Export to Elude

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Abstract

How does domestic tax affect firms' export? We address this question via a model in which firms choose their outputs for the domestic and foreign markets optimally under export tax rebates. The model predicts that increasing domestic tax rate has a positive effect on exports when firms are financially constrained. We test the model predictions using detailed firm- and product-level data from Chinese industrial surveys and customs records. Our empirical analysis uses China's Golden Tax Project, which is an information technology introduced in 2001-2002 that has dramatically reduced the cost of domestic value-added tax (VAT) enforcement. We find that after the adoption of the technology, firms located further away from local tax agencies face higher effective VAT rates (the enforcement effect) and export more (the elusion effect) than they did before the adoption. We also find that the elusion effect is stronger for firms subject to higher export rebates or more severe financial constraints.

Keywords: Enforcement technology, VAT export rebate, financial constraints, exports

JEL Classification: H26, H32, F13, F14

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1 Introduction

China began its domestic economic reform and opening up in 1979. Since then, the country has achieved and maintained high economic growth (9.6 percent per annum on average) and trade growth (10.9 percent per annum on average) for almost 40 years, which is unprecedented in the world economic history. By 2013, China had become the largest exporter of goods and commodities in the world. What accounts for the spectacular performance of China's exports? Trade theories and empirical evidence point to factors such as domestic economic reforms, which reduce distortions and improve efficiencies (Tombe and Zhu, 2017), and trade liberalization, which allows the country to better realize its comparative advantage and induces firms to improve productivity and product quality (Fan et al., 2015b; Brandt et al., 2017). However, the existing literature does not provide the complete picture. In this paper, we argue and show that some domestic reforms, which are seemingly unrelated to trade, can have a significant effect (both statistically and economically) on exports, along both extensive and intensive margins.

The domestic reform we focus on is the adoption of a technology that aims to enforce the value-added tax (VAT). VAT is a type of consumption tax that has been adopted by approximately 80 percent of all countries in the world.[1] To understand how a domestic VAT policy influences firms' exporting behaviors, we build a monopolistic competition model in which each firm simultaneously decides its total production and distribution of sales in multiple markets. We follow Arkolakis (2010) to assume that a firm incurs a market penetration cost in each market and the cost increases with the proportion of consumers to be served in the market. The market penetration costs need to be paid upfront using the firm's financial resources (Manova, 2012). Firms pay VAT on all their sales, but can reclaim part or all of their VAT paid on exports due to an export rebate policy. Strengthening domestic tax enforcement, therefore, increases the cost of domestic sales relative to exports because of the export rebates. The model predicts that the tax enforcement reduces firms' sales in the domestic market but induces firms to export (extensive margin) and export more (intensive margin). This effect is stronger when the export rebate rate is higher or when the financial constraint is more severe.

We use panel data of Chinese industrial firms between 1998 and 2007 to test the model pre-

[1] United States is the only major developed country that does not have VAT in its tax system (US Chamber of Commerce, 2016).

dictions. Two major challenges are present when we try to identify the causal effects of the VAT policy. First, the *de jure* VAT rates are uniform across firms and time in the period of our data sample. Second, the effective VAT rates, affected by the enforcement of local governments, may be correlated with firms' exporting behaviors. Fortunately, the experience of China allows us to overcome these two major challenges. First, although firms in the same industry face the same nominal VAT rate which does not change over time, they have different abilities to evade VAT and thus face different effective VAT rates. The reasons are as follows. A government tax agency incurs a cost of checking and verifying a firm's production and sales, and travel cost is an important component of the cost. Firms located farther from their local tax agency have higher incentives to underreport their value-added tax as they are less likely to be checked, compared to firms located closer to the local tax agency. Second, in late 2001, China began to implement the *Golden Tax Project* (GTP) which adopts a technology that obviates the need for tax agencies to verify firms' purchases and sales through on-site inspections. As a result, evasion of VAT becomes much more difficult for all firms, and firms at various distances to the local tax agency no longer face different enforcement probabilities. In other words, the GTP significantly improves VAT enforcement on all Chinese firms, especially those located farther away from their respective local tax agencies. We exploit the heterogeneous enforcement shocks that the GTP exerts on firms at different distances to local tax agencies to identify the causal effects of the VAT enforcement.

Specifically, we can identify the effects of VAT enforcement on firms' effective VAT rates, domestic sales, and exports by comparing how the changes in these outcomes after the GTP differ across firms at different distances to their respective local tax offices. We find that before the GTP, far-away firms paid lower effective rates than nearby firms, and as a result, the former experienced a bigger increase in their effective VAT rates after the GTP: a one-standard-deviation increase in a firm's distance to its tax agency increases the firm's post-GTP effective VAT rate by approximately 0.1 percentage point. We also find that the GTP reduces firms' domestic sales and increases their exports: a one-standard-deviation increase in a firm's distance to its tax agency leads the firm to reduce domestic sales by 3 percent (or 3 percent relative to the national median) and increase exports by 10 percent on average. Because the average distance between a firm and the corresponding local tax agency is about 4.6 standard deviations, the empirical finding implies that the GTP increased an average firm's export by 46% and has contributed to approximately 15 percent of the

China's overall export growth over the study period.[2]

Employing a triple difference strategy, we find that the positive effect of domestic tax enforcement on firms' exports is (i) more pronounced for products with higher VAT export rebate rates, and (ii) higher if the firms are more dependent on external finance, located in regions that are financially less developed, or are non-state-owned.

We have conducted various robustness checks on the preceding results obtained using our difference-in-differences (DiD) strategy. For example, our placebo tests on the subsamples of small VAT payers and pure exporters, which are not affected by the GTP, falsify any unobservable different over-time changes across firms at different distances to their local tax agency, and thus support our argument that the increase in firms' exports are driven by the GTP. We also use the sample of collective firms, which are less prone to the endogeneity issues of firm location, to further support the main finding.

Our findings provide a new perspective to understand China's rapid surge in exports since the beginning of the century. Most of the current research attributes this surge to China's trade policies in the past decades, such as export incentives (including export tax rebate) and China's accession to the World Trade Organization (WTO). Our analysis suggests that China's domestic reforms, such as the GTP, which improves the domestic tax enforcement capacity, also plays an important role.

Our study contributes to the literature in several ways. First, it relates to studies on the effects of domestic institutions on foreign trade. Existing literature has covered contract and property-right institutions (Greif, 1992; Berkowitz et al., 2006; Nunn, 2007; Levchenko, 2007; Yue et al., 2010), financial institutions (Beck, 2002; Manova, 2012; Manova et al., 2015; Chaney, 2016), labor-market institutions (Costinot, 2009), and informal institutions (Greif, 1993; McMillan and Woodruff, 1999; Rauch and Trindade, 2002; Ding et al., 2018). Our study focuses on the institution and technology of domestic tax enforcement. We find that domestic tax enforcement has positive effects on firm exports because firms have incentives to elude domestic tax.[3]

[2]The national export growth was 312 percent from the pre-GTP (1998-2001) to the post-GTP (2002-2007) period. If we assume that the difference in export growth between a firm in an average distance and a firm located right next to the tax agency reflects the contribution of the GTP, we can multiply the distance (4.6) and its average effect on exports (0.1) and divide it by the growth of national exports (3.12) to obtain a back-of-the-envelope calculation of the export contribution of the GTP.

[3]Our paper also presents evidence of prevalent tax evasion by Chinese firms, which supplements the recent research on weak enforcement environment and large evasion rates in developing countries (Kleven et al. (2011); Naritomi

Second, our paper relates to the literature on the interdependence of domestic and foreign markets.[4] Existing studies of this literature (Vannoorenberghe, 2012; Nguyen and Schaur, 2012; Blum et al., 2013; Soderbery, 2014; Ahn and McQuoid, 2015; Berman et al., 2015) provide evidence on substitution between firms' domestic and export sales: the linkage of sales across markets implies susceptibility of firms' sales in one market to shocks from another market.[5] In those studies, a common assumption or observation which drives the sales substitution is that firms face capacity constraint and increasing marginal cost. Different from these studies, our work stresses the role of financial constraints for the interdependence of firms' sales across markets. With such an emphasis, our finding also supplements the literature on the effects of financial frictions on firms' exporting behaviors (Minetti and Zhu, 2011; Manova, 2012; Fan et al., 2015a; Manova et al., 2015; Chaney, 2016).

Third, our paper is related to the literature of geography and trade. Some studies in this literature examine the uneven gains from trade over space caused by intranational transportation costs. Atkin and Donaldson (2017) show that intranational trade costs significantly reduce the gains of globalization in developing countries. Different form those studies, our work shows that firms in distant locations within a *county* may see the global market as a less attractive alternative when they receive less audit from local tax officials and so could evade domestic taxes more easily. This finding implies the geographic disparity in the gains from trade within *counties*, not only within countries as shown by Atkin and Donaldson (2017).

The rest of this paper is organized as follows. Section 2 provides background information on China's VAT policy and the Golden Tax Project. Section 3 presents a simple model to generate predictions for empirical analysis. Section 4 discusses the data. Section 5 introduces the empirical model and strategy. Section 6 presents and discusses the empirical results. Section 7 concludes.

(2015); Pomeranz (2015); Liu and Zhao (2016)). This finding is related to the growing literature on tax design and enforcement in low- and middle-income countries.

[4]This line of studies also belongs to the literature on shock transmission across borders, but at a more disaggregate (firm) level.

[5]Some papers find a positive correlation between firms' exports and domestic sales (e.g., Salomon and Shaver, 2005; Berman et al., 2015). The complementary relationship may happen because the increased profits or the learning from one market can be applied to other markets.

2 VAT and Enforcement in China

VAT was first experimented on two industrial products in four Chinese cities in 1979. Since its nationwide implementation in 1994, VAT has been a major source of tax revenue for the Chinese government. For example, in 2007, the revenue from VAT was 1547 billion yuan (RMB), which accounted for 33.9 percent of China's total tax revenue for the year. A firm's value added is the difference between its sales revenue and material input costs.[6] The standard VAT rate is 17 percent, with a reduced rate of 13 percent applying to a small number of designated products.

Similar to most of the other countries that adopt VAT, China uses a credit-invoice system to collect VAT. Firms pay VAT according to invoice/sales rather than the actual value-added of their economic activities. Let us use a simple example to illustrate the process. Suppose that A produces a product and sells it to B at a price of \$100 (excluding tax). B then further processes the product and sells it to C as a final consumption good at \$300 (excluding tax). In this value chain, the value-added of A is \$100, and the value-added of B is \$200. With a VAT rate of 17 percent, A should pay the government \$17 and B should pay \$34. Therefore, anticipating the VAT payment, A charges B 100 (1+17%) = \$117 and shows this amount on the invoice. The invoice has two copies: one is the seller's copy, known as output VAT invoice which is kept by the seller, and the other is the buyer's copy, known as input VAT invoice which is kept by the buyer. A shows the government its seller's copy and pays \$17. On the other hand, B charges C 300 (1 + 17%) = \$351 and shows this amount on the invoice. B shows the government its seller's copy to pay \$51 and shows its buyer's copy of the \$117 to have a \$17 return. Therefore, in practice, firms are paying like sales tax (17 percent of the sales invoice) and they can claim back the tax paid on inputs.

Obviously, the buyer and the seller of each transaction have opposite interests in misreporting the value of the transaction to pay less tax. On the one hand, a firm wants to underreport its sales to pay less (of the sales tax), and on the other hand, the firm wants to overreport its purchase to claim a larger tax return. However, the government can use the invoices submitted by the two parties for the same transaction to cross check and identify possible misreporting. This paper trail and the built-in "self-enforcing" mechanism in the VAT system make VAT particularly appealing

[6] Note that this "value-added" is the conceptual tax base of VAT. It is different from the firm value-added reported to the Bureau of Statistics (shown in the *Annual Survey of Above-scale Industrial Firms Panel* dataset), which is computed as sales minus intermediate input costs (including material input costs, capital input costs, and other input costs) plus VAT.

to governments that seek to reduce the costs of tax administration.

Nevertheless, firms can still find ways to evade taxes. In the 1990s, most invoices in China were handwritten. Each invoice consists of several special carbon paper sheets coated with a layer of dry ink at the back. Thus, when the selling firm writes down all transaction information on the top sheet of a blank invoice (the output VAT invoice), other sheets underneath, including the input VAT invoice designated for the buyer, would (supposedly) copy the same information.

However, because cross-checking invoices involves a significant amount of manpower and administrative costs, the government cannot implement cross-checking on many transactions. Anticipating this imperfect monitoring, firms that want to evade taxes can at least do two things. First, they provide authentic invoices (i.e., the blank invoices are issued by the government) but write different transaction values on the seller sheet and the buyer sheet of the same invoice (*da tou xiao wei piao* in Chinese). Given the particular method of invoice system and tax collection in China, firms have less room (or incentive) to cheat on the seller's copy because the buyer pays the tax (included in the selling price) and the seller often insists on the amount paid. Often, the buyer could write more on his copy so that he can claim a larger tax refund. Second, the buyer may provide a fake copy of the buyer's invoices (e.g., a blank invoice not issued by the government), that is, invoices not based on real transactions, to claim tax refunds.

Several ways are available for the government to fight tax evasion. Some common practices include *ex ante* onsite visits and *ex post* audits. *Ex ante* onsite visits, also known as regular tax checks, cover all firms in the jurisdiction. The visits are conducted by tax inspectors from the department of tax collection in the county office of the State Administration of Taxation (SAT). Typically, each inspector covers a few hundred firms and makes scheduled visits. The main purpose of the visits is to check firms' operating status and remind firms of reporting true VAT, which helps to deter tax evasion. *Ex post* audits, also known as tax investigations, target firms that are suspicious of tax fraud. Investigations are conducted by the tax auditors from the department of tax inspection in the county office of the SAT. The auditors bring with them government warrants to visit the firms to collect evidence, such as accounting books. The purpose is to recover revenue loss and punish unlawful tax evasion.

Both *ex ante* onsite tax inspections and *ex post* tax audits require physical visits to firms. As the visits involve costs and difficulty, two results are inevitable. First, tax inspectors do not visit

all firms, and tax auditors investigate fewer suspicious firms. Second, firms located further away from the local tax office have lower probability of being inspected and audited. The high travel costs also inhibit the higher level governments from monitoring local tax inspectors and auditors, which in turn exacerbates the shirking behavior of the latter. Given this reality, in the early 2000s, the government implemented a reform to introduce the Golden Tax Project as an endeavor to strengthen tax enforcement. This project is an information technology developed to tackle the two types of misbehavior discussed. First, the GTP builds a nationwide interconnected computer network at all levels of the government, which enables electronic cross-checking of all invoices. The interconnected government computer network automatically cross-checks invoices between firms to eliminate the value-inconsistency problem of invoices. Second, the GTP has a technology that encrypts all transaction information on each invoice into a unique code, making it almost impossible to make fake invoices.

The roll-out of the project is described as follows. Starting from January 1, 2000, handwritten invoices of transactions exceeding 100,000 RMB have been abolished. Invoices of such transactions must be printed out using the new encryption software. Handwritten invoices exceeding 10,000 RMB have also been abolished since January 1, 2002 and firms are required to issue computerized invoices.[7] The nationwide interconnected computer network for invoice cross-checking has been in operation since July 1, 2001.

Although handwritten VAT invoices with value exceeding 100,000 RMB were abolished as early as 2000, we do not take 2000 as the starting year of the GTP in our analysis for two reasons. First, this change in 2000 only covers very large transactions, and thus is only relevant to some of the firms in our sample. Second, the policy was not very effective initially. Firms can avoid using the new encrypted invoices by splitting up their large transactions or issuing multiple handwritten invoices for one large transaction. Therefore, we take 2002 as the year of the introduction of the GTP because in 2002, smaller transactions also used encrypted invoices and the nationwide interconnected computer network for invoice cross-checking was already in operation.

The GTP obviates the need for tax agents to physically travel to local firms to detect VAT evasion. The reform is expected to significantly improve VAT enforcement on all Chinese firms,

[7]Less than 20 percent of those firms, mostly the small-scale firms, did not adopt the technology until the extended deadline on July 1, 2003. The average annual sales of these firms is approximately half a million, and therefore most of these firms are not in our sample, which includes mostly above-scaled firms as described later.

especially those located further away from local tax agencies. In the next section, we build a simple model to examine how tax enforcement will influence firms' sales decisions in various markets. We will then empirically investigate the effects of the GTP in later sections.

3 A Simple Model

3.1 Model Setup

We consider a model in which there are one industry and J countries (markets). All markets are segmented and each market is characterized by monopolistic competition. Each firm in this world produces a single and differentiated variety.

In country j, a representative consumer exists, who has a constant-elasticity-of-substitution (CES) utility function given by

$$U_j = \left[\int_{\omega \in \Omega_j} x_{ij}^c (\omega)^{\frac{\sigma-1}{\sigma}} d\omega \right]^{\frac{\sigma}{\sigma-1}},$$

where ω indexes varieties in product set Ω_j, which is available in country j; $x_{ij}^c (\omega)$ is the consumer's consumption of variety ω produced by country i; and $\sigma > 1$ is the elasticity of substitution between varieties.

Consumer optimization yields the following demand function for variety ω:

$$x_{ij}^c (\omega) = \frac{[p_{ij} (\omega)]^{-\sigma}}{P_j^{1-\sigma}} w_j, \tag{1}$$

where $p_{ij} (\omega)$ is the price of variety ω from country i sold in country j, P_j is an aggregate price index in country j, and w_j is the expenditure of each consumer of country j.

We assume that production uses labor only. Production function is the same for all firms, given as $y = \varphi l$, where y is the quantity of output, l is the amount of labor, and φ is productivity.[8] In each country, workers are hired in the competitive labor market, and w_i is the wage rate in country i.

Following Arkolakis (2010), we assume that a firm from country i can attract n_{ij} fraction of

[8] Firm heterogeneity can be introduced here: firms are allowed to have different values of φ.

consumers in country j if the firm pays a market penetration cost $f_{ij}w_i\frac{1-(1-n_{ij})^{1-\beta}}{1-\beta}$, where f_{ij} is a country-pair specific constant and $\beta \in (0,1)$ is a constant. Firms face financial constraints. We follow Manova (2012) to assume that a fraction $s \in (0,1)$ of the market penetration cost is borne upfront and must be funded using outside financial resources. A higher s implies greater financial needs. Firms can borrow to relax the financial constraints. We assume that firms can borrow up to a fraction $\eta \in (0,1)$ of their total collateralizable assets, K.[9] A higher η is a result of a highly developed financial market.

In country i, firms need to pay value-added tax (VAT), at the statutory tax rate t_i.[10] However, in a world with imperfect monitoring and implementation, firms have tax-evasion incentives. We assume that the effective VAT rate is $e_i t_i$, where $e_i \in [0,1]$ is the tax enforcement level in country i.

Country i may provide tax rebate to firms that export their products. Let $t_{ij} = (1-\gamma_{ij})\, e_i t_i$ denote the effective tax rate on products of a firm from country i sold in country j, where export tax rebate rate $\gamma_{ij} \in [0,1]$ is given by $\gamma_{ij} = 0$ for $j = i$ and $\gamma_{ij} = \gamma$ for $j \neq i$. Note that for domestic sales ($i = j$), $\gamma_{ii} = 0$, and thus $t_{ii} = e_i t_i$. In the case of full export tax rebate (FETR), $\gamma = 1$ and $t_{ij} = 0$ for $j \neq i$.

The profit-maximization problem faced by a firm in country i is given as follows:

$$\max_{p_{ij},n_{ij}} \sum_j \left[\left(p_{ij} - \frac{w}{\varphi} \right) x_{ij}^c n_{ij} L_j - t_{ij} p_{ij} x_{ij}^c n_{ij} L_j - f_{ij} w_i \frac{1-(1-n_{ij})^{1-\beta}}{1-\beta} \right]$$
$$\text{s.t.} \quad \sum_j s f_{ij} w_i \frac{1-(1-n_{ij})^{1-\beta}}{1-\beta} \leq \eta K, \tag{2}$$

where each consumer's demand x_{ij}^c satisfies equation (1) and L_j is the number of consumers in country j. The firm chooses the price levels, p_{ij}, and market penetration rates, n_{ij}, to maximize its total profits. In the preceding profit function, the firm's quantity (x_{ij}) and revenue (R_{ij}) sold

[9] Firms are heterogeneous productivity φ and collateralizable asset K, which are separately drawn from some distributions.

[10] To simplify our analysis, we ignore the intermediat inputs and VAT is equivalent to sales tax. Our results also hold even if we introduce deductible intermediate inputs to our model. When firms export, the government collect VAT based on the gap between the VAT rate and VAT rebate rate, i.e., following $(VAT\ rate - VAT\ rebate\ rate) \times FOB$. This is consistent with our model setting.

in market j are, respectively,

$$x_{ij} = x_{ij}^c n_{ij} L_j = \frac{p_{ij}^{-\sigma}}{P_j^{1-\sigma}} n_{ij} Y_j \quad \text{and} \quad R_{ij} = p_{ij} x_{ij}^c n_{ij} L_j = \frac{p_{ij}^{1-\sigma}}{P_j^{1-\sigma}} n_{ij} Y_j,$$

where $Y_j = w_j L_j$ denote the total expenditure by consumers in country j. Note that the firm only reaches a fraction n_{ij} of the entire market Y_j. The financial constraint, that is, condition (2), can be rewritten as

$$\sum f_{ij} w_i \frac{1 - (1 - n_{ij})^{1-\beta}}{1 - \beta} \leq b, \quad \text{where } b \equiv \frac{\eta K}{s}.$$

The newly defined parameter b represents the tightness of financial constraint for a firm. The firm faces a tighter constraint (a smaller b) when it is in an industry that requires a larger fraction of outside resources (a larger s), it is in a region where financial resources is less abundant (a smaller η), or it has a smaller amount of collateral asset (a smaller K). These three effects can be combined in one analysis, that is, a change in b.

Taking derivatives with respect to p_{ij} and n_{ij} yields the following first-order conditions:

$$p_{ij} = \frac{\sigma}{\sigma - 1} \frac{w_i}{(1 - t_{ij})\,\varphi} \tag{3}$$

$$\frac{1 - t_{ij}}{\sigma} \frac{p_{ij}^{1-\sigma}}{P_j^{1-\sigma}} Y_j = (1 + \lambda) f_{ij} w_i \frac{1}{(1 - n_{ij})^{\beta}}, \tag{4}$$

where λ is the Lagrangian multiplier associated with the budget constraint (2).

3.2 Firms' Optimal Decision and Equilibrium

In order to understand the importance of financial constraints, we first analyze the case without financial constraints as a reference, and then examine the case with financial constraints to highlight the difference.

3.2.1 Without Financial Constraints

When no financial constraint exists, $\lambda = 0$. In this case, from equation (4), we immediately obtain the optimal market penetration:

$$n_{ij} = 1 - \left[\frac{(1-t_{ij})^{\sigma} \left(\frac{\sigma}{\sigma-1} \frac{w_i}{\varphi} \right)^{1-\sigma} Y_j}{\sigma f_{ij} w_i P_j^{1-\sigma}} \right]^{-\frac{1}{\beta}}. \tag{5}$$

To see how a change in the effective tax rate (or equivalently, an increase in e_i) affects the firm's sales in each market, we take the total differentiation of sales R_{ij}, using (3) and (5), to obtain (d denotes differentiation as follows):

$$\begin{aligned} d\ln R_{ij} &= \frac{1-n_{ij}}{n_{ij}} \frac{\sigma}{\beta} d\ln(1-t_{ij}) + (\sigma-1)\, d\ln(1-t_{ij}) \\ &= \begin{cases} -\left[\frac{1-n_{ii}}{n_{ii}} \frac{\sigma}{\beta} + (\sigma-1) \right] \frac{t_i}{1-e_i t_i} de_i & \text{for } j = i, \\ -\left[\frac{1-n_{ij}}{n_{ij}} \frac{\sigma}{\beta} + (\sigma-1) \right] \frac{(1-\gamma)t_i}{1-(1-\gamma)e_i t_i} de_i & \text{for } j \neq i. \end{cases} \end{aligned} \tag{6}$$

In the FETR case (i.e., $\gamma = 1$), $d\ln R_{ij} = 0$ for $j \neq i$.

It is clear from (6) that as e_i increases, the firm's domestic sales (R_{ii}) will decrease, its export sales (R_{ij}) will also decrease except in the FETR case ($\gamma = 1$), in which no change occurs in export sales. To summarize, we have the following proposition:

Proposition 1. *When no financial constraint exists, strengthening domestic tax enforcement reduces a firm's domestic sales, as well as its export sales except in the FETR case. Export sales are not affected in the FETR case.*

The intuition is simple. When a firm faces no financial constraint, its sales decision for each market is made *independently*. Strengthening domestic tax enforcement reduces the firm's profitability in the domestic market and thus reduces its sales. The same is true for its export market in the non-FETR case, albeit to a less extent. However, in the FETR case, strengthening domestic tax enforcement does not affect a firm's cost and profitability in its export markets and therefore its export sales are not affected.

Proposition 1 presents results on the effects of domestic tax enforcement on the intensive margins

of the firms in domestic and export markets. Firms' extensive margins are also affected. In the non-FETR case, strengthening domestic tax enforcement reduces a firm's profits in every market. When the profits drop below the fixed penetration cost to attract the first customer in the market, the firm exits the market. In other words, the increased domestic tax enforcement may also reduce firm exports at the extensive margin. In the FETR case, the domestic tax enforcement, e_i, does not affect firm export profits and therefore would not influence firm exports at the extensive margin.

3.2.2 With Financial Constraint

When a firm is financially constrained, $\lambda \neq 0$. We can obtain the optimal market penetration rate as (see the derivation details in Appendix 7)

$$n_{ij} = 1 - \left\{ \sum_k f_{ik} w_i \left[\frac{(1-t_{ik})^{\sigma}}{(1-t_{ij})^{\sigma}} \frac{\Psi_{ik}}{\Psi_{ij}} \right]^{\frac{\beta-1}{\beta}} \right\}^{\frac{1}{\beta-1}} \left[\sum_k f_{ik} w_i - (1-\beta) b \right]^{\frac{1}{1-\beta}}, \tag{7}$$

where $\Psi_{ij} = \frac{Y_j}{f_{ij} P_j^{1-\sigma}}$. Taking total differentiation of the sales R_{ij} yields

$$\begin{aligned} & d \ln R_{ij} \\ = \; & \frac{1-n_{ij}}{n_{ij}} \sum_k \frac{\sigma}{\beta} A_{ik} \left[\Delta \ln (1-t_{ij}) - \Delta \ln (1-t_{ik}) \right] + (\sigma - 1) \Delta \ln (1-t_{ij}) ; \\ = \; & \begin{cases} - \left\{ \frac{1-n_{ii}}{n_{ii}} \frac{\sigma}{\beta} (1-A_{ii}) \left[\frac{1}{1-e_i t_i} - \frac{1-\gamma}{1-(1-\gamma) e_i t_i} \right] + (\sigma - 1) \frac{1}{1-e_i t_i} \right\} t_i de_i & \text{for } j = i, \\ \left\{ \frac{1-n_{ij}}{n_{ij}} \frac{\sigma}{\beta} A_{ii} \left[\frac{1}{1-e_i t_i} - \frac{1-\gamma}{1-(1-\gamma) e_i t_i} \right] - (\sigma - 1) \frac{1-\gamma}{1-(1-\gamma) e_i t_i} \right\} t_i de_i & \text{for } j \neq i, \end{cases} \end{aligned} \tag{8}$$

where

$$A_{ij} = \frac{f_{ij} \left[(1-t_{ij})^{\sigma} \Psi_{ij} \right]^{\frac{\beta-1}{\beta}}}{\sum_k f_{ik} \left[(1-t_{ik})^{\sigma} \Psi_{ik} \right]^{\frac{\beta-1}{\beta}}} > 0, \quad \text{and} \quad \sum_j A_{ij} = 1.$$

In the FETR case,

$$d \ln R_{ij} = \begin{cases} - \left[\frac{1-n_{ii}}{n_{ii}} \frac{\sigma}{\beta} (1-A_{ii}) + (\sigma - 1) \right] \frac{t_i}{1-e_i t_i} de_i & \text{for } j = i, \\ \frac{1-n_{ij}}{n_{ij}} \frac{\sigma}{\beta} A_{ii} \frac{t_i}{1-e_i t_i} de_i & \text{for } j \neq i. \end{cases} \tag{9}$$

Based on (9) (when $\gamma = 1$), we observe that an increase in e_i will reduce R_{ii} but raise R_{ij} for $j \neq i$. On the other hand, at $\gamma = 0$, from (8) we know that domestic tax enforcement would decrease

the export sales. Therefore, $\tilde{\gamma} \in (0,1)$ exists such that the effect of domestic tax enforcement on the export sales $d\ln R_{ij}/de_i > 0$ for all $\gamma > \tilde{\gamma}$. This analysis allows us to establish the following proposition:[11]

Proposition 2. *Suppose that financial constraint exists. Strengthening domestic tax enforcement always reduces firm domestic sales.* $\tilde{\gamma} \in (0,1)$ *exists such that strengthening domestic tax enforcement increases the firm's export sales if* $\gamma > \tilde{\gamma}$.

The intuition behind the reduction of a firm's domestic sales is the same as that explained in the no-financial-constraint case. For the export markets, with financial constraint, a reduction in the domestic sales frees up financial resources that a firm can allocate to its export market. This effect tends to raise the firm's export market sales. However, strengthening domestic tax enforcement also reduces the firm's export profitability except in the FETR case. The effect tends to lower the firm's export market sales. The net result is that the positive effect dominates the negative effect when export tax rebate is sufficiently large ($\gamma > \tilde{\gamma}$) because, in this case, export profitability is not significantly affected by the strengthening of tax enforcement.

The preceding discussion shows that tax enforcement affects firm exports at the intensive margin. It is straightforward to show that tax enforcement also affects firm exports at the extensive margin. We can show that

$$\frac{\partial \ln n_{ij}}{\partial e_i} = \begin{cases} -\frac{1-n_{ii}}{n_{ii}}\frac{\sigma}{\beta}\left(1-A_{ii}\right)\left[\frac{1}{1-e_i t_i}-\frac{1-\gamma}{1-(1-\gamma)e_i t_i}\right]t_i & \text{for } j=i, \\ \frac{1-n_{ij}}{n_{ij}}\frac{\sigma}{\beta}A_{ii}\left[\frac{1}{1-e_i t_i}-\frac{1-\gamma}{1-(1-\gamma)e_i t_i}\right]t_i & \text{for } j\neq i, \end{cases},$$

which suggests that for $j = i$, $\frac{\partial \ln n_{ij}}{\partial e_i}$ is non-positive and for $j \neq i$, $\frac{\partial \ln n_{ij}}{\partial e_i}$ is non-negative. Contrary to the results in section 3.2.1, when firms face financial constraint, the domestic tax enforcement increases would push firms to reshuffle resources from the domestic market to the foreign markets. As the profits earned from a foreign market surpass the fixed penetration costs, the firm will enter the new market. Therefore, the enhanced tax enforcement also increases a firm's exports at the extensive margin.

[11] In our data, about 95 percent products receive VAT export rebates more than 75 percent and roughly 20 percent products receive full rebates.

3.3 Comparative Statics Analysis and Applications to China

In this subsection, we explore various types of heterogeneous effects of tax enforcement change on firms' sales decision across markets under the situation of financial constraint. While some of the analyses are specific to China, most are quite general and applicable to other countries.

First, in the context of China, we show in Appendix 7 that before the implementation of the GTP, firms faced various degrees of enforcement e_i depending on their locations, and the firm-specific enforcement is a decreasing function of the geographical distance, v, between the firm and the local tax agency. Moreover, we show that the reduced-form effective tax rate assumption, $e_i t_i$, is equivalent to the result derived from the standard set-up in the corporate tax evasion literature. In the standard set-up, a risk-neutral firm maximizes its profits by choosing the optimal amount of evasion given the audit probability. The GTP obviates the need for taxation officials to physically visit firms to enforce tax payment and therefore e_i becomes 1 after the GTP is implemented. As the initial enforcement level e_i is a decreasing function of the geographical distance between the firm and the local taxation enforcement agency, Proposition 2 immediately implies the following result.

Prediction 1. *Suppose that the export tax rebate is sufficiently high ($\gamma > \tilde{\gamma}$). The positive (negative) effect of domestic tax enforcement on export (domestic) sales is larger for firms located further away from the local tax office.*

Notice that even within the same country (for example, China), export tax rebate rates may vary across products. We are interested in knowing how the effects in Prediction 1 will change at different rebate rates. Taking the derivative of $\frac{\partial \ln R_{ij}}{\partial e_i}$ for $j \neq i$ with respect to γ, we obtain[12]

$$\frac{\partial^2 \ln R_{ij}}{\partial e_i \partial \gamma} = \frac{1-n_{ij}}{n_{ij}} \frac{\sigma}{\beta} A_{ii} \frac{t_i}{\left[1-(1-\gamma)e_i t_i\right]^2} + (\sigma - 1) \frac{t_i}{\left[1-(1-\gamma)e_i t_i\right]^2} + \frac{\sigma}{\beta} \left[(1-n_{ij}) \frac{A_{ii}}{n_{ij}} \frac{\partial \ln A_{ii}}{\partial \gamma} - \frac{A_{ii}}{n_{ij}} \frac{\partial \ln n_{ij}}{\partial \gamma} \right] \left[\frac{t_i}{1-e_i t_i} - \frac{(1-\gamma)t_i}{1-(1-\gamma)e_i t_i} \right],$$

which is larger than zero if e_i is sufficiently small. The preceding analysis, together with $d \ln R_{ij}/de_i >$

[12] Differentiating n_{ij} and A_{ij} with respect to γ, we have $\partial \ln n_{ij}/\partial \gamma = \frac{1-n_{ij}}{n_{ij}} A_{ii} \frac{e_i t_i}{1-(1-\gamma)e_i t_i} > 0$ and $\partial \ln A_{ii}/\partial \gamma = (1-\beta)(1-A_{ii}) \frac{e_i t_i}{1-(1-\gamma)e_i t_i} > 0$, where $\frac{\partial \ln n_{ij}}{\partial \gamma}$ and $\frac{\partial \ln A_{ii}}{\partial \gamma}$ are both close to zero if e_i is close to zero. Thus, when e_i is small enough, $\frac{\partial^2 \ln R_{ij}}{\partial e_i \partial \gamma} > 0$.

0 for all $\gamma > \tilde{\gamma}$ in Prediction 1, leads to the following prediction under certain conditions on e_i and γ:

Prediction 2. *The (positive) effect of domestic tax enforcement on exports is larger for products with a higher export tax rebate rate.*

Finally, we turn to the impact of financial constraint on Prediction 1. Taking the derivative of $\frac{\partial \ln R_{ij}}{\partial e_i}$ (for $j \neq i$) with respective to b, we obtain

$$\frac{\partial \ln R_{ij}}{\partial e_i \partial b} = -\frac{\sigma}{\beta} B_{ij} A_{ii} \left[\frac{t_i}{1 - e_i t_i} - \frac{(1-\gamma)\, t_i}{1 - (1-\gamma)\, e_i t_i} \right] < 0 \text{ for } j \neq i,$$

where $B_{ij} = \frac{1-n_{ij}}{n_{ij}^2} \frac{1}{\sum\limits_k f_{ik} w_i - (1-\beta) b}$. Then, $\frac{\partial^2 \ln R_{ij}}{\partial e_i \partial s} = \frac{\partial^2 \ln R_{ij}}{\partial e_i \partial b} \frac{\partial b}{\partial s} > 0$, $\frac{\partial^2 \ln R_{ij}}{\partial e_i \partial \eta} = \frac{\partial^2 \ln R_{ij}}{\partial e_i \partial b} \frac{\partial b}{\partial \eta} < 0$, and $\frac{\partial^2 \ln R_{ij}}{\partial e_i \partial K} = \frac{\partial^2 \ln R_{ij}}{\partial e_i \partial b} \frac{\partial b}{\partial K} < 0$ for $j \neq i$.[13] Thus, we have the following prediction:

Prediction 3. *The (positive) effect of domestic tax enforcement on exports is larger for firms in sectors that face higher credit needs (a larger s), have smaller assets (a smaller K), or are in regions with less credit access (a smaller η).*

The intuition is that less financially constrained firms have already penetrated a greater pool of customers in the foreign markets, and thus, attracting additional demand is more costly for them.

In summary, the model predicts that stronger domestic tax enforcement increases firm exports, and this positive effect increases with the extent of VAT export rebate rates and the degree of financial constraints. In the following sections, we describe the data and measurement, and devise simple econometric models to test these predictions.

4 Data and Measurement

We need a rich set of data to test the three predictions presented in the previous section. To this end, we construct our dataset based on a number of data sources that we describe and discuss in the following.

[13] For $j = i$, we have $\frac{\partial^2 \ln R_{ij}}{\partial e_i \partial s} = \frac{\partial^2 \ln R_{ij}}{\partial e_i \partial b} \frac{\partial b}{\partial s} < 0$, $\frac{\partial^2 \ln R_{ij}}{\partial e_i \partial \eta} = \frac{\partial^2 \ln R_{ij}}{\partial e_i \partial b} \frac{\partial b}{\partial \eta} > 0$, and $\frac{\partial^2 \ln R_{ij}}{\partial e_i \partial K} = \frac{\partial^2 \ln R_{ij}}{\partial e_i \partial b} \frac{\partial b}{\partial K} > 0$. This is to say, the negative effect of raising the domestic tax enforcement on domestic sales is greater for firms in sectors that face higher credit needs (a larger s), have smaller assets (a smaller K), or are in regions with less credit access (a smaller η).

■ **Firm level data**

The *Annual Survey of Above-scale Industrial Firms Panel* (ASIFP) (1998-2007) from the National Bureau of Statistics of China (NBSC) is a comprehensive dataset on Chinese firms and has been widely used. This data panel covers all state-owned industrial firms and non-state-owned industrial firms with annual sales above 5 million RMB. It contains detailed information on each of those Chinese firms' location, ownership, input, output, cash flow, sales, profits, exports, tax payments, and others. Although some of the information has been commonly used by many studies (e.g., Hsieh and Klenow, 2009; Fan et al., 2015b, 2018; Brandt et al., 2012), we also employ some other less-used information which is particularly relevant and important for our empirical study. The location information allows us to calculate the distance between the firm and the government tax office. The value-added tax payment information allows us to verify firms' effective VAT rate. Furthermore, firms' export and domestic sales, which are commonly used in many existing studies, are key outcome variables of our study. We also use this dataset to construct and calculate a set of control variables in our regressions, including firms' employment, sales, total asset, and productivity.

■ **Geodesic distance**

We use three data sources to construct a proxy for firm-specific tax inspection costs. The first is the hand-collected addresses of county tax offices of the State Administration of Taxation, which are typically located in the urban centers of the counties. We use Baidu Map to find the geographic coordinates of each county's tax office according to its address. The second data source is ASIFP. As mentioned, ASIFP contains each firm's location, that is, the registered address, which is used to locate the firm's geographic coordinates from Baidu Map. With these two sets of coordinates, we then compute the *geodesic* distance between each firm's initial location prior to the GTP and the corresponding county's tax office, based on the two coordinates. To translate distance to travel difficulty (costs), we also need to know the terrain conditions of each county, which can be calculated based on the GTOPO30 China Digital Elevation Model (DEM), the third data source that we use. This data source records the ground elevation of grid cells at 30 arc-second spacings (approximately 1 kilometer). We use the DEM data to compute the terrain ruggedness of each county, measured as the simple standard deviation of elevations in each county. Using these three data sources, we can construct and compute the firm-level tax inspection cost, proxied by the *adjusted geodesic*

distance, which is defined as the standardized value of the product of the geodesic distance between a firm and the corresponding tax office and the county terrain ruggedness. We discuss alternative measures in Appendix 7.[14]

■ **VAT rebates and tariffs**

VAT export rebate is an important tax policy in China. Basically, the government provides partial or full rebates of the VAT payment on exports. The rebate rates, however, change over time and vary across industries and products. The post-2001 rebate data are available online, maintained by the Chinese government.[15] Although the pre-2002 rebate data are not readily available, we can calculate the rebate rates based on the official data of 2002 and the changes in VAT rebate policies during the 1998-2002 period (Tomatsu, 2005). We follow Garred (2016) to construct the VAT rebate rates at the Harmonized System (HS) 6-digit code level and China Industry Classification's (CIC) 4-digit industry level from 1998 to 2007.[16]

We compute the import tariff rates for each Chinese industry in each year. To perform this task, we need information from the *Trade Analysis and Information System* (TRAINS), which provides China's tariff rates on each traded product at the HS 8-digit code level. Using this information, we calculate the import tariff rates on each 4-digit CIC industry as the simple average of the tariff rates for all 8-digit HS codes within the industry.

A Chinese firm's exports are affected by tariffs imposed by the importing countries. We call the foreign importing countries' tariffs as the Chinese firms' export tariffs. To obtain those export tariff rates, we use the HS 8-digit level tariff rates by all foreign countries from the TRAINS data to first calculate the simple average tariff rate imposed on a product by all countries, and then compute the industry-level export tariff rate of each 4-digit CIC industry by taking the average of all products that fall into the industry.

■ **Financial constraints**

[14] In Appendix 7, we compute the least-cost paths in ArcGIS for a randomly selected 166 counties, based on the geographic features (e.g., slopes) of the county terrain. Although these paths could measure the travel cost more accurately, the calculation for all firms in the sample is inhibitingly time-consuming. We show the paths for 9 counties in Figure A.1. To simplify the calculation, we use the product of the geodesic distance between a firm and the corresponding tax office and the county terrain ruggedness to proxy for the tax inspection cost. We show, in Figure A.2, the proxy is highly positively correlated with the costs along the least-cost paths, whereas the simple geodesic distance measure is only weakly correlated with these costs.

[15] http://www.taxrefund.com.cn.

[16] In order to merge the VAT data with the ASIFP data, we compute the simple average of HS 6-digit product VAT rebate rates within each 4-digit CIC industry.

Financial constraint is a key factor in the model and plays an important role in all three predictions. We follow Manova (2012) and use two proxies to measure industry-level financial constraints faced by the firms. The first is external finance dependence, which is defined as the share of firms' capital expenditure *not* financed by operational cash flows. The second is asset tangibility, which is defined as the share of firms' net value of fixed asset (e.g., plants, properties, and equipment) in total asset. Firms in an industry are financially more vulnerable and face tighter credit constraints when the external finance dependence is higher or the industry has a lower asset tangibility.

To construct these two measures, we first use data on publicly listed companies in the United States to calculate the external finance dependence and asset tangibility for each ISIC 3-digit industry.[17] We then map the values of the two measures to the Chinese industries at the CIC 4-digit level. The reasons for constructing these measures based on the US data are twofold. First, the US is a developed country with a mature financial market and hence firm decisions reflect industry-specific credit needs. Second, as argued by Rajan and Zingales (1998), Claessens and Laeven (2003), and Kroszner et al. (2007), the difference in the reliance on external finance and asset tangibility across industries is attributable to technological reasons, and these technological differences persist across countries.[18]

In addition to facing different degrees of financial constraints in various industries, firms in different regions are also faced with different financial constraints. To measure such a regional difference, we use the average bank loan over GDP ratio in each province in 2000 to proxy for the firm credit access in each province. The required data are from *Almanac of China's Finance and Banking*, which covers bank loans for all provinces.[19]

Firms with various types of ownership may also face different financial constraints. In China, state-owned enterprises (SOEs) are more favorable to the state banks, and non-state-owned enterprises (non-SOEs) face tighter credit constraints than SOEs (Boyreau-Debray and Wei, 2005; Song et al., 2011; Dollar and Wei, 2007). In this study, a firm is considered as an SOE if state-owned registered capital of the firm is greater than half of the firm's total capital. Otherwise, the firm is

[17] Following Manova (2012), these data are obtained from the work of Rajan and Zingales (1998) and Braun (2003).

[18] Rajan and Zingales (1998) indicate that "most of the determinants of ratio of cash flow to capital are likely to be similar worldwide: the level of demand for a certain product, its stage in the life cycle, and its cash harvest period."

[19] Our sample covers 31 provincial-level areas including 22 provinces, 4 municipalities, and 5 autonomous regions.

considered as a non-SOE.

5 Empirical Strategy

We will run several regressions to investigate the effects of domestic tax enforcement on firm performance. To obtain the causal effects of VAT on firms' exports, we adopt an identification strategy that exploits the heterogeneous VAT enforcement shocks that the GTP in 2002 exerted on firms at different distances to local tax agencies. Before the GTP, firms located further away from their tax agencies are subject to less monitoring and checking and therefore pay lower effective VAT rates. The implementation of the GTP significantly reduced tax agencies' VAT enforcement costs by introducing a technology that enables them to detect VAT fraud without physically visiting the firms. Thus, we expect that the GTP will significant reduce VAT evasion and increase the effective VAT rate, and more importantly, it will increase more for firms located further away from their respective county's tax office.

We first test the preceding conjecture by exploiting both the distance and time variations in a DiD specification as follows:

$$y_{jt} = \alpha + \beta Distance_j \times Post_t + \sum_t \gamma_t X_i \times \delta_t + \sum_t \theta_t X_j \times \delta_t + \delta_j + \delta_{ot} + \varepsilon_{jt}, \tag{10}$$

where y_{jt} is the effective VAT rate imposed on firm j in year t; $Distance_j$ is the adjusted geodesic distance between firm j and its corresponding county tax agency, which has been described in Section 4 to represent firm specific tax inspection cost; $Post_t$ is a dummy variable, which takes value zero for all years before 2002, and 1 from 2002 onwards; X_i is a set of characteristic variables of county i in year 2000, including the GDP per capita and population density; X_j is a set of initial performances of firm j, including firm sales, assets, employment, labor productivity, and export status; δ_j, δ_t, and $\delta_{o,t}$ represent firm, year, and ownership-year fixed effects, respectively; and ε_{jt} is the error term that captures all unobserved factors that influence y_{jt}.[20] In this regression, we expect β, which measures how the change in a firm's effective VAT rate after the GTP varies with

[20]There are five different types of ownership: SOEs, collective firms, private firms, Hong Kong-Macau-Taiwan firms, and foreign firms. The ownership of a firm is defined according to the type of the largest registered capital in a firm's total capital provided that the share is greater than 50 percent. Based on this rule, 99.43 percent of firms in our sample is well-defined.

the firm's distance to its local tax office, to be *positive*.

By strict definition, the effective VAT rate of a firm in a particular year is the ratio between the firm's actual VAT payment and its total value-added tax base.[21] The effective rate should be equal to the *de jure* (official) rate (17 percent) if a firm is truthful. However, in our paper, we calculate a firm's effective VAT rate as the ratio between its actual value-added tax payment and its *sales.*[22] There are three reasons why we use this measure instead. First, the sales figure is more trustworthy than the value-added information (denominators of the ratios) because fabricating costs is easier than concealing revenues (Best et al., 2015). If somehow firms also misreport their sales and input costs in the ASIFP in order to match with what they report to tax agencies, firms' reported sales will capture less mis-reporting compared to their value-added and therefore gives us a more accurate measure of the effective VAT rate firms face. Second, and also importantly, using sales instead of the value-added as the denominator ensures that any measurement error due to firms' mis-reporting will only bias us against finding a significant β for equation (10). Suppose firms underreport sales in the ASIFP to match with what they report to tax agencies. We should expect such underreporting, which introduces an upward bias in our calculated effective VAT rate, to be more severe exactly for firm-years with higher VAT evasion (i.e. the firms located further away from local tax agencies in the pre-reform period). Therefore, firms' misreporting, which may be correlated with their evasion incentives, will only introduce a downward bias in our estimated effect of the GTP on effective VAT rate. Third, although we can calculate each firms' "value-added" as the difference between its sales and input costs using the ASIFP, this measure does not correspond to what the tax agencies use to calculate a firm's VAT base. In tax agencies' calculation, some input costs (e.g., materials) are deductible from the VAT base while others are not (e.g., capital purchases), but the deductible and non-deductible costs cannot be separated in the ASIFP data. Thus, using value-added data from ASIFP to calculate the effective VAT rates is not accurate either.[23] In results not shown, we rerun equation (10) using the ratio between VAT payment and the ASIFP reported value-added as our effective VAT rate measure, our estimates remain robust.

[21] Note that this "value-added" is the conceptual tax base of the VAT, which is different from the number reported to the Bureau of Statistics by firms.

[22] We multiply this ratio by 100 to show the change in the percentage points.

[23] Moreover, if firms use more deductible inputs relative to non-deductible inputs after the GTP, which is not captured by sales, our measure of effective rate using sales as the denominator will introduce a bias that against finding any significant effect. The fact that we still find significant effect of the GTP shows that the GTP indeed changed the effective VAT rate imposed on firms.

Our DiD strategy specified in equation (10) helps to address several endogeneity problems in estimating the causal effects of domestic fiscal enforcement. First, restricting the estimates to the change in firm effective VAT rate due to an exogenous shock from the GTP ensures that the estimated effects are not biased by reverse causality. Second, controlling for the firm fixed-effect should eliminate any omitted variable bias caused by time-invariant firm characteristics. Third, to further ensure that our estimated effects do not reflect other over-time changes that may differ across firms located at different distances from their local tax agency, we also control for the interaction between the year dummies and a set of county and firm initial characteristics and ownership-year fixed effects.

After verifying GTP's heterogeneous tax enforcement shocks on firms, we then use the same specification to examine how domestic tax enforcement affects a firm's exports and domestic sales as stated in Prediction 1. Specifically, we replace the dependent variable in equation (10), respectively, with a dummy variable indicating whether a firm is an exporter, with the log value of a firm's exports, with the log value of a firm's domestic sales, and with the share of a firm's exports in total sales.[24] Prediction 1 indicates that β should be *negative* when the outcome variable is domestic sales, but *positive* for all other outcome variables.

Then, we turn to Prediction 2 by running the following regression to examine how the causal effects of domestic tax enforcement on exports differ with the export rebate rates varying at the product level:

$$\begin{aligned} y_{jpt} = \alpha + \beta_0 Rebate_{pt} \times Distance_j \times Post_t + \beta_1 Distance_j \times Post_t + \beta_2 Rebate_{p,t} \times Post_t \\ + \beta_3 Rebate_{pt} \times Distance_j + \beta_4 Rebate_{pt} + \sum_t \gamma_t X_i \times \delta_t + \sum_t \theta_t X_j \times \delta_t + \delta_{jp} + \delta_t + \delta_{ot} + \varepsilon_{jt}, \end{aligned} \tag{11}$$

where y_{jpt} is the log export value and export quantity of product p of firm j in year t, respectively; $Rebate_{pt}$ is the official VAT export tax rebate rate for product p in year t; δ_{jp} refers to the firm-product fixed effects, and other variables are defined in equation (10). We are interested in coefficient of β_0, which estimates the heterogeneous effect of tax enforcement on firm exports varying by export VAT rebate policies. Prediction 2 implies that β_0 should be *positive*. We are also

[24]Throughout the paper, we use $log(1 + exports)$ to define the log value of firm exports and use $log(1 + domestic\ sales)$ to define the log value of firm domestic sales.

interested in coefficient of β_1, which estimates the effect of tax enforcement on firm exports when export tax rebate rate is equal to 0. The value of β_1 should be negative according to our model predictions.

Finally, we test Prediction 3. We run a triple difference regression to examine how the impact of domestic tax enforcement on a firm's exports varies with the degree of financial constraint that the firm faces based on the following model:

$$\begin{aligned} y_{jt} = \alpha + \beta_0 FC_j \times Distance_j \times Post_t + \beta_1 Distance_j \times Post_t + \beta_2 FC_j \times Post_t \\ + \sum_t \gamma_t X_i \times \delta_t + \sum_t \theta_t X_j \times \delta_t + \delta_j + \delta_{ot} + \varepsilon_{j,t}, \end{aligned} \tag{12}$$

where y_{jt} is the log export value of firm j in year t, and FC_j is the degree of financial constraint faced by firm j. We use three separate measures to estimate FC_j as discussed in the previous section. According to Prediction 3, coefficient β_0 should be *positive* when FC_j is measured by firms' external finance dependence but *negative* when FC_j is measured by firms' asset tangibility or regional financial development.

When we replace the dependent variable, y_{jt}, by a firm's domestic sales in (12), the signs are opposite to those for export sales.

When we examine Prediction 3 by comparing the exports of SOEs with those of non-SOEs, we let FC_j equal 1 if the firm is a non-SOE and 0 if it is an SOE. In this case, β_0 should also be positive. That is, the effects of the GTP on non-SOEs are stronger because they face more stringent financial constraints compared to SOEs.

6 Empirical Analysis and Results

In this section, we conduct empirical analyses based on the econometric models described in the previous section. We report and discuss the regression results in relation to the theoretical analysis in Section 3.

6.1 Distance, Effective VAT Rate, and Firm Exports

Table 1 reports the results of the estimates of β in equation (10) when the dependent variable is the effective VAT rate. Column (1) shows the baseline results, where we only control for firm and year fixed effects. The estimate of β is positive and statistically significant, as the model predicts. Quantitatively, a 1 standard deviation increase in a firm's distance to the corresponding county's tax office leads to a 0.09 percentage point increase in the effective VAT rate after the GTP.[25] We then add more control variables, one at a time, to run the regressions.

In column (2), we add the interaction between the year dummy and each county's pre-GTP characteristics (X_i) including population density and log GDP per capita. In column (3), we also add the ownership-year fixed effects. In column (4), we further add the interaction between the year dummy and each firm's initial characteristics (X_j), including firm initial employment, sales, total assets, productivity, and export share. In all columns, our estimates of β are positive and highly significant.

Table 2 shows the estimates of β when we rerun equation (10) to examine the effect of domestic tax enforcement on firm exports and domestic sales. All regressions control for county initial characteristics interacted with year fixed effects, firm initial characteristics interacted with year fixed effects, and ownership-year fixed effects to eliminate potential biases caused by omitted variables.

Column (1) reports the result with log value of firm exports as the dependent variable, and thus is about the intensive margin of firm exports. The estimate indicates that firms located further away from the respective county tax offices exported more after the GTP. Specifically, a 1 standard deviation increase in a firm's distance to its local tax office leads to a 10 percent increase in the firm's exports in the post-GTP period. Then, we analyze the effects of GTP on the extensive margin of firm exports by replacing the dependent variable with a firm's export dummy, equal to 1 for export and zero otherwise. The result is reported in column (2), which shows that a 1 standard deviation increase in a firm's distance to its local tax office leads to a 1 percentage point increase in the firm's probability of export (extensive margin).[26] Column (3) turns to the effects on domestic sales and shows that a 1 standard deviation increase in a firm's distance to its local tax office

[25] Note that we multiply the VAT over sales ratio by 100 to show the change in percentage points. We use the standardized value of the distance and therefore a 1 standard deviation increase in a firm's distance is equivalent to a 1-unit increase in the distance variable.

[26] If we use the logit model instead of the linear probability model, the results remain robust.

leads to a 3.7 percent *decrease* in the firm's domestic sales. The results from columns (1)-(3) have a clear implication: firms switch their market emphasis from domestic to foreign, which implies an increase in export share. This change in export share is evident in column (4): a 1 standard deviation increase in a firm's distance to its local tax office leads to a 0.7 percentage point increase in the share of a firm's exports in total sales. All results in Table 2 are consistent with Prediction 1.

The extensive-margin in column (2) of Table 2 implies that the GTP has led to new entries into the export markets. Will the new exporters behave differently from the experienced exporters? To address this question, we split all firms to two subsamples based on a firm's exporting experience prior to 2002: a subsample of new exporters, which are firms that did not have exports before 2002, and a subsample of experienced exporters, that is, those that had at least some exports before 2002. We run separate regressions using those two subsamples, respectively.[27] The results are presented in Table 3, with columns (1) to (3) based on new exporters, and columns (4) to (6) based on experienced exporters. Estimates in columns (1) and (4) suggest that experienced exporters exported two times more in terms of value compared to new exporters; estimates in columns (2) and (5) suggest that experienced exporters reduced domestic sales 5 times more compared to new exporters. Furthermore, a comparison between columns (3) and (6) indicates that compared compared to the new exporters, the experienced exporters made a sixfold adjustment between domestic sales and exports. A plausible explanation for this contrast is that the adjustment cost is lower for firms that already have their export markets.[28]

An important assumption of our DiD identification strategy is that the different over-time changes in outcomes across firms at different distances away from their local tax agency are caused solely by the GTP, not by any pre-existing differential time trends across comparison firms. To test this assumption, we replace the interaction between distance and the post dummy in equation (10) with the sum of the interaction terms between distance and all the year dummies. In Figure 1, we plot the estimated yearly effects of distance on firms' effective VAT rate. Similarly, in Figure 2, we plot the yearly estimated effects of distance on the log value of firms' exports (in panel (a))

[27] Since we use $log(1 + exports)$ as the dependent variable, the value for the new exporters is 0 before 2002.

[28] Table 1-3 show the reduced-form effects of the GTP on firms' effective VAT rate and exports. To further confirm the causal effects of the GTP on exports, we rerun the regression using the two-stage least squares approach, and report the results in Table A.1 in Appendix 7.

and the share of exports in total sales (in panel (b)). We observe no significant pre-trends before 2002 but a break in trend for both plots in 2002.

6.2 Heterogeneity

Although China has a uniform VAT rate and VAT export rebate policy towards all manufacturing products, we are able to identify the causal effects of the GTP on firms' export behavior because firms had different effective VAT rates before 2002 and face financial constraints. To further investigate this issue, we explore the differential effects of the GTP on firms facing different export rebates and financial constraints.

6.2.1 VAT Export Rebates

Under certain special situations, firms may face different VAT export rebate rates. An extreme situation of such is related to two types of trade in China: ordinary trade and processing trade. Processing trade includes "processing trade with imported inputs" and "processing trade with supplied inputs". The former refers to trade by firms that purchase the imported inputs from foreign suppliers, and export all processed goods with no intent to sell domestically. The latter refers to trade by firms that receive inputs from the trading partners, assemble them, and then export the final products back to the same partners. As the latter type of processing trade is exempted from paying VAT, we use it as a placebo check for our study.[29] In particular, we run regressions based on equation (11) with two subsamples, one for firm-products in ordinary trade and one for firm-products in the "processing trade with supplied input." While we expect domestic VAT tax enforcement to significantly increase exports in ordinary-trade firm-products, given that "processing trade with supplied input" is exempted from VAT, we should expect the GTP to have no effect on the exports of firm-products in the latter subsample.

The regression results are shown in Table 4. All regressions control for firm-product and year fixed effects. Columns (1) and (2) are for ordinary trade. Column (1) uses the logarithm of a firm-product's export value as the dependent variable, while column (2) uses the logarithm of a firm-product's export quantity. We find that the positive effects of tax enforcement on export

[29]The "processing trade with imported inputs" needs to pay VAT. For a more detailed discussion, see Liu et al. (2016).

value and quantity are higher for firm-products with a higher VAT rebate rate. Moreover, when the product rebate rate is zero, firms located further away from the local tax offices reduced exports, as evidenced by the negative coefficients of the interaction term between firm distance and the post dummy. This finding is consistent with the model. Columns (3) and (4) run the same regressions with a different sample of "processing with supplied inputs" trade, which is exempted from VAT and thereby unaffected by tax rebate incentives. As expected, we find no effects of the GTP on the "processing trade with supplied inputs." The estimates of the coefficient on the triple interaction terms are indistinguishable from zero. To summarize, all the tests above lend support to Prediction 2: the effect of domestic tax enforcement on exports is larger for products with a higher export tax rebate rate.

6.2.2 Financial Constraints

Our theoretical model and Prediction 3 show that financial constraint is the reason behind the effects of increased domestic tax enforcement on firm exports. We introduce regression equation (12) to examine the importance of financial constraint.

Table 5 presents our estimates of equation (12) when we use industry-level external finance dependence and asset tangibility, respectively, as the proxy for financial constraint. Table 6 reports the results with financial constraint measured by the degree of regional financial development in the firm's home province. The results confirm Prediction 3: the effects of tax enforcement on firms' exports and domestic sales are stronger for firms that depend more on external finance (see Columns (1)-(4) of Table 5), for firms that have fewer tangible assets (see Columns (5)-(8) of Table 5), and for firms located in regions with less developed financial markets (see Table 6).

In Table 7, we use the non-SOE dummy to replace the financial constraint variable. The coefficients of β_0 are positive for exports and negative for domestic sales, which is consistent with the discussion of equation (12) in relation to Prediction 3.[30]

To further explore the importance of financial constraint, we replicate Figure 2 using two sub-samples with different financial status and depict the results of the estimated yearly effects of the

[30]Compared to non-SOEs, SOEs are more connected to the government and tax enforcement may be more lenient. Yet, managers of SOEs tend to have a lower incentive to evade taxes because they have a lower stake in the profits. If we restrict our sample to either non-SOEs or SOEs, we find that the effective VAT rate increases after GTP. Thus, our finding that non-SOEs switch more to exports compared to SOEs is consistent with the financial constraint mechanism.

GTP on exports in Figure 3. In panels (a) and (b), we divide the two subsamples according to industry-level external financial dependence: one including firms in industries with high external finance dependence (see panel (a)) and the other consisting of firms in industries with low external finance dependence (see panel (b)).

We also conduct another analysis by dividing the sample to two subsamples according to regional financial development, one for firms in provinces with low financial development (see panel (c)) and the other for firms in provinces with high financial development (see panel (d)). We define low financial development as the situation of a province in which the credit-over-GDP ratio is below the median of the full sample, and high financial development as those with the ratios above the median.

Finally, we have the two subsamples, one being non-SOEs (see panel (e)) and the others being SOEs (see panel (f)). These six panels all show similar results: the effects of the GTP exist on firms faced with more financial constraint (see panels (a), (c), and (e)), but do not exist on firms faced with less financial constraint (see panels (b), (d), and (f)).

6.3 Robustness Checks

6.3.1 Falsification Tests

In this subsection, we conduct two placebo tests to show that the observed heterogeneous changes in firm outcomes after 2002 are indeed driven by the tax enforcement shocks of the GTP but not by unobservable differences across firms located at different distances to their local tax offices.

In the first placebo test, we examine the effects of the GTP on firm exports and domestic sales using a sample that consists of only the small VAT taxpayers. Small taxpayers are firms with annual sales below 1 million RMB. Although most firms in our sample have annual sales above 5 million RMB, some firms have sales below this cutoff because of the sample adjustment cost of the Bureau of Statistics. The small taxpayers pay VAT based on annual sales rather than the amount of value added, with a statutory tax rate of 6 percent.[31] The invoice used by small VAT taxpayers is the Ordinary Invoice, which is different from the Special Invoice used by the regular

[31]We define small VAT taxpayers as the firms that pay VAT around 6 percent of sales in all years. In our small taxpayer sample, firms with sales above 1 million RMB exist in several years. A plausible explanation for this observation is that they are small VAT taxpayers before their sales surpass 1 million RMB and have not yet registered as regular VAT taxpayers. Our results hold robust if we exclude small SOE taxpayers from our sample.

VAT taxpayers. Since the cross-checking technology of the GTP only applies to the Special Invoice, the small taxpayers would not be affected by the GTP. We run the regressions based on equation (10) with this sample of firms and present the results in columns (1)-(4) of Table 8. Unlike the results obtained based on the regular VAT taxpayers, Table 8 shows that the effects of the increased domestic tax enforcement on small taxpayers' exports and domestic sales are very small and not statistically significant.

In our second placebo test, we run regressions based on the sample of pure exporters, which are the firms that sell products only to overseas markets (i.e., no domestic sales). Our analysis implies that no switching occurs from domestic sales to exports by these firms and thus, they are not affected by the GTP in the same way as ordinary firms are. The estimated results based on equation (10) with pure exporters are presented in column (5) of Table 8, which indicate that the GTP had no significant impacts on exports of the pure exporters.[32]

The preceding two falsification tests provide evidence to support our finding: our main estimates obtained earlier reflect the effects of the GTP rather than any bias from unobservable differential over-time changes across firms located at different distances from their local tax agencies.

6.3.2 Trade Reforms and Policy Changes related to China's Accession to the WTO

Regarding our identification strategy, a concern is that our estimated effects may be confounded by other over-time exogenous changes that happened around the same time as the GTP in 2002. For instance, China's accession to the WTO occurred at the end of 2001, which could bias our results if the effects of China's WTO entry on Chinese firms' exports are also correlated with the firms' distances to their local tax agencies. Given that trade liberalization should in general benefit firms with easier market access (Atkin and Donaldson, 2017), it is unlikely that our findings, that is, firms in more remote locations experience higher increases in exports, is driven by China's accession to the WTO. Nevertheless, we still want to test the robustness of our estimates by controlling for trade policy changes in our regressions.

The key effects of China's WTO accession are the significant reductions of China's import tariff rates. During the same period, foreign countries' tariff rates on Chinese exports also decrease and

[32]Our main results hold robust if we exclude the small VAT payers and pure exporters from our sample. The results are available upon request.

China's VAT rebate policies have changed over time. To prevent those changes from biasing our estimates, we add the import and export tariff rates of each industry (at CIC 4-digit level) of each year to control for the WTO accession effects. We also add the average VAT rebate rate of each industry (at CIC 4-digit level) of each year to control for the effects of changing rebate rates.

Moreover, in all regressions, we include the interaction terms between firm distance to county tax offices and export tariff, import tariff, and rebate rates. Adding these interaction terms addresses the concern that the changes in tariffs and rebates may have stronger effects on distant firms compared to nearby firms, which could confound our results.

Column (1) of Table 9 presents the effect of the GTP on firms' effective VAT rate, controlling for the aforementioned variables related to trade reforms. The estimated coefficient of the main variable, firm distance times the post dummy, stays almost identical as the one in Column (1) of Table 1: a 1 standard deviation increase in firm distance implies a 0.09 percentage point increase in the firms' effective VAT rate after the GTP. Columns (2)-(5) report the GTP impacts on firm export and domestic sales. The estimated coefficients of the firm distance by the post dummy variable in all columns are consistent with those in Table 2. Therefore, our results are unlikely driven by China's WTO accession.

In fact, the coefficients of the three interaction terms are statistically insignificant. This evidence suggests that the changes in tariffs and rebates have no differential impacts on distant firms compared to nearby firms. This finding is not in contradiction to that of Atkin and Donaldson (2017) who find that trade liberalization benefits more those firms with easier market access because the intranational trade costs reduce the gains from falling international trade barriers. Our measure of distance is unrelated to their measure of intranational trade cost. While their measure is the distance between two city locations with an average of over 200 miles, our distance measure is a local one, which is the distance between a firm and the local county tax office, with an average of approximately 15 kilometers. It is unlikely that the within-county firm distance variation is a key factor in explaining firms' decision to export, as stated by Atkin and Donaldson (2017), because all firms within the same county have more or less the same distance to the ports (i.e., intranational trade cost).

To further alleviate potential biases due to other time-variant changes in China's trade policies, we add three interaction terms in the regressions, which are the interactions between the year

dummies and each firm's shortest distance to the top 5 international trading ports in China, between year dummies and each county's export intensity in 2001, and between year dummies and each industry's average labor share.[33] The first interaction term captures part of the intranational trade costs, the second term captures the importance of export for the firms in different counties, and the last term measures the factor intensity of the firms in different industries. If firms are different in any of these three aspects, they will be affected differently by a change in trade policy.

Table 10 reports the regression results. Column (1) reports the GTP impacts on firms' effective VAT rate. The estimated coefficient remains robust. Columns (2)-(5) show the effects of the GTP on firm exports and domestic sales after controlling the additional variables that capture trade policy effects. The estimated coefficients remain highly consistent with those estimates reported in Table 2.

In summary, our estimated results remain highly robust after controlling for the effects of various trade policy changes including China's WTO accession.

6.3.3 Endogeneity of Firm Location

Firms' locational decisions may be related to firms' characteristics. If this is the case, firm characteristics may confound our results. This naturally leads to a concern that distance may not be exogenous in our DiD analysis, and consequently, the estimation results obtained earlier may not truly reflect the effects of the GTP. However, in the earlier sections, we have partially addressed this issue to a certain degree. In particular, we control for a set of firms' pre-GTP characteristics interacted with the year dummies to eliminate confounding effects from firm characteristics other than distance.[34]

We conduct a test in this subsection to further alleviate the endogeneity concern. We restrict our sample to township and village enterprises (TVEs), which are firms established in the rural area by rural collectives. They produce industrial products and thus are included in the ASIFP, provided that they are sufficiently large. The locations of TVEs are not endogenously determined by the firms' characteristics because TVEs are required by law to reside within the towns and villages

[33] The top 5 international trading ports, in terms of cargo-handling capacity, are Shanghai, Shenzhen, Qingdao, Tianjin, and Guangzhou.

[34] Our falsification test also partially resolves the issue by showing that our main results are not driven by unobserved differences across firms located at different distances to their local tax offices.

where the collectives belong to. The idea of using only TVEs in the regressions is that should our estimates obtained from the full sample be driven by a bias due to endogeneity of firm locations, we would have observed the estimated coefficients for the TVE subsample to be significantly smaller than those for the full sample. Table 11 shows the regression results based on the TVE subsample. Compared to the results in Table 2, the magnitudes of the estimates of all outcome variables are not smaller than those reported in Table 11. Thus, our results obtained earlier are unlikely to be biased by the endogeneity of firms' pre-GTP locations.

7 Conclusion

This study examines the effects of domestic tax enforcement on firms' exports. With a simple model in which firms endogenously choose between domestic and foreign markets under imperfect domestic tax enforcement, we demonstrate that strengthening domestic tax enforcement has positive effects on firms exports, along both extensive and intensive margins, when firms face financial constraints. We empirically test the model by exploiting the heterogeneous tax enforcement shocks that the Golden Tax Project exerts on firms located at different distances from their local tax agency. We find evidence that is highly consistent with the model predictions: higher effective VAT rate causes firms to increase their exports, and the positive effect of the effective VAT rate on firms' exports increases with the VAT export rebate rates and financial constraints faced by the firms.

Our results point to a by-product of strengthening domestic tax enforcement: increased exports. The original motivation of the GTP is not to encourage export, but to increase government tax revenue. Thus, this paper helps to shed light on the observed puzzling positive correlation between an economy's exposure to international trade and the size of its government (Cameron, 1978; Rodrik, 1998). The extant literature explains this correlation by emphasizing the role of government spending in reducing external risks caused by international trade (e.g., Rodrik, 1998) and proposing that involvement in foreign trade lowers the cost of providing public goods (e.g., Epifani and Gancia, 2009). Our findings suggest a plausible alternative explanation: while a country's higher fiscal capacity leads to a larger government, it may also cause firms to divert their sales to foreign markets to elude taxes. We leave a more thorough investigation of this channel to future research.

Table 1: Impact of the GTP on Firm Effective VAT Rate

	(1) VAT Rate	(2) VAT Rate	(3) VAT Rate	(4) VAT Rate
Distance × Post	0.090***	0.108***	0.097***	0.106***
	(0.021)	(0.023)	(0.022)	(0.022)
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	No	No
Ownership-year FE	No	No	Yes	Yes
$X_{i,2000} \times \delta_t$	No	Yes	Yes	Yes
$X_{j,initial} \times \delta_t$	No	No	No	Yes
Sample	All	All	All	All
Obs.	738811	738811	738811	738811
R-sq.	0.66	0.66	0.66	0.67

Notes: This table shows the effects of the GTP on the firm effective value added tax rates varied by firms' initial distance to the local tax office prior to the GTP. $X_{i,2000}$ includes GDP per capita and population density for county i in 2000, and $X_{j,initial}$ includes the initial sales, employment, total fixed assets, labor productivity, and export status of firm j. δ_t refers to year dummy that equals 1 if year equals t and 0 if otherwise. Standard errors in parentheses are clustered at the county level. * $p < 0.10$, ** $p < 0.5$, *** $p < 0.01$

Table 2: Impact of the GTP on Firm Exports and Domestic Sales

	(1) Log exports	(2) Export dummy	(3) Log domestic sales	(4) Export share
Distance × Post	0.103***	0.010***	-0.037**	0.007***
	(0.022)	(0.002)	(0.015)	(0.002)
Firm FE	Yes	Yes	Yes	Yes
Year FE	No	No	No	No
Ownership-year FE	Yes	Yes	Yes	Yes
$X_{i,2000} \times \delta_t$	Yes	Yes	Yes	Yes
$X_{j,initial} \times \delta_t$	Yes	Yes	Yes	Yes
Sample	All	All	All	All
Obs.	738811	738811	738811	738812
R-sq.	0.83	0.80	0.82	0.86

Notes: This table shows the effects of the GTP on firm exports and domestic sales, varied by firms' initial distances to local tax offices before the GTP. $X_{i,2000}$ includes GDP per capita and population density for county i in 2000, and $X_{j,initial}$ includes the initial sales, employment, total fixed assets, labor productivity, and export status of firm j. δ_t refers to year dummy that equals 1 if year equals t and 0 if otherwise. Standard errors in parentheses are clustered at the county level. * $p < 0.10$, ** $p < 0.5$, *** $p < 0.01$

Table 3: Impact of the GTP on Firm Sales Varied by Pre-Existing Export Status

	(1) Log exports	(2) Log domestic sales	(3) Export share	(4) Log exports	(5) Log domestic sales	(6) Export share
Distance × Post	0.067***	-0.014	0.003***	0.191***	-0.083**	0.018***
	(0.021)	(0.010)	(0.001)	(0.048)	(0.035)	(0.004)
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	No	No	No	No	No	No
Ownership-year FE	Yes	Yes	Yes	Yes	Yes	Yes
$X_{i,2000} \times \delta_t$	Yes	Yes	Yes	Yes	Yes	Yes
$X_{j,initial} \times \delta_t$	Yes	Yes	Yes	Yes	Yes	Yes
Sample	Non-Exporter	Non-Exporter	Non-Exporter	Exporter	Exporter	Exporter
Obs.	522998	522998	522999	215813	215813	215813
R-sq.	0.53	0.83	0.58	0.62	0.79	0.78

Notes: This table shows the effects of the GTP on firm exports and domestic sales, varied by firms' initial distances to local tax offices before the GTP. $X_{i,2000}$ includes GDP per capita and population density for county i in 2000, and $X_{j,initial}$ includes the initial sales, employment, total fixed assets, labor productivity, and export status of firm j. δ_t refers to year dummy that equals 1 if year equals t and 0 if otherwise. Columns (1) to (3) show the results for new exporters, defined as firms that had no exporting experience before 2002; Columns (4) to (6) restrict the sample to the existent exporters, defined as firms that had exporting experience before 2002. Standard errors in parentheses are clustered at the county level. * $p < 0.10$, ** $p < 0.5$, *** $p < 0.01$

Table 4: Heterogeneous Effects of the GTP on Exports at Firm-Product Level

	(1) Export Value	(2) Export Quantity	(3) Export Value	(4) Export Quantity
Distance × Rebate × Post	1.773**	1.656**	-2.099	-1.095
	(0.700)	(0.687)	(1.801)	(1.808)
Distance × Post	-0.256**	-0.249**	0.351	0.206
	(0.105)	(0.104)	(0.287)	(0.290)
Rebate × Post	3.495***	3.312***	-2.176*	-1.949
	(0.655)	(0.657)	(1.298)	(1.394)
Distance × Rebate	-1.557	-1.469	1.261	-0.304
	(0.972)	(0.977)	(2.042)	(1.874)
Rebate	-0.882	-0.415	1.136	0.202
	(1.029)	(1.049)	(2.376)	(2.339)
Firm-Product FE	Yes	Yes	Yes	Yes
Year FE	No	No	No	No
Ownership-year FE	Yes	Yes	Yes	Yes
$X_{i,2000} \times \delta_t$	Yes	Yes	Yes	Yes
$X_{j,initial} \times \delta_t$	Yes	Yes	Yes	Yes
Sample	Ordinary	Ordinary	Processing	Processing
-			Supplied Input	Supplied Input
Obs.	496705	496705	75672	75672
R-sq.	0.87	0.90	0.81	0.86

Notes: This table shows the heterogeneous effects of the GTP on firm-product exports varied by export VAT rebate rates, which are constructed at the HS6 product level for each year. In columns (1) and (3), the dependent variable is the log export value, whereas the dependent variable is the log export quantity for columns (2) and (4). We control for both the firm-product and ownership-year fixed effects in all regressions. $X_{i,2000}$ includes GDP per capita and population density for county i in 2000, and $X_{j,initial}$ includes the initial sales, employment, total fixed assets, labor productivity, and export status of firm j. Standard errors in parentheses are clustered at the county level. * $p < 0.10$, ** $p < 0.5$, *** $p < 0.01$

Table 5: Heterogeneous Effects of the GTP on Firm Sales Varied by Sector Financial Vulnerability

	(1) Log exports	(2) Export dummy	(3) Log domestic sales	(4) Export share	(5) Log exports	(6) Export dummy	(7) Log domestic sales	(8) Export share
External Finance Dependence × Distance × Post	0.108**	0.012**	-0.051	0.005*				
	(0.052)	(0.006)	(0.035)	(0.003)				
Tangibile Asset × Distance × Post					-0.410***	-0.039**	0.234**	-0.033***
					(0.154)	(0.017)	(0.098)	(0.011)
Distance × Post	0.090***	0.008***	-0.025	0.007***	0.251***	0.024***	-0.119***	0.019***
	(0.030)	(0.003)	(0.019)	(0.002)	(0.053)	(0.006)	(0.041)	(0.005)
External Finance Dependence × Post	0.077	0.003	0.120***	-0.000				
	(0.056)	(0.006)	(0.040)	(0.004)				
Tangibile Asset × Post					-0.950***	-0.078***	0.873***	-0.081***
					(0.168)	(0.018)	(0.102)	(0.012)
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Ownership-year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
$X_{i,2000} \times \delta_t$	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
$X_{j,initial} \times \delta_t$	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Obs.	645903	645904	645903	645904	645903	645904	645903	645904
R-sq.	0.83	0.80	0.81	0.86	0.83	0.80	0.81	0.86

Notes: This table shows the heterogeneous effects of the GTP on firm exports varied by the degree of financial constraints. We follow Manova (2012) and use external finance dependence and asset tangibility to proxy for the financial vulneralbility of a sector. $X_{i,2000}$ includes GDP per capita and population density for county i in 2000, and $X_{j,initial}$ includes the initial sales, employment, total fixed assets, labor productivity, and export status of firm j. δ_t refers to year dummy that equals 1 if year equals t and 0 if otherwise. In columns (1) to (4), we use the external finance dependence as the proxy; in columns (5) to (8), we use the asset tangibility as another proxy. Standard errors in parentheses are clustered at the county level. * $p < 0.10$, ** $p < 0.5$, *** $p < 0.01$

Table 6: Heterogeneous Effects of the GTP on Firm Sales Varied by Regional Financial Development

	(1) Log exports	(2) Export dummy	(3) Log domestic sales	(4) Export share
Credit/GDP × Distance × Post	-0.288***	-0.027**	0.053	-0.019*
	(0.111)	(0.011)	(0.083)	(0.010)
Credit/GDP × Post	0.228*	0.034***	-0.371***	0.029***
	(0.119)	(0.012)	(0.095)	(0.009)
Distance × Post	0.342***	0.031***	-0.075	0.023**
	(0.105)	(0.011)	(0.078)	(0.009)
Firm FE	Yes	Yes	Yes	Yes
Ownership-year FE	Yes	Yes	Yes	Yes
$X_{i,2000} \times \delta_t$	Yes	Yes	Yes	Yes
$X_{j,initial} \times \delta_t$	Yes	Yes	Yes	Yes
Obs.	646780	646780	646779	646780
R-sq.	0.83	0.80	0.82	0.86

Notes: This table shows the heterogeneous effects of the GTP on firm exports and domestic sales, varied by regional financial development. The regional financial development is measured as the bank loan over GDP ratio in each province in 2000. $X_{i,2000}$ includes GDP per capita and population density for county i in 2000, and $X_{j,initial}$ includes the initial sales, employment, total fixed assets, labor productivity, and export status of firm j. δ_t refers to year dummy that equals 1 if year equals t and 0 if otherwise. Standard errors in parentheses are clustered at the county level. * $p < 0.10$, ** $p < 0.5$, *** $p < 0.01$

Table 7: Heterogeneous Effects of the GTP on Firm Sales Varied by Firm Ownership

	(1) Log exports	(2) Export dummy	(3) Log domestic sales	(4) Export share
Non-SOE × Distance × Post	0.144***	0.014***	-0.015	0.007***
	(0.028)	(0.003)	(0.018)	(0.002)
Non-SOE × Post	0.294***	0.027***	0.122***	0.010***
	(0.030)	(0.003)	(0.017)	(0.002)
Distance × Post	-0.006	-0.001	-0.021*	0.002**
	(0.016)	(0.002)	(0.011)	(0.001)
Firm FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
$X_{i,2000} \times \delta_t$	Yes	Yes	Yes	Yes
$X_{j,initial} \times \delta_t$	Yes	Yes	Yes	Yes
Obs.	738812	738813	738812	738813
R-sq.	0.83	0.80	0.82	0.86

Notes: This table compares the impacts of the GTP on firm sales for the non-SOE firms and for state-owned firms. non-SOE is a dummy variable that equals 1 if a firm is of non-SOE ownership. $X_{i,2000}$ includes GDP per capita and population density for county i in 2000, and $X_{j,initial}$ includes the initial sales, employment, total fixed assets, labor productivity, and export status of firm j. δ_t refers to year dummy that equals 1 if year equals t and 0 if otherwise. Standard errors in parentheses are clustered at the county level. * $p < 0.10$, ** $p < 0.5$, *** $p < 0.01$

Table 8: Falsification Tests: the GTP Impacts on VAT Small Taxpayers and Pure Exporters

	(1) Log exports	(2) Export dummy	(3) Log domestic sales	(4) Export share	(5) Log exports
Distance × Post	-0.009	-0.000	-0.021	0.000	0.032
	(0.051)	(0.006)	(0.040)	(0.004)	(0.022)
Firm FE	Yes	Yes	Yes	Yes	Yes
Year FE	No	No	No	No	No
Ownership-year FE	Yes	Yes	Yes	Yes	Yes
$X_{i,2000} \times \delta_t$	Yes	Yes	Yes	Yes	Yes
$X_{j,initial} \times \delta_t$	Yes	Yes	Yes	Yes	Yes
Sample	Small Payer	Small Payer	Small Payer	Small Payer	Pure Exporter
Obs.	13095	13095	13095	13095	17174
R-sq.	0.94	0.92	0.96	0.96	0.86

Notes: This table shows the GTP impacts on the small VAT payers and pure exporters. $X_{i,2000}$ includes GDP per capita and population density for county i in 2000, and $X_{j,initial}$ includes the initial sales, employment, total fixed assets, labor productivity, and export status of firm j. δ_t refers to year dummy that equals 1 if year equals t and 0 if otherwise. Standard errors in parentheses are clustered at the county level. * $p < 0.10$, ** $p < 0.5$, *** $p < 0.01$

Table 9: The GTP Impacts after Controlling for Effects from Trade Reforms

	(1) VAT Rate	(2) Log exports	(3) Export dummy	(4) Log domestic sales	(5) Export share
Distance × Post	0.093***	0.108***	0.011***	-0.033**	0.007***
	(0.024)	(0.025)	(0.003)	(0.015)	(0.002)
Distance × Export Tariff	0.033	0.816*	0.072	-0.184	0.026
	(0.473)	(0.486)	(0.053)	(0.358)	(0.033)
Distance × Import Tariff	0.311	-0.318	-0.012	0.186	-0.025*
	(0.236)	(0.208)	(0.022)	(0.157)	(0.014)
Distance × Rebate	-0.005*	0.000	-0.000	-0.003	0.000
	(0.003)	(0.003)	(0.000)	(0.002)	(0.000)
Firm FE	Yes	Yes	Yes	Yes	Yes
Ownership-year FE	Yes	Yes	Yes	Yes	Yes
Export Tariff	Yes	Yes	Yes	Yes	Yes
Import Tariff	Yes	Yes	Yes	Yes	Yes
Export VAT Rebate	Yes	Yes	Yes	Yes	Yes
$X_{i,2000} \times \delta_t$	Yes	Yes	Yes	Yes	Yes
$X_{j,initial} \times \delta_t$	Yes	Yes	Yes	Yes	Yes
Obs.	631052	631052	631052	631051	631052
R-sq.	0.86	0.87	0.85	0.98	0.88

Notes: This table checks the robustness of our findings by controlling for the impacts from concurrent trade reforms. $X_{i,2000}$ includes GDP per capita and population density for county i in 2000, and $X_{j,initial}$ includes the initial sales, employment, total fixed assets, labor productivity, and export status of firm j. δ_t refers to year dummy that equals 1 if year equals t and 0 if otherwise. Standard errors in parentheses are clustered at the county level. * $p < 0.10$, ** $p < 0.5$, *** $p < 0.01$

Table 10: The GTP Impacts after Controlling for More Variables Related to Trade Reforms

	(1) VAT Rate	(2) Log exports	(3) Export dummy	(4) Log domestic sales	(5) Export share
Distance × Post	0.090***	0.108***	0.011***	-0.047***	0.008***
	(0.024)	(0.024)	(0.003)	(0.015)	(0.002)
Distance × Export Tariff	0.036	0.600	0.054	0.116	0.006
	(0.473)	(0.485)	(0.053)	(0.355)	(0.033)
Distance × Import Tariff	0.297	-0.127	0.003	-0.028	-0.008
	(0.238)	(0.207)	(0.023)	(0.143)	(0.014)
Distance × Rebate	-0.004	-0.000	-0.000	-0.000	0.000
	(0.003)	(0.003)	(0.000)	(0.002)	(0.000)
Firm FE	Yes	Yes	Yes	Yes	Yes
Ownership-year FE	Yes	Yes	Yes	Yes	Yes
Export Tariff	Yes	Yes	Yes	Yes	Yes
Import Tariff	Yes	Yes	Yes	Yes	Yes
Export VAT Rebate	Yes	Yes	Yes	Yes	Yes
$X_{i,2000} \times \delta_t$	Yes	Yes	Yes	Yes	Yes
$X_{j,initial} \times \delta_t$	Yes	Yes	Yes	Yes	Yes
Port Distance × δ_t	Yes	Yes	Yes	Yes	Yes
County Export Intensity × δ_t	Yes	Yes	Yes	Yes	Yes
Sector Labor Share × δ_t	Yes	Yes	Yes	Yes	Yes
Obs.	631053	631053	631053	631052	631053
R-sq.	0.86	0.87	0.85	0.98	0.88

Notes: This table checks the robustness of our findings by controlling for more variables related to trade liberalization. $X_{i,2000}$ includes GDP per capita and population density for county i in 2000, and $X_{j,initial}$ includes the initial sales, employment, total fixed assets, labor productivity, and export status of firm j. δ_t refers to year dummy that equals 1 if year equals t and 0 if otherwise. Port distance measures the shortest distance to one of the top 5 international trading ports in China. County export intensity measures the share of total exports in total sales in a county in 2000. Sector labor share measures the total wage payment in overall sales in each sector in 2000. Standard errors in parentheses are clustered at the county level. * $p < 0.10$, ** $p < 0.5$, *** $p < 0.01$

Table 11: The GTP Impacts on Collectively-owned Firms

	(1) VAT Rate	(2) Log exports	(3) Export dummy	(4) Log domestic sales	(5) Export share
Distance × Post	0.110***	0.116***	0.012***	-0.002	0.007***
	(0.036)	(0.038)	(0.004)	(0.021)	(0.002)
Firm FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
$X_{i,2000} \times \delta_t$	Yes	Yes	Yes	Yes	Yes
$X_{j,initial} \times \delta_t$	Yes	Yes	Yes	Yes	Yes
Obs.	176295	176295	176295	176295	176295
R-sq.	0.66	0.81	0.78	0.80	0.85

Notes: This table shows the GTP impacts on the collectively-owned firms. $X_{i,2000}$ includes GDP per capita and population density for county i in 2000, and $X_{j,initial}$ includes the initial sales, employment, total fixed assets, labor productivity, and export status of firm j. δ_t refers to year dummy that equals 1 if year equals t and 0 if otherwise. Standard errors in parentheses are clustered at the county level. * $p < 0.10$, ** $p < 0.5$, *** $p < 0.01$

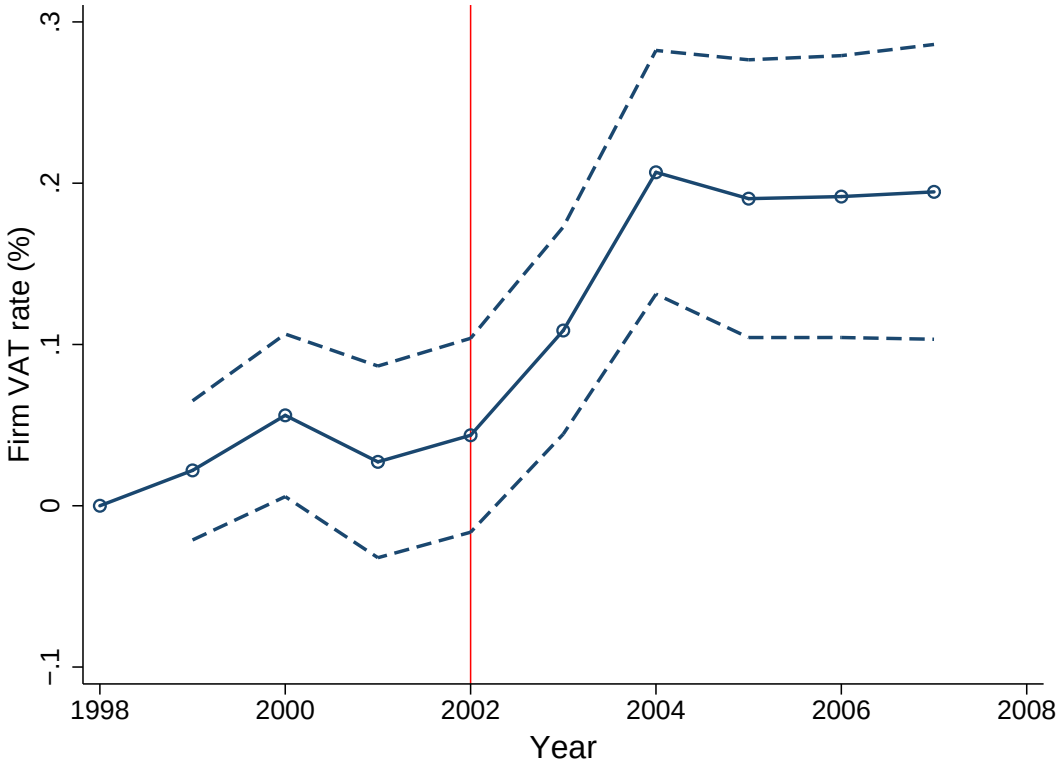
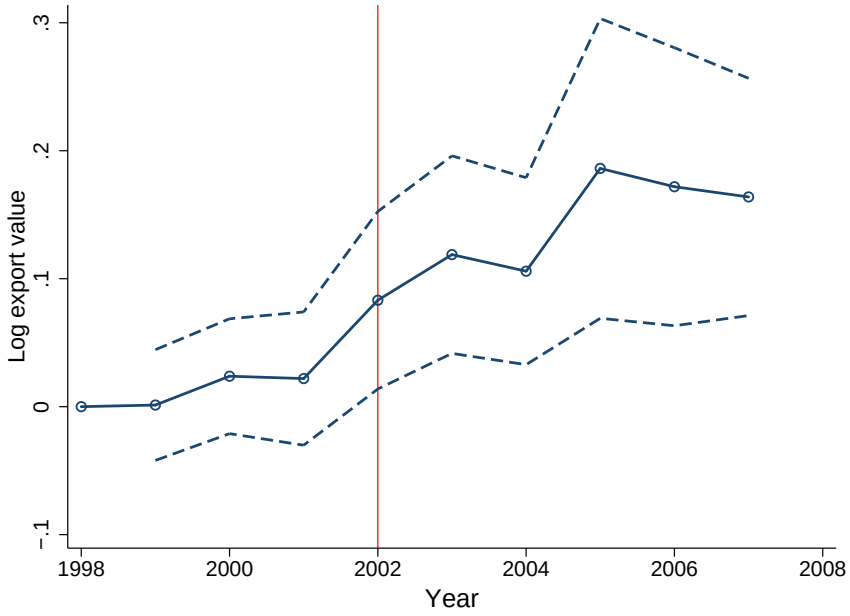
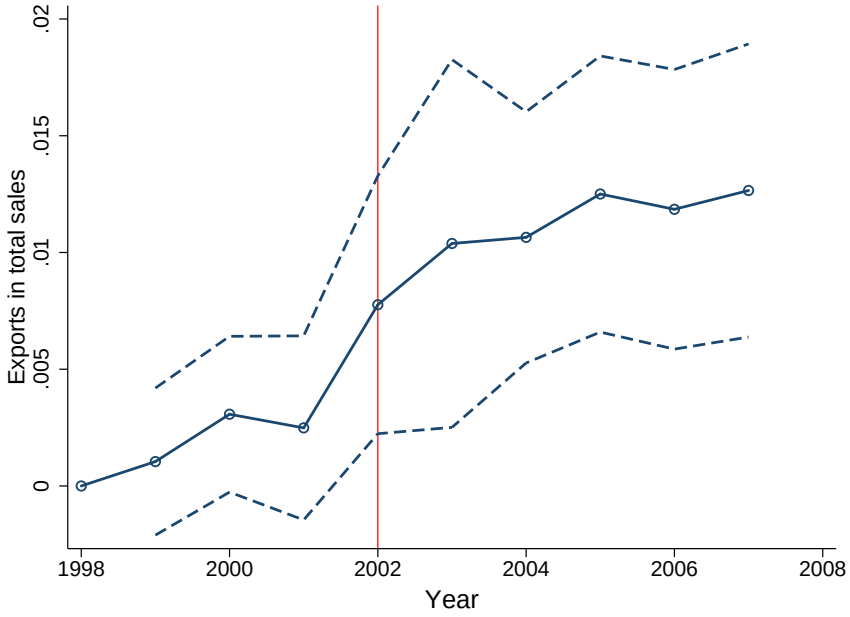


Figure 1: Year-by-Year Impact of the GTP on Firm Effective VAT Rate

Notes: This figure shows the impact of the GTP on firm VAT rate. The x-axis denotes the year; the y-axis denotes the firm-level effective value-added tax rate. The dots are estimates, β_t, of the following regression: $y_{j,t} = \alpha + \sum \beta_t Distance_j \times \delta_t + \sum \gamma_t \times X_i + \sum \theta_t \times X_j + \delta_j + \delta_{o,t} + \varepsilon_{j,t}$, where $y_{j,t}$ refers to the VAT rate, computed as the amount of value-added tax over firm sales for firm j in year t. The variable $Distance_j$ denotes the initial distance from the firm j to the respective county tax office. X_i includes the GDP per capita and population density of county i where the firm j was located in 2000; X_j covers a set of firm initial characteristics, including firm sales, total assets, employment, labor productivity, and export status of firm j. δ_j, δ_t, and $\delta_{o,t}$ are the firm fixed effects, year fixed effects, and ownership-year fixed effects, respectively. Standard errors are clustered at the county level. The solid line connects all the estimated β_t; the dashed lines describe the 95 percentile confidence intervals. The evidence suggests that the effect of the GTP took place after 2002.



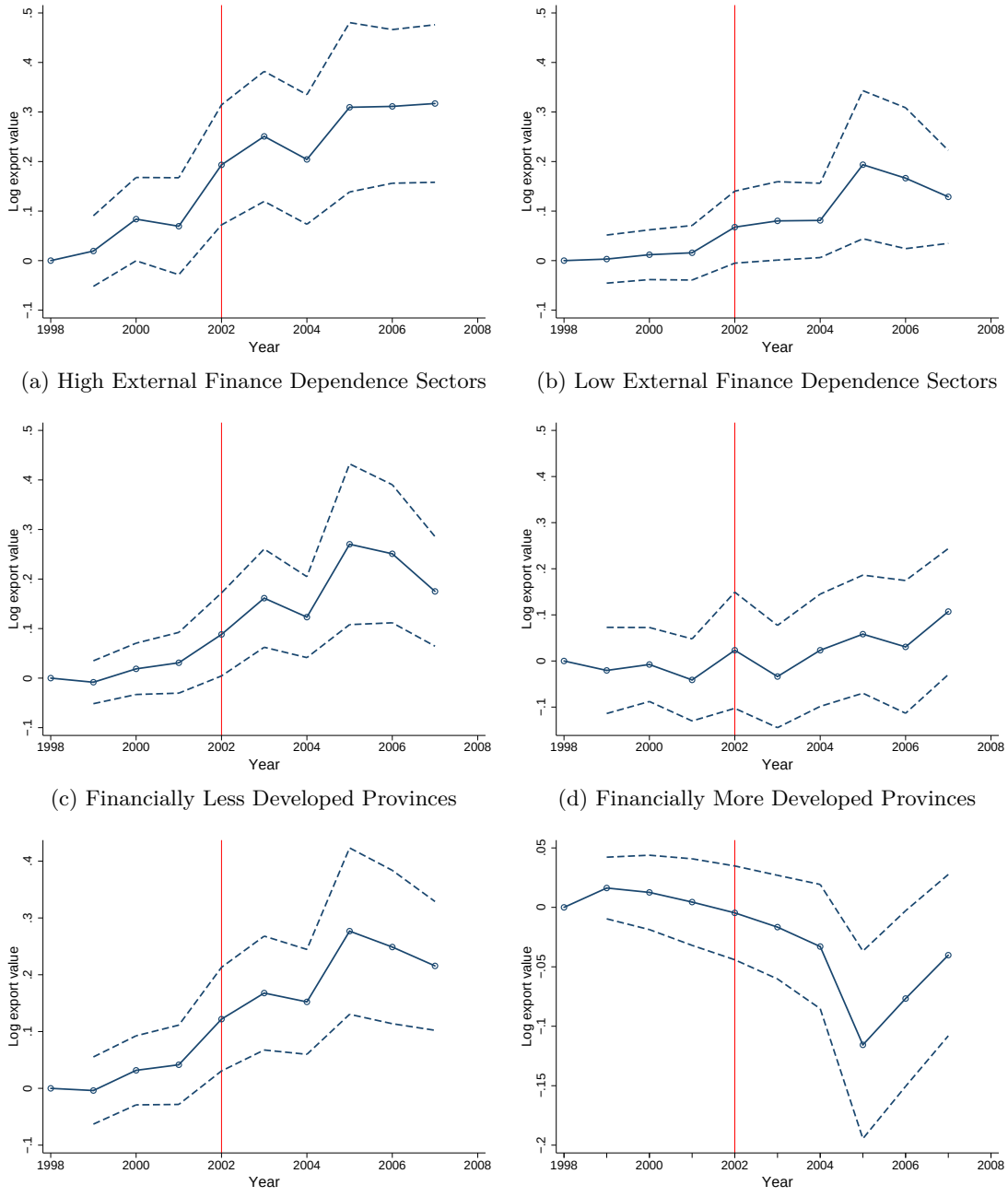
(a) Firm Export Value



(b) Firm Export Share in Total Sales

Figure 2: Year-by-Year Impact of the GTP on Firm Exports

Notes: These figures show the GTP impact on firm export sales and export share in total sales respectively. The dots are estimated β_t of the following regression: $y_{j,t} = \alpha + \sum \beta_t Distance_j \times \delta_t + \sum \gamma_t \times X_i + \sum \theta_t \times X_j + \delta_j + \delta_{o,t} + \varepsilon_{j,t}$, where $y_{j,t}$ refers to the log value of firm exports and firm exports over sales ratio, respectively. The variable $Distance_j$ denotes the initial distance from the firm j to the respective county tax office. X_i includes the GDP per capita and population density of county i where the firm j was located in 2000; X_j covers a set of firm initial characteristics, including firm sales, total assets, employment, labor productivity, and export status of firm j. δ_j, δ_t, and $\delta_{o,t}$ are the firm fixed effects, year fixed effects, and ownership-year fixed effects, respectively. Standard errors are clustered at the county level. The solid line connects all the estimated β_t; the dashed lines describe the 95 percentile confidence intervals. The evidence suggests that the effect of the GTP took place after 2002.



(a) High External Finance Dependence Sectors

(b) Low External Finance Dependence Sectors

(c) Financially Less Developed Provinces

(d) Financially More Developed Provinces

(e) non-SOEs

(f) SOEs

Figure 3: The GTP Effects on Exports by Degrees of Financial Constraint

Notes: This figure shows GTP impacts on firm exports for samples separated by the degrees of financial constraint. The dots are estimates, β_t, of the following regression: $y_{j,t} = \alpha + \sum \beta_t Distance_j \times \delta_t + \sum \gamma_t \times X_i + \sum \theta_t \times X_j + \delta_j + \delta_{o,t} + \varepsilon_{j,t}$, where $y_{j,t}$ refers to the log value of firm exports. The variable $Distance_j$ denotes the initial distance from the firm j to the respective county tax office. X_i includes the GDP per capita and population density of county i where the firm j was located in 2000; X_j covers a set of firm initial characteristics, including firm sales, total assets, employment, labor productivity, and export status of firm j. δ_j, δ_t, and $\delta_{o,t}$ are the firm fixed effects, year fixed effects, and ownership-year fixed effects, respectively. Standard errors are clustered at the county level. The solid line connects all the estimated β_t; the dashed lines describe the 95 percentile confidence intervals. The evidence suggests that the effect of the GTP took place after 2002.

APPENDIX

A.1 Model Derivation

From (4), we obtain

$$1-n_{ik}=(1-n_{ij})\left[\frac{(1-t_{ij})^{\sigma}}{(1-t_{ik})^{\sigma}}\frac{\Psi_{ij}}{\Psi_{ik}}\right]^{\frac{1}{\beta}},\ \text{where}\ \Psi_{ij}=\frac{Y_j}{f_{ij}P_j^{1-\sigma}}.$$

The firm allocates resources across different markets according to the preceding equation. This, together with the budget constraint, implies the following:

$$\sum_k f_{ik}w_i-(1-n_{ij})^{1-\beta}\sum_k f_{ik}w_i\left(\frac{(1-t_{ik})^{\sigma}}{(1-t_{ij})^{\sigma}}\frac{\Psi_{ik}}{\Psi_{ij}}\right)^{\frac{\beta-1}{\beta}}=(1-\beta)b.$$

Based on the preceding equation, the optimal n_{ij} satisfies (7).

A.2 Firm Tax Evasion Assumption

We denote a firm's sales by s, its total input cost by c, and the value-added tax rate it faces by t. The firm can choose to evade the tax. The probability of detecting tax evasion is $\phi(a)$, which is a decreasing function of the auditing "cost" of the government, denoted by a. This auditing "cost" of the government increases with the geographical distance between the firm and the tax enforcement agency, denoted by v. With a focus on distance as a key variable cost of auditing, we can assume that the probability of detecting tax evasion is $\phi(v)$ and $\phi'(v)<0$. Following the standard assumptions in the corporate tax evasion literature, the after-tax profits for a firm when evasion is not detected is defined as follows:

$$\pi^{nd}=s-c-(1-e)\,ts-g(e)ts, \tag{A.1}$$

where e is the evasion rate and $g(e)$ is the cost of hiding. We assume that $g'(e)>0$; $g''(e)>0$; $g(0)=0$ and $g(1)=\infty$. When evasion is detected, the firm's profits become

$$\pi^{d}=\pi^{nd}-\beta ets, \tag{A.2}$$

where $\beta > 1$ is the penalty factor.

Combining equations (A.1) and (A.2), we obtain the expected payoff of a risk-neutral firm as follows:

$$\pi = (1-\phi)\,\pi^{nd} + \phi\pi^{d} = s - c - (1 - e + g(e) + \beta\phi e)\,ts.$$

From the FOC with respect to e, we obtain the optimal tax evasion, which is determined by $g'(e) = 1 - \beta\phi$. Then, the effective tax rate for the risk-neutral firm is

$$\tilde{t} = (1 - e + g(e) + \beta\phi e)\,t = (1 - eg'(e) + g(e))\,t.$$

The partial effect of v on $\tilde{t}$ is given by

$$\begin{aligned}\frac{\partial \tilde{t}}{\partial v} &= \frac{\partial\,(g(e) - eg'(e))}{\partial v} = \frac{\partial\,(g(e) - eg'(e))}{\partial e}\frac{\partial e}{\partial v} \\ &= -eg''(-\beta\frac{\partial \phi}{\partial v}\frac{1}{g''}) = e\beta\frac{\partial \phi}{\partial v} < 0.\end{aligned}$$

Thus, the model assumption in the main text is a reduced form derived from a standard model in the literature.

A.3 Distance between Firm and County Tax Agency

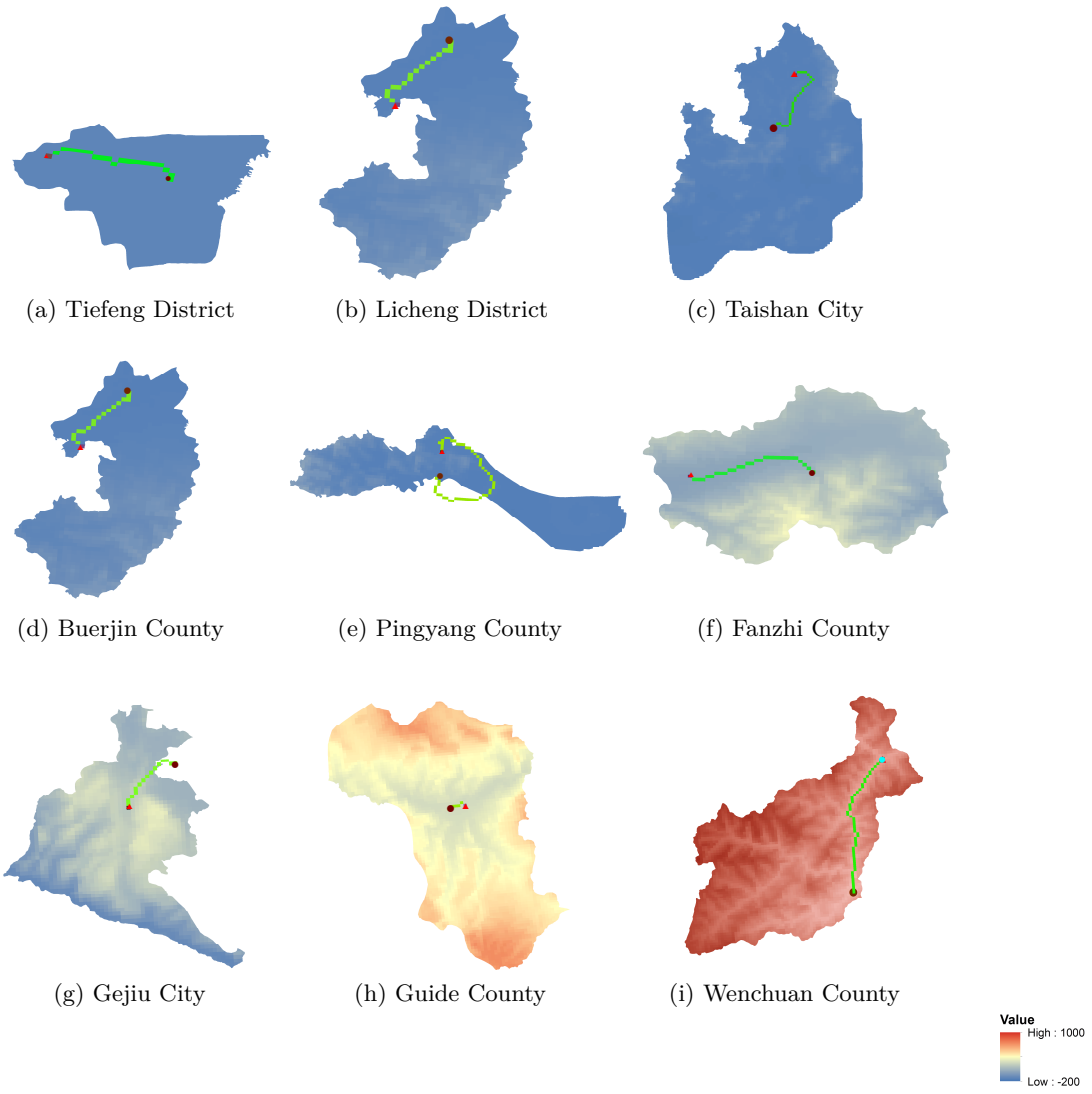
We discuss three different measures of distance. The first measure is the *simple geodesic distance*, which is calculated according to Euclidean distance between the firm and the corresponding county tax office. The second measure is the *weighted geodesic distance*, which is calculated as the product of simple geodesic distance and the county terrain ruggedness. A county's terrain ruggedness is computed as the standard deviation of the terrain elevation for all grids in the county. The third one is the *cost distance*, which is the cost of the least-cost path computed in ArcGIS, based only on the geographic features (e.g., slopes) of the terrain.

The cost distance is considered as the most accurate measure of distance in terms of travel cost between a firm and the county tax office, but computing a least-cost path for every firm in the full sample is extremely time-consuming.[35] Thus, it is impossible for us to use in this study. Figure A.1 shows the least-cost paths (the third measure) for 9 counties of various geographic ruggedness. Figure A.2 shows that, in a sample of randomly chosen 166 firms, the cost distance is positively correlated with both the simple geodesic distance (upper figure) and the weighted geodesic distance (lower figure). However, the correlation of the latter is much stronger than that of the former. Thus, we use the weighted distance as our main measure of travel cost between a firm and the local tax office.

A.4 Two-Stage Least Squares Results

Tables 1-3 show the reduced-form effects of the GTP on firms' effective VAT rate and exports. To further confirm the causal effects of the reform on exports, we rerun the regression using the two-stage least squares approach, and report the results in Table A.1. In Panel A of the table, the dependent variable is the log value of firm exports in column (1), export dummy in column (2), log value of domestic sales in column (3), and export share in column (4). Panel B shows the first-stage results. The results show that a 1 percentage point increase in the effective VAT rate leads to a 1 percent increase in firm exports and a 0.3 percent decline in firm domestic sales.

[35] Each observation takes about half an hour to calculate on ArcGIS.



(a) Tiefeng District (b) Licheng District (c) Taishan City

(d) Buerjin County (e) Pingyang County (f) Fanzhi County

(g) Gejiu City (h) Guide County (i) Wenchuan County

Figure A.1: Least Cost Paths for Nine Counties

Notes: We compute the least cost path for nine counties. The cost path tool in ArcGIS creates the least cost path from a source point (the tax agency's location) to a destination point (the firm's location), taking the slope feature into account. Blue color refers to low elevation and red color refers to high elevation. All elevation values are in meters. The average time to compute 1 least cost path is approximately 30 minutes for an average computer.

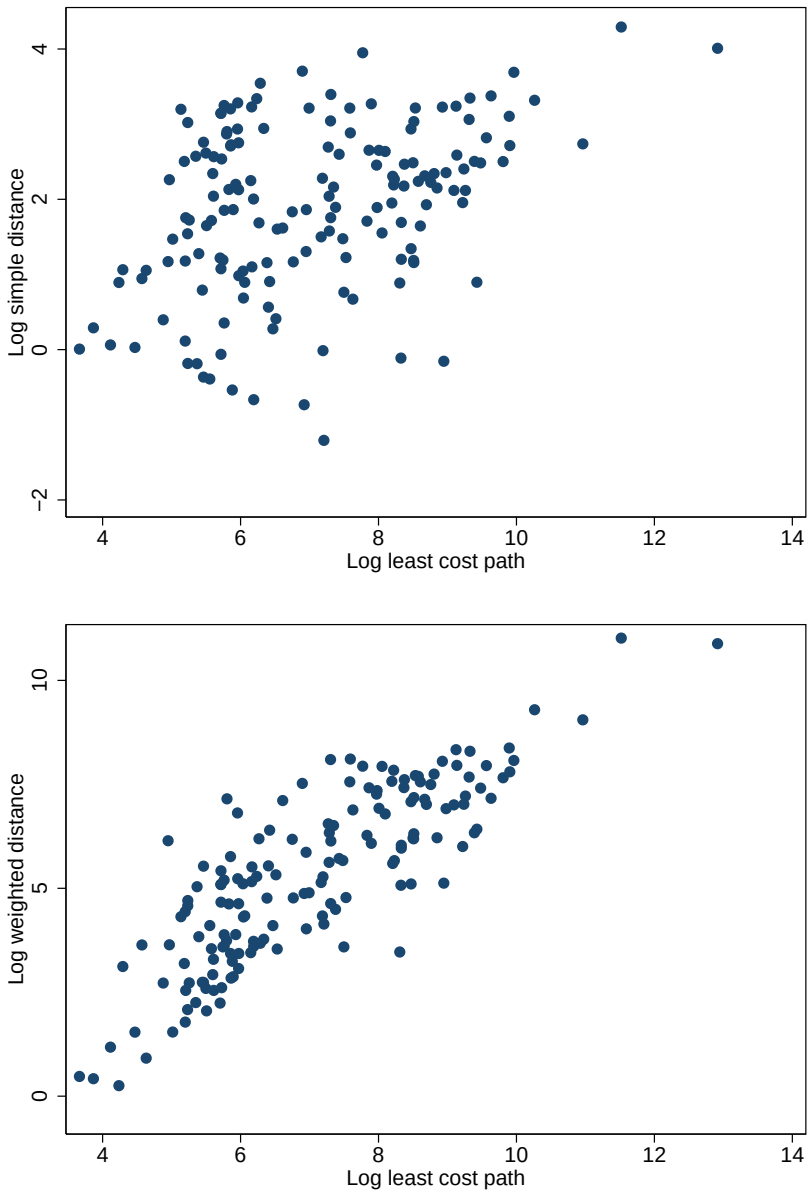


Figure A.2: Least Cost Path Distance, Geodesic Distance, and Weighted Distance

Notes: This figure shows the correlations between different measures of firm distance to tax agencies. We randomly choose 166 firms from 165 counties and computed different measures of distance based on firms' addresses and the address the the corresponding tax agencies. Least cost path refers to (cost of) the path between a source and destination that is the most cost-effective route to travel along. We use a raster file in ArcGIS that defines the cost to move through each raster cell. Simple geodesic distance is the direct distance between the two points. Weighted distance is the direct distance times the standard deviation of the county terrain. We see the strong correlation between the log least cost path and the log weighted distance. However, we see a weaker correlation between the log least cost path and the log simple geodesic distance.

Table A.1: The Two-Stage Least Squares Results

	(1) Log exports	(2) Export dummy	(3) Log domestic sales	(4) Export share
Panel A. IV				
Effective VAT rate	0.975**	0.093***	-0.345**	0.070***
	(0.247)	(0.024)	(0.127)	(0.017)
Panel B. First Stage				
Distance × Post	0.106***	0.106***	0.106***	0.106***
	(0.019)	(0.019)	(0.019)	(0.019)
F-test on excluded instrument	31.17	31.17	31.17	31.17
Firm FE	Yes	Yes	Yes	Yes
$X_{i,2000} \times \delta_t$	Yes	Yes	Yes	Yes
$X_{j,initial} \times \delta_t$	Yes	Yes	Yes	Yes
Ownership-year FE	Yes	Yes	Yes	Yes
Obs.	707456	707456	707456	707456

Notes: $X_{i,2000}$ includes GDP per capita and population density for county i in 2000, and $X_{j,initial}$ includes the initial sales, employment, total fixed assets, labor productivity, export share in total sales of firm j located in county i in year t. δ_t refers to year dummy that is equal to 1 if year equals t and zero if otherwise. Standard errors in parentheses are clustered at the county level. * $p < 0.10$, ** $p < 0.5$, *** $p < 0.01$

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