-level input tariffs are much lower than output tariffs (see Yu, 2015 for a detailed discussion). To this end, we also construct the dummy of processing indicator and find that around 27% of firms are processing importers. Last, we report the firm's export scope and import scope by counting the HS 8-digit product lines reported in China's customs data. On average, Chinese firms export around seven products to, but import more than 21 products from, the rest of the world.

Table 2: Statistics Summary of Key Variables

	All Exporters		>5% Import Shares from Indonesia		>10% Import Shares from Indonesia	
Variable	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
Exports	9.664	1.694	10.515	1.683	10.466	1.720
Home Output Tariffs (industry-level)	11.71	0.056	11.80	0.058	11.74	0.057
Foreign Industry Tariffs	9.60	0.048	10.13	0.050	10.02	0.049
Home Input Tariffs (firm-level)	2.554	4.255	1.536	3.135	1.561	3.256
Firm TFP (Olley–Pakes)	1.072	0.668	1.196	0.863	1.202	0.862
Foreign Indicator	0.569	0.495	0.774	0.419	0.763	0.426
SOE Indicator	0.021	0.142	0.013	0.113	0.013	0.114
Log Labour	5.456	1.167	5.876	1.249	5.853	1.283
Processing Indicator	0.271	0.445	0.513	0.500	0.490	0.500
Export Scope	7.421	10.990	8.640	11.127	8.254	10.855
Import Scope	20.595	37.301	26.358	41.646	23.819	39.358

SOE = state-owned enterprise, Std. Dev. = standard deviation, TFP = total factor productivity.
Source: compiled by authors.

By way of comparison, firm TFP increases from 1.07 for all Chinese exporters to 1.19 for Chinese exporters with more than a 5% import share from Indonesia and 1.20 for those with more than a 10% import share from Indonesia, suggesting that the higher the import share from Indonesia, the higher the firm productivity will be.

It is also important to stress that the share of 'processing' (indicated by processing indicator) is higher for firms with higher import shares from Indonesia than that of the average exporting firms. The firms with more than a 5% import share from Indonesia have 50% more processing activities compared to 27% for the average of all Chinese exporters.

3.1. Trade liberalisation and firm exports

In this part, we examine the impact of three types of liberalisation on firm export value. Table 3 shows the estimations of the impact of trade liberalisation on firm exports. Columns (1) to (4) include Chinese exporters with more than a 10% import share from Indonesia,

whereas Columns (5) to (7) include those firms with more than a 5% import share. Several important findings deserve to be highlighted.

We consider the following empirical specification:

$$\log exp_{ijt} = \beta_0 + \beta_1 TFP_{it} + \beta_2 OT_{jt} + \beta_3 IT_{it} + \beta_4 ET_{jt} + \theta X_{it} + \varepsilon_{it}$$

where $\log exp_{ijt}$ is log export of firm *i* in industry *j*, TFP_{it} is total factor productivity, OT_{jt} is the output tariff of industry *j*, IT_{it} is input import tariff level faced by the firm *i*, and ET_{jt} is the foreign tariff level of industry *j* at year *t*. X_{it} is a vector of control variables, including firm's size, ownership type (SOE, multinational firm, or others), and trade mode (processing or ordinary trade).

First, the coefficients of firm productivity are positive and significant in all estimates, indicating that firms with high productivity tend to export more. More importantly, the magnitude of firm TFP increases with the import share from Indonesia, suggesting that the effect of TFP on firm exports is more pronounced for firms with more imports from main developing countries like Indonesia. The economic rationale is clear. As Chinese firms import more intermediate inputs or raw materials from Indonesia, they are more likely to engage in processing trade (as confirmed in Table 2) and hence export more. With more imported intermediate goods, firms are able to employ the advantage of the combination of domestic inputs and imported inputs, as suggested by Halpern et al. (2015).

Table 3: Estimates of Trade Liberalisation on Firm Exports

Regress and: Log Firm Exports	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Import Share from Indonesia	>10%				>5%			<5%		
Home Output Tariffs	–2.218*	–2.699**	–2.048*	–2.005	–2.509***	–1.845*	–2.062*	–4.294***	–3.236***	–3.054***
(industry-level)	(–1.65)	(–2.50)	(–1.81)	(–1.56)	(–2.74)	(–1.93)	(–1.95)	(–5.57)	(–3.83)	(–3.16)
Foreign Tariffs	–2.914**	–2.299**	–2.042**	–1.863*	–2.12***	–1.88**	–1.749**	–3.428***	–3.401***	–2.317***
(industry-level)	(–2.19)	(–2.36)	(–2.09)	(–1.81)	(–2.62)	(–2.32)	(–2.04)	(–4.43)	(–4.32)	(–2.58)
Home Input Tariffs	–0.051	–0.055**	–0.056**	–0.059**	–0.06***	–0.05***	–0.060***	–0.077***	–0.075***	–0.066***
(firm-level)	(–1.60)	(–2.16)	(–2.13)	(–2.28)	(–2.78)	(–2.70)	(–2.83)	(–4.88)	(–4.78)	(–4.35)
Firm TFP (Olley–Pakes)	0.304***	0.158***	0.140***	0.144***	0.108**	0.091*	0.099**	0.035	0.016	0.027
	(3.86)	(3.03)	(2.71)	(2.75)	(2.26)	(1.94)	(2.07)	(0.67)	(0.30)	(0.53)
Foreign Indicator		0.033	0.086	0.100	0.185*	0.234**	0.238**	0.415***	0.419***	0.410***
		(0.29)	(0.75)	(0.85)	(1.80)	(2.27)	(2.29)	(3.63)	(3.70)	(3.65)
SOE Indicator		0.749***	0.920***	0.939***	0.833***	1.013***	1.031***	0.349	0.318	0.111
		(4.54)	(4.84)	(4.38)	(5.61)	(6.10)	(5.67)	(0.89)	(0.79)	(0.27)
Log Firm Labour		0.891***	0.895***	0.903***	0.890***	0.890***	0.897***	0.952***	0.940***	0.909***
		(23.59)	(24.00)	(23.97)	(25.77)	(26.02)	(26.11)	(36.96)	(35.92)	(33.56)
Processing Indicator		0.240**	0.253**	0.272**	0.213**	0.236***	0.253***	–0.068	–0.070	–0.087
		(2.35)	(2.42)	(2.58)	(2.44)	(2.66)	(2.83)	(–0.96)	(–0.98)	(–1.23)
Year Fixed Effects	No	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes
Industry Fixed Effects	No	No	No	Yes	No	No	Yes	No	No	Yes
Observations	743	743	743	743	1008	1008	1008	1,630	1,630	1,630
R-squared	0.04	0.47	0.48	0.49	0.46	0.47	0.47	0.48	0.48	0.50

Note: Numbers in parentheses are robust t-value. *(**, ***) denotes significance at 10% (5%, 1%).
SOE = state-owned enterprise, TFP = total factor productivity.
Source: compiled by authors.

Second and equally important, we find that trade liberalisation boosts exports. This holds for all aspects of trade liberalisation, including output tariff reductions, input tariff reductions, and foreign tariff reductions. And trade liberalisation has stronger impacts on firms importing less from Indonesia. With input trade liberalisation, firms are able to save costs in intermediate inputs, and thus earn more profit. Similarly, with lower trading partners' tariffs, firms gain easier access to foreign markets and have more exports. By contrast, the role of output trade liberalisation is different. A large degree of output tariff reductions suggests tough import competition effects from international markets. Thus, only efficient firms are able to survive in the markets. As efficient firms are larger and export more, we see negative coefficients of output tariffs.

Last, SOEs and larger firms tend to export more. Also, processing firms export more, which makes good sense as processing firms, by definition, will export all products to foreign markets.

3.2. Trade liberalisation and export and import scope

Table 3 examines the intensive margin of trade liberalisation on firm exports. We now move to explore the impact of trade liberalisation on the extensive margin of exports. In particular, we focus on the change in export and import scope. By definition, following Qiu and Yu (2014), we define a firm's export scope as the number of HS 8-digit products exported by a Chinese manufacturing firm. The empirical specification is as follow:

$$es_{ijt} = \beta_0 + \beta_1 TFP_{it} + \beta_2 OT_{jt} + \beta_3 IT_{it} + \beta_4 ET_{jt} + \theta X_{it} + \varepsilon_{it}$$

where es_{ijt} is export product scope of firm *i* in industry *j*.

Table 4 reports the count-data estimate of trade liberalisation on firm export scope. As before, columns (1) to (3) include a sample of Chinese exporters with more

than a 10% import share from Indonesia and columns (4) to (6) cover firms with more than a 5% import share from Indonesia.

We start from the Poisson estimates in which the mean of export scope is presumed to equal its variance. The Poisson estimate in column (1) suggests that both home output tariffs and foreign tariff reductions decrease firm export scope. In addition, firm input tariff reductions overall decrease export scope. Such findings are exactly consistent with the findings of Qiu and Yu (2017), which covered the whole sample of Chinese exporters. The economic rationale of the positive coefficient of output tariff is straightforward. Lower output tariffs lead to tougher import competition, which in turn makes firms focus on their competitive products. At first glance, the positive coefficient of foreign tariffs is counter-intuitive. But this is because of the trade-off between positive shock and negative shock raised by a trading partner's tariff reductions. On the one hand, larger foreign markets induce exporting firms to open more product lines as a result of higher profits. On the other hand, foreign markets are also more competitive due to exporting firms entering the market, so a firm also has an incentive to reduce product scope to avoid cannibalisation. As presented in Qiu and Yu (2014), once the negative competition impact dominates the positive one, export scope falls.

However, the assumption that the mean of the export scope equals its variance seems too strong. Instead, we adopt the negative binomial estimates in column (2) for Chinese exporters with more than a 10% import share from Indonesia and those in column (5) with more than a 5% import share from Indonesia. The negative binomial estimates are more attractive here as they allow the sample to exhibit a pattern of over-dispersion. However, there may be a concern that some other macroeconomic fluctuations such as yuan appreciation during the sample period, particularly after 2005, may affect a firm's export scope. In addition, other unspecified factors such as a firm's managerial efficiency, as introduced in Qiu and Yu (2017), may also affect the firm's extensive margin. We thus control for firm-specific fixed effects and

year-specific fixed effects in columns (3) and (6). It turns out that the binomial estimation results in columns (2) and (3) and (5) and (6) are qualitatively identical to their counterparts in columns (1) and (4) with Poisson estimates. Thus, our estimates are insensitive to different empirical specifications.

Table 4: Count-Data Estimates of Trade Liberalisation on Firm Export Scope

Regression: Export Scope	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Econometric Method	Poisson	Negative Binomial		Poisson	Negative Binomial		Poisson	Negative Binomial	
Import Share from Indonesia		> 10%			>5%			<5%	
Home Output Tariffs	0.724***	1.100**	0.942**	1.102***	1.347***	0.871***	1.363***	1.050***	0.473**
	(4.75)	(2.57)	(2.36)	(9.05)	(3.79)	(2.71)	(13.09)	(3.81)	(2.10)
Foreign Tariffs	5.078***	4.189***	1.709***	4.472***	3.848***	1.782***	1.041***	1.433***	1.589***
(industry-level)	(21.68)	(6.97)	(3.05)	(23.17)	(7.60)	(3.78)	(8.40)	(3.56)	(4.53)
Home Input Tariffs	–0.006	–0.007	0.004	–0.016***	–0.013*	–0.001	–0.006***	–0.011	–0.033***
(firm-level)	(–1.64)	(–0.85)	(0.45)	(–4.87)	(–1.90)	(–0.13)	(–2.80)	(–1.63)	(–4.06)
Firm TFP (Olley–Pakes)	0.353***	0.425***	0.226***	0.324***	0.397***	0.233***	0.485***	0.623***	0.191***
	(14.31)	(5.53)	(2.96)	(15.37)	(6.02)	(3.84)	(37.78)	(11.54)	(4.42)
Foreign Indicator	–0.200***	–0.114	–0.047	–0.128***	–0.067	–0.036	–0.493***	–0.548***	–0.006
	(–7.73)	(–1.55)	(–0.56)	(–5.78)	(–1.05)	(–0.49)	(–33.16)	(–8.46)	(–0.09)
SOE Indicator	0.093	–0.043	0.138	–0.071	–0.138	–0.046	–0.709***	–0.779***	–0.023
	(1.20)	(–0.17)	(0.42)	(–1.02)	(–0.64)	(–0.16)	(–9.86)	(–3.47)	(–0.10)
Log Firm Labour	0.187***	0.187***	0.202***	0.222***	0.222***	0.201***	0.223***	0.259***	0.251***
	(20.87)	(8.06)	(7.11)	(28.75)	(10.92)	(8.02)	(51.21)	(16.66)	(14.33)
Processing Indicator	–0.259***	–0.27***	–0.12***	–0.14***	–0.17***	–0.10***	–0.197***	–0.184***	–0.124***
	(–10.82)	(–4.50)	(–2.63)	(–7.40)	(–3.41)	(–2.65)	(–16.29)	(–4.30)	(–3.91)
Year-specific Fixed Effects	No	No	Yes	No	No	Yes	No	No	Yes
Firm-specific Fixed Effects	No	No	Yes	No	No	Yes	No	No	Yes
Observations	948	948	948	1323	1323	1323	2,123	2,261	2,261

Note: Numbers in parentheses are robust t-value. *(**, ***) denotes significance at 10% (5%, 1%). The home output tariff in column 1,4, and 7 are measured at industry-level, and in other columns are measured at firm level with weight fixed at initial year.
SOE = state-owned enterprise, TFP = total factor productivity.
Source: compiled by authors.

In addition to the above findings, we also observe that larger firms have relatively more export scope than average-sized firms. Interestingly, compared to non-processing firms (i.e. ordinary firms), processing firms seem to have less export scope. Combined with the above findings that processing firms have relatively higher export value, as shown in Table 3, the implication is clear: processing exporters reduce the variety of their trade products but focus on their core competitive products. Last, the negative sign of 'foreign indicator' suggests that multinational companies based in China have less export scope. Such a finding is consistent with the fact that processing firms also have less export scope, as processing firms generally are subsidiaries of multinational companies, as documented in Dai, et al. (2016).

Table 5 shows the impact of trade liberalisation on firm import scope. Once again, trade liberalisation is measured over three dimensions: output tariff reductions, input tariff reductions, and foreign tariff reductions. Columns (1) and (4) of Table 5 are Poisson estimates whereas the rest are negative binomial estimates. Columns (1) to (3) are estimates for Chinese exporters with more than a 10% import share from Indonesia, whereas columns (4) to (6) are firms with more than a 5% import share.

Table 5: Count-Data Estimates of Trade Liberalisation on Firm Import Scope

Regression: Import Scope	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Econometric Method	Poisson		Neg. Binomial	Poisson		Neg. Binomial	Poisson		Neg. Binomial
Import Share from Indonesia	> 10%			>5%			<5%		
Home Output Tariffs	–0.073	–1.419***	–0.601***	–0.977***	–1.183***	–1.038**	–1.526***	0.109***	0.109
	(–0.49)	(–13.96)	(–5.98)	(–8.10)	(–14.87)	(–2.52)	(–23.04)	(3.03)	(0.44)
Foreign Tariffs	–2.214***	–1.164***	–0.439***	–2.415***	–1.469***	–0.135	–2.638***	–3.367***	–2.762***
(industry-level)	(–13.57)	(–7.79)	(–3.45)	(–18.30)	(–12.32)	(–0.24)	(–42.63)	(–60.42)	(–7.70)
Home Input Tariffs	0.014***	0.023***	0.019***	0.022***	0.029***	0.046***	0.030***	0.034***	0.056***
(firm-level)	(7.41)	(12.20)	(10.28)	(13.92)	(18.86)	(3.92)	(34.94)	(39.51)	(6.98)
Firm TFP (Olley–Pakes)	0.260***	0.271***	0.192***	0.340***	0.346***	0.540***	0.452***	0.482***	0.624***
	(16.36)	(17.43)	(11.70)	(26.06)	(27.68)	(7.67)	(71.08)	(78.44)	(13.46)
Foreign Indicator	1.221***	1.249***	1.143***	1.168***	1.224***	1.116***	0.971***	0.932***	0.802***
	(54.47)	(55.68)	(46.68)	(63.41)	(65.98)	(16.19)	(87.49)	(87.63)	(14.66)
SOE Indicator	–0.846***	–0.865***	–0.932***	–0.860***	–0.810***	–0.727***	0.481***	0.369***	0.464**
	(–8.66)	(–10.33)	(–7.93)	(–10.33)	(–11.50)	(–2.92)	(12.78)	(9.87)	(2.38)
Log Firm Labour	0.497***	0.473***	0.475***	0.468***	0.454***	0.455***	0.418***	0.419***	0.385***
	(94.06)	(93.53)	(78.49)	(107.16)	(107.85)	(20.67)	(202.28)	(214.05)	(30.09)
Processing Indicator	–0.108***	–0.128***	–0.096***	–0.074***	–0.097***	–0.067	–0.232***	–0.220***	–0.195***
	(–7.31)	(–8.93)	(–9.13)	(–6.18)	(–8.42)	(–1.14)	(–40.84)	(–40.01)	(–5.22)
Year-specific Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm-specific Fixed Effects	No	No	No	No	No	No	No	No	No
Observations	948	948	948	1323	1323	1323	2,123	2,261	2,261

Note: Numbers in parentheses are robust t-value. *(**, ***) denotes significance at 10% (5%, 1%). The home output tariff in column 1,4, and 7 are measured at industry level, and in other columns are measured at firm level with weight fixed at initial year.
SOE = state-owned enterprise, TFP = total factor productivity.
Source: compiled by authors.

Table 5 illustrates that foreign tariff reductions increase a firm's import scope due to stimulated foreign demand and larger access to foreign markets. We also find that home output tariff reduction increases firm import scope. The implication is straightforward: with tougher import competition, firms import more foreign (Indonesian) varieties to promote productivity and upgrade product quality. Strikingly, home input tariff reductions are found to decrease a firm's import scope. Two possible reasons are noted to interpret such a counter-intuitive finding. The first one is due to the sample restriction as our sample only covers large exporting firms. With large profitability, large firms could instead use domestic varieties or import a lower number of varieties but of a higher volume. The second is that given input trade liberalisation has cost-saving effects, it in turn increases firm profitability and hence pushes firms to import more goods with higher quality from developed countries.

The estimation results of Tables 5 and 6 jointly suggest that South–North and South–South tariff reductions impact trade differently by an extensive margin: South–North trade liberalisation reduces export scope and increases import scope, while South–South liberalisation increases export scope and decreases import scope from Indonesia. Furthermore, the South–North liberalisation mainly takes effect through market expansion and severe competition, while the South–South liberalisation impacts firms through cost reduction and trade diversion.

3.3. More robustness checks

Thus far we have used the augmented Olley–Pakes TFP to measure firm productivity. Although such measured TFP has many advantages compared to other alternative measures of productivity, as discussed in Yu (2015), it also has two main disadvantages. First, the Olley–Pakes TFP assumes that firms adjust capital input when facing an exogenous shock. However, this may not happen in China, as China is a labour-abundant country and, hence, firms find it easier to adjust labour than capital. Second, the Olley–Pakes TFP does not allow output to have any serial correlations, which are likely to occur. For these reasons, the system-general method of moments (GMM) TFP measure seems an ideal complementary measure, as it has enough flexibility to allow for possible serial autocorrelations. We hence use system-GMM TFP to check whether our results will remain robust even when using other measures of TFP. Table 6 shows this comparison.

Table 6: Estimates of Trade Liberalisation on Firm Productivity

Import Share from Indonesia	>10%		>5%	
Regressand:				
Firm TFP (system GMM)	(1)	(2)	(3)	(4)
Home Output Tariffs	–1.177***	–0.666**	–1.343***	–0.925***
(industry-level)	(–4.76)	(–2.08)	(–6.46)	(–3.42)
Foreign Tariffs	–0.770***	–1.089***	–0.768***	–1.034***
(industry-level)	(–2.70)	(–3.17)	(–3.24)	(–3.57)
Home Input Tariffs	0.237	0.412	0.249	0.329
(firm-level)	(0.71)	(0.95)	(0.83)	(0.84)
Foreign Indicator	0.138	0.357**	0.064	0.209
	(0.70)	(2.22)	(0.43)	(1.63)
SOE Indicator	–0.002	0.028	0.016	0.038
	(–0.05)	(0.76)	(0.60)	(1.20)
Log Firm Labour	0.067***	0.067***	0.069***	0.063***
	(6.92)	(5.61)	(8.27)	(5.94)
Processing Indicator	–0.092***	–0.087***	–0.085***	–0.084***
	(–3.61)	(–2.62)	(–3.89)	(–2.98)
Year-specific Fixed Effects	No	Yes	No	Yes
Firm-specific Fixed Effects	No	Yes	No	Yes
Observations	828	828	1156	1156
R-squared	0.15	0.21	0.15	0.19

Note: Numbers in parentheses are robust t-value. *(**, ***) denotes significance at 10% (5%, 1%).
GMM = general method of moments, SOE = state-owned enterprise, TFP = total factor productivity.
Source: compiled by authors.

Following Yu (2015), we now move to discuss whether trade liberalisation boosts firm productivity for Chinese exporters with a significant import share from Indonesia. Once again, we consider firms with 10% and 5% import shares from Indonesia, respectively. As in other studies, we find that both output trade liberalisation and external trade liberalisation boost firm productivity. However, we do not find that input trade liberalisation raises firm productivity. The impact of home input trade liberalisation on firm productivity is insignificant. Such findings are robust even when we control for year-specific fixed-effects and firm-specific fixed-effects in Table 6 column (2) for firms with a 10% import share from Indonesia and in column (4) for those firms with a 5% corresponding import share.

This raises a concern over the previous estimates of the effects of trade liberalisation on firm productivity. One may worry that our estimates above have some estimation bias. To address this concern, following Feenstra, Li, and Yu (2014), we distinguish between ex ante TFP and ex post TFP measures.

Table 7: Estimates of Trade Liberalisation with Ex Ante Firm Productivity

Regress and:	Log Exports	Export Scope		Import Scope
Import Share from Indonesia	>5%	>5%	>10%	>5%
	(1)	(2)	(2)	(4)
Home Output Tariffs	–0.708	0.682*	0.826*	–1.218***
(industry-level)	(–0.78)	(1.89)	(1.95)	(–2.86)
Foreign Tariffs	–1.936**	2.806***	4.164***	0.734
(industry-level)	(–2.36)	(5.30)	(6.97)	(1.16)
Home Input Tariffs	–0.059***	–0.002	–0.005	0.063***
(firm-level)	(–3.24)	(–0.23)	(–0.64)	(5.36)
Firm TFP (Olley–Pakes)	–0.064	0.749***	0.666***	0.025
	(–0.49)	(9.16)	(6.89)	(0.27)
Foreign Indicator	0.280***	–0.035	–0.115	1.134***
	(2.82)	(–0.57)	(–1.58)	(16.22)
SOE Indicator	0.304	0.052	0.061	–0.512**
	(0.83)	(0.26)	(0.25)	(–2.04)
Log Firm Labour	0.893***	0.247***	0.236***	0.471***
	(28.39)	(12.65)	(10.05)	(20.61)
Processing Indicator	0.258***	–0.171***	–0.281***	–0.056
	(3.26)	(–3.38)	(–4.60)	(–0.95)
Year-specific Fixed Effects	No	Yes	Yes	Yes
Firm-specific Fixed Effects	No	Yes	Yes	Yes
Observations	1192	1324	949	1324

Note: Numbers in parentheses are robust t-value. *(**, ***) denotes significance at 10% (5%, 1%).
SOE = state-owned enterprise, TFP = total factor productivity.
Source: compiled by authors.

The conventional measures of TFP, including our above TFP measure (inclusive of both Olley–Pakes and system-GMM), is a Solow residual that includes both unspecified factors and production productivity. In this way, the measured TFP correlates with the error term. To avoid such a shortcoming and to be closer to the spirit of Melitz (2003) that puts greater emphasis on the ex ante random draw of firm productivity, we exactly follow Feenstra, Li, and Yu (2014) and Qiu and Yu (2017) to construct an ex ante TFP.

Table 7 reports the estimation results using the ex ante TFP measure. The regress and in column (1) is firm exports, whereas those in columns (2) and (3) are export scope, and that in column (4) is import scope. Estimates in column (1) show that all types of trade liberalisation boost firm exports, which makes good economic sense. Meanwhile, all estimates on export scope and import score are consistent with estimates with ex post firm productivity presented in Tables 4 and 5. Thus, our main findings are robust when using different measures of TFP.

4. Conclusions

In this paper, we predict that trade liberalisation in North and South production countries can boost firm exports, and we provide empirical exercises using detailed and highly disaggregated Chinese data to test such predictions. In particular, we use both Chinese firm-level production and transaction-level trade data to examine the effects of three types of tariff reductions on firm export, firm productivity, and firm export and import scope by considering vertical integration amongst production South and consumption North.

Our findings assert that trade liberalisation significantly raises firm exports. South–North liberalisation decreases the export scope and increases import scope, while South–South liberalisation decreases the import scope of all firms, but increases the export scope of firms importing less intensively from Indonesia and has no significant impact on firms importing intensively from Indonesia. Furthermore, the magnitude of impact of all types of trade liberalisation are heterogeneous for firms with a different import share from Indonesia: the impact of foreign market liberalisation on the export scope is more pronounced for firms with a larger import share from Indonesia. On the contrary, the impact on export value and import scope of all tariff reductions is less pronounced.

Moreover, our findings provide insightful policy implications. First, if deeper integration between North and South can increase trade flows, governments in the South and North should provide more trade facilitation to make trade integration possible. Second and equally important, we find that trade liberalisation in the destination countries (most likely in the North) and in the production countries (most likely in the South) boosts firm productivity and raises trade flows. Thus, it would be a wise strategy for trading countries to cut their tariffs, phase out other non-tariff barriers, and improve transparency of non-tariff measures.

References

Amiti, M. and J. Konings (2007), 'Trade Liberalization, Intermediate Inputs, and Productivity: Evidence from Indonesia', *The American Economic Review*, 97(5), pp.1611–38.

Arkolakis, C. and M.–A. Muendler (2011), 'The Extensive Margin of Exporting Products: A Firm-level Analysis', *NBER Working Paper*, No. 17991, Cambridge, MA: NBER.

Bernard, A., J. Eaton, J.B. Jensen, and S. Kortum (2003), 'Plants and Productivity in International Trade', *The American Economic Review*, 93, pp.1268–90.

Baldwin, J. and W. Gu (2009), 'The Impact of Trade on Plant Scale, Production-Run Length and Diversification', in T. Dunne, J. B. Jensen, and M. J. Roberts (eds.), *Producer Dynamics: New Evidence from Micro Data*. Chicago, IL: University of Chicago Press.

Bernard, A., S. Redding, and P. Schott (2007), 'Comparative Advantage and Heterogeneous Firms', *Review of Economic Studies*, 74, pp.31–66.

Bernard, A., S.J. Redding, and P.K. Schott (2011), 'Multiple-Product Firms and Trade Liberalization', *Quarterly Journal of Economics*, 126(1), pp.70–97.

Brandt, L., J. Van Bieseboreck, and Y. Zhang (2012), 'Creative Accounting or Creative Destruction? Firm Level Productivity Growth in Chinese Manufacturing', *Journal of Development Economics*, 97(2), pp.339–51.

Berthou, A. and L. Fontagne (2013), 'How Do Multi-Product Exporters React to a Change in Trade Costs?', *Scandinavian Journal of Economics*, 115(2), pp.326–53.

Dai, M., M. Maitra, and M. Yu (2016), 'Unexceptional Exporter Performance in China? Role of Processing Trade', *Journal of Development Economics*, 121, pp.177–89.

Dhingra, S. (2013), 'Trading Away Wide Brands for Cheap Brands', *American Economic Review*, 103(6), pp.2554–84.

Eckel, C. and J.P. Neary (2010), 'Multi-product Firms and Flexible Manufacturing in the Global Economy', *Review of Economic Studies*, 77, pp.188–217.

Feenstra, R., Z. Li, and M. Yu (2014), 'Exports and Credit Constraints under Incomplete Information: Theory and Application to China', *Review of Economics and Statistics*, 96(4), pp.729–44.

Feenstra, R. and H. Ma (2008), 'Optimal Choice of Product Scope for Multiproduct Firms under Monopolistic Competition', in E. Helpman, D. Marin, and T. Verdier (eds.), *The Organization of Firms in a Global Economy*. Cambridge, MA: Harvard University Press, pp.173–99.

Goldberg, P., A. Khandelwal, N. Pavcnik, and P. Topalova (2010), 'Imported Intermediate Inputs and Domestic Product Growth: Evidence from India', *Quarterly Journal of Economics*, 125(4), pp.1727–67.

Halpern, I., M. Koren, and A. Szeidl (2015). 'Imported Inputs and Productivity', *American Economic Review*, 105(12), pp. 3660–703.

Hummels, D., J. Ishii, and K.–M. Yi (2001), 'The Nature of Growth of Vertical Specialization in World Trade', *Journal of International Economics*, 54, pp.75–96.

Hummels, D. and P.L. Klenow (2005), 'The Variety and Quality of a Nation's Exports', *American Economic Review*, 95(3), pp.704–23.

Iacovone, L. and B.S. Javorcik (2010), 'Getting Ready: Preparation for Exporting', Manuscript.

Lileeva, A. and D. Trelfer (2010), 'Improved Access to Foreign Markets Raises Plant-level Productivity … for Some Plants', *Quarterly Journal of Economics*, 125(3), pp.1051–99.

Linder, S.B. (1961), *An Essay on Trade and Transformation*. Stockholm: Almqvist and Wiksell.

Mayer, T., M.J. Melitz, I. Gianmarco, and P. Ottaviano (2014), 'Market Size, Competition, and the Product Mix of Exporters,' *American Economic Review, American Economic Association,* 104(2), pp.495–536.

Melitz, M. (2003), 'The Impact of Trade on Intra-industry Reallocations and Aggregate Industry Productivity', *Econometrica,* 71(6), pp.1695–725.

Qiu, L.D. and W. Zhou (2013), 'Multiproduct Firms and Scope Adjustment in Globalization', *Journal of International Economics,* 91, pp.142–53.

Qiu, L.D. and M. Yu (2017), 'Managerial Efficiency and Product Line Decision under Market Competition and Expansion', mimeo, Peking University.

Tian, W. and M. Yu (2012), 'China's Processing Trade: A Firm-Level Analysis,' in H. McMay and L. Song (eds.), *Rebalancing and Sustaining Growth in China*. Australian National University E-press, pp.111–148.

Tian, W. and M. Yu (2015), 'Processing Trade, Export Intensity, and Input Trade Liberalization: Evidence from Chinese Firms', *Journal of the Asia–Pacific Economy,* 20(3), pp.444–64.

Topalova, P. and A. Khandelwal (2011), 'Trade Liberalization and Firm Productivity: The Case of India', *Review of Economics and Statistics,* 93(3), pp.995–1009.

Xing, Y. and N. Detert (2010), 'How the iPhone Widens the United States Trade Deficit with the People's Republic of China', *ADBI Working Paper,* No. 257. Tokyo: Asian Development Bank Institute.

Yu, M. (2015), 'Processing Trade, Tariff Reductions and Firm Productivity: Evidence from Chinese Firms', *Economic Journal,* 125(June), pp.943–88.

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