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THE IMPACT OF INTRANATIONAL TRADE BARRIERS ON EXPORTS:  
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Working Paper 26581  
<http://www.nber.org/papers/w26581>

NATIONAL BUREAU OF ECONOMIC RESEARCH  
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December 2019

We thank Nikhil Agarwal, Pol Antras, Abhijit Banerjee, Panle Jia Barwick, Arnaud Costinot, Dave Donaldson, Jack Feng, James Harrigan, Marc Melitz, Benjamin Olken, Gerard Padro, Robert Townsend, Jeffery Wang, and lunch, seminar and conference participants at ASSA annual meeting, Cornell, Harvard, MIT, and NEUDC for helpful discussions and comments. All errors are our own. The views expressed herein are those of the authors and do not necessarily reflect the views of the National Bureau of Economic Research.

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December 2019  
JEL No. F14,F15,O14

### **ABSTRACT**

It is well known that various forms of non-tariff trade barriers exist within a country. Empirically, it is difficult to measure these barriers as they can take many forms. We take advantage of a nationwide VAT rebate policy reform in China as a natural experiment to identify the existence of these intranational barriers due to local protectionism and study the impact on exports and exporting firms. As a result of shifting tax rebate burden, the reform leads to a greater incentive of the provincial governments to block the domestic flow of non-local goods to local export intermediaries. We develop an open-economy heterogenous firm model that incorporates multiple domestic regions and multiple exporting technologies, including the intermediary sector. Consistent with the model's predictions, we find that rising local protectionism leads to a reduction in interprovincial trade, more "inward-looking" sourcing behavior of local intermediaries, and a reduction in manufacturing exports. Analysis using micro firm-level data further shows that private companies with greater baseline reliance on export intermediaries are more adversely affected.

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*“Aside from tariff barriers (i.e., special charges levied at roadblocks), non-tariff methods such as physical barriers, outright prohibition, low-interest loans, and other financial benefits for commercial establishments marketing local goods, fines for commercial establishments marketing nonlocal goods, legal restrictions on price differences between local and nonlocal goods sold in commercial establishments, local purchasing quotas, and administrative trivia (e.g; medical, sanitation, epidemic prevention, product quality, measurement, and other such licenses and certificates) were used to hamper trade in products in a market economy.”* (Young, 2000)

## 1 Introduction

It is well known that various forms of non-tariff barriers exist within a country. While local governments cannot block their borders or impose tariffs, their influence over the local regulatory apparatus can allow them to impose significant non-tariff barriers to discourage non-local firms and non-local goods from entering the local markets. Young (2000) gives many examples of such non-tariff barriers in the Chinese context. These barriers are especially likely to arise in countries’ where political and fiscal powers are decentralized to subnational units. However, despite the general consensus on the existence of these local trade barriers, we know relatively little about how costly they are in terms of real economic outcomes: widespread interprovincial trade wars are very different from occasional protectionist practices. What makes this a challenging empirical problem to study is precisely the fact that these local barriers can take many forms, and unlike tariff barriers, they are difficult to measure or even just to observe.

In this study, we take advantage of a nationwide VAT rebate policy reform in China in 2004 as a natural experiment to first identify the existence of intranational trade barriers due to local protectionism and then to quantify the impact on exports and firm performance. As a result of the shifting tax rebate burden, the reform leads to a greater incentive of the provincial governments to block the domestic flow of non-local goods to local export intermediaries. By exploring a unique feature of the transaction-level Chinese Customs Data that allows us to trace the sourcing locations of the export intermediaries, we show that the intermediaries indeed become more “inward-looking” after the reform.

To go beyond the descriptive evidence and examine the impact on interprovincial trade and manufacturing exports, we develop a theoretical model to guide the empirical analysis. The model is built on the standard open-economy heterogeneous firm model by incorporating multiple domestic regions and multiple exporting technologies, including the intermediary sector. We model the intermediary technology following Ahn, Khandelwal, and Wei (2011), but with a new focus on the intermediary’s

role of domestic sourcing. The model predicts a fall in interprovincial trade (related to exporting via intermediaries) and a reduction in manufacturing exports as a result of rising local protectionism.

To bring the theory to the data, we explore subnational variations in rebate burden and exposure to the reform. First, for each province, we construct a measure of predicted rebate burden based on the local intermediaries' sourcing patterns prior to the reform and the tax rebate formula. Consistent with the descriptive evidence, we find that intermediaries located in provinces with a higher predicted rebate burden become more "inward-looking" after the reform. Specifically, they source from fewer non-local provinces and source a greater fraction of local goods. The results are robust to controlling for province and time fixed effects, time-varying rebate rates, and province-specific time trends.

Using a difference-in-difference framework, we then examine the impact of increasing provincial rebate burden on interprovincial trade flows of indirect exports (i.e., exports via intermediaries). Our estimate implies a trade elasticity of 1.2 with respect to provincial rebate burden. The magnitude is comparable to existing estimates in the trade literature with respect to physical transportation costs, indicating that political barriers can act as important frictions in hindering domestic trade.

Next, we examine the impact on manufacturing exports and manufacturing firms. To do so, we construct a measure of reform exposure for each province-industry as the weighted average of the predicted rebate burdens, where the weights are given by a province-industry's baseline reliance on intermediaries located in different provinces. The results show that greater exposure to the reform leads to reductions in both indirect exports as well as total exports. Using the NBS annual survey of manufacturing firms, we show that, while some firms manage to switch to direct exporting, most of the negative impact falls on private firms with a greater reliance on export intermediaries at baseline.

Last but not least, we explore the firm-level Customs data to shed light on local government behavior. While systematic documentation of the protectionist practices does not exist, we find suggestive evidence that local governments may target large intermediaries, either due to limited administrative capacity or fixed costs of the intervention technology. However, beyond that, local officials do not appear to employ additional local information in the targeting, such as an intermediary's history of non-local purchase and its product mix.

The study relates to the literature on domestic trade frictions. [Ramondo, Rodríguez-Clare, and Saborío-Rodríguez \(2016\)](#) find that domestic frictions are key to explaining the discrepancy between standard trade models and the data. [Costinot and Donaldson \(2016\)](#) find substantial gains from economic integration among US agricultural markets from 1880-2002. More recent studies have quantified domestic trade costs due to geographical barriers and poor transportation infrastructure (for example,

Limo and Venables (2001), Donaldson (2010), Banerjee, Duflo, and Qian (2012), and Faber (2014), Anderson, Milot, and Yotov (2014), Atkin and Donaldson (2015), and Coşar and Fajgelbaum (2016)). However, as discussed above, domestic trade barriers can take other forms. Lacking a good transportation network is responsible for the lack of greater economic integration, but it may not explain the full story. Our findings show that political barriers imposed by local governments play an important role.

The paper also contributes to the literature on local protectionism (for example, Young (2000), Naughton (2003), Bai, Du, Tao, and Tong (2004), Poncet (2003), Poncet (2005), and Holz (2009)). There are two strands of this literature: the first hinges on patterns of regional convergence as evidence of rising protectionism (Young, 2000). However, a challenge with this approach is the lack of a theoretical yardstick with which to evaluate the changes: reversal of inefficient patterns of specialization can be efficiency enhancing. The second strand of the literature relies on provincial input-output tables to estimate the border effect from a gravity equation (Poncet, 2005). The estimate may be confounded by the presence of non-traded local goods and non-homothetic preferences.<sup>1</sup> We use micro firm-level data to address some of the limitations and identify local trade barriers under relatively weak assumptions. Our study is closely related and complementary to a concurrent paper by Barwick, Cao, and Li (2017), in which the authors document local protectionism from “home bias” in passenger vehicle purchasing. We focus on the supply side and study firms’ responses in light of rising local protectionism.

Finally, the study relates to the literature on resource misallocation. Institutions that distort the efficient allocation of resources can have a sizable effect on economic outcomes. Hsieh and Klenow (2009) estimate that the distortions in the Chinese economy reduce manufacturing productivity by 30% to 50%. Brandt, Tombe, and Zhu (2013) estimate a large distortion on aggregate TFP due to inefficient factor inputs allocation within and between provinces in China. There has been a growing body of work that tries to uncover particular sources of misallocation, including industrial policies and labor market frictions (for example, Khandelwal, Schott, and Wei (2013), Fajgelbaum, Morales, Serrato, and Zidar (2018) and Garicano, Lelarge, and Van Reenen (2016)). We show that local protectionism induced by national tax policies can act as a potential source of resource misallocation.

The remainder of the paper is organized as follows. Section 2 describes the policy background. Section 3 presents the model. Section 4 describes the data. Section 5 discusses the empirical strategy. Section 6 presents the empirical results. Section 7 concludes.

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<sup>1</sup>Most of the studies rely on aggregate data. However, one limitation of the Chinese IO table is that it only reports a net trade value, which aggregates the total net trade with the rest of China and the rest of the world. As a result, the gravity equation estimates are also sensitive to functional form assumptions, including measures of distance between a given province and the rest of China.

## 2 Background

### 2.1 Export Value-Added Tax Rebate Policy and the 2004 Reform

Value-added tax (VAT) is a general broad-based tax assessed on incremental value at each stage of the production of goods and services. In China, the VAT rate is 17%, and it applies to most goods and services that are bought or sold for use. The export tax rebate policy is such that the VAT paid for exported goods can be refunded in whole or in part.<sup>2</sup> The idea is to remove taxes paid in all stages of the production process so that the goods can enter the international markets without tax.<sup>3</sup> Under the regime, when a manufacturer exports through an export intermediary (i.e., a foreign trade company, or FTC), the FTC is entitled to a “Pay-First-and-Refund-Later” VAT refund treatment (Chan, 2008): initially the FTC pays an output-tax-inclusive price to the manufacturer; after completing the export transaction, the FTC can collect a partial or full refund of the tax paid earlier.<sup>4 5</sup>

Prior to 2004, the central government was solely responsible for financing the VAT rebates — after completing an export transaction, an exporter first receives its VAT refund from the provincial government, which then receives the same amount of payment from the central government at the end of each fiscal year. However, the rapid growth of exports after China entered the WTO in 2001 led to a large backlog of rebate payments and put severe fiscal pressure on the central government. In response to the mounting financial burden, the central government implemented a major reform in 2004

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<sup>2</sup>The WTO Agreement on Subsidies and Countervailing Measures (SCM, Article 1.1a) allows members to provide rebates on export duties as long as the rebate does not exceed the full extent of the duty imposed. Thus, in contrast to other trade policies such as export subsidies, VAT rebates are sanctioned by the WTO.

<sup>3</sup>In practice, the VAT rebates have remained incomplete for most commodities in China, and the rebate rates have been adjusted over time as a policy tool to boost exports (Bai, Wang, and Zhong, 2011).

<sup>4</sup>In general, the exact VAT rebate formula varies across different business types. There are three VAT refund treatments applied to different types of exporters:

1. Pay-first-and-refund-later: an exporter, typically a commercial enterprise, can have the VAT incurred during the production process refunded in whole or in part prior to export. The refund rate could be lower than the VAT rate charged. No tax burden is incurred if the refund rate equals to the VAT rate. This paper mainly analyzes the result of a change to this treatment.
2. Exempt-credit-refund: an exporter, typically a production enterprise, will get refunded for the excess if the amount of input VAT, from which the disallowed credit has already been deducted, is bigger than the VAT payable for the current period. Exempt refers to the exemption of VAT for exports, and credit refers to the input VAT paid for the purchase used in the manufacture of exports that will be offset against the output VAT paid on local sales.
3. Tax exempt: an exporter, typically an export-processing enterprise, is not entitled to a VAT refund because either it has not previously paid any input VAT on exports or it has paid input VAT but the refund policy is not applicable. An example is bonded materials directly imported for use in export processing.

<sup>5</sup>In general, a Chinese manufacturer can export through an FTC in two ways: either by simply selling the goods to the FTC or by authorizing the FTC as an exporting agent (Wang, 2019). Before 2007, most manufacturer-FTC partnership was in the form of the former, in which the “Pay-First-and-Refund-Later” treatment applies.

that shifted part of the rebate burden to the provincial governments.<sup>6</sup> In particular, the new policy stipulates that, for the amount of rebates claimed by an exporter, the central government would finance 75% of the rebates, with the remaining 25% covered by the provincial government, depending on where the exporter is located.<sup>7</sup> The justification for the 75/25 sharing rule is that the VAT revenue is shared between the central and provincial governments according to this ratio.

## 2.2 Rising Local Protectionism

While the reform alleviated the fiscal pressure on the central government, it created an unintended consequence — it led to a strong incentive for provincial governments to discourage local FTCs from servicing non-local manufacturers. Operating as export intermediaries, FTCs do not engage in manufacturing activities but instead specialize in export services. They procure goods produced by other manufacturing firms and resell them to the international markets after simple processing, such as re-packaging and re-labeling. An FTC can source goods from manufacturers located in its own province or from manufacturers located in other provinces. Under the post-reform rebate regime, for any non-local goods sourced and exported by an FTC, the provincial government of the FTC has to finance 25% of the VAT rebates despite the fact that it has not collected the VAT revenue share in the first place, which is paid to the provincial government where the manufacturer is located.

Figure 1 provides a graphical illustration. In this example, an upstream manufacturing firm produces t-shirts worth 1000 USD. At the point of transaction between the manufacturer and the FTC, the latter pays the former 1000 USD plus 17% VAT. The VAT revenue is split between the upstream province and the central government. At the end of the transaction, the manufacturing firm issues a VAT invoice to the FTC, with which the latter can get the tax refunded after exporting the t-shirts. Prior to the reform, the entire rebates were financed by the central government, but after the reform, the downstream province where the FTC is located has to finance 25% of the rebates, even though it has not collected the revenue share. This generates a large fiscal burden on the provinces where many FTCs are located. As a result, the local governments have a strong incentive to block non-local goods, either by discouraging the activities of the intermediary sector in general or by asking its local FTCs to divert more sourcing toward local goods.

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<sup>6</sup>Note that the same reform also adjusted the rebate rates for many commodities across five distinct levels: 5%, 8%, 11%, 13%, and 17%, depending on the product category. In our empirical analysis, we collect detailed data on VAT rebate rates and control for the concurrent changes across product sectors.

<sup>7</sup>The sharing rule was later adjusted to 92.5/7.5 in 2005, in part due to the concerns over rising local protectionism — see Section 2.2. Since 2015, it has completely reverted back to the original scheme, in which the central government finances 100% of the rebates.

Media reports abound that the reform led to rising local protectionism in the ensuing years. Unfortunately, there has not been any systematic documentation of the protectionist measures introduced by the local governments due to the illegal nature of such activities.<sup>8</sup> To understand the situation, we conducted extensive research into media and government reports and interviewed a number of people working in the intermediary sector. One specific protectionist measure stands out from these qualitative accounts, which is through deliberate delays of VAT rebates for non-local goods: in particular, when the local tax bureau receives a lot of VAT invoices for non-local goods filed by an FTC, it could delay the refund to the firm. There were many reports of such delays in VAT rebates in the early 2000s (for example, [Zhong \(2004\)](#); [Wen \(2005\)](#); [Wu \(2004\)](#)).

Consistent with the above discussion, many FTCs became more “inward-looking” after the reform to avoid delays in VAT rebates from their local governments. [Figure 2](#) describes the changes in FTCs’ sourcing patterns before and after the reform. Panel A plots the cumulative distribution function of the number of sourcing provinces among the FTCs in different years. Panel B examines the fraction of local goods in total export sales. We see that along both the extensive and intensive margins, the FTCs had been becoming more outward-looking prior to the reform, but the trend sharply stopped in 2004.<sup>9</sup> While the time-series patterns are consistent with rising local protectionism, many macroeconomic factors could be at play. Our empirical strategy controls for the aggregate shocks and explores within-country across-province-industry and across-firm variations for identification (see [Section 5](#)).

### 2.3 Impacts on Manufacturing Exports and Firm Performance

In light of the disruption of the FTCs’ domestic sourcing, upstream manufacturing firms could be adversely affected. Consider a typical manufacturing firm in China. The firm has two ways to export its products to the international markets, either directly exporting on its own or indirectly exporting through the FTCs.<sup>10</sup> Exporting through FTCs constitutes a significant share of the total export activities in China. [Figure 3](#) shows that a relatively small number of FTCs account for more than 30% of the country’s total ordinary exports between 2001 and 2006. [Figure A.1](#) shows that FTCs are responsible for large fractions of exports in four major export industries, namely textiles, food products and

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<sup>8</sup>The Provisions on Prohibiting Regional Blockade in Market Economic Activities enacted in 2001 explicitly forbids local governments from restricting firms, in any manner, to purchase only the products and inputs that are locally made.

<sup>9</sup>The trend picked up again in 2006, which is consistent with the scaling down of the local rebate burden from 25% to 7.5%. In our empirical analysis, we take into account the revision of the sharing rule in constructing the policy shocks and the results are robust to this adjustment.

<sup>10</sup>There are two modes of indirect exporting via FTCs: the first is through formal contracting and the second is direct selling. The problem with the shifting tax rebate burden arises in the latter case; for the former, the rebate burden always falls on the province where the manufacturing firm is located. Our study therefore focuses on the second case.



beverages, chemicals and chemical products, and electrical machinery and apparatuses.

Due to the high fixed costs of direct exporting, many small and medium enterprises have relied on FTCs to export (Lin, 2017). This is especially true for manufacturing firms located in inland provinces. Panel A of Figure 4 shows the distribution of reliance on FTCs as defined by the percentage of a province’s total exports through FTCs. As the figure shows, many inland provinces heavily depend on FTCs for exporting. On the other hand, most FTCs are located in the coastal areas, as shown in Panel B of Figure 4.<sup>11</sup> As a result, small and medium manufacturers in inland regions may be particularly susceptible to the protectionist practices that suppress non-local sourcing activities of the coastal FTCs.

In principle, the policy could also affect downstream manufacturing firms that source production inputs from non-local upstream firms. To fully characterize the impact on the domestic supply chain, one would need information on firm-to-firm transactions. In this paper, we focus on the role of the intermediary sector and the impact on upstream manufacturing firms by exploring a unique feature of the Chinese Customs data that allows us to trace the sourcing locations of the FTCs. We describe the data in more detail in Section 4.

In the next section, we develop a theoretical framework to formalize the discussion above and derive testable predictions to guide our empirical analysis.

### 3 Theoretical Framework

The model extends the standard open-economy heterogeneous firm model in Melitz (2003) by adding an intermediary sector. We model the intermediary technology following Ahn, Khandelwal, and Wei (2011) but focus on its role in domestic sourcing and the result of impeding such activity. Importantly, we allow for multiple intermediary technologies with different costs of access, as well as heterogeneous reliance on these technologies among different provinces in China. This enables us to examine the differential impact of increasing the costs of “indirect exporting” (i.e., exporting through intermediaries) due to rising local protectionism on regions with different baseline characteristics. The model generates several reduced-form predictions that we bring to the data in the next section.

#### 3.1 Basic Setup

##### Demand Side

Consider two countries, China and the Rest of the World (ROW), and two sectors, one differentiated-

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<sup>11</sup>Of the 31 provinces, 12 are classified as coastal provinces according to the official Chinese definition: Beijing, Fujian, Guangdong, Guangxi, Hainan, Hebei, Jiangsu, Liaoning, Shandong, Shanghai, Tianjin, and Zhejiang.

good sector and one numeraire-good sector. Consumers in both countries have Cobb-Douglas preferences over the two sectors. In particular, foreign consumers' utility can be written as:

$$U = A_1^{\alpha_1} A_2^{\alpha_2}, \quad \alpha_1 + \alpha_2 = 1.$$

where  $A_1$  and  $A_2$  are the subutility obtained from numeraire good and differentiated good respectively. Within the differentiated-good sector, consumers have CES preference over different varieties  $\omega$ :

$$A_2 = \left[ \int_{\omega \in \Omega} q(\omega)^{\frac{\sigma-1}{\sigma}} d\omega \right]^{\frac{\sigma}{\sigma-1}} = \left[ (X^{CR})^{\frac{\sigma-1}{\sigma}} + (X^{RR})^{\frac{\sigma-1}{\sigma}} \right]^{\frac{\sigma}{\sigma-1}}$$

where  $X^{ij}$ , for  $i, j \in \{(C)hina, (R)OW\}$ , represents the subutility derived from the consumption of products made in  $i$  by consumers in  $j$ . Let  $P^{CR}$  denote the price index of Chinese export in the ROW:

$$P^{CR} = \left[ \int_{\omega \in \Omega^{CR}} p^{CR}(\omega)^{1-\sigma} d\omega \right]^{\frac{1}{1-\sigma}}.$$

Thus, demand from the ROW for variety  $\omega$  made in China is:

$$q^{CR}(\omega) = \left[ \frac{p^{CR}(\omega)}{P^{CR}} \right]^{-\sigma} X^{CR}$$

## Supply Side

Chinese consumers offer one unit of labor and receive a normalized wage of 1 (assuming a freely traded numeraire good produced by one unit of labor). Firms pay an entry cost of  $f_E$  and draw productivity  $\phi$  from a Weibull distribution  $G(\phi)$ . Assuming constant marginal cost, the amount of labor required to produce  $q$  units of output is  $l = \frac{q}{\phi}$  for a firm with productivity  $\phi$ . The CES demand function implies that the optimal price for the domestic market is  $p_D = \frac{1}{\rho\phi}$ . The domestic profits is  $\pi_D(\phi) = \frac{1}{\sigma} R^{CC} \left( \frac{p_D}{P^{CC}} \right)^{1-\sigma}$ .

A Chinese firm can access the foreign market by *directly* exporting on its own or *indirectly* exporting through an FTC. For direct exporting, the firm incurs a per period fixed cost  $f_X$  and a per unit iceberg cost  $\tau$ . For indirect exporting, the firm chooses among FTCs located in different provinces. Each province has a perfectly competitive intermediary sector consisting of identical FTCs open to all provinces. If a firm  $\phi$  of province  $i$  sells its variety through the intermediary sector in province  $j$ , it pays a fixed cost  $f_I^{ij}$  and a per-unit variable cost  $\gamma_I^{ij}$  to the FTC but no longer incurs the iceberg cost. Following [Ahn, Khandelwal, and Wei \(2011\)](#), we assume that the fixed cost of indirect exporting is lower than that of direct exporting, i.e., for any  $i$  and  $j$ ,  $f_I^{ij} < f_X$ .

### 3.2 Solving Firms' Profit Maximization Problem

The timing is as follows:

1. Entrants pays  $f_E$  to enter the market and draw productivity  $\phi$ . Low-productivity entrants exit.
2. Surviving firms make production and export decisions: firms choose to stay domestic or serve both the domestic and foreign markets. Exporters decide on the exporting technology: direct or indirect exporting, and if the latter, which FTC to use.
3. Prices and quantities are set.

We solve the firm's problem backward:

#### Stage 3

Direct exporter  $\phi$  solves the profit-maximization problem<sup>12</sup>:

$$\pi_X(\phi) = \max_{p_X} \pi_X(\phi, p_X) = p_X q(p_X) - \frac{1}{\phi} q(p_X) \tau - f_X \quad \Rightarrow \quad p_X(\phi) = \frac{\tau}{\rho \phi}$$

where  $p_X$  is the price charged to foreign consumers. On the other hand, indirect exporter  $\phi$  of province  $i$  solves the problem:

$$\pi_I^{ij^*}(\phi) = \max_{p_I} \pi_I^{ij^*}(\phi, p_I) = p_I \tau q(\tau p_I) - \frac{1}{\phi} \tau q(\tau p_I) \gamma_I^{ij^*} - f_I^{ij^*} \quad \Rightarrow \quad p_I^{ij^*}(\phi) = \frac{\gamma_I^{ij^*}}{\rho \phi}$$

where province  $j^*$  is the profit-maximizing FTC province for firm  $\phi$ , and  $p_I^{ij^*}(\phi)$  is the price the firm charges to the FTC in province  $j^*$ . Since the intermediary sector is perfectly competitive, it passes the iceberg trade cost by setting the price in the foreign market as  $\tau p_I$ . The exporter has to sell to the FTC quantity  $\tau q$  in order for quantity  $q$  to reach the foreign market.

#### Stage 2

Firms decide whether to produce and export, and if export, which exporting technology to use. Following the result above, the profits from direct exporting is:

$$\pi_X(\phi) = \frac{1}{\sigma} R \left( \frac{\tau}{\rho \phi P} \right)^{1-\sigma} - f_X.$$

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<sup>12</sup>From now on, we abbreviate  $CR$  subscript for  $q^{CR}$ ,  $R^{CR}$ , and  $P^{CR}$

Similarly, the profits of indirect exporting through the intermediary sector in province  $j$  is:

$$\pi_I^{ij}(\phi) = \frac{1}{\sigma} R \left( \frac{\tau \gamma_I^{ij}}{\rho \phi P} \right)^{1-\sigma} - f_I^{ij}$$

Let  $\pi_I^i = \pi_I^{ij^*}$ , where  $j^* = \operatorname{argmax}_j \pi_I^{ij}$ .

Firms choose the optimal production and exporting technology by solving the following:

$$\pi = \max\{\pi_I + \pi_D, \pi_X + \pi_D, \pi_D\}.$$

### Stage 1

Finally, a firm of province  $m_\phi$  decides whether to enter the market by calculating:

$$\mathbb{E}_\phi \pi(\phi) = \int_\phi \pi(\phi) dG(\phi) - f_E$$

### 3.3 Solving for Productivity Cutoffs of Various Exporting Technologies

Suppose there are  $M$  provinces in China. Due to the variation in the fixed and variable costs of direct and indirect exporting technologies, for every province there is naturally a pecking order of exporting technology, i.e., a productivity ladder that assigns firms with different productivities into different optimal exporting technologies. Without loss of generality, suppose that for province  $i$ , the productivity cutoffs of indirectly exporting through  $M$  provinces are ranked as  $\phi_I^{ii_1} < \phi_I^{ii_2} \dots < \phi_I^{ii_M}$ , where  $\phi_I^{ii_m}$  denotes the productivity cutoff of indirectly exporting through FTCs in province  $i_m$ , the  $m$ th province in the productivity ladder of province  $i$ .<sup>13</sup> This leads to an important observation that  $f_I^{ii_m} > f_I^{ii_{m-1}}$  and  $\gamma_I^{ii_m} < \gamma_I^{ii_{m-1}} \forall m \in [2, M]$ .<sup>14</sup> We assume that own province has the lowest fixed cost, and thus the own province is ranked at the last in the productivity cutoff ladder, i.e.,  $i = i_1$ . Furthermore, since  $f_X > f_I^{ii_m}, \forall m$  and direct exporting incurs no additional variable cost, we have  $\phi_I^{ii_m} < \phi_X, \forall m \in [1, M]$ , where  $\phi_X$  denotes the productivity cutoff of direct exporting.

<sup>13</sup>Mathematically, there may be a province  $j$  that would not be economically viable for indirect exporting by province  $j'$  if there exists another province  $j''$  such that  $f_I^{jj''} > f_I^{jj'}$  and  $\gamma_I^{jj''} > \gamma_I^{jj'}$ . This can rationalize the empirical observations that a province never indirectly exports through another province. However, for tractability here we assume away such provinces.

<sup>14</sup>Suppose that for firms in province  $m$ , no two provinces have the same fixed and variable costs of indirect exporting. If  $f_I^{ii_m} > f_I^{ii_{m-1}}$  and  $\gamma_I^{ii_m} > \gamma_I^{ii_{m-1}}$ , then province  $i_m$  would be strictly dominated by province  $i_{m-1}$ , and vice versa; if  $f_I^{ii_m} < f_I^{ii_{m-1}}$  and  $\gamma_I^{ii_m} > \gamma_I^{ii_{m-1}}$ , then province  $i_{m-1}$  would rank above  $i_m$  in the productivity cutoffs of indirect exporting.

We can obtain  $\phi_I^{ii_1}$  by setting the profits of indirectly exporting through local province to zero:

$$\pi_I^{ii_1}(\phi_I^{ii_1}) = 0, \quad \Rightarrow \phi_I^{ii_1} = A \left( \frac{(\gamma_I^{ii_1})^{1-\sigma}}{f_I^{ii_1}} \right)^{\frac{1}{1-\sigma}}$$

We can also solve any  $\phi_I^{ii_m}$ ,  $m \in [2, M]$  from the indifference conditions:

$$\pi_I^{ii_m}(\phi_I^{ii_m}) = \pi_I^{ii_{m-1}}(\phi_I^{ii_m}), \quad \Rightarrow \phi_I^{ii_m} = A \left( \frac{(\gamma_I^{ii_m})^{1-\sigma} - (\gamma_I^{ii_{m-1}})^{1-\sigma}}{f_I^{ii_m} - f_I^{ii_{m-1}}} \right)^{\frac{1}{1-\sigma}}$$

Finally,  $\phi_X$  can be obtained by equating the profits of exporting directly and the profits of exporting indirectly through the highest ranked province in the productivity cutoff ladder:

$$\pi_X(\phi_X) = \pi_I^{ii_M}(\phi_X), \quad \Rightarrow \phi_X = A \left( \frac{1 - (\gamma_I^{ii_M})^{1-\sigma}}{f_X - f_I^{ii_M}} \right)^{\frac{1}{1-\sigma}}$$

where  $A = \frac{\tau}{\rho P} \left( \frac{R}{\sigma} \right)^{1-\sigma}$ .

Figure A.3 illustrates the productivity cutoffs. One of the immediate implications from the discussion above is that the most productive firms will be direct exporters, followed by indirect exporters, and the least productive firms will serve domestic market only. We verify this pecking order in the Chinese context: Figure A.4 plots the empirical TFP distribution of the three groups of firms, and the patterns are largely consistent with the theoretical prediction, showing a rightward shift in productivity distribution as we move from non-exporting firms to indirect and direct exporters.<sup>15</sup>

### 3.4 Testable Predictions

After the policy reform, a greater fraction of the tax rebate burden falls on the provincial government, leading to rising local protectionism that hinders the non-local sourcing activity of the intermediary sector. To map the empirical context into the model, we consider an increase in the costs of indirect exporting through non-local intermediaries; the bigger the rebate burden (proxying a local government's incentives to block non-local trade), the greater the increase. For simplicity, we assume that the cost of the protectionist measures passes through the variable cost of indirect exporting. We state the

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<sup>15</sup>We follow [Olley and Pakes \(1996\)](#) and [Brandt, Van Biesebroeck, Wang, and Zhang \(2017\)](#) to estimate the TFP of the Chinese manufacturing firms. The TFP used in the plot is demeaned by province and industry. Because the export volume in the Customs Database is direct exports and that in the NBS survey is total exports, we define domestic firms as the ones that have zero exports in both datasets, indirect exporters as the firms which have positive exports in the NBS survey but zero exports in the Customs Database, and direct exporters as the ones whose share of direct exports among total exports are more than 0.9 ( $\sim$  the 90th percentile in the sample).

assumption formally below:

**Assumption 1.** Let  $c$  denote a measure of the tax rebate burden falling on the provincial governments. For any province  $i$ ,  $\frac{d\gamma_I^{iim}}{dc} > 0$  if  $i_m \neq i$ ,  $\frac{d\gamma_I^{iim}}{dc} = 0$  if  $i_m = i$ , and  $\frac{d\gamma_I^{iim}}{dc} = 0 \forall m \in [1, M]$ ,

In principle, both the fixed costs and variable costs of indirect exporting may be affected. We derive the predictions based on an increase in the variable costs, and all the results are qualitatively robust for an increase in the fixed costs.

**Assumption 2.**  $\frac{dP_{CB}}{dc} = 0$ .

We abstract away from general equilibrium effects and focus on partial equilibrium predictions. Our reduced form analysis explores subnational variations in rebate burdens and exposures to the reform, controlling for aggregate time shocks.<sup>16</sup>

Below, we derive five predictions on Chinese firms' exporting behavior as a result of the rebate burden and an increase in the costs of indirect exporting. Details of the proofs are in Appendix C.

**Prediction 1.** The number and the export volume of direct exporters increase in  $c$ .

Plot (a) in Panel A of Figure 5 illustrates how the number and the export volume of direct exporters respond in response to an increase in  $c$ . For province  $i$ , as  $c$  increases, the variable cost of indirect exporting increases through every non-local province, including province  $i_M$ , the highest province in the productivity cutoff ladder of indirect exporting. Therefore, some firms that were previously exporting through the FTCs in province  $i_M$  would switch to direct exporting, resulting in a leftward shift of the productivity cutoff of direct exporting  $\phi_X$  and an increase in the volume of direct exporting.

**Prediction 2.** For each province, the number of indirect exporters decreases in  $c$ . The indirect exporting volume also decreases in  $c$  if the productivity cutoffs increase across all indirect exporting technologies.

As  $c$  increases, the profits of indirect exporting through all provinces decrease, shifting up the productivity cutoff between staying domestic and indirect exporting. Combined with Prediction 1,  $[\phi_I^{i1}, \phi_X]$  shrinks and the number of indirect exporters decreases. However, the impact on the total indirect exporting volume is theoretically ambiguous. This is because firms can switch to different provinces for indirect exporting after the reform, depending on how much more costly it becomes to access an intermediary sector in a given province. It could be that a firm switches to a province with higher fixed cost but lower variable cost compared to what it has used before, in which case the firm's

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<sup>16</sup>The theoretical results hold under a more general condition that  $\frac{d\gamma}{dc} > \frac{dP_{CB}}{dc}$ .

(indirect) export volume would actually increase. On the other hand, if all the productivity cutoffs shift to the right among the set of viable indirect exporting technologies, as illustrated in plot (b) in Panel A of Figure 5, the indirect export volume would fall.<sup>17</sup>

Next, we examine how domestic trade along different indirect exporting routes, from manufacturing firms in a given province to the intermediary sector in another province, is distorted. Let  $R_I^{ii_m}$  denote the total indirect exporting volume flowing from province  $i$  to its  $m$ th ranked FTC province in the productivity cutoff ladder prior to the reform:

$$R_I^{ii_m} = \int_{\phi_I^{ii_m}}^{\phi_I^{ii_{m+1}}} r_I^{ii_m}(\phi) dG(\phi).$$

After the reform, with an increasing local tax rebate burden, we can show that:

$$\frac{\partial R_I^{ii_m}}{\partial c} = \underbrace{\int_{\phi_I^{ii_m}}^{\phi_I^{ii_{m+1}}} \frac{\partial r_I^{ii_m}(\phi)}{\partial c} dG(\phi)}_{\text{Price effect; } \leq 0} + \underbrace{\left( \frac{\tau \gamma_I^{ii_m}}{\rho P} \right)^{1-\sigma} R \times \left( \frac{\partial \Theta(\phi_I^{ii_{m+1}})}{\partial c} - \frac{\partial \Theta(\phi_I^{ii_m})}{\partial c} \right)}_{\text{Network effect; ambiguous sign}} \quad (1)$$

where  $\Theta(\phi) = \int_{-\infty}^{\phi} \phi'^{\sigma-1} dG(\phi')$ . This equation decomposes the effect of increase in  $c$  on  $R_I^{ii_m}$  into two parts: the price effect and the network effect. The price effect captures the change in  $R_I^{ii_m}$  if indirect exporters in  $i$  continue to export through the same provinces. The effect channels through the effect of  $c$  on  $p_I$  and the response of foreign demand to the change of prices. On the other hand, the network effect captures switchings among different indirect exporting routes: indirect exporters of province  $i$  may cease to export through province  $i_m$  or they may shift more trade to  $i_m$ , depending on how the other routes are affected. Panel B of Figure 5 illustrates the two effects graphically. Given that it takes time to look for new intermediaries and re-optimize among the indirect exporting routes, in the short run, one may expect that the price effect outweighs the network effect, as shown in the case of Panel B.

**Prediction 3.** Given an increase in  $c$ , for any province  $i$ : (1) local exporters rely more on local FTCs after the reform, i.e., the number and the export volume of indirect exports through local FTCs increase in  $c$ ; (2) the indirect export volume through other provinces decreases if the price effect outweighs the network effect (as defined in Equation (1)).

Finally, we examine heterogeneity across provinces based on their exposure to the reform, and map these predictions to the data. Let  $\mathcal{B}^{ij}$  denote the percentage change of the variable cost of indirectly exporting from province  $i$  through  $j$  with respect to a change in  $c$ , i.e.,  $\mathcal{B}^{ij} = \frac{d\gamma_I^{ij}/dc}{\gamma_I^{ij}}$ . We can define a

<sup>17</sup>A sufficient condition is that for any province  $i$ ,  $d\gamma_I^{ii_m}/dc > d\gamma_I^{ii_n}/dc$ ,  $\forall m, n$  s.t.  $\gamma_I^{ii_m} < \gamma_I^{ii_n}$  before the reform.

province  $i$ 's *exposure* to the reform:

**Definition 1.** The *exposure* of province  $i$  to an increase in  $c$ , denoted as  $\mathcal{E}^i$ , is the sum of the percentage change in variable costs of indirect exporting through all provinces from province  $i$ , weighted by the share of indirect export volume through each province:

$$\mathcal{E}^i \equiv \sum_{m \in [1, M]} \mathcal{B}^{im} \omega_I^{im}, \quad \text{where} \quad \omega_I^{im} = \frac{R_I^{im}}{\sum_{n \in [1, M]} R_I^{in}}$$

Intuitively, a province is more “exposed” to the reform if it relies more on intermediaries in provinces with larger increase in the variable cost of indirect exporting.

**Prediction 4.** If the price effect is sufficiently larger than the network effect, given an increase in  $c$ , indirect export volume from province  $i$  decreases more through provinces with larger  $\mathcal{B}^{ij}$ .

**Prediction 5.** If the price effect is sufficiently larger than the network effect, given an increase in  $c$ , a province with higher exposure  $\mathcal{E}$  will experience a larger percentage decrease in indirect exports.

## 4 Data

### 4.1 Chinese Customs Database

Our main data set is the Chinese Customs Database, which provides transaction-level trade flows information on the universe of China’s exports and imports. For this study, we focus on exports during the time period between 2001 and 2006.<sup>18</sup> The data is collected and made available by the Chinese Customs Office. For each transaction, we observe the exporting firm identity, ownership type and location, trade type, value and quantity of the exports, 8-digit HS code, city in China where the product is manufactured (i.e., the origin location), customs office where the transaction is processed and the final destination. The origin location information is a unique feature of the Chinese data that is typically not present in other Customs databases. Conversations with officials from the Chinese Customs office revealed that the collection of this information is required by the State Administration of Taxation, for the purpose of cross-validating the VAT receipts for tax rebate.

To examine the behavior of FTCs, we follow the strategy in [Manova and Zhang \(2009\)](#) to identify the set of FTCs based on Chinese characters that have the English-equivalent meaning of “importer”,

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<sup>18</sup>China entered WTO in 2001. The data after 2006 is no longer at the “transaction” level, and thus does not allow one to identify the origin location of each export transaction.



“exporter”, and/or “trading” in their firm name.<sup>19</sup> This classification is not perfect as there can be both inclusion and exclusion errors.<sup>20</sup> As a first pass, Figure A.2 plots the sourcing patterns of FTCs and non-FTCs using the pooled data from 2000 to 2006. Reassuringly, we see that on average, FTCs source from more provinces than non-FTCs. Not surprisingly, most (80%) non-FTCs export products that come from a single province—the province in which the exporting firm is located. In other words, these are manufacturing firms that produce and export on their own. Panel A of Table 1 presents the summary statistics of FTCs in the pre-reform baseline year 2003.

## 4.2 NBS Survey of Manufacturing Firms

To examine the impact of local protectionism on manufacturing firm performance, we merge the Customs data with the NBS annual survey of manufacturing firms.<sup>21</sup> The annual survey is conducted by the National Bureau of Statistics (NBS), and it includes all industrial firms that are identified as being either state-owned or non-state firms with sales revenue above 5 million RMB. As discussed in Brandt, Biesebroeck, and Zhang (2012), even though a large number of firms (80%) are excluded from the sample, they account for only a small fraction (9.3%) of the total economic activities in China.<sup>22</sup> Panel B of Table 1 presents the summary statistics of the balanced sample of manufacturing firms (i.e., 57,301 firms that appear in all 6 years in the data from 2001 to 2006).<sup>23</sup>

One important variable in the NBS data is a firm’s total export revenue. Compared to the export sales captured in the Customs data, which only reflects a firm’s direct exports, the self-reported amount in the NBS data presumably captures both direct exports and indirect exports through FTCs. In principle, we can derive a firm’s indirect export revenue by subtracting the two numbers. One concern with this approach is reporting noise, especially if firms consider some of their sales to FTCs as domestic sales rather than “exports”. We address this concern in our empirical analysis (see Section 6.4).

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<sup>19</sup>In pinyin (Romanized Chinese), these phrases are: jin4chu1kou3, jing1mao4, mao4yi4, ke1mao4 and wai4jing1.

<sup>20</sup>As noted in Khandelwal, Schott, and Wei (2013), some state-owned manufacturers may export through trading arms of their production facilities under a name that contains phrases such as importer, exporter and trader.

<sup>21</sup>We follow the standard procedure and link firms by their names following Yu and Tian (2012). We improve on the previous procedure by first standardizing firm names in both datasets.

<sup>22</sup>Trade in services accounts for a small fraction of the total trade activities during this period. We follow the industry concordance constructed by Brandt, Biesebroeck, and Zhang (2012) to ensure a coherent classification over time.

<sup>23</sup>There is a sharp increase in the number of firms in the sample between 2003 and 2004 as a result of the 2004 Industrial census—many firms above the 5 million RMB cutoff should have been in the sample in earlier years, but had been left out due to issues with the business registry. To avoid the composition change, we focus on a balanced sample of firms. A comparison between the balanced sample and the unbalanced sample can be found in Table B.1.

### 4.3 Export VAT Rebate Rates

We compile a comprehensive list of export VAT rebate rates at 10-digit HS product code from 2001 to 2006 based on official announcements released by the Chinese government.<sup>24</sup> We aggregate the rebate rates to 6-digit HS code by taking arithmetic averages (rebate rates within a 6-digit code are usually identical). Panel C of Table 1 describes the distribution of rebate rates across 6-digit HS industries in 2003. Over 80% of goods have a rebate rate of 13%; others categories include 0%, 5%, 10%, and 17% (full rebate). Section 5.1 describes how we use the rebate rates to construct measures of predicted rebate burden for local governments under the new policy.

### 4.4 Provincial Statistical Yearbooks

The Provincial Statistical Yearbooks provide basic macroeconomic statistics for 31 provinces in mainland China. Panel D of Table 1 presents basic summary statistics for the year 2003. We use information on government revenue and expenditures to construct various proxies for local fiscal capacity. We expect that the higher the predicted rebate burden as a share of local fiscal capacity, the stronger the incentive of the local government to discourage non-local sourcing to alleviate the rebate burden.<sup>25</sup>

## 5 Empirical Strategy

This section describes the empirical strategy to test the predictions in Section 3. We focus on Prediction 4 and 5, which guide us to exploit subnational variations and employ a difference-in-difference strategy for identification. Section 5.1 and 5.2 describe how we measure the rebate burden and exposure to reform. Section 5.3 describes the empirical specifications for examining the impact on interprovincial trade, sourcing patterns of FTCs, and exporting activities of manufacturing firms.

### 5.1 Predicted Rebate Burden

For each province, we compute a measure of predicted rebate burden based on local intermediaries' pre-reform trading patterns and rebate rates across industries. Specifically, we calculate the amount of VAT rebates each province would have to pay out due to its local FTCs' non-local businesses for each

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<sup>24</sup>Export VAT rebate rates are published on the government website <http://www.gov.cn/fuwu/chaxun/ckts1.html>.

<sup>25</sup>One caveat is that certain extra-budgetary sources of revenue are off the book (for example, money from selling lands, which is known to be an important source of revenue for local governments in China). However, such information has been poorly documented. To the extent that the different sources of revenue may be correlated, we perform a series of robustness checks using various measures that are available.

post-reform year had the non-local trading volume stayed the same as the pre-reform period. We scale the predicted rebate amount by a province’s fiscal capacity, measured by total government revenue, to capture the degree of fiscal stress induced by the policy change.<sup>26</sup> Formally,

$$\hat{\mathcal{B}}_t^j = \frac{\sum_{s \in \mathbb{S}} 0.25 \times \iota_{st} \times \sum_{i \neq j} \overline{R_{I,s}^{ij}}}{\overline{G_j}}, \quad \text{for } t \geq 2004$$

where  $s$  is 6-digit HS code and  $\mathbb{S}$  is the universe of export products<sup>27</sup>;  $\iota_{st}$  is the VAT rebate rate of sector  $s$  in year  $t$ ;  $\sum_{i \neq j} \overline{R_{I,s}^{ij}}$  is the sum of average indirect export volume from other provinces through  $j$  for the three years before the reform;  $\overline{G_j}$  indicates the average total government revenue of province  $j$  in the pre-reform period. 0.25 is the rebate share borne by the provincial government after the reform.<sup>28</sup>  $\hat{\mathcal{B}}_t^j = 0$  for  $t < 2004$ .

Conceptually, we expect that the higher predicted rebate burden would lead to a stronger incentive to discourage non-local sourcing and consequently to greater costs of accessing the local intermediary sector. Therefore,  $\hat{\mathcal{B}}_t^j$  is a reduced-form way of capturing the cost shocks to the indirect exporting technology as a result of increasing  $c$ , mapping to  $\mathcal{B}^{ij} = \frac{d\gamma_I^{ij}/dc}{\gamma_I^{ij}}$  in the model.

Table 2 shows substantial variations across Chinese provinces in terms of the predicted rebate burden.<sup>29</sup> An important part of the heterogeneity is coming from variations in baseline sourcing patterns of the local FTCs, particularly the average non-locally sourced exports between 2001 and 2003.

## 5.2 Exposure to Reform

Next, we use the predicted rebate burden to construct a measure of reform exposure for each province. The idea is that a province that relies more on FTCs in provinces with larger predicted rebate burden would be more exposed to the reform in light of the greater protectionist incentives of other provinces. Mathematically, following Definition 1 in the model, we construct the exposure measure as weighted sum of the rebate burden:

$$\hat{\mathcal{E}}_t^i = \sum_{m \in [1, M]} \hat{\mathcal{B}}_t^m \hat{\omega}_I^{im} \quad (2)$$

<sup>26</sup>In the robustness checks, we consider alternative measures of fiscal capacity, including total tax revenue, VAT revenue, and rollover balance, and obtain very similar results.

<sup>27</sup>Throughout the paper, we use  $s$  to denote 6-digit HS code,  $S$  2-digit HS code, and  $\mathbb{S}$  the universe of export products.

<sup>28</sup>There was a subsequent revision of the sharing rule after 2005, which changed the rebate share falling on the provincial government to 0.075. In the robustness checks, we take into account the subsequent revision of the policy in constructing the predicted rebate burden.

<sup>29</sup>The complete list of predicted burdens in 2004 for each province can be found in Table B.2.

where  $\hat{\omega}_I^{i_m} = \frac{\overline{R_I^{i_m}}}{\sum_n \overline{R_I^{i_n}}}$  is the average pre-reform share of indirect export volume of province  $i$  through  $i_m$ . It captures  $i$ 's baseline reliance on export intermediaries in other provinces.

Table 2 shows meaningful variations in reform exposure across provinces.<sup>30</sup> This is primarily driven by heterogeneity in indirect exporting choices at baseline. Figure 6 illustrates the cases for four provinces: two northern provinces, Shanxi and Qinghai, and two southern provinces, Jiangxi and Hunan. For the two northern provinces, most of their indirect exports in 2003 were through FTCs in the northern coastal provinces. The opposite is true for the two southern provinces, suggesting that distance matters for domestic trade.

Analogously, we can define the exposure measure at province-industry (2-digit HS code) level:

$$\hat{\mathcal{E}}_{St}^i = \sum_{m \in [1, M]} \hat{\mathcal{B}}_t^{i_m} \hat{\omega}_{I,S}^{i_m}$$

where  $\hat{\omega}_{I,S}^{i_m} = \frac{\overline{R_{I,S}^{i_m}}}{\sum_n \overline{R_{I,S}^{i_n}}}$  is the average pre-reform share of indirect exports of industry  $S$  in province  $i$  that are through the intermediary sector of  $i_m$ . This allows us to exploit finer subnational variations for identification. We now turn to describe our empirical specifications in detail.

## 5.3 Empirical Specifications

### 5.3.1 Impact on Interprovincial Trade

Prediction 4 says that indirect export volume from province  $i$  would decrease more through provinces with larger rebate burden. To examine this, we look at interprovincial trade flows and exploit heterogeneity in the predicted rebate burden of the downstream province:

$$R_{It}^{ij} = \alpha + \beta \hat{\mathcal{B}}_t^j + \nu_{ij} + \lambda_t + \kappa_i \text{Year} + \kappa_j \text{Year} + \theta_1 \overline{\nu}_{it} + \theta_2 \overline{\nu}_{jt} + \epsilon_{ijt} \quad (3)$$

The dependent variable is the total amount of indirect exports that originated from province  $i$  and were exported through FTCs in province  $j$ . The key regressor is  $j$ 's predicted rebate burden in year  $t$ . Our baseline regression controls for province-pair FE  $\nu_{ij}$ , year FE  $\lambda_t$ , and province-specific linear time trends for both provinces. Standard errors are clustered at the province-pair level.

This corresponds to a difference-in-difference specification. The key assumption for identification is that without the reform, the average change in export volume would have been the same across each

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<sup>30</sup>The complete list of exposure measures in 2004 for each province can be found in Table B.2.

indirect exporting route. To examine this assumption, we check the correlations between the predicted rebate burden with a rich set of provincial pre-reform characteristics, both in terms of the baseline level and the growth rate.<sup>31</sup> The results, shown in Table B.3, are reassuring. Our main results in Section 6 are robust to controlling for these variables and their interactions with time (not shown).

One potential confounding factor is changing industrial rebate rates over time, which may be correlated with both the predicted rebate burden and the volume of indirect trade. To address this, we further control for the average rebate rates faced by provinces  $i$  and  $j$  given their baseline export mix, denoted as  $\overline{\iota_{it}}$  and  $\overline{\iota_{jt}}$  in Equation (3).<sup>32</sup>

### 5.3.2 Impact on the Sourcing Patterns of FTCs

A direct implication of Prediction 4 is that FTCs in provinces with a greater rebate burden would become more “inward-looking” in terms of their sourcing behavior. To examine this, we run the following difference-in-difference regression at the firm level:

$$Y_{ft} = \alpha + \beta \hat{B}_t^j + \nu_f + \lambda_t + \kappa_j \text{Year} + \theta \overline{\iota_{jt}} + \epsilon_{ft} \quad (4)$$

where the outcome variables include exports sourced from local and non-local manufacturers, as well as the share of exports sourced from local manufacturers by FTC  $f$  of province  $j$  at year  $t$ . The key regressor of interest is  $\hat{B}_t^j$ , the predicted rebate burden of province  $j$  in which  $f$  is located. We control for firm FE  $\nu_f$ , year FE  $\lambda_t$ , province-specific linear time trends, and the average rebate rate faced by  $m_f$ . Standard errors are clustered at the province level.<sup>33</sup>

<sup>31</sup>The variables we examine include the baseline levels and the growth rates of provincial government revenue, balance, tax revenue, value-added tax, GDP, population and the baseline levels of total provincial exports, direct exports, indirect exports, number of FTCs, and number of exporting firms.

<sup>32</sup>The average rebate rate faced by province  $i$  is constructed as the average rebate rates of industries weighted by their pre-reform value shares in the total exports the province manufactures:

$$\overline{\iota_{it}} = \sum_{s \in \mathbb{S}} \iota_{st} \times \frac{\overline{i\text{'s total exports of } s^{01-03}}}{\overline{i\text{'s total exports}^{01-03}}}.$$

The average rebate rate faced by province  $j$  is constructed as the average rebate rates of industries weighted by their pre-reform value shares in total indirect exports through  $j$ :

$$\overline{\iota_{jt}} = \sum_{s \in \mathbb{S}} \iota_{st} \times \frac{\sum_i \overline{r_s^{ij}}}{\sum_{v \in \mathbb{S}} \sum_i \overline{r_v^{ij}}}$$

<sup>33</sup>In total, there are 31 provinces. All the main results in Section 6 are robust to using bootstrapped standard errors.

### 5.3.3 Impact on Manufacturing Exports

To examine the impact of local protectionism on manufacturing exports, we test Prediction 5 by using the empirical exposure measure  $\hat{\mathcal{E}}_{St}^i$  described in Section 5.2:

$$Y_{St}^i = \alpha + \beta \hat{\mathcal{E}}_{St}^i + \nu_i + \mu_S + \lambda_t + \kappa_i \text{Year} + \theta \overline{\nu_{iSt}} + \epsilon_{iSt} \quad (5)$$

where the outcome variables include total exports and indirect exports originated from province-industry  $iS$  in year  $t$ . The regression controls for province FE, industry FE, year FE, and province-specific linear time trend. As discussed above, we further control for the time-varying average rebate rate at the province-industry level.<sup>34</sup> Standard errors are clustered at the province level.<sup>35</sup>

The identification assumption is that without the reform, the average change in export volume would have been the same across each province or province-industry. Table B.4 examines the correlations between the province-level exposure measure with a rich set of provincial pre-reform characteristics, both in terms of the baseline level and the growth rate. The main results in Section 6 are robust to controlling for these variables and their interactions with time (not shown).

### 5.3.4 Impact on Manufacturing Firms

Finally, we examine the impact on manufacturing firms in terms of their performance and exporting behavior using the firm-level annual NBS survey data. As discussed in Section 4.2, we can compute a firm's indirect exporting volume by comparing the export revenue reported in the NBS data and that registered in the Customs data. Using this information, we can measure a firm's baseline reliance on indirect exports, *IndirectDependence*, as the fraction of indirect exports over total exports in the pre-reform period. We focus on the sample of manufacturing firms with positive export volume at baseline (either direct or indirect). A simple difference-in-difference regression examines the differential impact of the reform on firms with varying degrees of baseline reliance on indirect exports:

$$Y_{\phi t} = \alpha + \beta \text{IndirectDependence}_{\phi} \times \text{Post}_t + \nu_{\phi} + \lambda_t + \kappa_i \text{Year} + \theta \overline{\nu_{it}} + \epsilon_{\phi t} \quad (6)$$

<sup>34</sup>The average rebate rate of industry  $S$  (2-digit HS) in province  $i$  at year  $t$  is constructed analogously to  $\overline{\nu_{it}}$  in Footnote 32 as the average rebate rates of exports weighted by the pre-reform value share in total exports of industry  $S$  in province  $i$ :

$$\overline{\nu_{iSt}} = \sum_{s \in S} \nu_{st} \times \frac{i\text{'s total exporexportst of } s^{01-03}}{i\text{'s total exports of } S^{01-03}}.$$

<sup>35</sup>When the dependent variable is total exports, we modify the empirical exposure measure to more closely capture the reform's potential effect on total exports. In particular, the weight in Equation (2) becomes the pre-reform value share of indirect exports over *total* exports.

where the outcome variables include direct and indirect export revenue, dummies for direct and indirect exporting, and total sales (including domestic sales) of firm  $\phi$  in province  $i$  at year  $t$ . The key regressor is the interaction between firm  $\phi$ 's baseline reliance on indirect exports and the post-reform dummy, which equals to 1 for  $t \geq 2004$ .  $\lambda_t$  and  $\nu_\phi$  are year and firm fixed effects. The regression further controls for the province-specific linear time trend and average rebate rate. Standard errors are clustered at the province level.

We could replace the post-reform dummy with the reform exposure measure:

$$Y_{\phi t} = \alpha + \beta_1 \text{IndirectDependence}_\phi \times \hat{\mathcal{E}}_{St}^i + \beta_2 \hat{\mathcal{E}}_{St}^i + \nu_\phi + \lambda_t + \kappa_i \text{Year} + \overline{\theta_{list}} + \epsilon_{\phi t} \quad (7)$$

The same framework also allows us to examine the heterogeneous impact across different types of firms. In light of a negative shock on the indirect exporting technology, firms that face greater challenges of switching to direct export would be more adversely affected. We examine the heterogeneity across firms in Section 6.4. Last but not least, as discussed in Section 4.2, one caveat of the *IndirectDependence* measure is that firms may not report all indirect exports in the NBS survey. In other words, some of the “non-exporters” in the NBS data could well export through FTCs. We return to this point in Section 6.4 after presenting the main results.

## 6 Results

### 6.1 Impact on Interprovincial Trade

We begin by examining the impact of increasing provincial rebate burden on interprovincial trade flows of indirect exports, following the empirical specification in Equation (3).

Results are shown in Table 3. Columns 1 and 2 show that increasing the predicted burden of a province reduces the amount of indirect exports from other provinces, consistent with Prediction 4. At the same time, the value share of indirect exports from other provinces via the local intermediary sector decreases, as shown in Columns 3 and 4, and so does the number of FTCs engaging in non-local sourcing, as shown in Columns 5 and 6. Based on the coefficient estimate in Column 2, we can compute the elasticity of interprovincial trade flows of indirect exports with respect to provincial rebate burden, which equals to 1.15.<sup>36</sup> This implies that an increase in a province's rebate share from

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<sup>36</sup>Given that the indirect exports dependent variable in Section 5.3.1 is under inverse hyperbolic sine transformation, the elasticity is calculated as  $\xi = \beta \times \mathcal{B}_t^i \times \frac{\sqrt{R_{It}^2+1}}{R_{It}} \approx \beta \mathcal{B}_t^i$ . We use the 2004 provincial average predicted burden as an empirical equivalent for  $\mathcal{B}_t^i$ .

25% to 30% would lead to a reduction of 23% of indirect exports from other provinces through the local intermediary sector.<sup>37</sup> The magnitude is around 30% of existing elasticity estimates in the trade literature with respect to physical transportation costs, suggesting that political barriers due to local protectionism can act as important frictions in domestic trade.<sup>38</sup>

Table B.5 shows the results using alternative measures of predicted burden. Table B.6 measures predicted rebate burden accounting for the revision of the sharing rule in 2005. The results are robust.

## 6.2 Impact on the Sourcing Patterns of FTCs

Next, we examine how increasing provincial rebate burden affects the sourcing patterns of the FTCs. Table 4 presents the results following the empirical specification in Equation (4). Consistent with the results at the interprovincial level, Columns 1 and 2 show that increasing rebate burden decreases the volume of indirect exports from non-local manufacturers. The magnitude of the estimated coefficient in Column 2 implies that increasing local rebate share from 25% to 30% would decrease a local FTC's non-local sourcing by 12%.<sup>39</sup> This captures the intensive-margin effect, i.e., conditioning on still engaging in non-local sourcing, comparing to the 23% reduction of total non-local indirect exports in Section 6.1, which captures both the intensive-margin and extensive-margin effects.

Columns 3 and 4 examine the impact on local goods. While negative, the impact is much less pronounced compared to non-local goods (Column 4 versus Column 2). Together, these results imply that the FTCs become more inward-looking after the reform: the share of local goods increases as firms shift their sourcing activities away from non-local manufacturers, as shown in Columns 5 and 6.

The results using different measures of the predicted rebate burden are presented in Table B.7 and Table B.8. The results are robust to the alternative definitions.

## 6.3 Impact on Manufacturing Exports

Given that exporting through non-local FTCs constitutes an important exporting channel for Chinese manufacturers (Figure 4), we next turn to examine the impact of increasing local trade barriers on manufacturing exports, exploiting variations in the exposure to the reform across provinces and industries.

Table 5 shows the regression results, following the specification in Equation (5). Columns 1 and 2 show that exports of a province-industry is negatively affected by its exposure to the reform. The

<sup>37</sup>Using the estimated elasticity, we can compute the effect as  $(\frac{0.3-0.25}{0.25} \times 100\%) \times \hat{\xi} = -23\%$ .

<sup>38</sup>Recent papers such as Bernard, Eaton, Jensen, and Kortum (2003) and Eaton, Kortum, and Kramarz (2011) use firm-level data and estimate trade elasticity in the range of 3.6 to 4.8.

<sup>39</sup>The calculation follows the same procedure explained in Footnote 36 and 37.



magnitude of the estimated coefficients implies that increasing the VAT rebate share from 25% to 30% would decrease total exports of a given province-industry by 4% and decrease indirect exports by 6%.<sup>40</sup>

Results using alternative exposure measures (based on different measures of predicted rebate burden) are presented in Table B.9 and Table B.10. Results are robust.

## 6.4 Impact on Manufacturing Firms

Finally, we delve into the level of individual manufacturers and examine how their production and exporting activities are affected by the reform based on their reliance on indirect exporting prior to the reform. We focus on the sample of exporting firms at baseline.<sup>41</sup> Columns 1 and 2 of Table 6 report the regression results of estimating Equations (6) and (7). The results indicate a substitution pattern from indirect export to direct export among Chinese manufacturers after the reform.<sup>42</sup> The coefficient estimates in Panel A imply that, with a median exposure in the year after the reform, a firm with a 10 percentage point higher baseline dependence on indirect exporting would experience a 20% greater reduction in indirect exports and a 9% increase in direct exports.<sup>43</sup> Alternatively, for a firm with a median baseline dependence on indirect exporting (among exporters), increasing the local government’s VAT rebate share from 25% to 30% would decrease indirect exports by 7% and increase direct exports by 4%.<sup>44</sup> Despite the substitution, Column 3 shows that firms with a greater baseline dependence on indirect exporting experience a greater reduction in total exports after the reform, especially if they are located in provinces with greater exposure to the reform. Columns 4 and 5 examine the extensive margin responses, and the results are consistent with the above. Results using alternative exposure measures (based on different measures of predicted rebate burden) are presented in Table B.11.

Next, we investigate the heterogeneous impact across firms. Given that firms may switch to direct exporting when indirect exporting becomes more expensive, those who can more easily switch would be less affected. Given the relatively high fixed costs of direct exporting, the switchers are more likely to

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<sup>40</sup>The calculation follows the same procedure explained in Footnote 36 and 37.

<sup>41</sup>Exporting firms are defined as firms with positive export value reported in the NBS survey between 2001 and 2003. Results on non-exporters are shown in Table B.12. We see that the impact of the reform mostly falls on the exporters. In principle, the non-exporters could be affected via local general equilibrium effects.

<sup>42</sup>Since more than 75% of existing exporters sell more than 97% of their exports indirectly prior to the reform as shown in Table 1, the majority of firms experienced a decrease in indirect exports and an increase in direct exports when we take into account the main effect of exposure and the interaction effect (Panel A of Table 6).

<sup>43</sup>Since direct and indirect exports are generally large in value, when taken inverse hyperbolic transformation, we have  $\ln(y + \sqrt{y^2 + 1}) \approx \ln(y) + \ln(2)$ . Therefore, the fraction change in  $y$  given a change in the dependence on indirect exporting can be calculated as  $\frac{y_1}{y_0} - 1 = e^{\beta_1 \times \hat{\mathcal{E}} \times \Delta \text{IndirectDependence}} - 1$ .

<sup>44</sup>Analogous to the previous footnote, the fraction change in  $y$  given a change in the exposure can be calculated as  $\frac{y_1}{y_0} - 1 = e^{\beta_1 \times \Delta \hat{\mathcal{E}} \times \text{IndirectDependence} + \beta_2 \times \Delta \hat{\mathcal{E}}} - 1$ .

be firms with good access to credit and/or sufficient working capital. We consider two proxies, namely ownership type and baseline size. It has been well documented that in the Chinese context, state owned enterprises (SOEs) enjoy easier access to bank credit than private firms (e.g; [Song, Storesletten, and Zilibotti \(2011\)](#)). To examine the heterogeneity, we add a triple interaction term to our main specifications in Equations (6) and (7):

$$Y_{\phi t} = \alpha + \beta_1 \text{IndirectDependence}_{\phi} \times \text{Post}_t + \beta_2 \text{IndirectDependence}_{\phi} \times \text{Post}_t \times z_{\phi} \quad (8)$$

$$+ \beta_3 \text{Post}_t \times z_{\phi} + \nu_{\phi} + \lambda_t + \kappa_i \text{Year} + \theta \overline{\nu_{it}} + \epsilon_{\phi t}$$

$$Y_{\phi t} = \alpha + \beta_1 \text{IndirectDependence}_{\phi} \times \hat{\mathcal{E}}_{St}^i + \beta_2 \text{IndirectDependence}_{\phi} \times \hat{\mathcal{E}}_{St}^i \times z_{\phi} \quad (9)$$

$$+ \beta_3 \hat{\mathcal{E}}_{St}^i \times z_{\phi} + \beta_4 \hat{\mathcal{E}}_{St}^i + \nu_{\phi} + \lambda_t + \kappa_i \text{Year} + \theta \overline{\nu_{it}} + \epsilon_{\phi t}$$

where  $z_{\phi}$  indicates: (1) a dummy of being a SOE, defined using a firm’s registered capital share, and (2) log baseline average annual output.

Table 7 reports the results using the exposure measure in Equation (9). The results of estimating Equation (8) are presented in Table B.13. Panel A shows that the adverse impact of the reform primarily falls on private firms with a greater baseline reliance on indirect exporting, whereas SOEs are much better shielded in terms of the reductions in indirect exports and appear to be able to better switch to direct exporting (however, the estimates are noisy in Column 2). On the other hand, we do not see much heterogeneity in terms of baseline firm size (Panel B).

So far, the analysis builds on the assumption that we can infer a firm’s indirect exports by comparing the reported total export revenue in the NBS survey data and the direct exports captured in the Customs data. However, to the extent that firms may not consider all of their indirect exports as “exports”, some of the “non-exporters” in the NBS data could well be exporting through FTCs and thus would be exposed to the reform as well. To examine this possibility, we perform an alternative empirical analysis that explores heterogeneity across industries in terms of export intensity. We measure export intensity by the fraction of directly exporting firms in a given 2-digit HS industry (see Table 1 Panel C). The idea is that if a firm is a “non-exporter” in one of the export-intensive industries (i.e., industries with high foreign demand for Chinese exports), then it is more likely to have been exporting through FTCs, compared to a “non-exporter” in non export-intensive industries. As a result, the former group would be

more affected by the reform. Specifically, we can run the following difference-in-difference specification:

$$Y_{\phi t} = \alpha + \beta_1 \hat{\mathcal{E}}_{St}^i + \beta_2 \text{ExportIntensity}_S \times \hat{\mathcal{E}}_{St}^i + \nu_\phi + \lambda_t + \kappa_i \text{Year} + \kappa_S \text{Year} + \theta \overline{v_{iSt}} + \epsilon_{\phi t}. \quad (10)$$

where the sample consists of “non-exporters” in the NBS survey and the key regressor is the interaction between export intensity of firm  $\phi$ ’s industry and the reform exposure of  $\phi$ ’s province-industry  $iS$ . We control for province and industry linear time trends, and average rebate rate at province-industry level. Standard errors are clustered at the province level.

Results are shown in Table 8. We see that “non-exporters” in more export-intensive industries suffer greater reductions in total sales and output in light of greater exposure to the reform, consistent with the discussion above. Reassuringly, as a falsification test, there is no significant difference in performance among “non-exporters” in the least export-intensive industries across provinces with different exposure to the reform.

## 6.5 Discussion

The reduced results in this section lend empirical support to rising local protectionism after the reform. While systematic documentation of various protectionist practices does not exist, we try to shed some light on local government behavior by exploring additional firm-level variations we observe in the data. As discussed in Section 2.2, deliberate delays of VAT rebates are reported as a commonly used tool of discouraging non-local sourcing of the FTCs. The question is, how is it carried out? Specifically, do local tax officials target large FTCs, perhaps due to fixed costs of their intervention technologies or limited administrative capacity? Do they take advantage of other local information in the targeting, such as an FTC’s history of non-local purchase and the types of products an FTC handles?

To examine these possibilities, we extend the baseline FTC regression framework in Equation (4) and add two additional interaction terms:

$$Y_{ft} = \alpha + \beta_1 \hat{\mathcal{B}}_t^j + \beta_2 \hat{\mathcal{B}}_t^j \times \overline{R}_f + \beta_3 \hat{\mathcal{B}}_t^j \times \overline{S}_f + \nu_f + \lambda_t + \kappa_j \text{Year} + \theta \overline{v_{jt}} + \epsilon_{ft} \quad (11)$$

where  $\overline{R}_f$  is the pre-reform average exports of FTC  $f$  and  $\overline{S}_f$  is the pre-reform average share of total rebates attributable to non-local goods.

The results are shown in Table 9. Columns 1 and 2 suggest that local governments may indeed target large firms, but not necessarily those with large baseline non-local rebate share (conditioning on size). We further investigate the possibility of industry-specific targeting. That is, do local governments

target industries with higher rebate rates? One observation is that FTCs, unlike manufacturing firms, typically source and export multiple product varieties: the average is 13 and the median is 7 at the 2-digit HS level. We consider every product line within a given FTC and run the following regression:

$$Y_{fst} = \alpha + \beta_1 \hat{\mathcal{B}}_t^j + \beta_2 \hat{\mathcal{B}}_t^j \times \bar{\nu}_S + \nu_{fs} + \lambda_t + \kappa_j \text{Year} + \theta_{jt} + \epsilon_{ft}$$

The key regressor is the interaction term between the predicted local rebate burden and the average industry rebate rate prior to the reform. Column 3 of Table 9 shows limited evidence of industry-specific targeting, which may not be surprising given the multi-product nature of the intermediary firms. Overall, the results suggest that most of the government intervention appears to take place at the firm level.

## 7 Conclusion

This study takes advantage of a nationwide VAT rebate policy reform in China in 2004 as a natural experiment to identify the existence of intranational trade barriers and to study the impacts on export activities and firm performance. As a result of the shifting tax rebate burden, the reform leads to a greater incentive of the provincial governments to block the domestic flow of non-local goods to local export intermediaries. We document reduced firm evidence consistent with rising local trade barriers as a result of the policy change, which leads to a reduction in interprovincial trade, more “inward-looking” sourcing behavior of the local intermediaries, and a reduction in manufacturing exports. Exploring micro firm-level data, we further show that the negative impact mainly falls on private companies with a greater baseline reliance on export intermediaries.

Intranational trade barriers can arise for many reasons. Our study shows that political barriers imposed by local governments can play an important role. These barriers act as wedges that could distort the flow of goods within the domestic economy and affect real economic activities. As highlighted in Melitz (2003), policies that hinder the reallocation process or otherwise interfere with the flexibility of the factors and goods markets may delay or even prevent a country from reaping the full benefits from trade. China and many other developing countries have experienced significant global integration over the past decades. However, the question is, to what extent have the domestic frictions undermined countries’ gains from global integration? Examining the interaction between intranational and international trade costs remains an important area for empirical research. We leave this for future exploration.

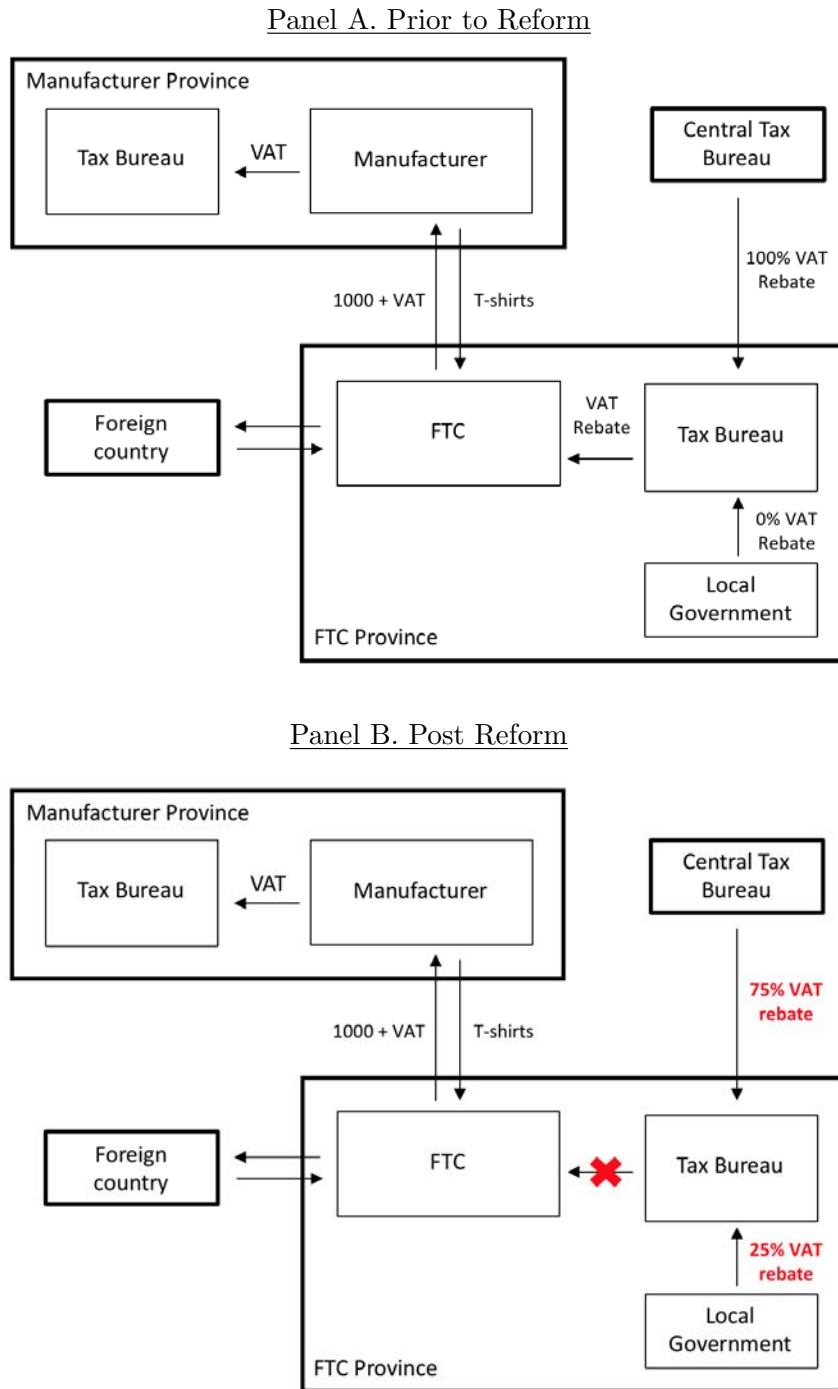
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Figure 1: Export VAT Rebate Obligations Before and After the 2004 Reform

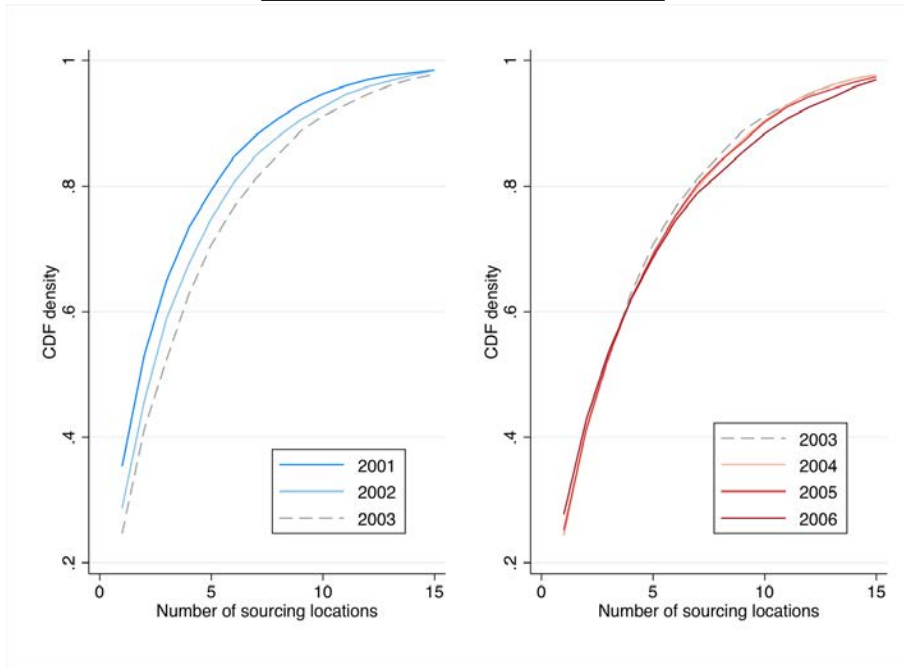


Note: This figure illustrates the export rebate obligations of the central and FTC governments before and after the 2004 policy reform, when a manufacturer indirectly exports T-shirts through an FTC. In this example, we assume complete rebate of VAT, i.e; rebate rate equals to VAT rate. Panel A illustrates the case prior to the reform and Panel B illustrates the case post reform.

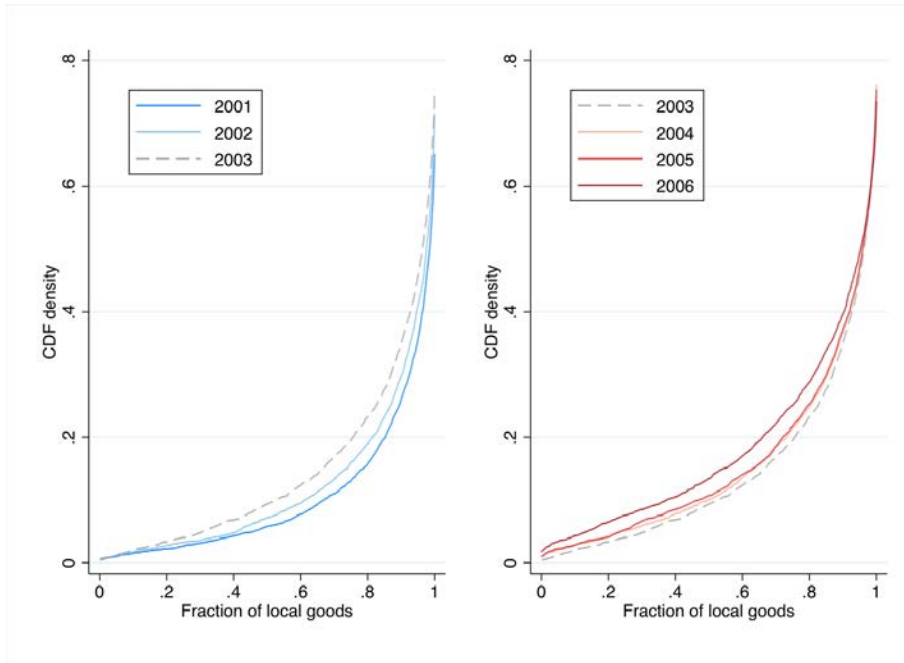


Figure 2: Changes in FTCs' Sourcing Pattern

Panel A. The Extensive Margin



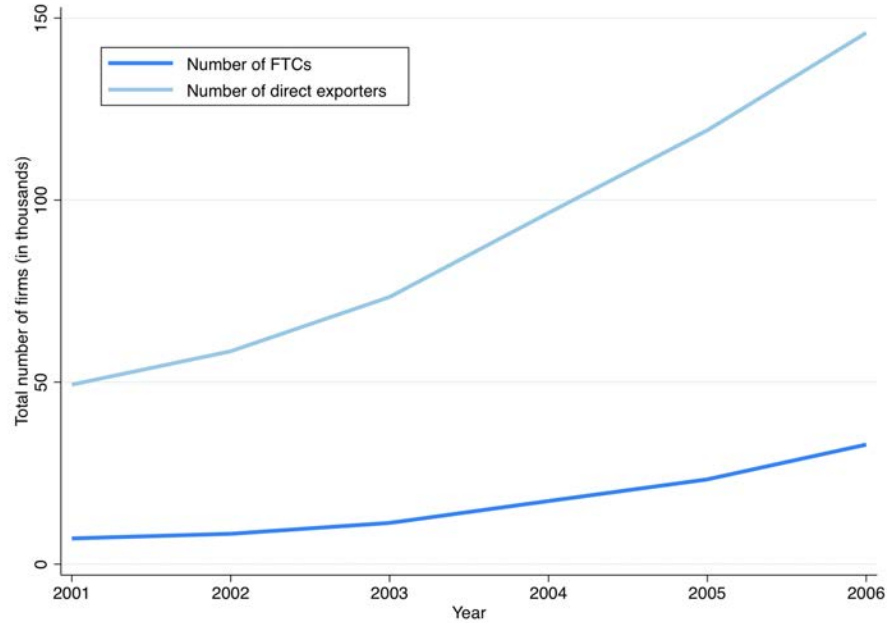
Panel B. The Intensive Margin



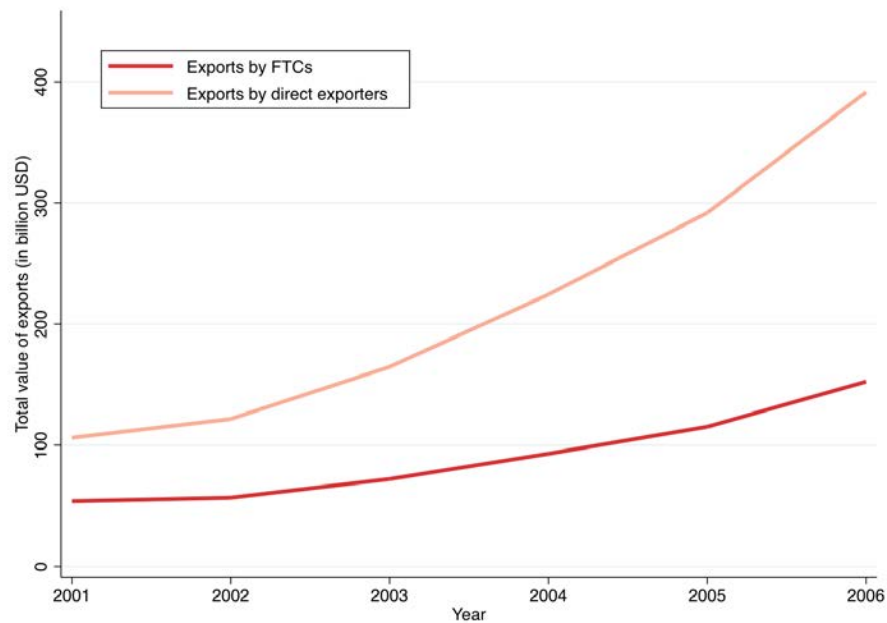
Note: This figure shows the changes in FTCs' sourcing patterns from 2001 to 2006. The sample consists of FTCs that had engaged in ordinary manufacturing export throughout 2001-06. Panel A is a CDF plot of the number of sourcing locations of an FTC for each of the six years, and Panel B is a CDF plot of the fraction of local goods exported by an FTC. In both panels, the left graphs exhibit the years prior to the reform (2001-03) and the right graphs show the post-reform years (2004-06) along with 2003 as a reference year. Panel A indicates the increase in the number of sourcing locations slowed down immediately after the reform in 2004 but started to bounce back after the reversion of the policy in 2005. Similarly, one can observe the decrease in the fraction of local exports temporarily stopped right after the reform in 2004 but resumed following the reversion of the policy in 2005.

Figure 3: The Role of FTCs in China's Manufacturing Exports

Panel A. Number of FTCs and Direct Exporters



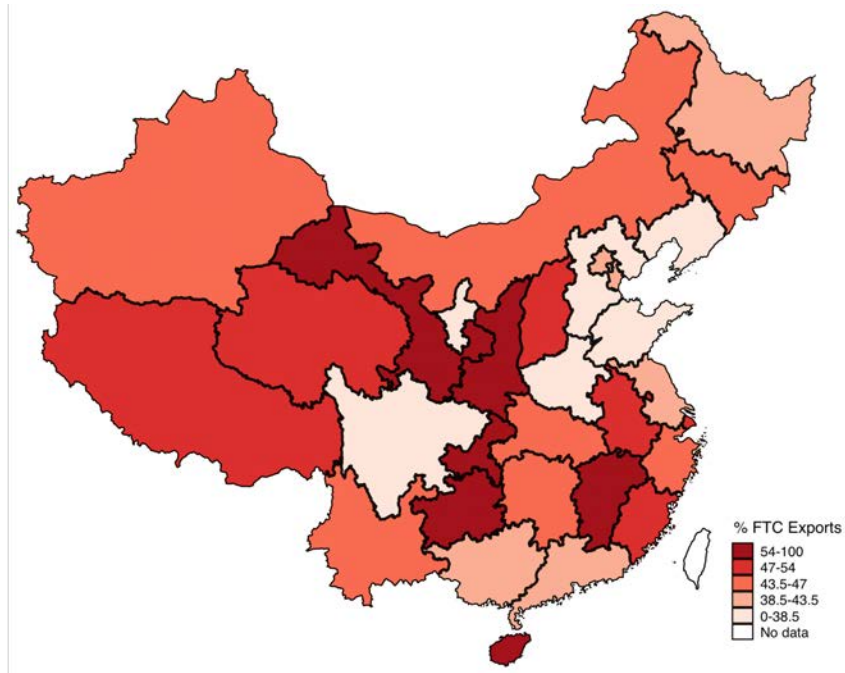
Panel B. Manufacturing Exports by FTCs and Direct Exporters



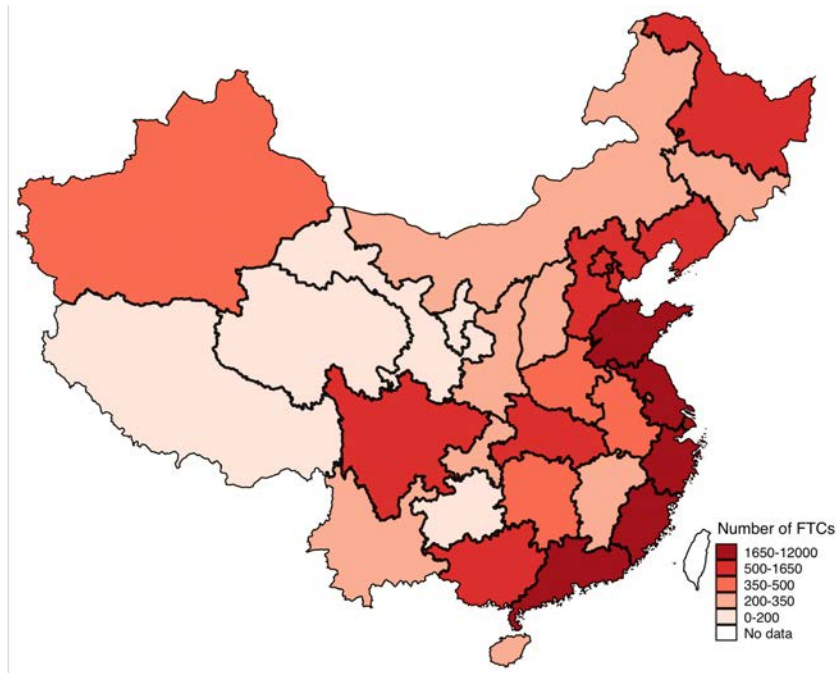
Note: This figure describes the role of FTCs in China's manufacturing exports between 2001 and 2006. Panel A plots the numbers of FTCs and direct exporters engaging in ordinary manufacturing export from 2001 to 2006. Panel B plots the total value of exports by FTCs and direct exporters from 2001 to 2006.

Figure 4: The Geography of FTCs and FTC Reliance

Panel A. Geographical Distribution of Reliance on FTCs



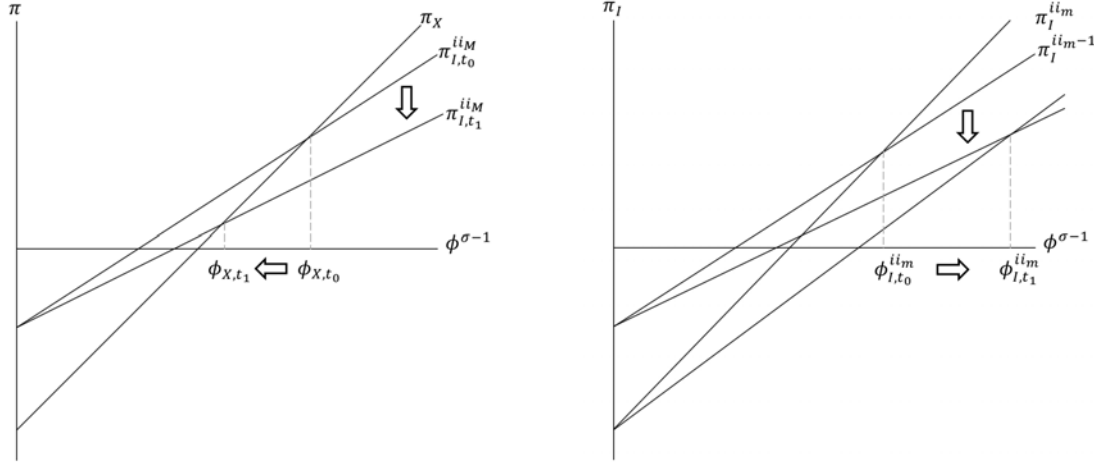
Panel B. Geographical Distribution of FTCs



Note: This figure describes the geography of FTCs and reliance on indirect exporting through FTCs. Panel A shows the 2003 share of indirect exports among total manufacturing exports by province. Panel B shows the geographical distribution of FTCs that engaged in ordinary manufacturing exports in 2003. Each color gradient consists 20% of the sample. The map is a map of land territory of China, which is based on the standard map GS(2016)2884 from the Standard Map Service of the National Administration of Surveying, Mapping, and Geoinformation of China.

Figure 5: Predicted Impacts of Increasing Local Rebate Burden

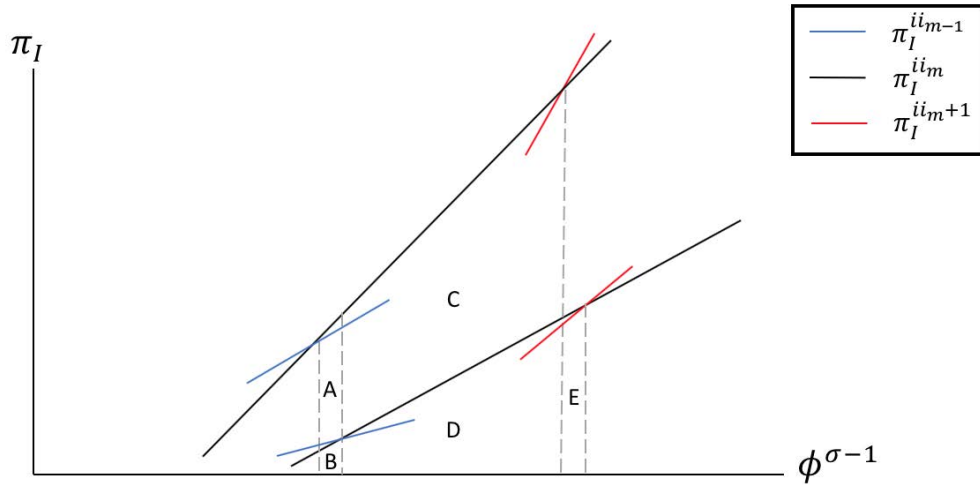
Panel A. Changes in Exporting Technologies



(a) Direct exporting

(b) Indirect exporting

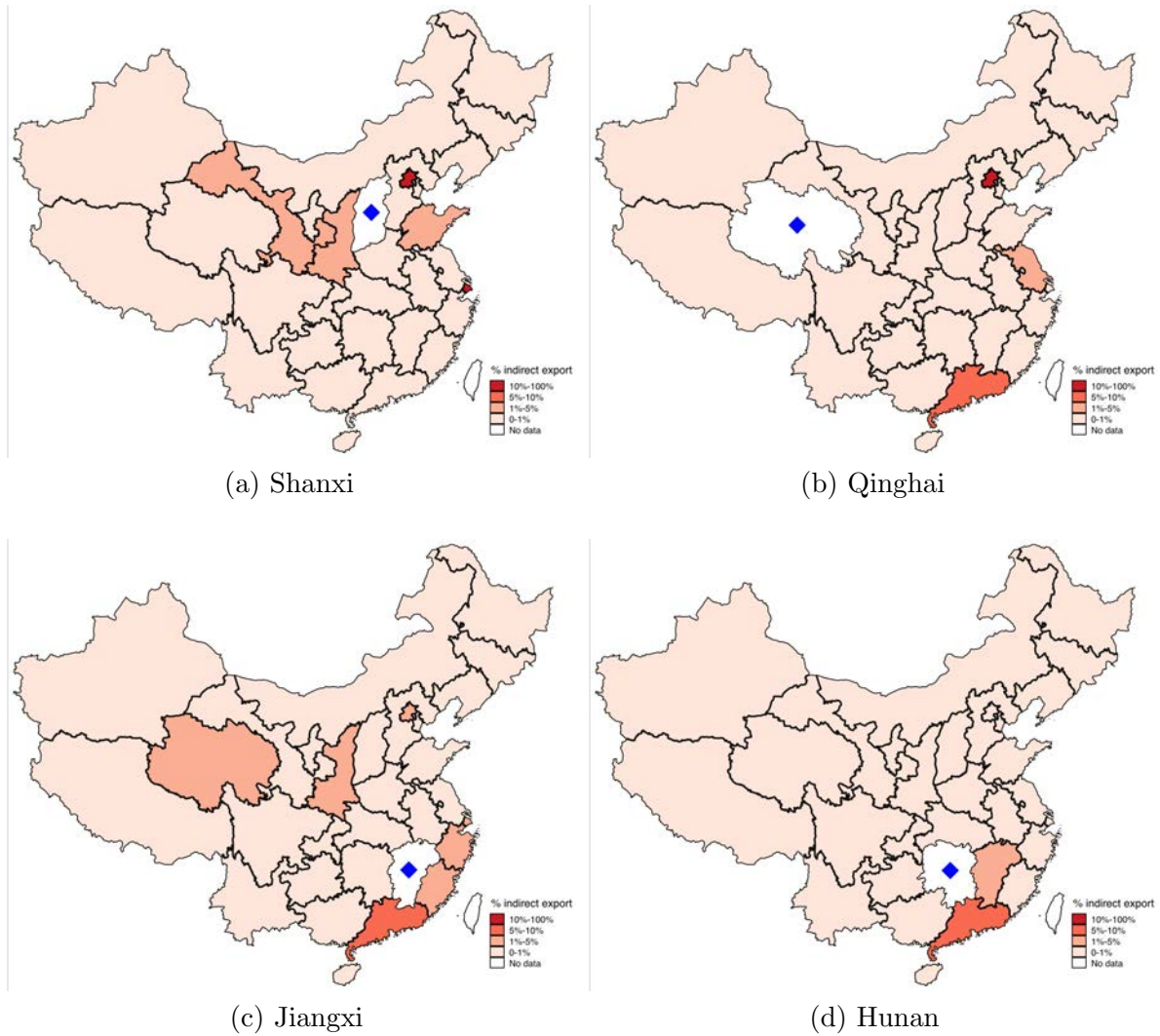
Panel B. Interprovincial Trade Flow of Indirect Exports



Note: Panel A illustrates how the productivity cutoffs of direct and indirect exporting change if the share of the VAT rebate burden to be paid by provincial governments increases.  $\pi_X(\phi)$  is the profits of direct exporting of firm  $\phi$  in province  $i$ , and  $\pi_I^{ii_m}(\phi)$  is the profits of indirect exporting through province  $i_m$ , the  $m$ th ranked province in province  $i$ 's indirect exporting productivity cutoff ladder (see Section 3.3 for detail).  $\phi_X$  is the productivity cutoff of direct exporting and  $\phi_I^{ii_m}$  is the productivity cutoff of indirect exporting from province  $i$  through  $i_m$ . In (a), the cutoff of direct exporting shifts to the left as firms around the old cutoff find it more profitable to switch to direct exporting. In (b), the cutoff of indirect exporting through province  $i_m$  shifts to the right as firms around the old cutoff find it more profitable to switch to indirect exporting through province  $i_{m-1}$ .

Panel B illustrates how the indirect export volume of province  $i$  through province  $i_m$  would change given an increase in  $c$ . The indirect export volume prior to the change is proportional to the sum of area A, B, C and D and the indirect export volume after the change is proportional to the sum of area D and E. The effect of the increase in  $c$  can be decomposed into two parts, the price effect which is proportional to area A and C and the network effect which is proportional to area A and B minus E. In the scenario shown in the figure, the overall effect of an increase in  $c$  can be roughly approximately by the price effect since the former outweighs the latter by a large margin.

Figure 6: Heterogeneity in Reliance on Non-local FTCs for Indirect Exporting



Note: This figure plots the baseline reliance on other provinces for indirect exporting in terms of the share of indirect exports for four provinces, namely Shanxi, Qinghai, Jiangxi and Hunan. In each subfigure, the province marked with a blue diamond is the manufacturing province that relies on other provinces for indirect exporting. The figure exhibits clear heterogeneity among manufacturing provinces in terms of the degree of reliance on each of other provinces for indirect exporting. The map is a map of land territory of China, which is based on the standard map GS(2016)2884 from the Standard Map Service of the National Administration of Surveying, Mapping, and Geoinformation of China.

Table 1: Summary Statistics of the Baseline Year

| Variable   | Obs   | Mean  | SD    | Min    | Q1    | Q2    | Q3    | Max    |
|--|-------|-------|-------|--------|-------|-------|-------|--------|
| Panel A: FTCs (Customs Database)                     |       |       |       |        |       |       |       |        |
| Non-locally sourced FTC exports                      | 11324 | .844  | 4.08  | 0      | 0     | .0109 | .289  | 175    |
| Locally sourced FTC exports                          | 11324 | 5.52  | 17.5  | 0      | .0968 | .678  | 3.45  | 543    |
| Share of locally sourced FTC exports                 | 11324 | .846  | .276  | 0      | .84   | .993  | 1     | 1      |
| Number of HS2 varieties                              | 11324 | 12.6  | 13.3  | 1      | 2     | 7     | 19    | 67     |
| Panel B: Manufacturing Firms (NBS Survey)            |       |       |       |        |       |       |       |        |
| Is exporter prior to reform                          | 57301 | .249  | .432  | 0      | 0     | 0     | 0     | 1      |
| Indirect exports                                     | 57301 | 1.17  | 9.92  | 0      | 0     | 0     | 0     | 670    |
| Direct exports                                       | 57301 | .111  | 1.29  | 0      | 0     | 0     | 0     | 173    |
| Total exports  | 57301 | 1.28  | 10.1  | 0      | 0     | 0     | 0     | 670    |
| Average share of indirect exports                    | 57301 | .225  | .405  | 0      | 0     | 0     | 0     | 1      |
| Average share of indirect exports among exporters    | 14254 | .903  | .216  | .00108 | .971  | 1     | 1     | 1      |
| Output   | 57301 | .0944 | .766  | 0      | .011  | .0225 | .0525 | 86     |
| Sales  | 57301 | .0927 | .759  | 0      | .0107 | .0219 | .0512 | 86     |
| Employment   | 57301 | 387   | 1852  | 0      | 76    | 150   | 312   | 126876 |
| Is SOE   | 57301 | .205  | .404  | 0      | 0     | 0     | 0     | 1      |
| Panel C: Industries (VAT Rebate Rate & NBS Survey)   |       |       |       |        |       |       |       |        |
| VAT rebate rate (HS6)                                | 5227  | .137  | .0373 | 0      | .13   | .15   | .17   | .17    |
| Export intensity (HS2)                               | 23    | .245  | .148  | .0587  | .122  | .228  | .288  | .589   |
| Panel D: Provinces (Provincial Statistical Yearbook) |       |       |       |        |       |       |       |        |
| GDP  | 31    | 45    | 37.4  | 1.85   | 23.9  | 28.6  | 60    | 158    |
| Population   | 31    | 41.4  | 26.9  | 2.72   | 19.3  | 38.2  | 61.6  | 96.7   |
| Fiscal revenue                                       | 31    | 3.83  | 3.55  | .0982  | 1.67  | 2.66  | 4.07  | 15.8   |
| Tax revenue  | 31    | 2.18  | 2.36  | .0683  | .847  | 1.27  | 2.12  | 9.87   |
| Fiscal balance                                       | 31    | .809  | .83   | -.0698 | .31   | .589  | .887  | 4.08   |
| VAT revenue  | 31    | .697  | .686  | .0113  | .278  | .471  | .734  | 2.82   |

Note: This table presents the summary statistics of the baseline year 2003 for the four main datasets we use in the analysis, namely the Chinese Customs Database, the NBS Survey of Manufacturing Firms, the Export VAT Rebate Rate Database, and the Provincial Statistical Yearbooks. We organize the statistics into four panels based on unit of observation: FTCs, manufacturing firms, industries, and provinces. In particular, Panel A is based on an unbalanced panel of FTCs whereas Panels B, C, and D are all based on balanced panels. All summary statistics are in the baseline year 2003 except for average share of indirect exports which is the 2001-2003 average and export intensity which is an industry's average percentage of firms engaging in exporting activity in the NBS survey between 2001 and 2003. The currency unit in Panel A and B is million USD and in Panel D is billion USD.

Table 2: Heterogeneity in Predicted Rebate Burden and Exposure Measure

| Variable   | Obs  | Mean   | SD     | Min     | Q1      | Q2     | Q3     | Max   |
|--|------|--------|--------|---------|---------|--------|--------|-------|
| Panel A: Provinces                               |      |        |        |         |         |        |        |       |
| Predicted rebate burden (amount) in 04           | 31   | .00662 | .00831 | .000123 | .00174  | .00437 | .00686 | .0316 |
| Predicted rebate burden (% fiscal revenue) in 04 | 31   | .196   | .163   | .0379   | .09     | .161   | .214   | .86   |
| Exposure measure in 04                           | 31   | .0187  | .0168  | .000565 | .00971  | .0134  | .0214  | .0744 |
| Average non-locally sourced FTC exports 01-03    | 31   | .212   | .266   | .00378  | .0587   | .14    | .219   | .99   |
| % of non-locally sourced FTC exports 01-03       | 31   | 18.4   | 10.8   | 2.73    | 10.2    | 16.8   | 24.9   | 48.8  |
| Average rebate rate of manufacturers in 04       | 31   | .122   | .00875 | .102    | .118    | .126   | .128   | .13   |
| Average rebate rate of FTCs in 04                | 31   | .124   | .0075  | .104    | .121    | .127   | .128   | .132  |
| Panel B: Province-industries                     |      |        |        |         |         |        |        |       |
| Exposure measure in 04                           | 1977 | .0237  | .0529  | 1.72e-7 | .00213  | .00778 | .0215  | .86   |
| Indirect exports in 03                           | 1977 | .0362  | .142   | 0       | .000345 | .0026  | .0168  | 2.01  |
| Total exports in 03                              | 1977 | .0829  | .298   | 0       | .00106  | .00779 | .0418  | 4.22  |
| Average rebate rate of manufacturers in 04       | 1977 | .123   | .0224  | 0       | .127    | .13    | .13    | .17   |

Note: This table presents the heterogeneity in 2004 predicted rebate burden and exposure measure and FTCs' pre-reform sourcing pattern. The currency unit is billion USD. In general, the 2004 predicted rebate amount is calculated as the pre-reform average of non-locally sourced FTC exports  $\times$  the 2004 rebate rate  $\times$  share of rebate burden on provincial government (see Section 5.1 for details on constructing predicted burdens). We then scale it based on provincial governments' fiscal capacity, namely the pre-reform average of fiscal revenue. The exposure measure of a province is calculated as a weighted average of intermediary provinces' predicted burden, weighted by the reliance on each intermediary province (see Section 5.2 for details on constructing the exposure measure at both province and province-industry levels).

Table 3: Impact on Interprovincial Trade of Indirect Exports

Sample: China Customs Data 2001-2006, Balanced Sample of Pairs of Manufacturing Province and Intermediary Province

|   | Indirect exports from<br>manufacturing province |                      | Share of Indirect exports<br>from manufacturing province |                         | Number of FTCs hired |                     |
|---|---|----------------------|--|-------------------------|----------------------|---------------------|
|   | (1)   | (2)                  | (3)  | (4)                     | (5)                  | (6)                 |
| Predicted burden                                  | -6.181***<br>(1.115)                            | -5.888***<br>(1.110) | -0.0118***<br>(0.00311)                                  | -0.0112***<br>(0.00308) | -11.35***<br>(2.738) | -6.856**<br>(3.109) |
| Observations                                      | 5580  | 5580                 | 5580   | 5580                    | 5580                 | 5580                |
| Pair FE   | Y   | Y                    | Y  | Y                       | Y                    | Y                   |
| Year FE   | Y   | Y                    | Y  | Y                       | Y                    | Y                   |
| Manufacturing province specific linear time trend | Y   | Y                    | Y  | Y                       | Y                    | Y                   |
| Intermediary province specific linear time trend  | Y   | Y                    | Y  | Y                       | Y                    | Y                   |
| Manufacturing province weighted rebate rate       |   | Y                    |  | Y                       |                      | Y                   |
| Intermediary province weighted rebate rate        |   | Y                    |  | Y                       |                      | Y                   |

Note: This table examines the changes in interprovincial trade of export goods by intermediary provinces' predicted rebate burden. Each observation is a pair of a manufacturing province and an intermediary province in a given year. The dependent variables are indirect exports from the manufacturing province through FTCs in the intermediary province (Columns 1 and 2), the value share of indirect exports through the intermediary province over all indirect exports from the manufacturing province (Columns 3 and 4), and the number of FTCs in the intermediary province hired by the manufacturing province (Columns 5 and 6). We apply inverse hyperbolic sine transformation on indirect exports to account for zero-valued observations. The key regressor of interests is the predicted rebate burden of the intermediary province (as % of provincial fiscal revenue; see Section 5.1 for details on constructing predicted burdens). All regressions control for pair fixed effect, year fixed effect, intermediary-province- and manufacturing-province-specific linear time trends. Even columns further control for the average rebate rate of the two provinces. Standard errors are clustered at the province-pair level. \*\*\* implies significance at 0.01 level, \*\* 0.5, \* 0.1.



Table 4: Impact on FTCs' Sourcing Activities

Sample: China Customs Data 2001-2006, Unbalanced Sample of FTC

|                                     | Non-locally sourced<br>FTC exports |                      | Locally sourced<br>FTC exports |                     | Share of non-locally<br>sourced FTC exports |                      |
|-------------------------------------|------------------------------------|----------------------|--------------------------------|---------------------|---|----------------------|
|                                     | (1)                                | (2)                  | (3)                            | (4)                 | (5)   | (6)                  |
| Predicted burden                    | -2.091***<br>(0.457)               | -3.155***<br>(1.103) | -0.205<br>(0.314)              | -1.282**<br>(0.568) | 0.0925***<br>(0.0161)                       | 0.105***<br>(0.0364) |
| Observations                        | 100189                             | 100189               | 100189                         | 100189              | 100189                                      | 100189               |
| Firm FE                             | Y                                  | Y                    | Y                              | Y                   | Y   | Y                    |
| Year FE                             | Y                                  | Y                    | Y                              | Y                   | Y   | Y                    |
| Province specific linear time trend | Y                                  | Y                    | Y                              | Y                   | Y   | Y                    |
| Province-level weighted rebate rate |                                    | Y                    |                                | Y                   |   | Y                    |

Note: This table examines the changes in FTCs' sourcing activities by local provinces' predicted rebate burden. The dependent variables are exports of an FTC bought from non-local manufacturers (Columns 1 and 2), exports of an FTC bought from local manufacturers (Columns 3 and 4), and value share of exports from local manufacturers (Columns 5 and 6). We apply inverse hyperbolic sine transformation on non-locally and locally sourced FTC exports to account for zero-valued observations. The regressor of interest is the predicted rebate burden (as % of provincial fiscal revenue; see Section 5.1 for details on constructing predicted burdens). All regressions control for firm fixed effect, year fixed effect, province-specific linear time trend. Standard errors are clustered at the province level. \*\*\* implies significance at 0.01 level, \*\* 0.5, \* 0.1.

Table 5: Impact on Manufacturing Exports

Sample: China Customs Data 2001-2006, Balanced Sample of Chinese Province-industries

|                                     | Indirect exports   |                    | Total exports      |                    |
|-------------------------------------|--------------------|--------------------|--------------------|--------------------|
|                                     | (1)                | (2)                | (3)                | (4)                |
| Exposure                            | -6.73***<br>(1.52) | -6.75***<br>(1.51) | -9.23***<br>(1.94) | -9.23***<br>(1.93) |
| Observations                        | 11862              | 11862              | 11862              | 11862              |
| Province FE                         | Y                  | Y                  | Y                  | Y                  |
| Industry FE                         | Y                  | Y                  | Y                  | Y                  |
| Year FE                             | Y                  | Y                  | Y                  | Y                  |
| Province specific linear time trend | Y                  | Y                  | Y                  | Y                  |
| Weighted rebate rate                |                    | Y                  |                    | Y                  |

Note: This table examines the changes in manufacturing provinces' exporting activities by exposure to reform. The dependent variables are total exports produced in a manufacturing province-industry (Columns 1 and 2) and indirect export produced in a province-industry (Columns 3 and 4). We apply inverse hyperbolic sine transformation on indirect exports and total exports to account for zero-valued observations. The regressor of interest is the exposure measure constructed using the predicted burdens (as % of provincial fiscal revenue; see Section 5.2 for details on constructing the exposure measures). The sample is a balanced panel of province-industries from 2001 to 2006. All regressions control for province fixed effects, industry fixed effects, year fixed effects, province-specific linear time trend, and weighted-rebate rate. Standard errors are clustered at the province level. \*\*\* implies significance at 0.01 level, \*\* 0.05, \* 0.1.

Table 6: Impact on Manufacturing Firms

Sample: China NBS Data 2001-2006, Balanced Sample of Baseline Exporters

|                                     | Indirect exports<br>(1) | Direct exports<br>(2) | Total exports<br>(3) | Is indirect exporter<br>(4) | Is direct exporter<br>(5) |
|-------------------------------------|-------------------------|-----------------------|----------------------|-----------------------------|---------------------------|
| Panel A: Using exposure measure     |                         |                       |                      |                             |                           |
| IndirectDependence X Exposure       | -46***<br>(10.8)        | 18.4*<br>(9.81)       | -46.2***<br>(11.6)   | -2.66***<br>(.742)          | 3.42***<br>(.435)         |
| Exposure                            | 39.9***<br>(9.89)       | -14.6<br>(9.24)       | 40.1***<br>(10.8)    | 2.3***<br>(.67)             | -2.95***<br>(.288)        |
| Observation                         | 61206                   | 61206                 | 61206                | 61206                       | 61206                     |
| Panel B: Using post-reform dummy    |                         |                       |                      |                             |                           |
| IndirectDependence X Post           | -2.6***<br>(.377)       | 1.25**<br>(.496)      | -2.59***<br>(.378)   | -.154***<br>(.0267)         | .191***<br>(.00976)       |
| Observation                         | 61272                   | 61272                 | 61272                | 61272                       | 61272                     |
| Firm FE                             | Y                       | Y                     | Y                    | Y                           | Y                         |
| Year FE                             | Y                       | Y                     | Y                    | Y                           | Y                         |
| Province specific linear time trend | Y                       | Y                     | Y                    | Y                           | Y                         |
| Weighted rebate rate                | Y                       | Y                     | Y                    | Y                           | Y                         |

Note: This table examines the changes in Chinese manufacturers' production and exporting activities by its exposure to reform and reliance on indirect export channel. The dependent variables are firms' indirect exports, direct exports, total exports, and whether firms are indirect exporters or direct exporters. The sample is a balanced panel of above-scale existing exporters prior to the reform. We apply inverse hyperbolic sine transformation on indirect exports, direct exports, and total exports to account for zero-valued observations. The regressor of interest is the interaction term between the pre-reform dependence on indirect exporting and either the exposure measure for Panel A (as % of provincial fiscal revenue; see Section 5.2 for details on constructing the exposure measures) or a post-reform dummy for Panel B. The pre-reform dependence on indirect exporting is defined as the pre-reform fraction of indirect exports over total exports. All regressions control for firm fixed effects, year fixed effects, and province-specific linear time trend, and weighted-rebate rate. Panel A in addition controls for exposure. Standard errors are clustered at the province level. \*\*\* implies significance at 0.01 level, \*\* 0.05, \* 0.1.

Table 7: Heterogeneous Impact on Manufacturing Firms by Ownership Type and Baseline Firm Size

Sample: China NBS Data 2001-2006, Balanced Sample of Baseline Exporters

|   | Indirect exports   | Direct exports    | Total exports      |
|---|--------------------|-------------------|--------------------|
|   | (1)                | (2)               | (3)                |
| Panel A: Heterogeneity on Firm Ownership          |                    |                   |                    |
| IndirectDependence X Exposure X SOE               | 59.6***<br>(14.4)  | 30.7<br>(19.2)    | 65.4***<br>(14.5)  |
| IndirectDependence X Exposure                     | -137***<br>(25.8)  | -15.2<br>(22.9)   | -146***<br>(27.2)  |
| Exposure X SOE                                    | -60.6***<br>(14)   | -38.3**<br>(18.3) | -66.1***<br>(14.3) |
| Exposure  | 133***<br>(24.7)   | 31.6<br>(21.1)    | 142***<br>(26.6)   |
| Observation                                       | 29976              | 29976             | 29976              |
| Panel B: Heterogeneity on Firm Size               |                    |                   |                    |
| IndirectDependence X Exposure X Pre-reform Output | 3.52<br>(2.14)     | .505<br>(3.75)    | 5.09**<br>(2.45)   |
| IndirectDependence X Exposure                     | -88.6***<br>(28.9) | 13.9<br>(38.9)    | -108***<br>(35.6)  |
| Exposure X Pre-reform Output                      | 3.52<br>(2.14)     | .505<br>(3.75)    | 5.09**<br>(2.45)   |
| Exposure  | 76.1**<br>(33.2)   | -27.4<br>(43.2)   | 92.7**<br>(42.7)   |
| Observation                                       | 61206              | 61206             | 61206              |
| Firm FE   | Y                  | Y                 | Y                  |
| Year FE   | Y                  | Y                 | Y                  |
| Province specific linear time trend               | Y                  | Y                 | Y                  |
| Weighted rebate rate                              | Y                  | Y                 | Y                  |

Note: This table examines the heterogeneous effect of the reform on Chinese manufacturers due to ownership types and baseline firm size. The dependent variables are firms' indirect exports, direct exports, and total exports. We apply inverse hyperbolic sine transformation on indirect exports, direct exports, and total exports to account for zero-valued observations. The regressor of interest is the triple interaction term between the pre-reform dependence on indirect exporting (defined as the pre-reform fraction of indirect exports over total exports), the exposure measure (as % of provincial fiscal revenue; see Section 5.2 for details on constructing the exposure measures), and either a dummy indicating whether a manufacturer is SOE in Panel A or the baseline average output in Panel B. All regressions control for firm fixed effects, year fixed effects, province-specific linear time trend, weighted-rebate rate, and other relevant interaction terms in Equation 9. The sample is a balanced panel of above-scale manufacturers from 2001 to 2006. We further restrict the sample in Panel A to either SOEs or private firms. SOE is defined as firms whose state capital constitutes more than 50% of the total capital. Standard errors are clustered at the province level. \*\*\* implies significance at 0.01 level, \*\* 0.5, \* 0.1.

Table 8: Robustness Check Using Non-Exporting Manufacturing Firms

Sample: China NBS Data 2001-2006; Balanced Sample of Baseline Non-Exporters

|  | Sales              | Output              |
|--|--------------------|---------------------|
|  | (1)                | (2)                 |
| Exposure X Export Intensity above 75th Percentile            | -1.758*<br>(0.893) | -2.052**<br>(0.979) |
| Exposure X Export Intensity between 50th and 75th Percentile | -0.035<br>(0.618)  | -0.141<br>(0.542)   |
| Exposure X Export Intensity between 25th and 50th Percentile | -0.218<br>(0.630)  | -0.295<br>(0.630)   |
| Exposure   | 0.518<br>(0.469)   | 0.472<br>(0.441)    |
| Observation  | 157411             | 157411              |
| Firm FE  | Y                  | Y                   |
| Year FE  | Y                  | Y                   |
| Province specific linear time trend                          | Y                  | Y                   |
| Weighted rebate rate   | Y                  | Y                   |

Note: This table examines the differential effect on manufacturers which do not have record of exporting in the NBS survey prior to the reform. The dependent variables are sales and employment. We apply inverse hyperbolic sine transformation on sales and output to account for zero-valued observations. The regressors of interest are a set of double interaction terms between exposure measure (as % of provincial fiscal revenue; see Section 5.2 for details on constructing the exposure measures) and dummies indicating whether the firm's industry is within a certain quarter of the distribution of export intensity. The sample is a balanced panel of above-scale manufacturers which do not have record of exporting in the NBS survey prior to the reform. All regressions control for firm fixed effects, year fixed effects, and province-specific linear time trend, and weighted-rebate rate. Standard errors are clustered at the province level. \*\*\* implies significance at 0.01 level, \*\* 0.05, \* 0.1.

Table 9: Heterogeneous Impact on FTCs by Baseline Sourcing Activities

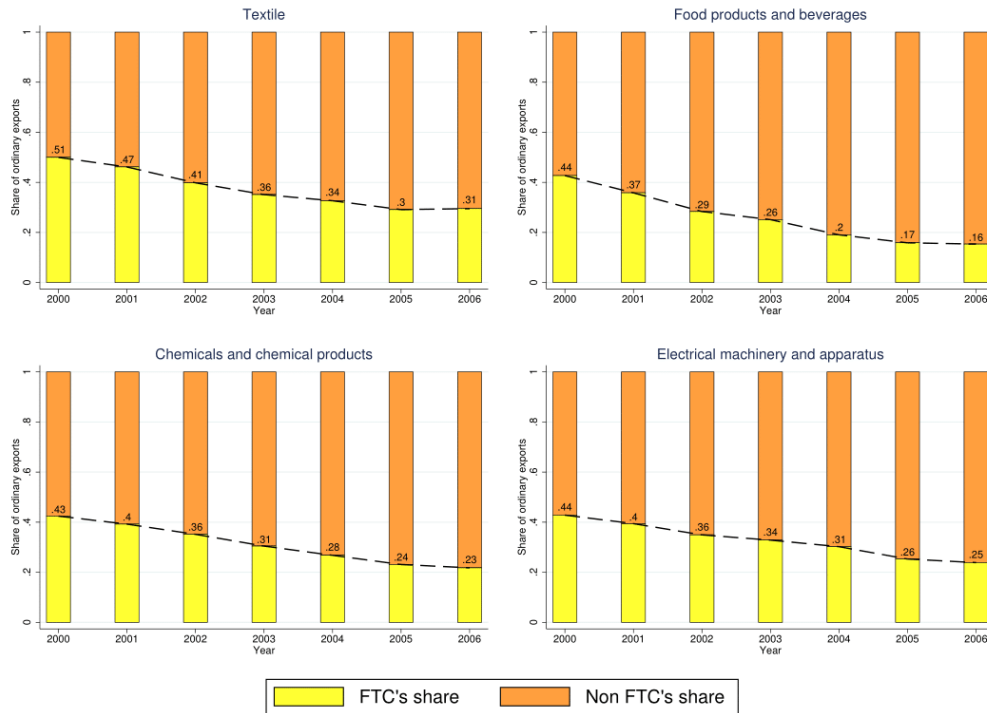
Sample: China Customs Data 2001-2006, Unbalanced Sample of FTC-Industries

|   | Dependent variable: FTC exports |                      |                |
|---|---------------------------------|----------------------|----------------|
|   | (1)                             | (2)                  | (3)            |
| Predicted burden X 01-03 exports  | -1.111***<br>(0.182)            | -1.112***<br>(0.179) |                |
| Predicted burden X 01-03 fraction<br>of rebate due to non-local exports |                                 | 0.195<br>(0.496)     |                |
| Predicted burden X 01-03 industrial<br>rebate rate                      |                                 |                      | -2.46<br>(2)   |
| Predicted burden  | 15.84***<br>(2.651)             | 15.79***<br>(2.719)  | .139<br>(.325) |
| Observations  | 53076                           | 53076                | 606061         |
| Firm FE   | Y                               | Y                    | Y              |
| Year FE   | Y                               | Y                    | Y              |
| Province specific linear time trend                                     | Y                               | Y                    | Y              |
| Province-level weighted rebate rate                                     | Y                               | Y                    | Y              |

Note: This table examines the heterogeneous effect of the reform on FTCs' exporting activities based on size and industry. The observation is FTCs in Columns 1 and 2 and FTC-industry sub-firms in Column 3. The dependent variables are exports through an FTC (-industry). We apply inverse hyperbolic sine transformation on FTC exports to account for zero-valued observations. The regressors of interest are the interaction terms between province-level predicted rebate burden (as % of provincial fiscal revenue; see Section 5.1 for details on constructing predicted burdens) and pre-reform export volume, average rebate rate of non-locally sourced exports, and industrial average rebate rate respectively. All regressions control for firm fixed effect, year fixed effect, province-specific linear time trend. Standard errors are clustered at the province level. \*\*\* implies significance at 0.01 level, \*\* 0.5, \* 0.1.

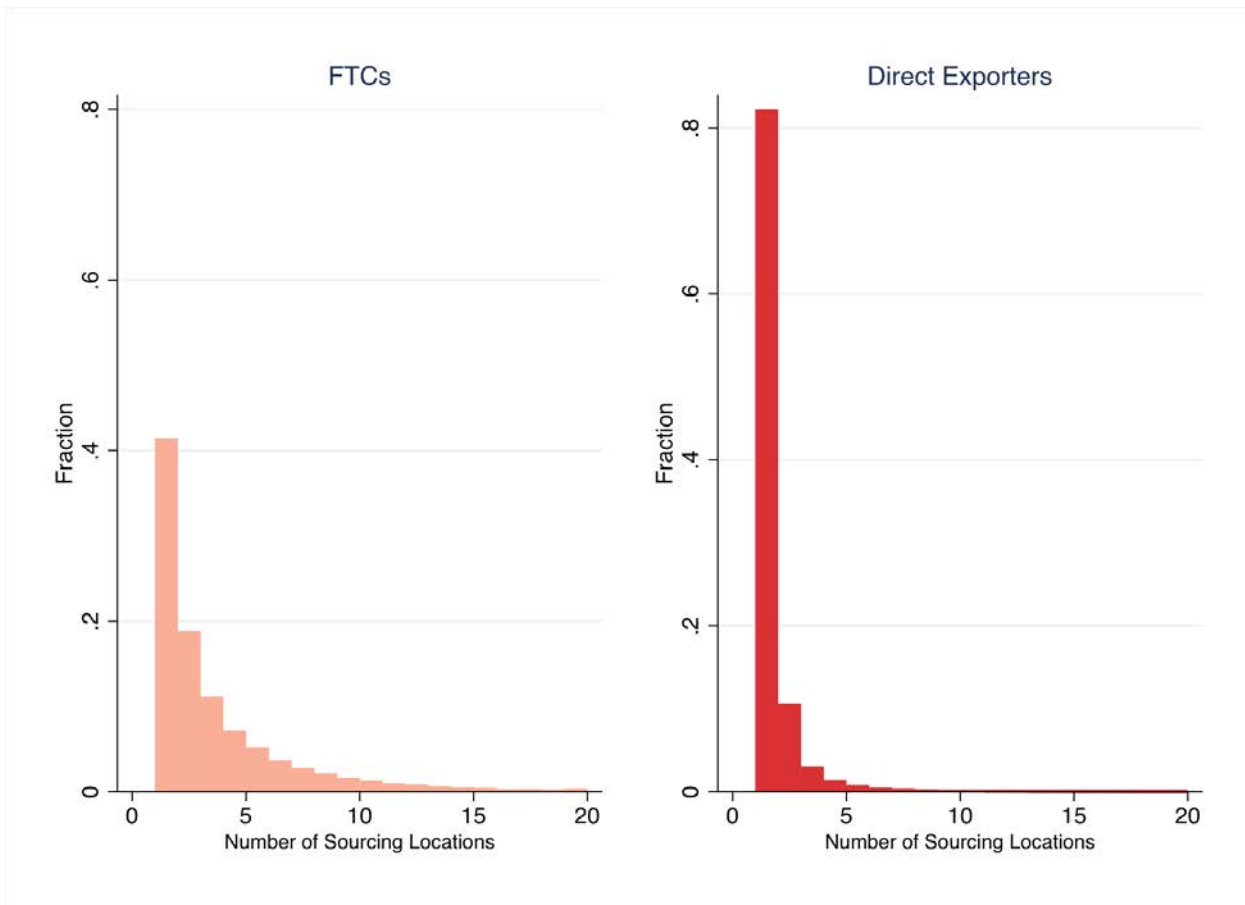
# A Appendix Figures

Figure A.1: The Role of FTCs in Ordinary Exports: Four Export-intensive Industries



Note: This figure plots the share of exports via FTCs for four export-intensive industries, namely textile, food products and beverages, chemicals and chemical products, and electrical machinery and apparatus.

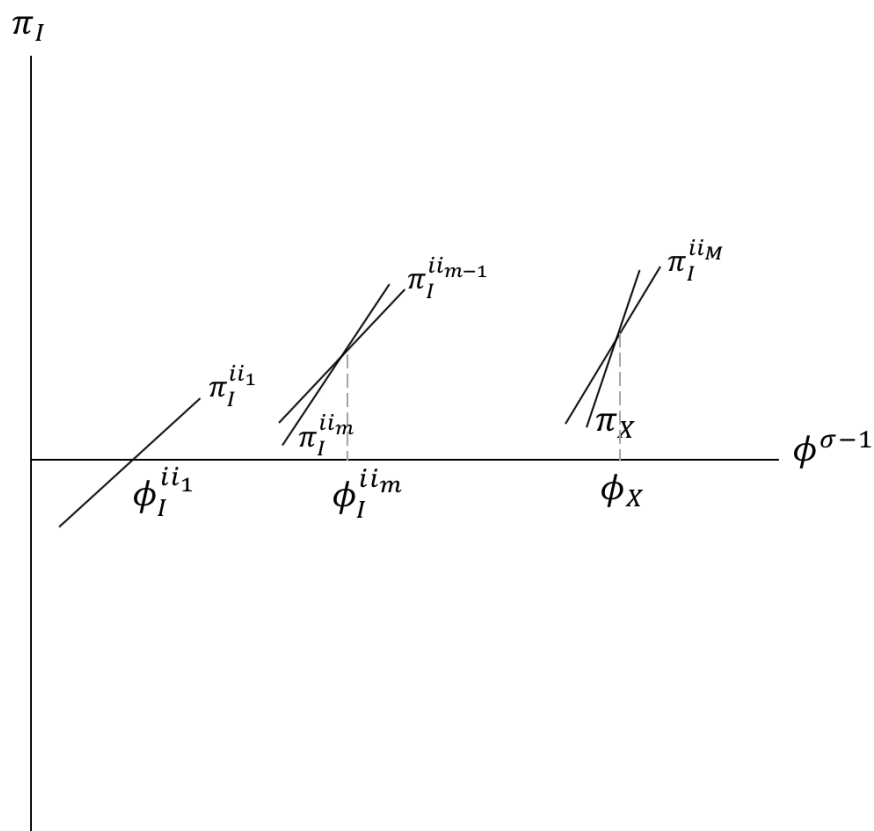
Figure A.2: Number of Sourcing Locations of FTCs and direct exporters



Note: This figure plots the distribution of the number of sourcing locations of FTCs and direct exporters. FTCs are classified using firm names following [Manova and Zhang \(2009\)](#)—see Section 4.2 for more detail.

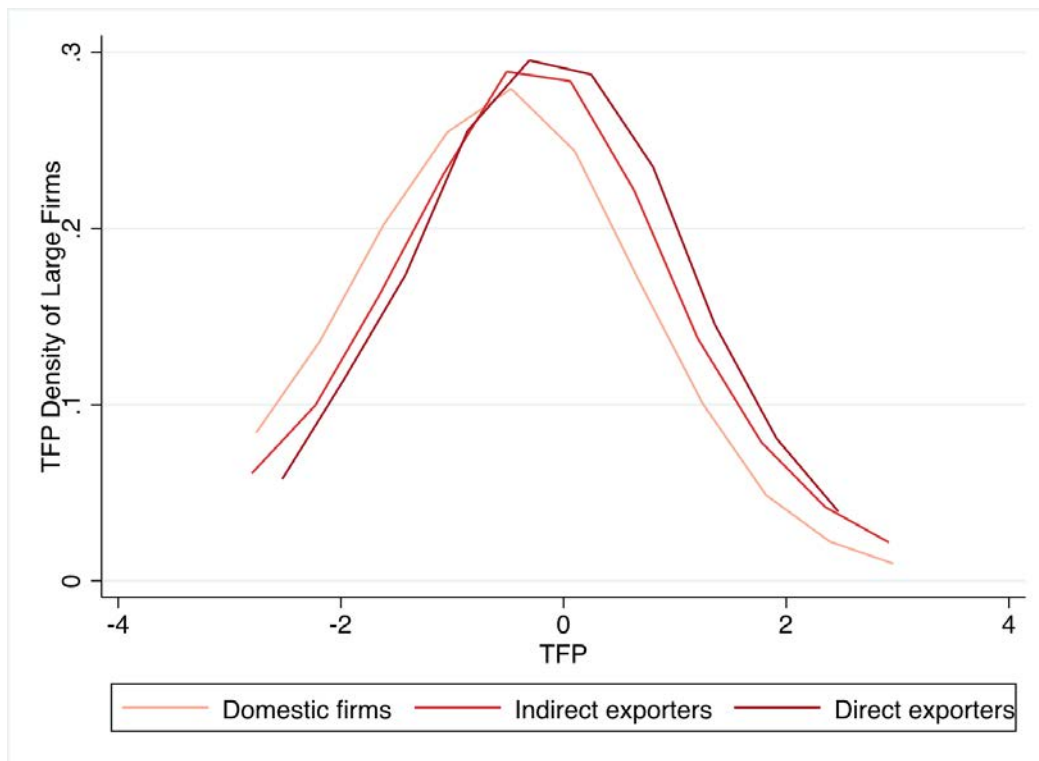


Figure A.3: The Productivity Cutoffs of Direct and Indirect Exporting Technologies



Note: This figure illustrates the productivity cutoffs of direct and indirect exporting technologies.  $\pi_I(\phi, j)$  is the profits of indirect exporting from province  $m_\phi$  through  $m_\phi(j)$ , the  $j$ th ranked province in province  $m_\phi$ 's indirect exporting productivity cutoff ladder (see Section 3.3 for detail).  $\phi_x$  is the productivity cutoff of direct exporting and  $\phi_j$  is the productivity cutoff of indirect exporting from province  $m_\phi$  through  $m_\phi(j)$ .

Figure A.4: The TFP Distribution of Different Exporting Technologies



Note: This figure exhibits the probability distributions of TFPs of domestic firms and firms using different exporting technologies. The figure suggests that direct exporters are more productive than indirect exporters, which are more productive than domestic firms.

## B Appendix Tables

Table B.1: Sample Description of the NBS Survey of Manufacturing Firms (2001-2006)

| Year  | Number of Firms | % of Private Domestic Firms | % of Exporting Firms |
|---|-----------------|-----------------------------|----------------------|
| Panel A. Sample: All Industrial Firms in the Manufacturing Sector |                 |                             |                      |
| 2001  | 154278          | 0.32                        | 0.26                 |
| 2002  | 165815          | 0.39                        | 0.27                 |
| 2003  | 181131          | 0.47                        | 0.28                 |
| 2004  | 259302          | 0.54                        | 0.3                  |
| 2005  | 251434          | 0.57                        | 0.3                  |
| 2006  | 279205          | 0.6                         | 0.28                 |
| Panel B. Sample: Balanced Panel from 2001-2006                    |                 |                             |                      |
| 2001  | 65453           | 0.34                        | 0.35                 |
| 2002  | 65453           | 0.37                        | 0.36                 |
| 2003  | 65453           | 0.39                        | 0.37                 |
| 2004  | 65453           | 0.41                        | 0.39                 |
| 2005  | 65453           | 0.42                        | 0.38                 |
| 2006  | 65453           | 0.43                        | 0.38                 |

Note: This table describes the sample of firms in the NBS Survey of Manufacturing Firms. Panel A describes the full sample. Panel B describes the balanced sample from 2001 to 2006.

Table B.2: Heterogeneity Across Provinces in Predicted Rebate Burden and Exposure to Reform

| Province     | 01-03 Avg FTC Export made by Non-local Manufacturers | Percentage of 01-03 Avg FTC Export made by Non-local Manufacturers | 2004 Predicted Rebate Amount | 2004 Rebate burden as % Revenue | 2004 Exposure Measure (Revenue-Based) |
|--------------|--|--|------------------------------|---------------------------------|---------------------------------------|
| Beijing      | 0.949  | 32.89  | 0.0286                       | 0.45                            | 0.0036                                |
| Tianjin      | 0.140  | 10.44  | 0.0044                       | 0.20                            | 0.0175                                |
| Hebei        | 0.099  | 8.19   | 0.0029                       | 0.08                            | 0.0201                                |
| Shanxi       | 0.060  | 10.20  | 0.0018                       | 0.10                            | 0.0629                                |
| Neimenggu    | 0.018  | 8.89   | 0.0005                       | 0.04                            | 0.0177                                |
| Liaoning     | 0.197  | 13.26  | 0.0059                       | 0.12                            | 0.0159                                |
| Jilin        | 0.035  | 15.26  | 0.0011                       | 0.07                            | 0.0214                                |
| Heilongjiang | 0.088  | 28.79  | 0.0026                       | 0.09                            | 0.0220                                |
| Shanghai     | 0.919  | 11.64  | 0.0289                       | 0.33                            | 0.0006                                |
| Jiangsu      | 0.434  | 5.84   | 0.0136                       | 0.17                            | 0.0065                                |
| Zhejiang     | 0.333  | 2.73   | 0.0107                       | 0.15                            | 0.0134                                |
| Anhui        | 0.274  | 21.50  | 0.0088                       | 0.36                            | 0.0088                                |
| Fujian       | 0.175  | 4.53   | 0.0055                       | 0.16                            | 0.0322                                |
| Jiangxi      | 0.231  | 31.27  | 0.0073                       | 0.41                            | 0.0242                                |
| Shandong     | 0.219  | 6.31   | 0.0069                       | 0.09                            | 0.0125                                |
| Henan        | 0.101  | 19.70  | 0.0031                       | 0.09                            | 0.0162                                |
| Hubei        | 0.154  | 21.15  | 0.0050                       | 0.17                            | 0.0210                                |
| Hunan        | 0.186  | 20.77  | 0.0059                       | 0.21                            | 0.0167                                |
| Guangdong    | 0.990  | 10.37  | 0.0316                       | 0.21                            | 0.0125                                |
| Guangxi      | 0.116  | 23.35  | 0.0037                       | 0.16                            | 0.0275                                |
| Hainan       | 0.156  | 48.81  | 0.0049                       | 0.86                            | 0.0053                                |
| Chongqing    | 0.075  | 12.76  | 0.0024                       | 0.15                            | 0.0098                                |
| Sichuan      | 0.199  | 27.97  | 0.0063                       | 0.18                            | 0.0097                                |
| Guizhou      | 0.035  | 18.95  | 0.0010                       | 0.08                            | 0.0527                                |
| Yunnan       | 0.073  | 16.80  | 0.0023                       | 0.09                            | 0.0117                                |
| Xizang       | 0.004  | 34.20  | 0.0001                       | 0.14                            | 0.0021                                |
| Shan3xi      | 0.185  | 24.86  | 0.0058                       | 0.31                            | 0.0111                                |
| Gansu        | 0.059  | 20.74  | 0.0017                       | 0.18                            | 0.0057                                |
| Qinghai      | 0.023  | 35.69  | 0.0007                       | 0.29                            | 0.0744                                |
| Ningxia      | 0.007  | 7.38   | 0.0002                       | 0.07                            | 0.0117                                |
| Xinjiang     | 0.029  | 16.23  | 0.0009                       | 0.07                            | 0.0118                                |

This table shows the heterogeneity across provinces in FTCs' pre-reform inward-lookingness and the 2004 predicted rebate burden and exposure measure. The 2001-03 average FTC export made by non-local manufacturers and the 2004 predicted rebate amount are denoted in billion USD. The 2004 predicted rebate amount is calculated as the pre-reform average of the value of non-local exports of an industry  $\times$  the 2004 rebate rate of the industry  $\times$  25%, which is then summing over all industries, where 25% is the share of VAT rebate financed by provincial governments. Finally, to calculate the rebate burden as % of the average pre-reform government revenue, we use information from the 2001-03 Provincial Statistical Yearbook, where these values are reported in RMB and are converted to dollars using the exchange rate during 2001-03 (8.3 RMB  $\approx$  1 USD).

Table B.3: Correlation between Predicted Rebate Burden and Baseline Provincial Characteristics

|   | Dependent variable: 2004 predicted burden |              |                  |                 |                 |               |                 |               |                    |               |                       |              |                       |                       |                       |                      |      |                       |                       |
|---|---|--------------|------------------|-----------------|-----------------|---------------|-----------------|---------------|--------------------|---------------|-----------------------|--------------|-----------------------|-----------------------|-----------------------|----------------------|------|-----------------------|-----------------------|
|   | (1)                                       | (2)          | (3)              | (4)             | (5)             | (6)           | (7)             | (8)           | (9)                | (10)          | (11)                  | (12)         | (13)                  | (14)                  | (15)                  | (16)                 | (17) | (18)                  |                       |
| 2003 provincial revenue                 | .000026<br>(.0085)                        |              |                  |                 |                 |               |                 |               |                    |               |                       |              |                       |                       |                       |                      |      |                       | -.28<br>(.3)          |
| 2003-04 growth in provincial revenue    |   | -.41<br>(.4) |                  |                 |                 |               |                 |               |                    |               |                       |              |                       |                       |                       |                      |      |                       | -1.3<br>(.99)         |
| 2003 province balance                   |   |              | -.0097<br>(.036) |                 |                 |               |                 |               |                    |               |                       |              |                       |                       |                       |                      |      |                       | .057<br>(.11)         |
| 2003-04 growth in provincial balance    |   |              |                  | .0095<br>(.011) |                 |               |                 |               |                    |               |                       |              |                       |                       |                       |                      |      |                       | .0072<br>(.026)       |
| 2003 provincial tax revenue             |   |              |                  |                 | .0043<br>(.013) |               |                 |               |                    |               |                       |              |                       |                       |                       |                      |      |                       | .41<br>(.37)          |
| 2003-04 growth in provincial tax        |   |              |                  |                 |                 | -.18<br>(.28) |                 |               |                    |               |                       |              |                       |                       |                       |                      |      |                       | 1.2<br>(.92)          |
| 2003 value-added tax                    |   |              |                  |                 |                 |               | -.012<br>(.044) |               |                    |               |                       |              |                       |                       |                       |                      |      |                       | -.34<br>(.49)         |
| 2003-04 growth in value-added tax       |   |              |                  |                 |                 |               |                 | -.12<br>(.12) |                    |               |                       |              |                       |                       |                       |                      |      |                       | -.32<br>(.59)         |
| 2003 provincial GDP                     |   |              |                  |                 |                 |               |                 |               | -.00055<br>(.0008) |               |                       |              |                       |                       |                       |                      |      |                       | .0031<br>(.0088)      |
| 2003-04 growth in provincial GDP        |   |              |                  |                 |                 |               |                 |               |                    | -.95<br>(.92) |                       |              |                       |                       |                       |                      |      |                       | -.64<br>(1.9)         |
| 2003 provincial population              |   |              |                  |                 |                 |               |                 |               |                    |               | -.000015<br>(.000011) |              |                       |                       |                       |                      |      |                       | .000027<br>(.000057)  |
| 2003-04 growth in provincial population |   |              |                  |                 |                 |               |                 |               |                    |               |                       | 4.8<br>(3.3) |                       |                       |                       |                      |      |                       | 4.3<br>(8.3)          |
| 2003 total export                       |   |              |                  |                 |                 |               |                 |               |                    |               |                       |              | -4.9e-13<br>(3.5e-12) |                       |                       |                      |      |                       | -5.4e-11<br>(1.4e-10) |
| 2003 direct export                      |   |              |                  |                 |                 |               |                 |               |                    |               |                       |              |                       | -1.3e-12<br>(6.2e-12) |                       |                      |      |                       | 5.0e-11<br>(3.2e-10)  |
| 2003 indirect export                    |   |              |                  |                 |                 |               |                 |               |                    |               |                       |              |                       |                       | -1.3e-12<br>(6.2e-12) |                      |      |                       | 0<br>(.)              |
| Number of FTCs                          |   |              |                  |                 |                 |               |                 |               |                    |               |                       |              |                       |                       |                       | .000015<br>(.000055) |      |                       | -.000061<br>(.00045)  |
| Number of exporters                     |   |              |                  |                 |                 |               |                 |               |                    |               |                       |              |                       |                       |                       |                      |      | -1.5e-06<br>(8.5e-06) | .000082<br>(.0002)    |
| Observation                             | 31  | 31           | 31               | 31              | 31              | 31            | 31              | 31            | 31                 | 31            | 31                    | 31           | 31                    | 31                    | 31                    | 31                   | 31   | 31                    | 31                    |

Note: This table presents the regression coefficients of 2004 predicted burden on the baseline provincial characteristics that may correlate with the outcome variables in Section 5.3.1 and 5.3.2. Columns 1 to 17 are regressions on each single provincial characteristics and Column 18 is the regression on all provincial characteristics. The results show that the 2004 predicted burden are uncorrelated with any baseline provincial characteristics.

Table B.4: Correlation between Exposure Measure and Baseline Provincial Characteristics

|   | Dependent variable: 2004 exposure measure |                 |                   |                    |                    |                |                   |               |                      |                |                       |               |                       |                       |                       |                       |                       |      |                       |
|---|---|-----------------|-------------------|--------------------|--------------------|----------------|-------------------|---------------|----------------------|----------------|-----------------------|---------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|------|-----------------------|
|   | (1)                                       | (2)             | (3)               | (4)                | (5)                | (6)            | (7)               | (8)           | (9)                  | (10)           | (11)                  | (12)          | (13)                  | (14)                  | (15)                  | (16)                  | (17)                  | (18) |                       |
| 2003 provincial revenue                 | -0.0014<br>(.00084)                       |                 |                   |                    |                    |                |                   |               |                      |                |                       |               |                       |                       |                       |                       |                       |      | -0.028<br>(.031)      |
| 2003-04 growth in provincial revenue    |   | .0046<br>(.042) |                   |                    |                    |                |                   |               |                      |                |                       |               |                       |                       |                       |                       |                       |      | -.14<br>(.1)          |
| 2003 province balance                   |   |                 | -.0024<br>(.0037) |                    |                    |                |                   |               |                      |                |                       |               |                       |                       |                       |                       |                       |      | .006<br>(.012)        |
| 2003-04 growth in provincial balance    |   |                 |                   | -.00095<br>(.0011) |                    |                |                   |               |                      |                |                       |               |                       |                       |                       |                       |                       |      | -.0022<br>(.0028)     |
| 2003 provincial tax revenue             |   |                 |                   |                    | -.0022*<br>(.0013) |                |                   |               |                      |                |                       |               |                       |                       |                       |                       |                       |      | .024<br>(.039)        |
| 2003-04 growth in provincial tax        |   |                 |                   |                    |                    | .041<br>(.028) |                   |               |                      |                |                       |               |                       |                       |                       |                       |                       |      | .13<br>(.097)         |
| 2003 value-added tax                    |   |                 |                   |                    |                    |                | -.0064<br>(.0044) |               |                      |                |                       |               |                       |                       |                       |                       |                       |      | .049<br>(.052)        |
| 2003-04 growth in value-added tax       |   |                 |                   |                    |                    |                |                   | .02<br>(.012) |                      |                |                       |               |                       |                       |                       |                       |                       |      | .0089<br>(.063)       |
| ∞ 2003 provincial GDP                   |   |                 |                   |                    |                    |                |                   |               | -.00011<br>(.000081) |                |                       |               |                       |                       |                       |                       |                       |      | -.0002<br>(.00093)    |
| 2003-04 growth in provincial GDP        |   |                 |                   |                    |                    |                |                   |               |                      | .031<br>(.097) |                       |               |                       |                       |                       |                       |                       |      | .05<br>(.2)           |
| 2003 provincial population              |   |                 |                   |                    |                    |                |                   |               |                      |                | -7.1e-07<br>(1.2e-06) |               |                       |                       |                       |                       |                       |      | 3.8e-06<br>(6.0e-06)  |
| 2003-04 growth in provincial population |   |                 |                   |                    |                    |                |                   |               |                      |                |                       | -.34<br>(.35) |                       |                       |                       |                       |                       |      | .33<br>(.87)          |
| 2003 total export                       |   |                 |                   |                    |                    |                |                   |               |                      |                |                       |               | -3.8e-13<br>(3.5e-13) |                       |                       |                       |                       |      | 8.5e-12<br>(1.4e-11)  |
| 2003 direct export                      |   |                 |                   |                    |                    |                |                   |               |                      |                |                       |               |                       | -7.2e-13<br>(6.2e-13) |                       |                       |                       |      | -2.6e-11<br>(3.3e-11) |
| 2003 indirect export                    |   |                 |                   |                    |                    |                |                   |               |                      |                |                       |               |                       |                       | -7.2e-13<br>(6.2e-13) |                       |                       |      | 0<br>(.)              |
| Number of FTCs                          |   |                 |                   |                    |                    |                |                   |               |                      |                |                       |               |                       |                       |                       | -6.5e-06<br>(5.6e-06) |                       |      | -.000011<br>(.000048) |
| Number of exporters                     |   |                 |                   |                    |                    |                |                   |               |                      |                |                       |               |                       |                       |                       |                       | -1.1e-06<br>(8.6e-07) |      | .000018<br>(.000021)  |
| Observation                             | 31  | 31              | 31                | 31                 | 31                 | 31             | 31                | 31            | 31                   | 31             | 31                    | 31            | 31                    | 31                    | 31                    | 31                    | 31                    | 31   | 31                    |

Note: This table presents the regression coefficients of 2004 exposure measure on the baseline provincial characteristics that may correlate with the outcome variables in Section 5.3.3 and 5.3.4. Columns 1 to 17 are regressions on each single provincial characteristics and Column 18 is the regression on all provincial characteristics. The results show that the 2004 predicted burden are uncorrelated with any baseline provincial characteristics.

Table B.5: Impact on Interprovincial Trade of Indirect Exports: Alternative Measures of Rebate Burden

Sample: China Customs Data 2001-2006, Balanced Sample of Pairs of Manufacturing Province and Intermediary Province

|  | Indirect exports from manufacturing province |                       | Share of Indirect exports from manufacturing province |                           | Number of FTCs hired |                      |
|--|--|-----------------------|---|---------------------------|----------------------|----------------------|
|  | (1)  | (2)                   | (3)   | (4)                       | (5)                  | (6)                  |
| Panel A: Province-pair level                         |  |                       |   |                           |                      |                      |
| Predicted burden (%tax)                              | -2.762***<br>(0.536)                         | -2.637***<br>(0.534)  | -0.00395***<br>(0.000958)                             | -0.00370***<br>(0.000942) | -3.670***<br>(1.215) | -1.795<br>(1.531)    |
| Predicted burden (%balance)                          | -0.394***<br>(0.0806)                        | -0.374***<br>(0.0786) | -0.000890**<br>(0.000449)                             | -0.000849*<br>(0.000448)  | -1.045**<br>(0.446)  | -0.749*<br>(0.451)   |
| Predicted burden (%VAT)                              | -0.644***<br>(0.104)                         | -0.613***<br>(0.104)  | -0.00110***<br>(0.000333)                             | -0.00104***<br>(0.000322) | -0.964***<br>(0.265) | -0.490<br>(0.323)    |
| Observations   | 5580   | 5580                  | 5580  | 5580                      | 5580                 | 5580                 |
| Pair FE  | Y  | Y                     | Y   | Y                         | Y                    | Y                    |
| Year FE  | Y  | Y                     | Y   | Y                         | Y                    | Y                    |
| Manufacturing province specific linear time trend    | Y  | Y                     | Y   | Y                         | Y                    | Y                    |
| Intermediary province specific linear time trend     | Y  | Y                     | Y   | Y                         | Y                    | Y                    |
| Manufacturing province weighted rebate rate          |  | Y                     |   | Y                         |                      | Y                    |
| Intermediary province weighted rebate rate           |  | Y                     |   | Y                         |                      | Y                    |
| Panel B: Province-pair-industry level                |  |                       |   |                           |                      |                      |
| Predicted burden (\%rev)                             | -2.049***<br>(0.282)                         | -2.054***<br>(0.282)  | -0.0212***<br>(0.00652)                               | -0.0212***<br>(0.00653)   | -0.193<br>(0.235)    | -0.199<br>(0.234)    |
| Predicted burden (\%tax)                             | -0.958***<br>(0.138)                         | -0.961***<br>(0.138)  | -0.00633**<br>(0.00314)                               | -0.00632**<br>(0.00314)   | 0.0413<br>(0.162)    | 0.0381<br>(0.161)    |
| Predicted burden (\%balance)                         | -0.154***<br>(0.0265)                        | -0.154***<br>(0.0265) | -0.00159**<br>(0.000713)                              | -0.00159**<br>(0.000713)  | -0.0240<br>(0.0255)  | -0.0241<br>(0.0255)  |
| Predicted burden (\%VAT)                             | -0.197***<br>(0.0303)                        | -0.198***<br>(0.0303) | -0.00170**<br>(0.000691)                              | -0.00170**<br>(0.000691)  | -0.00490<br>(0.0274) | -0.00548<br>(0.0273) |
| Observations   | 404052                                       | 404052                | 404052  | 404052                    | 404052               | 404052               |
| Pair FE  | Y  | Y                     | Y   | Y                         | Y                    | Y                    |
| Year FE  | Y  | Y                     | Y   | Y                         | Y                    | Y                    |
| Industry FE  | Y  | Y                     | Y   | Y                         | Y                    | Y                    |
| Manufacturing province specific linear time trend    | Y  | Y                     | Y   | Y                         | Y                    | Y                    |
| Intermediary province specific linear time trend     | Y  | Y                     | Y   | Y                         | Y                    | Y                    |
| Manufacturing province-industry weighted rebate rate |  | Y                     |   | Y                         |                      | Y                    |
| Intermediary province-industry weighted rebate rate  |  | Y                     |   | Y                         |                      | Y                    |

Note: This table examines the changes in interprovincial trade of export goods by intermediary provinces' predicted rebate burden. Each coefficient in the table represents a separate regression. Dependent variables are at province-pair-year level in Panel A and at province-pair-industry-year level in Panel B. The dependent variables are indirect exports from the manufacturing province (-industry) through FTCs in the intermediary province, the value share of indirect exports through the intermediary province over all indirect exports from the manufacturing province (-industry), and the number of FTCs in the intermediary province hired by the manufacturing province (-industry). We apply inverse hyperbolic sine transformation on indirect exports to account for zero-valued observations. The key regressors of interests are various measures of predicted rebate burden of the intermediary province. In separate regressions we use predicted burdens scaled by different measures of local governments' fiscal capacity (as % of tax revenue, VAT revenue, and rollover balance respectively; see Section 5.1 for details on constructing predicted burdens) to test the robustness of the main results. All regressions control for pair fixed effect, year fixed effect, intermediary-province- and manufacturing-province-specific linear time trends. Even columns further control for the average rebate rate of the two provinces. The regressions in Panel B additionally control for industry fixed effects. Standard errors are clustered at the province-pair level. \*\*\* implies significance at 0.01 level, \*\* 0.5, \* 0.1.

Table B.6: Impact on Interprovincial Trade of Indirect Exports: Two Consecutive Policy Reforms

Sample: China Customs Data 2001-2006, Balanced Sample of Pairs of Manufacturing Province and Intermediary Province

|   | Indirect exports from manufacturing province |                   | Share of Indirect exports from manufacturing province |                        | Number of FTCs hired |                  |
|---|--|-------------------|---|------------------------|----------------------|------------------|
|   | (1)  | (2)               | (3)   | (4)                    | (5)                  | (6)              |
| Predicted burden                                  | -1.264<br>(0.897)                            | -0.948<br>(0.889) | -0.00328**<br>(0.00150)                               | -0.00265*<br>(0.00150) | -3.105<br>(2.090)    | 1.408<br>(2.048) |
| Observations                                      | 5580   | 5580              | 5580  | 5580                   | 5580                 | 5580             |
| Pair FE   | Y  | Y                 | Y   | Y                      | Y                    | Y                |
| Year FE   | Y  | Y                 | Y   | Y                      | Y                    | Y                |
| Manufacturing province specific linear time trend | Y  | Y                 | Y   | Y                      | Y                    | Y                |
| Intermediary province specific linear time trend  | Y  | Y                 | Y   | Y                      | Y                    | Y                |
| Manufacturing province weighted rebate rate       |  | Y                 |   | Y                      |                      | Y                |
| Intermediary province weighted rebate rate        |  | Y                 |   | Y                      |                      | Y                |

Note: This table examines the changes in inter-provincial trade of export goods by the intermediary provinces' predicted rebate burdens. Each observations is a pair of a manufacturing province and an intermediary province in a certain year. The dependent variables are indirect exports from the manufacturing province through FTCs in the intermediary province (Columns 1 and 2), the value share of indirect exports through the intermediary province over all indirect exports from the manufacturing province (Columns 3 and 4), and the number of FTCs in the intermediary province hired by the manufacturing province (Columns 5 and 6). We apply inverse hyperbolic sine transformation on indirect exports to account for zero-valued observations. The regressor of interests is the predicted rebate burden of the intermediary province (as % of provincial fiscal revenue; see Section 5.1 for details on constructing predicted burdens). The predicted burden takes into account the adjustments of sharing rules in both 2004 and 2005 (see Section about the two consecutive adjustments). All regressions control for pair fixed effect, year fixed effect, intermediary-province- and manufacturing-province-specific linear time trends. Standard errors are clustered at the province-pair level. \*\*\* implies significance at 0.01 level, \*\* 0.5, \* 0.1.



Table B.7: Impact on FTCs' Sourcing Activities: Alternative Measures of Rebate Burden

Sample: China Customs Data 2001-2006, Unbalanced Sample of FTC

|                                     | Non-locally sourced<br>FTC exports |                        | Locally sourced<br>FTC exports |                     | Share of non-locally<br>sourced FTC exports |                          |
|-------------------------------------|------------------------------------|------------------------|--------------------------------|---------------------|---|--------------------------|
|                                     | (1)                                | (2)                    | (3)                            | (4)                 | (5)   | (6)                      |
| Predicted burden (%tax)             | -1.175***<br>(0.327)               | -1.459*<br>(0.776)     | -0.122<br>(0.158)              | -0.651*<br>(0.330)  | 0.0536***<br>(0.0120)                       | 0.0518**<br>(0.0216)     |
| Predicted burden (%balance)         | -0.0993***<br>(0.0242)             | -0.0760***<br>(0.0230) | 0.0126<br>(0.0129)             | 0.00850<br>(0.0149) | 0.00513***<br>(0.000530)                    | 0.00384***<br>(0.000479) |
| Predicted burden (%VAT)             | -0.267***<br>(0.0934)              | -0.251<br>(0.162)      | -0.0300<br>(0.0396)            | -0.117<br>(0.0715)  | 0.0125***<br>(0.00367)                      | 0.00961*<br>(0.00472)    |
| Observations                        | 100189                             | 100189                 | 100189                         | 100189              | 100189                                      | 100189                   |
| Firm FE                             | Y                                  | Y                      | Y                              | Y                   | Y   | Y                        |
| Year FE                             | Y                                  | Y                      | Y                              | Y                   | Y   | Y                        |
| Province specific linear time trend | Y                                  | Y                      | Y                              | Y                   | Y   | Y                        |
| Province-level weighted rebate rate |                                    | Y                      |                                | Y                   |   | Y                        |

Note: This table examines the changes in FTCs' export activities by local provinces' predicted rebate burden. Each coefficient in the table represents a separate regression. The dependent variables are exports of an FTC bought from non-local manufacturers (Columns 1 and 2), exports of an FTC bought from local manufacturers (Columns 3 and 4), and value share of exports from local manufacturers (Columns 5 and 6). We apply inverse hyperbolic sine transformation on non-locally and locally sourced FTC exports to account for zero-valued observations. The regressor of interests are various measures of predicted rebate burden. In separate regressions we use predicted burdens scaled by different measures of local governments' fiscal capacity (as % of tax revenue, VAT revenue, and rollover balance respectively; see Section 5.1 for details on constructing predicted burdens) to test the robustness of the main results. All regressions control for firm fixed effect, year fixed effect, province-specific linear time trend. Standard errors are clustered at the province level. \*\*\* implies significance at 0.01 level, \*\* 0.05, \* 0.1.

Table B.8: Impact on FTCs' Sourcing Activities: Two Consecutive Policy Reforms

Sample: China Customs Data 2001-2006, Unbalanced Sample of FTC

|                                     | Non-locally sourced<br>FTC exports |                      | Locally sourced<br>FTC exports |                      | Share of non-locally<br>sourced FTC exports |                     |
|-------------------------------------|------------------------------------|----------------------|--------------------------------|----------------------|---|---------------------|
|                                     | (1)                                | (2)                  | (3)                            | (4)                  | (5)   | (6)                 |
| Predicted burden                    | -1.833***<br>(0.289)               | -2.103***<br>(0.523) | -0.984***<br>(0.330)           | -1.986***<br>(0.465) | 0.0259*<br>(0.0135)                         | -0.0191<br>(0.0134) |
| Observations                        | 100189                             | 100189               | 100189                         | 100189               | 100189                                      | 100189              |
| Firm FE                             | Y                                  | Y                    | Y                              | Y                    | Y   | Y                   |
| Year FE                             | Y                                  | Y                    | Y                              | Y                    | Y   | Y                   |
| Province specific linear time trend | Y                                  | Y                    | Y                              | Y                    | Y   | Y                   |
| Province-level weighted rebate rate |                                    | Y                    |                                | Y                    |   | Y                   |

Note: This table examines the changes in FTCs' export activities by local provinces' predicted rebate burdens. The dependent variables are exports of an FTC bought from non-local manufacturers (Columns 1 and 2), exports of an FTC bought from local manufacturers (Columns 3 and 4), and value share of exports from local manufacturers (Columns 5 and 6). We apply inverse hyperbolic sine transformation on non-locally and locally sourced FTC exports to account for zero-valued observations. The regressor of interests is the predicted rebate burden of the intermediary province (as % of provincial fiscal revenue; see Section 5.1 for details on constructing predicted burdens). The predicted burden takes into account the adjustments of sharing rules in both 2004 and 2005 (see Section about the two consecutive adjustments). All regressions control for firm fixed effect, year fixed effect, province-specific linear time trend. Standard errors are clustered at the province level. \*\*\* implies significance at 0.01 level, \*\* 0.5, \* 0.1.

Table B.9: Impact on Manufacturing Exports: Alternative Measures of Exposure Measure

Sample: China Customs Data 2001-2006, Balanced Sample of Chinese Province-Industries

|                                     | Indirect exports   |                    | Total exports      |                    |
|-------------------------------------|--------------------|--------------------|--------------------|--------------------|
|                                     | (1)                | (2)                | (3)                | (4)                |
| Exposure (%tax)                     | -4.5***<br>(.992)  | -4.52***<br>(.986) | -6.1***<br>(1.35)  | -6.1***<br>(1.34)  |
| Exposure (%balance)                 | -.196*<br>(.1)     | -.199*<br>(.102)   | -.275*<br>(.15)    | -.275*<br>(.15)    |
| Exposure (%VAT)                     | -.739***<br>(.219) | -.741***<br>(.218) | -.966***<br>(.263) | -.966***<br>(.262) |
| Observations                        | 11862              | 11862              | 11862              | 11862              |
| Province FE                         | Y                  | Y                  | Y                  | Y                  |
| Industry FE                         | Y                  | Y                  | Y                  | Y                  |
| Year FE                             | Y                  | Y                  | Y                  | Y                  |
| Province specific linear time trend | Y                  | Y                  | Y                  | Y                  |
| Weighted rebate rate                |                    | Y                  |                    | Y                  |

Note: This table examines the changes in manufacturing provinces' exporting activities by exposure to reform. Each coefficient in the table represents a separate regression. The dependent variables are total exports produced in a manufacturing province-industry (Columns 1 and 2) and indirect exports produced in a province-industry (Columns 3 and 4). We apply inverse hyperbolic sine transformation on indirect exports and total exports to account for zero-valued observations. The regressors of interest are various exposure measures. In separate regressions we use exposure measures constructed using different predicted burdens (as % of tax revenue, VAT revenue, and rollover balance respectively; see Section 5.2 for details on constructing the exposure measures) to test the robustness of the main results. The sample is a balanced panels of province-industries from 2001 to 2006. All regressions control for province fixed effects, year fixed effects, industry fixed effects, province-specific linear time trend, and weighted-rebate rate. Standard errors are clustered at the province level. \*\*\* implies significance at 0.01 level, \*\* 0.5, \* 0.1.

Table B.10: Impact on Manufacturing Exports: Two Consecutive Policy Reforms  
Sample: China Customs Data 2001-2006, Balanced Sample of Manufacturing  
Province-Industries

|                                     | Indirect exports   |                    | Total exports      |                    |
|-------------------------------------|--------------------|--------------------|--------------------|--------------------|
|                                     | (1)                | (2)                | (3)                | (4)                |
| Exposure                            | -7.94***<br>(2.06) | -7.94***<br>(2.05) | -10.8***<br>(2.63) | -10.8***<br>(2.62) |
| Observations                        | 11862              | 11862              | 11862              | 11862              |
| Province FE                         | Y                  | Y                  | Y                  | Y                  |
| Industry FE                         | Y                  | Y                  | Y                  | Y                  |
| Year FE                             | Y                  | Y                  | Y                  | Y                  |
| Province specific linear time trend | Y                  | Y                  | Y                  | Y                  |
| Weighted rebate rate                |                    | Y                  |                    | Y                  |

Note: This table examines the heterogeneous effect of the reform on Chinese manufacturers due to ownership types and baseline firm size. Dependent variables are firms' indirect exports, direct exports, and total exports. We apply inverse hyperbolic sine transformation on indirect exports, direct exports, and total exports to account for zero-valued observations. The regressor of interest is the triple interaction term between the pre-reform dependence on indirect exporting (defined as the pre-reform fraction of indirect exports over total exports), a post-reform dummy, and either a dummy indicating whether a manufacturer is SOE in Panel A or the baseline average output in Panel B. All regressions control for firm fixed effects, year fixed effects, province-specific linear time trend, weighted-rebate rate, and other relevant interaction terms in Equation (9). The sample is a balanced panel of above-scale manufacturers from 2001 to 2006. We further restrict the sample in Panel A to either SOEs or private firms. SOE is defined as firms whose state capital constitutes more than 50% of the total capital. Standard errors are clustered at the province level. \*\*\* implies significance at 0.01 level, \*\* 0.05, \* 0.1.

Table B.11: Impact on Manufacturing Firms: Alternative Measures of Exposure Measure

Sample: China NBS Data 2001-2006, Balanced Sample of Baseline Exporters

|  | Indirect exports<br>(1) | Direct exports<br>(2) | Total exports<br>(3)  | Is indirect exporter<br>(4) | Is direct exporter<br>(5) |
|--|-------------------------|-----------------------|-----------------------|-----------------------------|---------------------------|
| IndirectDependence X Exposure (%tax)     | -28.483***<br>(6.527)   | 11.125*<br>(6.222)    | -28.563***<br>(7.045) | -1.642***<br>(0.455)        | 2.151***<br>(0.238)       |
| Exposure (%tax)                          | 24.921***<br>(5.979)    | -8.584<br>(5.942)     | 25.045***<br>(6.557)  | 1.436***<br>(0.410)         | -1.821***<br>(0.162)      |
| IndirectDependence X Exposure (%balance) | -4.958***<br>(0.969)    | 1.940**<br>(0.753)    | -5.048***<br>(1.041)  | -0.295***<br>(0.064)        | 0.329***<br>(0.055)       |
| Exposure (%balance)                      | 4.283***<br>(0.933)     | -1.649**<br>(0.657)   | 4.372***<br>(1.018)   | 0.250***<br>(0.060)         | -0.298***<br>(0.040)      |
| IndirectDependence X Exposure (%VAT)     | -6.290***<br>(1.602)    | 2.472<br>(1.506)      | -6.275***<br>(1.720)  | -0.358***<br>(0.111)        | 0.480***<br>(0.065)       |
| Exposure (%VAT)                          | 5.522***<br>(1.446)     | -2.014<br>(1.423)     | 5.506***<br>(1.572)   | 0.315***<br>(0.099)         | -0.413***<br>(0.049)      |
| Observation                              | 61206                   | 61206                 | 61206                 | 61206                       | 61206                     |
| Firm FE                                  | Y                       | Y                     | Y                     | Y                           | Y                         |
| Year FE                                  | Y                       | Y                     | Y                     | Y                           | Y                         |
| Province specific linear time trend      | Y                       | Y                     | Y                     | Y                           | Y                         |
| Weighted rebate rate                     | Y                       | Y                     | Y                     | Y                           | Y                         |

Note: This table examines the changes in Chinese manufacturers' production and exporting activities by its exposure to reform and reliance on indirect export channel. Each coefficient in the table represents a separate regression. The dependent variables are firms' indirect exports, direct exports, total exports, and whether firms are indirect exporters or direct exporters. We apply inverse hyperbolic sine transformation on indirect exports, direct exports, and total exports to account for zero-valued observations. The regressor of interest is the interaction term between the pre-reform level of dependence on indirect exporting and the exposure measure. In separate regressions we use exposure measures constructed using different predicted burdens (as % of tax revenue, VAT revenue, and rollover balance respectively; see Section 5.2 for details on constructing the exposure measures) to test the robustness of the main results. The pre-reform level of dependence on indirect exporting is defined as the pre-reform fraction of indirect exports over total exports. The sample is a balanced panel of above-scale existing exporters prior to the reform. All regressions control for firm fixed effects, year fixed effects, and province-specific linear time trend, weighted-rebate rate and exposure. Standard errors are clustered at the province level. \*\*\* implies significance at 0.01 level, \*\* 0.5, \* 0.1.

Table B.12: Impact on Non-Exporters

Sample: China NBS Data 2001-2006, Balanced Sample of Baseline Non-Exporters

|                                     | Indirect exports<br>(1) | Direct exports<br>(2) | Total exports<br>(3) | Is indirect exporter<br>(4) | Is direct exporter<br>(5) |
|-------------------------------------|-------------------------|-----------------------|----------------------|-----------------------------|---------------------------|
| Exposure                            | -0.127<br>(0.458)       | 0.013<br>(0.123)      | -0.137<br>(0.460)    | -0.023<br>(0.032)           | 0.002<br>(0.009)          |
| Observation                         | 157411                  | 157411                | 157411               | 157411                      | 157411                    |
| Firm FE                             | Y                       | Y                     | Y                    | Y                           | Y                         |
| Year FE                             | Y                       | Y                     | Y                    | Y                           | Y                         |
| Province specific linear time trend | Y                       | Y                     | Y                    | Y                           | Y                         |
| Weighted rebate rate                | Y                       | Y                     | Y                    | Y                           | Y                         |

Note: This table examines the changes in Chinese manufacturers' production and exporting activities by its exposure to reform and reliance on indirect export channel. The sample is a balanced panel of above-scale non-exporters prior to the reform. The dependent variables are firms' indirect exports, direct exports, total exports, and whether firms are indirect exporters or direct exporters. We apply inverse hyperbolic sine transformation on indirect exports, direct exports, and total exports to account for zero-valued observations. The regressor of interest is the exposure measure (as % of provincial fiscal revenue; see Section 5.2 for details on constructing the exposure measures). All regressions control for firm fixed effects, year fixed effects, and province-specific linear time trend, and weighted-rebate rate. Standard errors are clustered at the province level. \*\*\* implies significance at 0.01 level, \*\* 0.5, \* 0.1.

Table B.13: Heterogeneous Impact on Manufacturing Firms by Ownership Type and Baseline Firm Size  
Sample: China NBS Data 2001-2006, Balanced Sample of Baseline Exporters

|   | Indirect exports   | Direct exports    | Total exports      |
|---|--------------------|-------------------|--------------------|
|   | (1)                | (2)               | (3)                |
| Panel A: Heterogeneity on Firm Ownership      |                    |                   |                    |
| IndirectDependence X Post X SOE               | 1.87***<br>(.67)   | 2.65***<br>(.803) | 2.17***<br>(.67)   |
| IndirectDependence X Post                     | -3.27***<br>(.326) | 1***<br>(.22)     | -3.4***<br>(.32)   |
| Post X SOE                                    | -2.03***<br>(.662) | -3.1***<br>(.828) | -2.31***<br>(.649) |
| Observation                                   | 30036              | 30036             | 30036              |
| Panel B: Heterogeneity on Firm Size           |                    |                   |                    |
| IndirectDependence X Post X Pre-reform Output | .102<br>(.121)     | .342<br>(.275)    | .192**<br>(.0796)  |
| IndirectDependence X Post                     | -3.62**<br>(1.37)  | -2.63<br>(2.83)   | -4.66***<br>(.919) |
| Post X Pre-reform Output                      | .0546<br>(.0668)   | -.193<br>(.284)   | -.0171<br>(.0788)  |
| Observation                                   | 61272              | 61272             | 61272              |
| Firm FE                                       | Y                  | Y                 | Y                  |
| Year FE                                       | Y                  | Y                 | Y                  |
| Province specific linear time trend           | Y                  | Y                 | Y                  |
| Weighted rebate rate                          | Y                  | Y                 | Y                  |

Note: This table examines the heterogeneous effect of the reform on Chinese manufacturers due to ownership types and baseline firm size. Dependent variables are firms' indirect exports, direct exports, and total exports. We apply inverse hyperbolic sine transformation on indirect exports, direct exports, and total exports to account for zero-valued observations. The regressor of interest is the triple interaction term between the pre-reform dependence on indirect exporting (defined as the pre-reform fraction of indirect exports over total exports), a post-reform dummy, and either a dummy indicating whether a manufacturer is SOE in Panel A or the baseline average output in Panel B. All regressions control for firm fixed effects, year fixed effects, province-specific linear time trend, weighted-rebate rate, and other relevant interaction terms in Equation (9). The sample is a balanced panel of above-scale existing exporters prior to the reform. We further restrict the sample in Panel A to either SOEs or private firms. SOE is defined as firms whose state capital constitutes more than 50% of the total capital. Standard errors are clustered at the province level. \*\*\* implies significance at 0.01 level, \*\* 0.05, \* 0.1.

## C Mathematical Proofs

**Prediction 1.** For each province, the number and export volume of direct exporters weakly increases in  $c$ .

*Proof.* Suppose after the increase in  $c$  province  $i_M$  is still economically viable. Since  $f_I^{i_M} > f_I^{i_m} \quad \forall m < M$ , province  $i_M$  is still the highest in the indirect export productivity cutoff ranking of province  $i$ . Therefore, we have

$$\begin{aligned} \frac{\partial \phi_X}{\partial c} &= \underbrace{A}_{>0} \underbrace{\frac{1}{1-\sigma}}_{<0} \underbrace{\left( \frac{1 - (\gamma_I^{i_M})^{1-\sigma}}{f_X - f_I^{i_M}} \right)^{\frac{\sigma}{1-\sigma}}}_{>0} \times \\ &\quad \frac{\underbrace{(\sigma - 1)(\gamma_I^{i_M})^{-\sigma} \frac{d\gamma_I^{i_M}}{dc} (f_X - f_I^{i_M})}_{\geq 0} + \underbrace{(1 - (\gamma_I^{i_M})^{1-\sigma}) \frac{df_I^{i_M}}{dc}}_{=0}}{(f_X - f_I^{i_M})^2} \\ &\leq 0 \end{aligned}$$

Thus, as  $c$  increases the productivity cutoff of direct export shifts to the left, implying more manufacturers would export directly. On the other hand, if province  $i_M$  is no longer an economically viable option because of the increase in variable cost, then either a province down the productivity cutoff ranking or a previously economically unviable province would replace  $i_M$  as the highest in the ranking. It can be easily shown that the resulting productivity cutoff of direct export would be smaller than  $\phi_X$  even before the reform. As a result, the number of direct exporters increases in  $c$ . The exporting revenue of direct exporter  $\phi$  is  $r_X(\phi) = R \left( \frac{\tau}{\rho \phi P} \right)^{1-\sigma}$  which does not change with  $c$ , so province  $i$ 's total direct export volume

$$R_X = \int_{\phi_X}^{\infty} r_X(\phi) dG(\phi) \quad (12)$$

increases in  $c$  as the range of integration expands with  $c$ . ■

Here we relax the assumption that the local province of firm  $\phi$  is ranked the lowest in the indirect export productivity cutoff ladder, i.e.  $i = i_1$ , and prove a more general version of Prediction 2:

**Prediction 2'.** For each province, the number of its indirect exporters weakly decreases in  $c$ . Furthermore, the export volume of its indirect exporters also weakly decreases in  $c$  if  $\frac{d\gamma_I^{i_m}/dc}{d\gamma_I^{i_n}/dc} > \left( \frac{\gamma_I^{i_m}}{\gamma_I^{i_n}} \right)^\sigma \quad \forall m, n$  s.t.  $\gamma_I^{i_m} < \gamma_I^{i_n}$ .

*Proof.* Suppose after the increase in  $c$  province  $i_1$  is still economically viable and therefore the lowest



in the productivity cutoff ranking.

$$\begin{aligned}
\frac{\partial \phi_I^{ii_1}}{\partial c} &= \underbrace{A}_{>0} \underbrace{\frac{1}{1-\sigma}}_{<0} \underbrace{\left( \frac{(\gamma_I^{ii_1})^{1-\sigma}}{f_I^{ii_1}} \right)^{\frac{\sigma}{1-\sigma}}}_{>0} \times \\
&\quad \underbrace{\left( (1-\sigma)(\gamma_I^{ii_1})^{-\sigma} \frac{d\gamma_I^{ii_1}}{dc} f_I^{ii_1} - (\gamma_I^{ii_1})^{1-\sigma} \frac{df_I^{ii_1}}{dc} \right)}_{\leq 0} \underbrace{\frac{1}{(f_I^{ii_1})^2}}_{=0} \\
&\geq 0
\end{aligned} \tag{13}$$

Thus, the productivity cutoff of indirectly exporting from the most easily accessed FTC province weakly increases in  $c$ . On the other hand, if province  $i_1$  is no longer an economically viable option because of the increase in variable cost, then either a province up the productivity cutoff ranking or a previously economically unviable province would replace  $i_1$  as the lowest in the ranking. It can be easily shown that the resulting lowest productivity cutoff of indirect exporting would be larger than  $\phi_I^{ii_1}$  even before the reform, leading to the same result as above. Combining with the proof of Prediction 1 we can see that the range of productivity of indirect export  $[\phi_I^{ii_1}, \phi_I^{ii_M}]$  shrinks as  $c$  increases.

Now we show that, given  $\frac{d\gamma_I^{ii_m}/dc}{d\gamma_I^{ii_n}/dc} > \left(\frac{\gamma_I^{ii_m}}{\gamma_I^{ii_n}}\right)^\sigma \forall m, n$  s.t.  $\gamma_I^{ii_m} < \gamma_I^{ii_n}$ , the volume of indirect export from province  $i$  decreases as well. To do so, we demonstrate that the volume of indirect export from any existing indirect exporters of province  $i$  decreases in  $c$ . First, we show that, if the set of economically viable provinces (and therefore the productivity cutoff ranking) does not change, then all such provinces become less *accessible* after the reform, i.e.  $\frac{\partial \phi_I^{ii_m}}{\partial c} \geq 0 \forall m \in [1, M]$ . We have proven this for  $m = 1$ . For  $m \geq 2$ ,

$$\begin{aligned}
\frac{\partial \phi_I^{ii_m}}{\partial c} &= \underbrace{A}_{>0} \underbrace{\frac{1}{1-\sigma}}_{<0} \underbrace{\left( \frac{(\gamma_I^{ii_m})^{1-\sigma} - (\gamma_I^{ii_{j-1}})^{1-\sigma}}{f_I^{ii_m} - f_I^{ii_{m-1}}} \right)^{\frac{\sigma}{1-\sigma}}}_{>0} \times \\
&\quad \underbrace{\left( (1-\sigma) \left( (\gamma_I^{ii_m})^{-\sigma} \frac{d\gamma_I^{ii_m}}{dc} - (\gamma_I^{ii_{m-1}})^{-\sigma} \frac{d\gamma_I^{ii_{m-1}}}{dc} \right) (f_I^{ii_m} - f_I^{ii_{m-1}}) \right)}_{>0} \\
&\quad \underbrace{\frac{1}{(f_I^{ii_m} - f_I^{ii_{m-1}})^2}}_{=0} \\
&\quad \underbrace{\left( \frac{((\gamma_I^{ii_m})^{1-\sigma} - (\gamma_I^{ii_{m-1}})^{1-\sigma}) \left( \frac{df_I^{ii_m}}{dc} - \frac{df_I^{ii_{m-1}}}{dc} \right)}{(f_I^{ii_m} - f_I^{ii_{m-1}})^2} \right)}_{>0} \\
&> 0
\end{aligned} \tag{14}$$

which is a direct result from the inequality condition that implies  $\frac{\partial^2 \pi_I^{ii_m}(\phi)}{\partial \phi^{\sigma-1} \partial c} < \frac{\partial^2 \pi_I^{ii_n}(\phi)}{\partial \phi^{\sigma-1} \partial c} < 0$  if  $\gamma_I^{ii_m} < \gamma_I^{ii_n}$ .<sup>45</sup> This means that, after the reform, firms used to indirectly export through province  $i_{m-1}$  would find it even more challenging to move up to  $i_m$  which had a higher fixed cost but a lower variable

<sup>45</sup>Even though we prove that  $\frac{\partial \phi_I^{ii_m}}{\partial c} > 0$ , without further assumptions we do not know about the relative magnitudes of the derivatives for different  $m$ .

cost of indirect exporting, since marginal profit of exporting through province  $i_m$  would decrease more substantially. The increasing barrier to entry thus drives the productivity cutoff of province  $i_m$  to the right.

Given the results above, a firm which used to export indirectly through province  $i_m$  would find itself in either of the four following situations after the reform:

1. continue to export through  $i_m$ ;
2. export through some province lower than  $i_m$  in the pre-reform productivity cutoff ranking;
3. export through some province used to be economically unviable;
4. exit the foreign market.

In first three cases the firm would face a higher variable cost of indirect exporting unless it continues to export through its local province, and in the last case the firm would stop exporting all together. Therefore, a firm's indirect export will always weakly decrease in  $c$  regardless of its productivity. Since the number of indirect exporters of province  $i$  also decreases in  $c$ , its volume of indirect export decreases in  $c$ . ■

**Prediction 3.** Given an increase in  $c$ , for any province  $i$ :

1. the local exporters rely more on local intermediary after the reform, i.e. the number and export volume of  $i$ 's indirect exporters through local intermediary (which is  $i_1$ ) increase in  $c$ ;
2. the export volume of  $i$ 's indirect exporters through province  $i_m$ ,  $m \in [2, M - 1]$  decreases if the price effect outweighs the network effect;
3. the number and export volume of  $m$ 's indirect exporters through province  $i_M$  decreases.

*Proof.* Since own province has the lowest fixed cost, the own province is ranked at the last in the productivity cutoff ladder, i.e.,  $i_1 = i$ . By Assumption 1  $\frac{d\gamma_I^{i_1}}{dc} = 0$ . We can therefore observe from inequality (13) that  $\frac{\partial\phi_I^{i_1}}{\partial c} = 0$ . From inequality (14) we also know that  $\frac{\partial\phi_I^{i_2}}{\partial c} > 0$ . Therefore, as  $c$  increases the range of productivity that chooses to indirectly export from province  $i$  expands. As for the effect on  $R_I^{i_1}$ , by Assumption 1 the price effect is zero. Since  $\Theta(\phi)$  is an increasing function of  $\phi$ , the network effect is positive. Thus, the indirect export volume through province  $i$ 's own intermediary increases.

As for province  $i_m$ ,  $m \in [2, M - 1]$ , the price effect is strictly negative by Assumption 1. If in addition the price effect dominates the network effect, the overall effect of  $c$  on  $R_I^{i_m}$  follows the sign of the price effect. In this case, as  $c$  increases, province  $i$ 's indirect export volume through each of such provinces decreases.

For province  $M$ , the price effect is also strictly negative. Moreover, the network effect is also strictly negative, since we have proved by inequality (12) that  $\phi_X$  is a decreasing function of  $c$  and by inequality (14) that  $\phi_I^{i_M}$  is an increasing function of  $c$ . These together imply that the number and export volume of province  $i$ 's indirect exporters through  $i_M$  decrease as  $c$  increases. ■

**Prediction 4.** If the price effects are sufficiently larger than the network effects, given an increase in  $c$  a province will experience larger percentage decrease in indirect export through provinces from which higher cost shocks are generated.

*Proof.* We want to prove that if  $\frac{\partial \gamma_I^{i_m}/\partial c}{\gamma_I^{i_m}} > \frac{\partial \gamma_I^{i_n}/\partial c}{\gamma_I^{i_n}}$  then  $\frac{\partial R_I^{i_m}/\partial c}{R_I^{i_m}} < \frac{\partial R_I^{i_n}/\partial c}{R_I^{i_n}}$ . Suppose the price effects are sufficiently larger than the network effects such that  $\frac{\partial R_I^{i_m}}{\partial c} \approx \int_{\phi_I^{i_m}}^{\phi_I^{i_m+1}} \frac{\partial r_I^{i_m}(\phi)}{\partial c} dG(\phi)$ , we only need to show that the price effect as a percentage of indirect export volume when exporting through province  $i_m$  is larger than that when through province  $i_n$ . The price effect through  $i_m$  is

$$\begin{aligned} \int \frac{\partial r_I^{i_m}(\phi)}{\partial c} dG(\phi) &= \int (1 - \sigma)(\gamma_I^{i_m})^{-\sigma} \frac{d\gamma_I^{i_m}}{dc} \left( \frac{\tau}{\rho\phi P} \right)^{1-\sigma} R dG(\phi) \\ &= (1 - \sigma) \frac{d\gamma_I^{i_m}/dc}{\gamma_I^{i_m}} \int \left( \frac{\tau\gamma_I^{i_m}}{\rho\phi P} \right)^{1-\sigma} R dG(\phi) \\ &= (1 - \sigma) \frac{d\gamma_I^{i_m}/dc}{\gamma_I^{i_m}} R_I^{i_m} \end{aligned} \quad (15)$$

The price effect relative to export volume through  $i_m$  is therefore  $(1 - \sigma) \frac{d\gamma_I^{i_m}/dc}{\gamma_I^{i_m}}$ . Similarly, the relative price effect through  $i_n$  is  $(1 - \sigma) \frac{d\gamma_I^{i_n}/dc}{\gamma_I^{i_n}}$ , and percentage decrease in indirect exporting through  $i_m$  will be higher than that through  $i_n$  as long as  $\frac{\partial \gamma_I^{i_m}/\partial c}{\gamma_I^{i_m}} > \frac{\partial \gamma_I^{i_n}/\partial c}{\gamma_I^{i_n}}$ . ■

**Prediction 5.** Suppose the price effects are sufficiently larger than the network effects. Given a marginal increase in  $c$ , a province with higher exposure will experience a larger percentage decrease in export volume of indirect exporters.

*Proof.* The indirect exporting volume from province  $i$  is

$$R_I^i = \sum_m R_I^{i_m}.$$

Following Equation (1), if the price effects are sufficiently larger than the network effects, the percentage change in indirect exporting volume w.r.t. a marginal increase in  $c$  is approximately

$$\begin{aligned} \frac{\partial R_I^i/\partial c}{R_I^i} &= \sum_m \frac{1}{R_I^i} \frac{\partial R_I^{i_m}}{\partial c} \\ &\approx \sum_m \frac{1}{R_I^i} \int_{\phi_I^{i_m}}^{\phi_I^{i_m+1}} \frac{\partial r_I^{i_m}(\phi)}{\partial c} dG(\phi) \\ &= \sum_m (1 - \sigma) \frac{\partial \gamma_I^{i_m}/\partial c}{\gamma_I^{i_m}} \frac{R_I^{i_m}}{R_I^i} \\ &= (1 - \sigma) \sum_m \mathcal{B}^{i_m} \omega_I^{i_m} \\ &= (1 - \sigma) \mathcal{E}^i. \end{aligned}$$

where the second to third step follows from Equation (15). Thus, if province  $i$  has higher exposure than province  $j$ , we can easily see from above that  $\frac{\partial R_I^i/\partial c}{R_I^i} < \frac{\partial R_I^j/\partial c}{R_I^j}$ . ■