Scand. J. of Economics 124(1), 243–277, 2022
DOI: 10.1111/sjoe.12453

Estimating the repercussions from China's export value-added tax rebate policy*

Julien Gourdon†

University of Clermont-Auvergne, FR-63000 Clermont-Ferrand, France
julien.gourdon@gmail.com

Laura Hering

Erasmus University, NL-3000 DR Rotterdam, The Netherlands
laura.hering@gmail.com

Stéphanie Monjon

University Paris Dauphine, FR-75016 Paris, Fance
stephanie.monjon@dauphine.fr

Sandra Poncet

Paris School of Economics (University of Paris 1), FR-75647 Paris, France
sandra.poncet@univ-paris1.fr

Abstract

Our study shows that China's export value-added tax (VAT) rebate system is a major industrial policy that affects its exports. We use export data at the HS6 product level for a panel of 329 Chinese cities over the 2003–2012 period to assess how changes in the export VAT tax have affected China's export performance. We consider different trade margins in terms of volumes, prices, and the number of countries served. To counter endogeneity, we exploit variations in the expected impact of the export VAT rebates by trade regime, which come from an eligibility rule disqualifying certain export flows from the rebates. Our results suggest that a 1 percent decline in the export VAT tax leads to a 7.2 percent relative increase in eligible export values at the city level. This effect is due to an adjustment of quantities and the number of foreign markets served while the average unit values of exports remain unchanged.

Keywords: China; export performance; export tax; policy evaluation; trade elasticity; VAT system
JEL classification: *F*10; *F*14; *H*20; *O*25

1. Introduction

In recent decades, the Chinese government has intervened openly and forcefully to promote the country's export performance while guiding the

†Also affiliated with CERDI.

*We are grateful to Zhang Yuheng for her research assistance. This paper benefited from the financial support of the program "Investissement d'Avenir" (reference ANR-10-LABX-14-01) of the French government.

structural transformation of the economy. A privileged instrument of this intervention is the country's unique system of export value-added tax (VAT) rebates directly influences China's competitiveness on the world market. In previous economic crises, export VAT rebates have been a key adjustment variable in supporting Chinese exporters. Notably, China's export VAT rebate system has been identified as the most important state measure in terms of international trade covered during the financial crisis (Global Trade Alert, 2010). Also more recently in 2018 and 2019, China repeatedly raised export VAT rebates for a wide range of products in a "bid to boost prospects for shipments amid its trade war with the United States".[1]

Contrary to other forms of public intervention such as currency manipulation, multiple subsidies, and trade protection, the rather confusing system of tax rebates for exporters has been largely overlooked. This is particularly surprising given that export VAT rebates can be modified easily, and directly affect the country's international competitiveness. Especially in the current context of calls to apply higher tariffs on Chinese products, it is crucial to be aware of the mechanisms available to the Chinese authorities to mitigate the effects of the more protectionist policies of their trading partners.

In this paper, we use a panel of exports of Chinese cities[2] disaggregated by product and trade regime for the period 2003–2012, which allows us to directly link export flows with their respective export VAT rebate at the very detailed HS6 product level.[3] We propose a new identification strategy based on a triple difference approach that exploits differences in the export VAT rebates across products, years, and trade regimes. Our analysis shows that China's export VAT rebate system is indeed an effective industrial policy and how it has affected the different trade margins in terms of volumes, prices, and the number of countries served.

China's VAT policy differs from the standard destination-based VAT system of the OECD countries by not fully refunding the VAT on exports.[4]

---

[1]See the 2018 Reuters article 'China to increase export tax rebates on 397 products' at https://www.reuters.com/article/china-economy-tax-idINKCN1LN1BR.

[2]Mainland China is divided into 31 province-level entities, which are further divided into cities (prefectures) that are administrative units encompassing an urban area and adjacent rural counties under its jurisdiction.

[3]China exports under three main trade regimes: ordinary trade, processing with imported materials, and processing with supplied materials. In our empirical analysis, we exploit the differential treatment of the policy across these trade regimes.

[4]The value-added tax (VAT) is an indirect consumption tax: it is paid to the revenue authorities by the seller of the goods, who is the "taxable person", but it is actually borne ultimately by the final consumer. Most countries, including also countries in the European Union (EU), the United States, and Japan, leave no residual VAT contained in the export price to avoid double taxation on final consumption. They follow an approach called exempt-credit-refund: exports are

Instead, Chinese exporters can receive VAT rebates that vary across commodities, and range from zero to the full refund of the typical 17 percent VAT rate.[5] The Chinese VAT system thus imposes a tax on exporters whose goods receive a VAT refund rate lower than the applicable VAT rate. These incomplete VAT rebates to exporters make it less advantageous to export a product than to sell it domestically. In Section 2, we show that the very name of export VAT rebates is actually misleading as the repercussions of a certain change in the rebate on exporters are not proportional to their value-added but only on the export value. Incomplete export VAT rebates hence amount to export taxes and are expected to lead to lower exports (Feldstein and Krugman, 1990).[6]

Even though most Chinese exporters face an export VAT tax, the export VAT rebate system has been considered as providing Chinese exporters with an advantage with respect to foreign competitors (Evenett et al., 2012). Two features have been highlighted as evidence that this export VAT rebate system is indeed a systematic form of export management. First, there is tremendous variation across goods in the levels of and changes to the export VAT rebates. Second, over the last decade, export VAT rebate rates have been adjusted frequently, both upwards and downwards (World Trade Organization, 2010).[7] In particular, since the beginning of the global financial crisis in 2008, China has increased export VAT rebate rates several times. In contrast to many other countries, China's exports resisted rather well during the crisis and more than sextupled between 2002 and 2012, growing two times faster than the world exports over that period.

Our empirical approach exploits variations in the policy across products (within a given industry), over time and across different types of trade. Using this, we build on efforts to address the problem of omitted variables, which has traditionally hindered the evaluation of the impact of trade policies on export performance. It is indeed likely that the timing and scope of changes in the refund rate are correlated with various broader economic variables, such as worldwide economic conditions and product characteristics, as well as other industrial policies that affect export performance.

We address the resulting endogeneity via two approaches. First, we exploit variations in the expected impact of the export VAT rebates by trade

---

exempt from VAT and exporters will be refunded the VAT paid on their purchases of inputs for the production of their exports.

[5]The standard VAT rate, which was 17 percent over the period studied, was reduced to 16 percent in May 2018, and then to 13 percent in April 2019.

[6]Hence, we use the terms "incomplete export VAT rebate" and "export VAT tax" interchangeably.

[7]We compute that, over the 2002–2012 period, 89 percent of the products underwent at least one change in their VAT-refund rate.

regime, which come from an eligibility rule disqualifying a specific kind of processing trade called "processing with supplied materials" from the rebates. The other kind of processing trade (referred to as "processing trade with imported materials") is subject to the standard rules. Chinese trade occurs through either ordinary or processing forms. Processing trade refers to the operations of enterprises that procure raw materials or intermediate inputs from abroad and, after assembling them in China, re-export the products.[8] The typical export VAT rebate policy is that of "pay first and refund later", which applies to ordinary trade and processing trade with imported inputs. By contrast, the policy of "no collection and no refund" applies to processing trade with supplied inputs. In this type of trade, the firm undertakes processing or assembly work on materials it does not own. Even if the exporter pays VAT on purchases of intermediates, there is no entitlement to any export refund. Therefore, we expect export VAT refunds to have an effect only on eligible export activities (ordinary and processing trade with imported materials), which is confirmed by our empirical results. We propose various exercises to ensure the validity of our difference-in-difference-in-differences estimation. Notably, using a strict set of fixed effects, we account for differences between the eligible and non-eligible trade regime that could bias our coefficients of interest. We also rule out the possibility that the export VAT rebate policy might change the trade form chosen by firms.

Second, we rely on disaggregated city-level data instead of national exports. This allows us to control for the heterogeneity in the dynamics of export flows across the Chinese territory. By being able to account for local comparative advantages and unevenly distributed shifts in exports between products or between trade regimes, we are able to reduce the concern that our estimates suffer from an omitted variable bias. Further, the inclusion of fixed effects at the city level takes into account various political economy mechanisms that cause trade performance to have a feedback effect on the level of trade protection, including the export VAT rebate rate. Breaking down the export data to the city–product–trade regime level also has the important advantage that it allows us to account for the granularity of exports and explore the different margins of adjustment to the policy even in absence of transaction-level data (Feenstra and Hanson, 2005).[9] Our

[8]China's processing regime confers substantial benefits on export processors such as the right to import duty-free raw materials, components, and capital equipment used in processing activity (Naughton, 1996). These benefits are the same for both kinds of processing trade and therefore do not differ according to eligibility for export VAT rebates.

[9]Unfortunately, we are not able to study in greater detail the margins of adjustment because information on the type of processing trade, which is key to our identification strategy, is available at the firm level only until 2006 and therefore covers only a period in which export VAT tax mostly

analysis will therefore focus on how city-level exports adjust to a change in the export VAT rebate in terms of quantities, prices, and number of export destinations.

With our approach, we propose a more detailed analysis than the few existing studies on this policy, which focus on averages of rates calculated at the national level (Chen et al., 2006)[10] or at the industry–province level (Chandra and Long, 2013).[11] The latter two studies cover periods ending in 2002 and 2006, respectively. Our sample extends to 2012, hence including the worldwide trade crisis of 2008–2010 during which the export VAT rebate rates rebounded after years of reduction. Our analysis is closer to that of Garred (2018), which also looks at export VAT rebates at the product level. His paper focuses mainly on the link between export VAT taxes and import tariffs, and shows that decreases in export VAT rebates have partly restored China's pre-World Trade Organization trade policy. He also identifies a negative correlation between China's export VAT tax and the value of the country's exports at the product level. However, he does not attempt to establish a causal link.

Our main contribution is to rely on more disaggregated data and apply a triple difference identification strategy so as to overcome the endogeneity concerns of Garred (2018) and establish a causal link between the export VAT tax policy and the various export margins (volumes, prices, and the number of countries served). Thus, we provide a detailed assessment of the different channels through which China's export VAT rebate policy affects the country's commercial performance while taking into account endogeneity issues that traditionally bias trade elasticities estimates (Goldberg and Pavcnik, 2016). Further, we develop a simple model of international trade with heterogeneous firms to highlight the expressions for the elasticity of the trade volume and price with respect to the export tax resulting from the incomplete VAT rebates. We hence contribute to the recent trade literature that aims at estimating trade elasticities with respect to tariffs and other variable trade costs (Bas et al., 2017). With our identification strategy, we can estimate the aggregate trade

---

only increased. By using city data we can rely on a longer time period that includes the recent financial crisis and allows us to study the intensive and extensive margins of adjustment at the city–product level.

[10] Chen et al. (2006) use aggregate data from 1985 to 2002 and find that export VAT rebates are positively correlated with China's exports, final domestic consumption, and foreign exchange reserves. The size of their sample is limited to 18 observations.

[11] Chandra and Long (2013) use firm-level panel data for 2004–2006 and find a positive association between firm export volume and the average rebate rate (over exports) in the firm's industry–province pair. The explanatory variable in this study is the average ratio of the value of VAT rebates over exports, calculated over all exporting firms in the same province, two-digit industry, and year. This is instrumented by a proxy for local fiscal conditions.

elasticity for China, a key parameter to evaluate the welfare effects of trade liberalization.[12] Our last contribution consists in uncovering differences in the adjustments made by exporters following tax changes according the time period. We are particularly interested in identifying the effect of the export VAT tax reduction implemented during the financial crisis.[13]

Our results confirm that China's export VAT rebate system is indeed an effective tool for export management. Whereas there is, as expected, no significant effect on non-eligible exports, we find a negative and significant effect of the export VAT tax on eligible exports. The estimation of our benchmark specification suggests that a 1 percent rise in the export VAT tax will lead to a 7.2 percent decline in eligible export values with respect to non-eligible trade.[14] This effect on city-level export values comes uniquely via a change in the quantities so that prices, measured as unit values, are unaffected. Our point estimates of the effect of the export VAT tax on exports are actually fully in line with the estimates obtained in the recent trade literature of the parameters included in its theoretical expression. Our estimates on both quantities and prices are consistent with our model and are coherent with the trade elasticity estimates obtained on more disaggregated data in the recent trade literature (Head and Mayer, 2014; Fontagné et al., 2018).

Overall, our findings suggest that higher rebates granted by the Chinese authorities to exporters do not translate into lower prices for foreign consumers but benefit companies exporting from China through increased margins. This allows exporters, particularly the least efficient among them, to maintain and even expand into international markets. Our estimates suggest that its policy of incomplete VAT rebates has allowed China to cope with negative external shocks such as the global financial crisis in 2008–2009, and hence provides room for maneuver that China can use to manage its exports to fit its development goals. Overall, however, China's unconventional approach on VAT rebates has actually depressed its export volumes: if China brought its system in line with that of Western countries and offered a full VAT refund to its exporters (who faced an average export VAT tax of 6.3 percent in 2012), this could lead potentially to a relative increase of 45 percent in eligible exports in the absence of any mitigating general equilibrium effects.

---

[12]Our results on unit values help to infer the effect of a rebate change on the pricing strategy of exporters, and hence are complementary to existing studies on pricing-to-market and pass-through (Fitzgerald and Hallerb, 2018; Fontagné et al., 2018).

[13]In our analysis, we also explicitly address possible tax avoidance strategies of exporters, as there is evidence that exporters under-report the value of their exports to avoid paying taxes based on the value of exports (Ferrantino et al., 2012).

[14]We use for this the linear approximation of $\ln(1 + t)$ by t, knowing that t, the average export VAT tax rate, is between 2 percent and 8 percent, as displayed by Figure B1.

The remainder of the paper is structured as follows. In Section 2, we describe the Chinese export VAT rebate system. In Section 3, we give an overview of our empirical specification that directly derives from a simple model, derived in Appendix A, which incorporates export taxation from incomplete export VAT rebates into a standard trade model with firm heterogeneity. In Section 3, we also describe the data. In Section 4, we discuss the results. We conclude in Section 5.

2. The export VAT rebate system

Implemented in 1994 to replace the old industrial and commercial standard tax, the Chinese VAT system differs from that applied in many Western countries, in particular because it is not neutral for exporters (Yan, 2010). In theory, neutral VAT implies a zero rate on exported goods and a full refund of the domestic VAT paid by exporters on their inputs. In practice, China's VAT applies at a standard rate of 17 percent on goods sold on the domestic and foreign markets.[15] Export goods are, however, subject to the export VAT rebate system, which might lead to a reduced VAT rate. These rebates for exported goods vary by commodity and range from 0 to the 17 percent VAT rate.[16] This implies that whenever the VAT rate is higher than the VAT rebate for a given product, this results in a positive export VAT tax rate, which is applied to the exported value of this product.

Even though the Chinese VAT rebate policy on exports is complex and has changed frequently over time,[17] the logic has remained fairly stable (Ferrantino et al., 2012). Ordinary trade and processing exports with purchased imported materials fall under the standard rule, which is known as the "pay first and refund later" method. The main point is that the export VAT rebate enters into the calculation of the tax burden of a producer through the term "export VAT tax", which corresponds to the product of the export VAT rate (VAT rate minus VAT rebate) and the total export value (and not the value added incorporated in exports). Equation (1) reports the official formula used to calculate the total amount of VAT to be paid by businesses (Circular No. 7, Notice on Further Implementing the

[15]A reduced rate of 13 percent applies to basic staples or household necessities such as food, fuel, electricity, books, newspapers and magazines, and agricultural products.

[16]China started off with a complete rebate in 1994, but the strong rise in exports during the 1990s led to a heavy fiscal burden for the government, so the country quickly lowered the export VAT rebates and fixed different rates across sectors (Chandra and Long, 2013).

[17]VAT rebates are set by the State Administration of Taxation. Changes are typically announced in a circular jointly edited by the State Administration of Taxation, the Ministry of Finance, the National Development and Reform Commission, the Ministry of Commerce, and the General Administration of Customs.

"Exemption-Credit-Refund" System of Export Tax Rebate, issued jointly by the Finance Ministry and the State Administration of Taxation in China, October 2002), including, next to a classical term where the VAT rate is applied to the VAT base, a specific term that corresponds to the export VAT tax and which is our focus of interest:

$$\begin{aligned}\text{VAT payable} = & \underbrace{\sum_k (\text{domestic sales}_k \times \text{VAT rate}_k)}_{\text{domestic sales VAT}} \\ & - \underbrace{\left(\sum_{k'} \text{inputs}_{k'} \times \text{VAT rate}_{k'}\right)}_{\text{input VAT}} \\ & + \underbrace{\sum_k \left(\text{Exports}_k - \sum_{k'} \text{BIM}_{k'}\right) \times (\text{VAT rate}_k - \text{export VAT rebate rate}_k)}_{\text{export VAT tax}}.\end{aligned} \tag{1}$$

Here, k denotes products and k' denotes the intermediate inputs used to produce k. Domestic sales VAT is the VAT collected on domestic sales and input VAT is the VAT paid on inputs subject to VAT. The input VAT applies to all inputs, whether domestically sourced or imported, except the bonded duty-free imported materials (BIM).[18]

The export VAT tax, captured by the last expression of equation (1), indicates that, all else equal, a higher export VAT rebate lowers the fiscal burden for exporters.[19] For exporters that do not use bonded duty-free inputs, a VAT rebate that is lower by one percentage point increases their tax payment by 1 percent of the value of their export. The change in the fiscal burden is thus not related to the value-added. The very name of the VAT rebate policy on exports is misleading as the bite of a certain shortfall in the rebate does not hurt firms in proportion to the importance of their domestic input purchases. Exporters can, of course, pay VAT on the inputs they use but this amount is not connected to the export VAT rebate they receive for their exports. It is therefore not necessary to know the share of domestic value-added in exports to assess the quantitative importance of the VAT rebate policy for exports. In our empirical strategy, the key explanatory variable is the export VAT tax rate defined as the difference

[18]Imports under the bonded status are free from import duties and VAT. This would typically be the case for processing trade activities.

[19]If the VAT payable is negative, then the tax bureau will refund it, but subject to a cap.

between the VAT rate and the export VAT rebate rate, in logs as derived from our model in Appendix A.

In contrast to ordinary trade and processing trade with imported materials, processing exports with supplied materials are not entitled to any VAT refund (Chan, 2008). This type of trade falls under the rule of the "tax-exempt" (or "no collection and no refund") method. In export processing with supplied materials, the Chinese firm undertakes processing or assembling work on materials it does not own. The property of these materials is retained by a foreign party. There is no sale and therefore no VAT is levied on these inputs. The exporting company, even if it has paid VAT on other local supplies, is in no way entitled to VAT rebates on the products it exports.

Our empirical approach, detailed in Section 3, exploits this eligibility rule that disqualifies processing trade with supplied materials from the rebates. We measure the impact of the export VAT rebate policy on city-level exports as its differential effect between eligible and non-eligible regimes for a given product–year pair, while taking into account structural differences between products, cities, and the two trade regimes through various sets of fixed effects.

Stylized facts on export VAT rebates are presented in Appendix B.

3. Empirical specification and data

3.1. Empirical specification

Our empirical specification is directly derived from the simple model presented in Appendix A. We expect that an increase in export taxes lowers the number of exporters and the value and volume of exports for surviving exporters. The overall effect on aggregate prices is predicted to be very small due to composition effects.

Our main dependent variable, $\ln \text{export}^R_{ck,t}$, is the log of the export values of HS6 product k in city c under regime R in year t, with R comprising the eligible and non-eligible regimes. In our empirical analysis, we also study the policy repercussions on export quantities, unit values, and the number of destinations to which a city exports a specific product.

Our benchmark specification is

$$\begin{aligned}\ln \text{export}^R_{ck,t} \;=\; & \alpha \;\ln \text{export VAT tax}_{k,t-1} \times \text{Eligibility}^R \\ & + \lambda X^R_{ck,t-1} + FE_{k,t} + FE^R_{ck} + FE^R_{cs,t} + \epsilon^R_{ck,t}. \qquad (2)\end{aligned}$$

In line with our model, the export VAT tax variable is defined as ln[1 + (VAT rate − export VAT rebate)]. The dummy $Eligibility^R$ takes the value of 1 if the export flow is in the eligible trade regime, and 0 otherwise.

Our key coefficient of interest, α, captures the differential impact of the export VAT tax on eligible exports relative to non-eligible exports. The export VAT tax variable is lagged by one year to allow the firms to adjust their production to the generally unanticipated changes in the tax rates.[20] In this triple difference specification, we include fixed effects at the product–year level ($FE_{k,t}$), city–product–regime level (FE^R_{ck}), and at the city–sector–regime–year level ($FE^R_{cs,t}$).

Product–year fixed effects ($FE_{k,t}$) capture all factors that shape the export performance for a given product in a given year and that might correlate with the rebate policy. They include world demand and all product-specific policies that have the same expected impact on eligible and non-eligible exports, such as subsidies, tariffs imposed by China's trading partners, and R&D promotion policies (Girma et al., 2009). Moreover, adjustments to VAT rebates appear to be made to meet various objectives such as technological upgrading, mitigating the risk of trade disputes, and food safety. Therefore, variations in export performance for a given product can lead to a change in the discount for that product. As these product-level factors do not vary much between trade regimes for a given product, such as export dynamics or sophistication (Eisenbarth, 2017; Garred, 2018), they are well captured by the product–year fixed effects.

The city–product fixed effects that vary by regime type (FE^R_{ck}) control for structural differences between eligible and non-eligible regimes and make both trade regimes more comparable.[21] Because these dummies are varied at the city level, they take into account the comparative advantage of each product in a given location. The evolution of China's comparative advantages in the export of a given product and regime type depends a lot on the geographical location of the producer. For example, the decline of often inefficient state-owned automobile producers in the interior of China has been accelerated by the establishment of partly foreign-owned electric vehicle producers in the south of the country. These evolutions can be correlated with our regressor of interest (export VAT tax × eligibility) because they occurred simultaneously with an increase in VAT export

[20] In unreported results available upon request, we add the contemporaneous export VAT tax variable in our specification to check whether firms anticipate or respond to policy changes faster than a one-year lag. This variable is not significant and its introduction does not affect the coefficient on the lagged rebate rate.

[21] Well-known differences between ordinary and processing trade flows are notably in terms of their domestic value-added, sectoral distribution, production structure, productivity, and factor intensity (Dai et al., 2016; Kee and Tang, 2016). In Section 4.4.1, we further show that our results hold when dropping ordinary trade and limiting the sample to processing trade only, where the structural differences between eligible and non-eligible trade are expected to be much smaller.

rebates[22] and affect exports differently according to the type of ownership and productivity of firms, two important factors in the choice of trade regime. These factors are difficult to control for if the study is conducted with data aggregated at the national level. The use of city-level exports allows us to account for unobserved changes in comparative advantages that lead to some unevenly distributed shifts in exports between products or between trade regimes for a given product.

Our last set of fixed effects are city–sector–regime–year dummies ($FE^{R}_{cs,t}$), which capture demand and supply shocks that are common to all products of regime type R in sector s in year t for city c.[23] Most importantly, they control for potential time-varying differences across regime types for a specific sector in a given city, such as local shocks affecting the two trade types differently or average rebate rates for all the products in the same sector. At the same time, these fixed effects control for all time-varying city and sector characteristics that can vary across trade regimes, such as labor and capital intensity.

Because of these very demanding fixed effects, our estimated effect is identified solely by the variation of exports across products within the same sector, city, trade regime, and year, while we control for everything that is specific to a product in a given year that is the same for both trade regimes and constant over time for each product–city–regime type combination.

We are not aware of any other national policy that is specific to non-eligible processing exports with supplied inputs. However, specific regulations apply to processing trade, so that they fully apply to non-eligible flows, while they only partially apply to eligible flows, which combine ordinary trade and processing with imported materials. We address these regulations explicitly to avoid bias in our estimates.

The main preferential treatment of processing trade consists in the exemption of import tariffs on inputs used in processing exports. Import tariffs thus only apply to ordinary trade. Because we do not know which inputs are used in the production of ordinary exports, we do not know the corresponding import tariffs at the product level. However, the city–sector–year–regime fixed effects account for the general level of import tariffs on inputs used by sector s in city c in year t in a way that is specific to each regime type R. To ensure that our results on the export VAT tax do not

[22] On average for the automotive sector (HS, Chapter 87), the export VAT rebate increased by 2 percentage points between 2008 and 2012.

[23] Sectors s are defined following the Chinese GB/T industry classification. Our main sample with 3,346 products at the HS6 level consists of 401 four-digit sectors. The match between Chinese GB/T industry codes and HS codes is taken from Upward et al. (2013). There are a few HS6 products for which the GB/T code is not available. In these cases, we assign missing values with the most common GB/T over coarser HS codes.

pick up the effect of import protection, we add import tariffs of product k interacted with the eligibility dummy.[24]

Finally, because – even with our various sets of fixed effects – it is still possible that export dynamics for a given product within the same sector vary by trade regime or city and are correlated with the export VAT rebate rate, we add a vector of control variables $X^R_{ck,t-1}$. To account for export dynamics at the city and HS6 product level, we control for the change in city–product export values from $t-2$ to $t-1$ (Export growth$_{ck,t-1}$).[25] Further, we include the share of exports by foreign firms (Foreign share$^R_{ck,t-1}$) and the share of state-owned firms (State share$^R_{ck,t-1}$) defined at the city–product–regime level. These two controls are crucial to account for the time-varying ability of different localities to export different products (under different regimes) as export performance in China varies greatly by firm ownership (Amiti and Freund, 2010).[26] $\epsilon^R_{ck,t}$ is the error term.

All regressions cluster standard errors at the product level to account for serial correlation of the error term within products.[27]

3.2. Data

Our variable of interest is the export VAT tax corresponding to the difference between the export VAT rebate and the VAT rate. Export VAT rebate rates and VAT rates at the tariff-line level (HS eight-digit or more disaggregated levels) are taken from the Etax yearbooks of Chinese Customs. While export VAT rebates change frequently, the VAT rates have remained constant between 2002 and 2012.[28] Online Appendix C-1 provides more detail.

---

[24]In Online Appendix D-3, we detail two additional policies that are specific to processing trade (export processing zones and product-specific restrictions to processing trade) and ensure that our results hold when accounting explicitly for these policies.

[25]See Online Appendix C-3 for the construction of these variables. Following the suggestion of an anonymous referee we have also ensured that our point estimates are not driven by "bad controls". For example, when foreign firms are less responsive to rebate rates, their share of exports can change in a particular city–product–year cell as a consequence of policy change. In unreported results available upon request, we find that our results are not significantly affected when the vector of control variables is not included.

[26]The export VAT rebate policy does not depend on the ownership of the firm but only on the chosen trade regime.

[27]One remaining concern of this triple-difference specification comparing export VAT tax repercussions on eligible and non-eligible exports is the possibility that the export VAT tax policy affects the trade form chosen by exporting firms; that is, higher export VAT tax for a given product might lead firms to switch from eligible to non-eligible trade. Online Appendix D-1 provides some suggestive evidence that this is not a major threat to our identification strategy.

[28]The standard rate of 17 percent applies to roughly 93 percent of our main sample.

We link the export VAT data to export data by city–product–year, which come from the Chinese Customs. We observe values, quantities, and the number of destination countries for a panel of 4,823 products over the 2003–2012 period.

We split export flows into two groups depending on whether they are eligible or not to VAT refund. Eligible trade includes ordinary trade and processing trade with imported materials (also known as import and assembly). The latter refers to "business activities in which the operating enterprise imports materials/parts by paying foreign exchange for their processing, and exports finished processed products for sale abroad" (Manova and Yu, 2016).

Non-eligible trade corresponds to processing trade with supplied materials – also called processing and assembly.[29] In their explanatory notes of 2021, the General Administration of Customs of the People's Republic of China refers to this as "the type of inward processing in which foreign suppliers provide raw materials, parts or components under a contractual arrangement for the subsequent re-exportation of the processed products. Under this type of transaction, the imported inputs and the finished outputs remain property of the foreign supplier."[30]

Over our sample period (2003–2012), China's export flows (excluding the category "other exports") are composed of 46 percent ordinary trade, 45 percent processing trade with imported inputs (eligible processing), and 9 percent processing trade with supplied inputs (non-eligible processing). While the share of the non-eligible export flows decreases over time (for reasons we discuss in Online Appendix D-1), the share of ordinary trade shows a small upward trend (see Figure C-1 in Online Appendix C). However, it remains comparable in size to processing with imported inputs whose share remains stable over the sample period.[31]

Combining the trade data and the VAT data leaves us with 4,792 HS6 products and 436 cities.[32] As our empirical strategy appeals to

[29]The other transaction types in the data include specific flows such as international aid, contracting projects, and customs warehousing trade. These other types together cover less than 7 percent of total exports over the 2003–2012 period. We do not include these flows in our analysis as we have only limited information on how the export VAT rebate policy is applied to them. Column 1 of Table D-3 in Online Appendix D-2 provides robustness checks to ensure that our results remain when this trade category ("others") is included and regarded as eligible.

[30]See http://english.customs.gov.cn/Statics/4de2825f-94d5-4bc4-8912-a3e0f49a352d.html.

[31]In Section 4.4.1, the sample is reduced to processing trade only, so that the identification is based on the comparison of eligible to non-eligible processing exports at the city–product–year level. In this sample, the non-eligible processing exports represent close to 40 percent of the sample.

[32]Cities are administrative units below the provinces encompassing an urban area and adjacent rural counties under its jurisdiction. Our sample includes prefecture- and county-level cities. Our main results hold if we limit our sample to prefecture-level cities only.

heterogeneous policy responses according to the trade regime, we drop products that are not exported under both the eligible and the non-eligible regimes, as well as localities that do not export under both the eligible and the non-eligible regimes.[33]

Our final sample includes observations for 329 cities on 3,346 HS6 products (representing 314,892 city–product pairs). The trade included in this sample represents over 80 percent of China's total exports under these two regimes over the sample period. The construction of unit value and extensive margin is described in Online Appendix C-1.

4. Results

4.1. Policy repercussions on export values

In this section, we present our main results on the average effect of the export VAT tax on export values following the specification in equation (2). The effect of the export VAT tax is identified by comparing its effect on eligible trade flows for a given city–product pair with that on the corresponding non-eligible flows.

Results are displayed in Table 1. Before we rely on our benchmark specification, Columns 1 and 2 estimate the effect of the export VAT tax separately on the two trade regimes. Including only one regime type in the regression does not allow to control for product–year specific fixed effects that can account for confounding factors at the product level. Therefore, we add a variety of product–year specific variables to compensate for the absence of $\mathrm{FE}_{k,t}$. Following the gravity literature (Head and Mayer, 2014), we account for supply-side determinants of exports by adding China's export growth in this product over the previous period and we control for demand-side determinants by including the world import value, again defined at the product level. Further, we add export taxes and import tariffs, which are specific to product k.[34]

Columns 1 and 2 indicate that the effect of the export VAT tax is – as expected – limited to the eligible exports. We have a negative and highly significant coefficient of −7.3 for eligible trade in Column 1, while the coefficient of the export VAT tax for non-eligible trade in Column 2 is close

[33]We exclude exports coming from the so-called "bonded zones" and "export processing zones" (EPZs) in which the VAT regime is different. In Online Appendix D-3, we show that our results are virtually unchanged when exports from these zones are included in our sample and coded as non-eligible exports in their corresponding city.

[34]Export tax is another fiscal measure affecting Chinese exports, although it applies to far fewer products than export VAT rebates. For a detailed description and the construction of the control variables, see Online Appendix C-3.

Table 1. Impact of the export VAT tax on export flows

	Trade regime			
	Eligible	Non-eligible	All	All (benchmark)
	(1)	(2)	(3)	(4)
ln VAT export $\text{tax}_{k,t-1}$	−7.262***	0.029	0.347	
	(0.523)	(1.076)	(1.074)	
ln VAT export $\text{tax}_{k,t-1} \times \text{Elig.}^{R}$			−7.629***	−7.178***
			(1.118)	(1.180)
$\text{Export growth}_{ck,t-1}$	0.161***	0.119***	0.159***	0.158***
	(0.002)	(0.007)	(0.002)	(0.002)
$\text{Foreign export share}^{R}_{ck,t-1}$	0.430***	0.479***	0.434***	0.418***
	(0.010)	(0.024)	(0.010)	(0.009)
$\text{State export share}^{R}_{ck,t-1}$	−0.013*	0.223***	0.003	−0.020***
	(0.007)	(0.027)	(0.007)	(0.007)
$\text{Export growth}_{k,t-1}$	0.133***	0.094***	0.129***	
	(0.011)	(0.028)	(0.010)	
$\text{World demand}_{k,t-1}$	2.074***	1.738***	2.040***	
	(0.143)	(0.292)	(0.142)	
$\text{Export tax}_{k,t-1}$	−1.140	1.463	−1.098	
	(0.891)	(2.050)	(0.893)	
$\text{Import tariff}_{k,t-1}$	−0.032	0.094	−0.144	
	(0.572)	(1.257)	(1.250)	
$\text{Import tariff}_{k,t-1} \times \text{Elig.}^{R}$			0.114	1.890
			(1.179)	(1.157)
Fixed effects				
City–product (FE_{ck})	Yes	Yes		
City–sector–year ($\text{FE}_{cs,t}$)	Yes	Yes		
City–product–regime (FE^{R}_{ck})			Yes	Yes
City–sector–regime–year ($\text{FE}^{R}_{cs,t}$)			Yes	Yes
Product–year ($\text{FE}_{k,t}$)				Yes
Observations	1,749,521	188,970	1,938,491	1,938,491
R^2	0.832	0.836	0.832	0.844

Notes: The dependent variable is ln export $\text{value}^{R}_{ck,t}$ (city/product/trade regime/year). Heteroskedasticity-robust standard errors clustered at the product level are given in parentheses. *c* stands for city, *k* for the HS6 product level, *t* for year, and *R* refers to the two eligibility regimes in the VAT rebate system: the non-eligible processing trade with supplied inputs and the eligible ordinary and processing trade with imported materials. Sectors are defined following the Chinese four-digit GB/T industry classification and regroup several products. ***, **, and * denote significance at the 1, 5, and 10 percent levels, respectively.

to zero and not significant. This latter result suggests that non-eligible trade is indeed a valid control group for evaluating the export repercussions of the changes in the VAT refunds to exporters. Changes in the export VAT

rebate rate hence do not seem to result in a simple nominal relabeling of the trade regime. Thus, we reject the possibility that the value of exports going up in the eligible regime after the rebate rise is being merely reallocated from the non-eligible regime with total exports remaining the same.

In Column 3, we combine the two trade regimes but still exclude the product–year fixed effects $FE_{k,t}$ to obtain an estimate of the repercussions of the export VAT tax on exports for both trade regimes. However, we add the city–sector–year–regime dummies ($FE^{R}_{cs,t}$), so that our coefficient is capturing only variations in exports in response to the VAT export tax across products that are within the same sector, city, trade regime, and year. To separate the effect of a change in the tax between eligible and non-eligible exports, we also include, next to the export VAT tax variable, its interaction with a dummy for Eligibility. As explained in Section 3, import tariffs only apply to ordinary trade. We thus also allow the coefficient of the import tariff to be different for eligible and non-eligible trade. The latter, which consists uniquely of processing trade, should not be affected by this tariff.

The negative and highly significant coefficient of the export VAT tax interacted with the Eligibility dummy in Column 3 suggests that the export tax stemming from incomplete VAT rebates has negative repercussions for eligible exports. In contrast, the export VAT tax has no significant effect on values when exports consist of non-eligible processing with supplied inputs, as indicated by the relatively small and non-significant coefficient of the average export VAT tax that captures the effect for the non-eligible export flows.

Our proxies for world demand- and supply-side dynamics have all the expected positive and significant effects on our dependent variable. However, other trade policy measures (export tax and import tariffs) fail to be significant. In the presence of sector–year dummies ($FE^{R}_{cs,t}$) this can reflect that there is limited heterogeneity in these rates between products in the same sector.

Column 4 reports our benchmark results (corresponding to equation (2)). The added product–year fixed effects account for all time-varying product-level factors, which are common to both regimes so these variables are dropped.[35] The results confirm that our key variable of interest, the interaction term between the export VAT tax and the Eligibility dummy, is highly significant. The coefficient of −7.17 suggests that a 1 percent increase in the export VAT tax leads to a 7.17 percent decrease in eligible export values relative to non-eligible exports. This effect is economically

[35]The export VAT tax (without the interaction term) is also dropped as it is accounted for by the product–year fixed effects.

significant even in the context of China's average export growth of about 20 percent per year over the last decades. A quick back-of-the-envelope calculation thus suggests that the adoption of a full VAT rebate system, as in many Western countries, would potentially induce a relative increase of 45 percent in the Chinese exports of eligible activities.[36]

While our estimate is half that of Chandra and Long (2013), it is about the same size as that of Garred (2018). By using more disaggregated data at the city and product level than Chandra and Long (2013), we obtain a more reasonable impact, which is consistent with our simple model presented in Appendix A. As we show in Appendix A.2, when we follow Chaney (2008) and assume that the marginal cost has a Pareto distribution, the export tax elasticity for the export value is equal to $[\sigma(1-\gamma)-1]/(\sigma-1)$ (equation (A12)). Using the parameters proposed by the literature for γ and $\gamma/(\sigma-1)$ we obtain a range for the elasticity between -5 and -11, which is remarkably consistent with our estimate of -7.17.

Table D-2 in Online Appendix D shows that our results hold and that the magnitude of the export VAT tax coefficients remains highly similar when we modify the sample and add more controls. Tables D-3, D-4, and D-5 ensure that the main results from Column 4 of Table 1 are robust across various subsamples.

4.2. Impact of the export VAT tax on different export margins

In this section, we investigate whether the strong reaction of export values to changes in export VAT tax is mainly due to changes in prices or changes in quantities. In line with our model, we expect that an increase in the export VAT tax will reduce the quantities shipped as the taxes are an additional cost to the producer. However, the increase in costs is expected to affect not only the intensive margin but also the extensive margin of exporters by driving the least productive firms out of the export market, leading to less destination countries served. We therefore study the impact of the policy on the different margins of adjustment: quantities, prices, and the number of export destinations.

While our theoretical model can provide a clear prediction of a negative effect of the tax on aggregate quantities, the net effect on aggregate prices is ambiguous: the direct negative repercussion of the tax on firm-level export prices can be more than compensated by the composition effect related to the exit of the least productive firms that charge high prices, leading actually to a decline in aggregate prices. Furthermore, the repercussions

[36]This number is obtained by multiplying the export VAT tax rate in 2012 (6.3 percent) with our average elasticity of 7.17 (Column 4 of Table 1).

of a change in rebates on export prices depend also on the extent to which exporters pass rebates through to prices. Exporters could well keep prices constant and absorb the changes in rebates in their margins. Also, considering that unit values are a common proxy for product quality, we could expect a positive effect on unit values when a decrease in the export VAT tax leads to quality improvements. The expected sign of the overall effect on the average price for product–city pairs is thus not clear.

Even though we cannot estimate the effect of the export VAT tax on the extensive margin at the firm level,[37] we can look at its impact on the number of destinations served by each city–product pair. If firms exit from the export market after a tax increase, we expect that, overall, fewer destinations will be served.

Table 2 reproduces the main results of Table 1 (corresponding to Columns 1, 2, and 4) for each of the three adjustment margins: the quantity exported, the average price, and the number of destinations, respectively.

Panel A of Table 2 presents the results for export quantities. The coefficient measured on the export VAT tax for export quantities is very similar to that obtained on export values. These results strongly suggest that the policy impact observed on export values is driven by a decrease in the eligible exported quantities.[38]

Panel B of Table 2 reports the estimation results for unit values and confirms this conclusion. Conditional on our strict controls, we find no significant differential effect of export VAT rebates on unit values for the two trade regimes. Our findings thus suggest that there is no change in average (tax inclusive) prices or in average quality of the exported goods after a change in the export VAT tax. This finding is in line with Garred (2018). If anything, the marginally significant negative estimate we measure in Column 1 may suggest that the least productive firms are driven out of the export market, so that overall prices fall as a result of an increase in taxes.

In the light of our simple model with heterogeneous firms, the finding that the elasticities are the same for export values as for export quantities suggests that while exporters pass on VAT rebate changes in prices, a

[37]As mentioned above, firm-level exports that provide information on export value by product for the different trade regimes are only available for a few years up to 2006.

[38]Looking at quantities rather than values has an interest that goes beyond simply decomposing the adjustment margin. Under-reporting of the value of exports by firms to avoid paying taxes based on the value of exports can pose measurement problems. If these practices affect values and not quantities as suggested by Fisman and Wei (2004), export prices should be under-reported. An increase in the export VAT rebate should encourage exporters to cheat less and thus report a higher price to customs. We also address this issue in Section 4.4.

Table 2. Impact of the export VAT tax on different export margins

	Eligible	Non-eligible	All
	(1)	(2)	(3)
Panel A			
		ln quantities$^{R}_{ck,t}$	
ln export VAT tax$_{k,t-1}$	−7.356***	0.113	
	(0.530)	(1.096)	
ln export VAT tax$_{k,t-1}$ × Elig.^{R}			−7.172***
			(1.249)
R^2	0.877	0.868	0.885
Panel B			
		ln unit values$^{R}_{ck,t}$	
ln export VAT tax$_{k,t-1}$	−0.401*	−0.122	
	(0.234)	(0.508)	
ln export VAT tax$_{k,t-1}$ × Elig.^{R}			−0.129
			(0.482)
R^2	0.921	0.927	0.924
Panel C			
		ln number of countries$^{R}_{ck,t}$	
ln export VAT tax$_{k,t-1}$	−2.609***	0.445	
	(0.228)	(0.359)	
ln export VAT tax$_{k,t-1}$ × Elig.^{R}			−2.906***
			(0.394)
R^2	0.883	0.851	0.896
Additional controls$^{R}_{ck,t-1}$	Yes	Yes	Yes
Additional controls$^{R}_{k,t-1}$	Yes	Yes	
Fixed effects			
City–product (FE$_{ck}$)	Yes	Yes	
City–sector–year (FE$_{cs,t}$)	Yes	Yes	
City–product–regime (FE$^{R}_{ck}$)			Yes
City–sector–regime–year (FE$^{R}_{cs,t}$)			Yes
Product–year (FE$_{k,t}$)			Yes
Observations	1,938,491	1,938,491	1,938,491

Notes: Heteroskedasticity-robust standard errors clustered at the product level appear in parentheses. *c* stands for city, *k* for the HS6 product level, *t* for year, and *R* refers to the two eligibility regimes in the VAT rebate system: the non-eligible processing trade with supplied inputs and the eligible ordinary and processing trade with imported materials. Sectors are defined following the Chinese four-digit GB/T industry classification and regroup several products. ***, **, and * denote significance at the 1, 5, and 10 percent levels, respectively.

substantial entry/exit by inferior firms leads to a compositional change such that there is no change in average prices. As shown at the end of the model in Appendix A.2, under a Pareto distribution, the export tax elasticity for

the unit value is $(-1)/(\sigma - 1)$, which equals -0.2 in the case where $\sigma = 6$. The predicted coefficient for export prices is hence much smaller than that for export values or quantities. Our results are in agreement: our estimates on unit values are very small and are not significantly different from zero.

Finally, Panel C presents the results on the number of destinations that city c serves with product k under regime R. If firms start or stop exporting a given product as a result of a change in the export VAT rebate, we expect the number of destinations to change as well. Indeed, we confirm that higher export VAT taxes discourage exporters from serving a specific market entirely: the point estimates suggest that the number of destinations to which a Chinese city exports is decreasing by nearly 3 percent as a result of a 1 percent rise in export VAT tax. Again, this only applies to eligible exports. As with the other margins, ineligible processing trade shows no reaction to a change in export VAT tax.

4.3. Role of the export VAT tax during the financial crisis

Claims that China is using its export VAT tax rebate system to give its exporters an unfair advantage on the world market were raised in particular during the financial crisis, which started in the last quarter of 2008. In 2009, global trade dropped by about 11 percent. In response to the global recession, the average export VAT tax declined from 7.94 percent in 2008 to 6.72 percent in 2009. In 2010, the government increased the VAT rebates even further for many of the products concerned by the initial tax cut in 2008 or 2009. In total, between 2008 and 2010, export VAT taxes declined for 2,870 HS6 products, while over the same time period it rose for only 382 products. This steep decline in tax rates came after several years of a steady increase in the average tax rates, as we show in Figure B1.

Given our previous findings, we would expect that these tax decreases have indeed helped Chinese exporters to perform better during the crisis. However, in the first years after the crisis hit, the government doubled down on its initial tax rebates in 2008 and 2009. Also, world demand for many products was very low at that time. Therefore, it is not clear that exporters could benefit from the tax cut to the same extent as in better times. To test whether the sensitivity of China's exports with respect to changes in the export VAT tax remained the same throughout the crisis years, we add interaction terms of the tax with year dummies for the last four years of our sample, which capture the year of the crisis and its immediate aftermath.

Table 3 shows the results of this specification for export values and the three margins of adjustments (quantities, unit prices, and the number of destinations). Column 1 shows results for export values, indicating that the

Table 3. Impact of the export VAT tax during the crisis

	(1)	(2)	(3)	(4)
ln export VAT $\text{tax}_{k,t-1}$	−9.196***	−8.938***	−0.021	−3.045***
$\times$ Elig.^{R}	(1.239)	(1.258)	(0.564)	(0.471)
ln export VAT $\text{tax}_{k,t-1}$	1.954	2.944*	−1.569*	0.168
$\times$ Elig.$^R \times$ 2009	(1.642)	(1.775)	(0.801)	(0.594)
ln export VAT $\text{tax}_{k,t-1}$	4.184**	4.114**	−0.203	0.176
$\times$ Elig.$^R \times$ 2010	(1.820)	(1.900)	(0.821)	(0.674)
ln export VAT $\text{tax}_{k,t-1}$	3.908**	2.957	0.424	0.914
$\times$ Elig.$^R \times$ 2011	(1.799)	(1.887)	(0.700)	(0.716)
ln export VAT $\text{tax}_{k,t-1}$	2.385	1.295	0.354	−0.422
$\times$ Elig.$^R \times$ 2012	(1.740)	(1.829)	(0.826)	(0.700)
Additional $\text{controls}^R_{ck,t-1}$	Yes	Yes	Yes	Yes
Fixed effects				
City–product–regime (FE^R_{ck})	Yes	Yes	Yes	Yes
City–sector–regime–year ($\text{FE}^R_{cs,t}$)	Yes	Yes	Yes	Yes
Product–year ($\text{FE}_{k,t}$)	Yes	Yes	Yes	Yes
Observations	1,938,491	1,938,491	1,938,491	1,938,491
R^2	0.844	0.885	0.924	0.896

Notes: The dependent variables vary by column and are the following: (1) ln $\text{value}^R_{ck,t}$; (2) ln $\text{quantity}^R_{ck,t}$; (3) ln $\text{unit value}^R_{ck,t}$; (4) ln $\text{number of countries}^R_{ck,t}$. Heteroskedasticity-robust standard errors clustered at the product level appear in parentheses. *c* stands for city, *k* for the HS6 product level, *t* for year, and *R* refers to the two eligibility regimes in the VAT rebate system: the non-eligible processing trade with supplied inputs and the eligible ordinary and processing trade with imported materials. Sectors are defined following the Chinese four-digit GB/T industry classification and regroup several products. ***, **, and * denote significance at the 1, 5, and 10 percent levels, respectively.

effect of the tax seems indeed less strong in 2010 and 2011, after the largest number of tax decreases. Using the average coefficient of the export tax and its interaction term with 2010 (4.184 – 9.196 = −5.012) in Column 1 of Table 2, we compute that the decline of 1.1 percent in our independent variable would be responsible for 5.5 percent higher eligible exports over that crisis year than in the counterfactual of no policy change. Even though this is lower than our benchmark estimate of 7.17, it is still important.

We thus conclude that even though there seems to be a somewhat lower sensitivity of exports to changes in the export VAT tax in the years after the crisis, there seems to be no disruption in the repercussions of the VAT policy.

When we look at the decomposition of this effect into price and quantity, we see that this effect is again driven mostly by the changes in quantities. Firms did not seem to use the decrease in taxes to increase their margins, as prices are unaffected. Interestingly, we see a negative and significant

effect on unit values in 2009. This could be potentially explained by the many firms who experienced an export VAT tax increase in 2008 (1,626 products observed an overall increase in their tax rate in 2008 compared with 2007), and who were thus particularly hit by the crisis as they were still adapting to the higher costs from the recent raise in export VAT tax. This could have led these firms to either exit from the export market or substantially decrease their margins in order to be still able to compete on the international markets.

From our findings we can conclude that even though the sensitivity of exports to changes in the VAT export tax was slightly lower during the global recession than in previous years, the massive rise in Chinese export VAT rebates in response to the crisis helped to maintain the profitability of domestic exporters amid declining world prices, and resulted in relatively higher Chinese exports for the products that benefited from this policy.

4.4. Are our results immune to exporters' misreporting practices?

Here, we ask whether our estimates of the decline in the value of exports as a result of the decrease in the export VAT rebate could simply reflect misreporting by businesses of their exports for tax evasion purposes. There is evidence that Chinese exporters under-report the value of their exports to avoid paying taxes based on the value of exports (Ferrantino et al., 2012). Misreporting can happen either through the under-reporting of export values or through the misclassification or mislabeling of goods from a higher-taxed to a lower-taxed product. If this is a common practice, this could lead to an upward bias of the estimate of the policy impact.

The fact that our estimate of the tax elasticity of trade is similar for quantities and values is, however, reassuring. Quantities are more easily observable by customs authorities and hence might be less subject to misreporting. Fisman and Wei (2004) find prevalent under-reporting of the total value imported to China from Hong Kong to avoid paying taxes based on export value. Quantities seem much less affected by these practices. This would imply that export prices are under-reported. An increase in the export VAT rebate should encourage exporters to cheat less and thus declare a higher price at customs. However, as we have shown in our results so far, the estimates for quantities and values are highly similar and do not suggest that there is much under-reporting of values that is systematically correlated with changes in the export VAT tax. Nevertheless, there might be still the problem of misclassification of products.

We follow two main strategies to alleviate the concerns. In our first approach, we exclude ordinary trade and focus only on processing trade, as stricter controls and enforcement of processing trade at the Chinese border makes exporters of processing products less likely to under-report

than normal exporters (Ferrantino et al., 2012). Our second approach is to compare trade elasticities of exports to high-income and low-income countries.

4.4.1. Processing trade. Table 4 reproduces our baseline results when focusing on the differential effect of the VAT policy between eligible and non-eligible processing trade. In addition to reducing the risk of under-reporting, limiting the sample to processing trade also allows us to ensure a greater comparability between the two trade regimes by making our sample more homogeneous. All eligible and ineligible trade flows are conducted under the processing regime and are therefore subject to the same regulations with the exception of the export VAT rebate policy. The rules specific to the processing trade, such as the exemption from import duties and restrictions under processing trade, now apply to the full sample and therefore cannot bias our coefficient of interest.

Ordinary and processing regimes differ in a variety of dimensions (notably the use of domestic inputs)[39] that could be perceived as potentially calling into question the identification strategy based on the comparison of ineligible processing flows with eligible flows combining eligible processing flows and ordinary flows. However, as we explain in Section 2, the increase in the export VAT tax does not hurt firms in proportion to the importance of their domestic input purchase. We thus do not expect a differential impact of the export VAT tax between ordinary and eligible processing trade due to their differential use of domestic inputs. Nevertheless, there could still be a worry that processing exporters, who are more likely (compared with ordinary exporters) to rely on bonded duty-free imported inputs (BIM in equation (1)), will respond less to a given change in the export rebate as the total value rebated is calculated using a lower tax base (exports minus BIM). Moreover, we could expect a stronger effect of changes in the export VAT tax for firms that also have good access to the domestic market. Because ordinary exporters are more likely to sell in the domestic market as well, they might be more responsive to a change in export VAT tax, as they can more easily shift sales between domestic and foreign buyers.

Results displayed in Table 4 confirm a negative effect of the export VAT tax on values, quantities, and the number of countries served, even though the coefficients are slightly lower compared with our full sample (Tables 1 and 2). This reduction is expected in view of the three arguments listed above: less under-reporting, smaller tax base for the rebate, and less capacity to redirect exports to the domestic market.

[39]Ordinary exports embody more than twice as much domestic value-added per US dollar as do processing exports (Kee and Tang, 2016; Koopman et al., 2012).

Table 4. Impact of the export VAT tax: only processing trade

	(1)	(2)	(3)	(4)
ln VAT tax$_{k,t-1}$ × Elig.^{R}	−3.810***	−4.663***	0.551	−1.538***
	(1.248)	(1.354)	(0.641)	(0.468)
Additional controls$^{R}_{ck,t-1}$	Yes	Yes	Yes	Yes
Fixed effects				
City–product–regime (FE$^{R}_{ck}$)	Yes	Yes	Yes	Yes
City–sector–regime-year (FE$^{R}_{cs,t}$)	Yes	Yes	Yes	Yes
Product–year (FE$_{k,t}$)	Yes	Yes	Yes	Yes
Observations	489,773	489,773	489,773	489,773
R^2	0.866	0.893	0.949	0.879

Notes: The dependent variables vary by column and are the following: (1) ln value$^{R}_{ck,t}$; (2) ln quantities$^{R}_{ck,t}$; (3) ln unit value$^{R}_{ck,t}$; (4) ln number of countries$^{R}_{ck,t}$. Heteroskedasticity-robust standard errors clustered at the product level are given in parentheses. *c* stands for city, *k* for the HS6 product level, *t* for year, and *R* refers here to the different eligibility regimes in the VAT rebate system among processing trade only: the non-eligible processing trade with supplied inputs and the eligible processing trade with imported materials. Sectors are defined following the Chinese four-digit GB/T industry classification and regroup several products. ***, **, and * denote significance at the 1, 5, and 10 percent levels, respectively.

However, the decrease in the coefficients actually appears to be mainly the result of the reduction in sample size. Our demanding set of fixed effects restricts the identification to variations of exports across products within the same sector, city, trade regime, and year. When ordinary trade is excluded, this restriction requires a city to export under both the non-eligible and eligible processing regime for a given sector. This constraint is much more restrictive than the initial requirement that a city must export in both the non-eligible and eligible processing regime for a given sector, regardless of whether the latter is in the ordinary or processing regime. Table D-6 in Online Appendix D reproduces our baseline results of Tables 1 and 2 with eligible exports including ordinary exports but on the restricted sample of Table 4. The point estimates are similar to those in Table 4, suggesting that the lower magnitude of the coefficients is mainly explained by the lower number of observations and thus a smaller range of cities and products used for the identification of the policy impact.

Overall, we believe that the main point is that the coefficients we obtained in those various tables are negative and significant for both ordinary and eligible processing trade, and that the effects on all margins are consistent with our theoretical expectations. This reassures us that the overall negative repercussions of the export VAT tax we identified in the previous sections are not mainly driven by misreporting or structural differences between processing and ordinary trade. As our intent is to assess how the changes in the export VAT tax have affected China's export performance, we feel it is appropriate to use the whole sample

of observations and include ordinary trade in the eligible trade, because ordinary transactions account for at least 45 percent of China's exports and hence constitute the main basis on which the export VAT rebate policy is applied.

4.4.2. High-income versus low-income countries. Our second approach to ensure that misreporting of export flows is not driving our results is to compare trade elasticities of exports to high-income and low-income countries. If misclassification or under-reporting in order to avoid paying taxes is common, it might be more likely to happen with shipments to less-developed countries, where there is less capacity to detect and sanction irregularities at border controls at arrival (Fisman and Wei, 2009; Jean and Mitaritonna, 2010). If that is the case, we would expect to see a stronger effect of the tax on shipments towards poorer countries.

To test for this hypothesis, we split the exports of each city–product–regime triplet into two groups of countries according to their income level. We construct, for each year, two different export flows for each triplet: one for high-income countries and one for lower-income countries.[40] In principle, this should double our sample size, but not all city–product–regime triplets export to both groups of countries every year. We add to our empirical specification a new interaction variable between the export VAT tax and a dummy for high-income countries. We also modify our set of fixed effects in order to better capture any potential differential evolution of exports between the two groups of destination countries. Notably, we let the product–year dummies and the city–product–regime dummies vary by the two different destination groups denoted d ($\text{FE}_{kd,t}$ and FE^{R}_{ckd}). We keep the already very demanding time-varying city–sector–regime dummies, $\text{FE}^{R}_{cs,t}$, as splitting them further by destination would lead to too many small groups without any variation to exploit. Instead, we add two different subsets that vary by type of destination: $\text{FE}^{R}_{sd,t}$ vary by sector, regime type, destination, and year, and $\text{FE}^{R}_{cd,t}$ are city–regime type fixed effects that vary by year and destination and control for the fact that cities can evolve differently in their orientation towards specific destinations.

Results for this strict specification for export values and the three margins of adjustment are displayed in Table 5. For all columns, the average effect of the export VAT tax remains similar to our main results in Tables 1 and 2. The interaction with the dummy for high income is never significant and the negative sign of the coefficient indicates that, if anything, the effect

[40]We follow the classification of the World Bank given by the World Development Indicators. High-income countries are those countries that are defined as *high income* in 2002. All other countries are classified as lower-income countries.

Table 5. Impact of the export VAT tax by group of country

	(1)	(2)	(3)	(4)
ln VAT $\text{tax}_{k,t-1} \times \text{Elig.}^{R}$	−5.120***	−5.600***	0.867	−2.258***
	(1.560)	(1.726)	(0.689)	(0.565)
ln VAT $\text{tax}_{k,t-1} \times \text{Elig.}^{R} \times \text{High Income}_{d}$	−1.652	−1.272	−1.047	−0.209
	(1.768)	(1.883)	(0.685)	(0.504)
Additional $\text{controls}^{R}_{ck,t-1}$	Yes	Yes	Yes	Yes
Fixed effects				
City–product–regime–group (FE^{R}_{ckd})	Yes	Yes	Yes	Yes
City–sector–regime–year ($\text{FE}^{R}_{cs,t}$)	Yes	Yes	Yes	Yes
Product–year–group ($\text{FE}_{kd,t}$)	Yes	Yes	Yes	Yes
Sector–regime–year–group ($\text{FE}^{R}_{sd,t}$)	Yes	Yes	Yes	Yes
City–regime–year–group ($\text{FE}^{R}_{cd,t}$)	Yes	Yes	Yes	Yes
Observations	3,009,119	3,009,119	3,009,119	3,009,119
R^2	0.823	0.869	0.914	0.874

Notes: The dependent variables vary by column and are the following: (1) ln $\text{value}^{R}_{ckd,t}$; (2) ln $\text{quantity}^{R}_{ckd,t}$; (3) ln $\text{unit value}^{R}_{ckd,t}$; (4) ln $\text{number of countries}^{R}_{ckd,t}$. Heteroskedasticity-robust standard errors clustered at the product level appear in parentheses. *c* stands for city, *k* for the HS6 product level, *t* for year, and *R* refers to the two eligibility regimes in the VAT-rebate system: the non-eligible processing trade with supplied inputs and the eligible ordinary and processing trade with imported materials. Sectors (*s*) are defined following the Chinese four-digit GB/T industry classification and regroup several products. *d* distinguishes between high-income and low-income countries. ***, **, and * denote significance at the 1, 5, and 10 percent levels, respectively.

of the tax seems to be stronger in high-income countries. These results therefore suggest that our estimates are not driven by misreporting to avoid export VAT taxes.

5. Conclusion

Our study shows that China's export VAT rebate system is a major industrial policy that affects its exports. We propose a new identification strategy using export data at the city–product level over the 2003–2012 period to show how changes in the export VAT tax affect the different trade margins in terms of volumes, prices, and the number of countries served. We address endogeneity by exploiting variations in the expected effect of the export VAT rebates by trade regime, which come from an eligibility rule disqualifying certain export flows from the rebates. Our difference-in-difference-in-differences results suggest that a 1 percent rise in the export VAT tax leads to a 7.2 percent relative decrease in eligible export values at the city level. This effect is due to an adjustment of quantities while the average unit values of exports remain unchanged. These results, combined with the finding of a decrease in the number of countries served, are in

line with our theoretical predictions that changes in export VAT tax pass through to prices, but that substantial entry/exit by inferior firms leads to a compositional change such that there is no change in average prices.

Appendix A. Theoretical framework

We present a simple model of international trade with heterogeneous firms to highlight the expressions for the elasticity of the trade volume and price with respect to the export tax resulting from the incomplete VAT rebates. As explained in the main text, the non-rebated VAT amounts to an export tax. While it is expected that an export tax lowers the number of exporters and the volume of exports for infra-marginal exports, we need to derive our estimating equation from a formal model of trade to interpret the elasticity we obtain on the tax for the export quantity and export price at the product level.

A.1. Production and consumption

Our model builds on Melitz (2003) and Chaney (2008). We focus on the behavior of exporters using a partial equilibrium. We consider a given industry, characterized by the standard Dixit–Stiglitz assumption of monopolistic competition. There are N firms in this industry, each producing a single differentiated variety.

To produce and sell good k on a foreign market, each firm i incurs a firm-specific marginal cost c_i, a product-specific ad-valorem export tax t_k,[41] and a destination-country export fixed cost C_j that is considered to be identical for all firms exporting to country j.

As is usual in the Dixit–Stiglitz monopolistic competition framework, the profit-maximizing price is a constant mark-up over marginal cost,

$$p_k(c_i) = \frac{\sigma}{\sigma - 1} c_i, \tag{A1}$$

where $\sigma > 1$ is the elasticity of substitution between two varieties of good k.

The price that firm i charges for product k with marginal cost c_i to consumers on market j also includes the export VAT tax:[42]

$$p_{kj}(c_i) = \frac{\sigma}{\sigma - 1} c_i \ (1 + t_k). \tag{A2}$$

[41] This corresponds to the un-rebated VAT. As indicated in equation (1) in the main text, the export tax rate implied by the incomplete VAT rebate applies to the export value.

[42] For simplicity, we abstract from transportation costs.

Let E_j denote the total expenditure in country j on the relevant industry, and P_j the price index in country j. The final demand for goods in location j is derived from the maximization of the representative consumer's CES utility function. Country j's demand for a given variety i of good k is

$$m_{kj}(c_i) = p_{kj}(c_i)\ q_{kj}(c_i) = [p_{kj}(c_i)]^{1-\sigma} \frac{E_j}{P_j^{1-\sigma}}. \tag{A3}$$

From these exports, firm i will receive the value net of taxes $m_{kj}(c_i)/(1 + t_k)$.

A.2. Export tax, trade volume, and price

Using profit-maximizing prices (equation (A1)), we can write the profit for firm i from exporting good k to country j as

$$\pi_{kj}(c_i) = \frac{m_{kj}(c_i)}{(1 + t_k)} - c_i q_{kj}(c_i) - C_j = \frac{m_{kj}(c_i)}{\sigma(1 + t_k)} - C_j. \tag{A4}$$

Firms decide to export based on their individual profit. Let $\bar{c}_j$ denote the marginal-cost level that ensures that the revenue from exporting to country j just equals the total exporting cost. Substituting equations (A3) and (A2) into equation (A4) gives

$$m_{kj} = \left[\frac{\sigma}{\sigma - 1}\bar{c}_i\ (1 + t_k)\right]^{1-\sigma} \frac{E_j}{P_j^{1-\sigma}} = C_j\sigma(1 + t_k). \tag{A5}$$

Hence, the marginal-cost threshold value is

$$\bar{c}_j = \lambda_j \frac{1}{C_j}^{1/(\sigma-1)} \frac{1}{(1 + t_k)}^{\sigma/(\sigma-1)}, \tag{A6}$$

with

$$\lambda_j = \frac{\sigma - 1}{\sigma} E_j^{1/(\sigma-1)} P_j.$$

All firms with marginal cost lower or equal to $\bar{c}_j$[43] will export to j a quantity equal to

$$q_{kj}(c_i) = \left[\frac{\sigma}{\sigma - 1}c_i\ (1 + t_k)\right]^{-\sigma} \frac{E_j}{P_j^{1-\sigma}}. \tag{A7}$$

[43]Note that $\bar{c}_j$ compares to $\bar{c}_j^*$ the classical threshold in Melitz (2003) in the following way: $\bar{c}_j = \bar{c}_j^*[1/(1 + t_k)]^{\sigma/(\sigma-1)}$.

Assuming that marginal cost is distributed as $P(\tilde{c} < c) = F(c)$ and $dF(c) = f(c)$, the total number of exporting firms is

$$N_j = \int_0^{\bar{c}_j} N f(c) dc, \tag{A8}$$

with the marginal-cost threshold $\bar{c}_j$ falling with the export tax (equation (A6)). A drop in $\bar{c}_j$ corresponds to a higher productivity threshold for exporting and hence fewer exporters.

The exported quantity is

$$Q_j = \int_0^{\bar{c}_j} N q_{kj}(c_i) f(c) dc. \tag{A9}$$

It is straightforward to see that the intensive margin (average quantity per exporting firm in equation (A7)) and the extensive margin (total number of firms in equation (A8)) of the bilateral exported quantity to j, Q_j, are negative functions of the export tax t_k.

Total export value also declines as the export tax rises as it brings a reduction in the number of exporters N and a rise in price p_{kj}:

$$V_j = \int_0^{\bar{c}_j} N m_{kj}(c_i) f(c) dc = \int_0^{\bar{c}_j} N [p_{kj}(c_i)]^{1-\sigma} \frac{E_j}{P_j^{1-\sigma}} f(c) dc. \tag{A10}$$

Thus, we expect a reduction in the export quantity and value following a rise in the export tax stemming from incomplete VAT rebates.

The theoretical prediction regarding average (tax-inclusive) export prices (V_j/Q_j) is less clear-cut as it depends on the assumptions regarding the distribution of marginal cost $F(c)$. On the one hand, a rise in trade costs results in higher prices (equation (A2)). On the other hand, a rise in the export tax induces a fall in the cut-off $\bar{c}$, which drives some of the less productive firms, those charging high prices, out of export markets. This composition effect induces a reduction in the average unit value of exports that could more than fully compensate the initial rise in individual prices.

We can obtain a direct expression of the export tax elasticity for the export value if we specify the marginal cost distribution function $F(c)$. Let us follow Chaney (2008) and assume that the marginal cost c has a Pareto distribution, bounded between 0 and 1, with a shape parameter $\gamma > \sigma - 1$. In that case, marginal cost is distributed as $P(\tilde{c} < c) = F(c) = c^{\gamma}$ and $dF(c) = f(c) = \gamma c^{\gamma-1}$.

Using the expressions of p_{kj} (equation (A2)) and of $\bar{c}_j$ (equation (A6)), equation (A10) then becomes

$$\begin{aligned} V_j &= \int_0^{\bar{c}_j} N\left[\frac{\sigma}{\sigma-1}c_i(1+t_k)\right]^{1-\sigma}\frac{E_j}{P_j^{1-\sigma}}f(c)dc \\ &= A(1+t_k)^{1-\sigma}[(1+t_k)^{(-\sigma)/(\sigma-1)}]^{(1-\sigma+\gamma)}, \end{aligned} \tag{A11}$$

where A includes parameters that do not vary as a function of c or t.

Once simplified and log-linearized, we obtain

$$\ln V_j = \ln A + \frac{\sigma(1-\gamma)-1}{\sigma-1}\ln(1+t_k). \tag{A12}$$

This yields an export tax elasticity for the export value, which is equal to $[\sigma(1-\gamma)-1]/(\sigma-1)$. The literature proposes average estimates of σ for China of about 6 (Broda et al., 2017). Following di Giovanni and Levchenko (2013) and considering that $\gamma/(\sigma-1)$ can range between 1 and 2, we obtain a range for the export tax elasticity for the export value between -5 and -11.

We can obtain a direct expression of the export tax elasticity for the export quantity by following the same approach for equation (A9).

We obtain

$$\ln Q_j = \ln B + (1-\gamma)\frac{\sigma}{\sigma-1}\ln(1+t_k). \tag{A13}$$

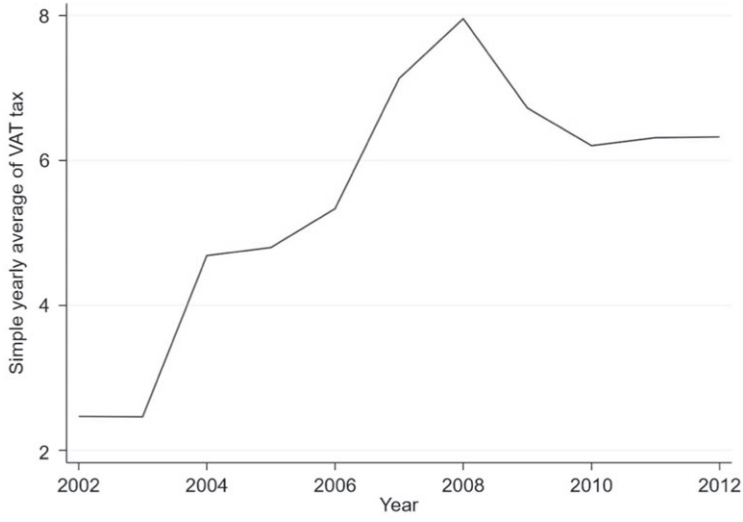
Using the average estimates of σ and γ as above, we obtain a range for the elasticity for the export quantity between -4.8 and -10.8.

Following the same logic, we find that export tax elasticity for the average export price (V_j/Q_j) is $(-1)/(\sigma-1)$, assuming that $\sigma = 6$ yields a value of -0.17.

Appendix B. Stylized facts on VAT rebates

Over the 2002–2012 period, only 13 percent of the products received rebates compensating for the full VAT rate. Incomplete rebates, which are equivalent to export taxation, are hence the rule in China. Export taxes are implemented in different countries for a variety of reasons, such as manipulation of the terms of trade, stabilization of domestic demand, food security or value-chain climbing (Bouët and Laborde, 2011). The temporal evolution of the average export VAT tax applied in China suggests that different motivations have prevailed over time. As can be seen in Figure B1, the average tax rate has increased continuously from 2002, before falling sharply in 2009 in reaction to the international crisis. The upward trend reflects mostly the attempt to reduce the growing financial burden of refunding the rebates for the government as China's trade surplus exploded

Figure B1. Evolution of yearly average export VAT tax 2002–2012



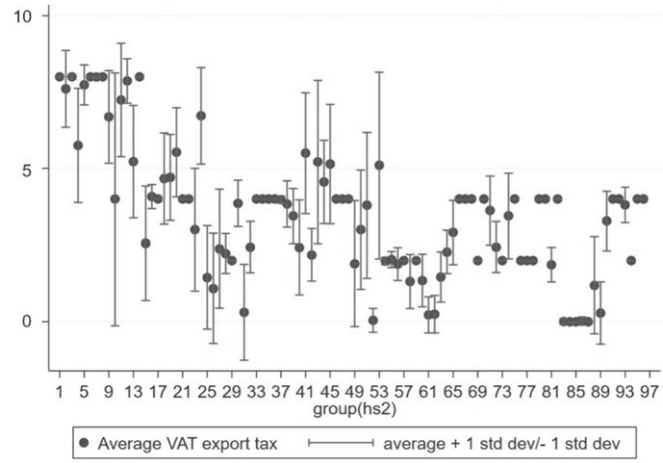
Notes: The VAT tax is calculated in percent as the simple average over all products. During our sample period, the export VAT tax rates range between 0 and 17 percent.

(Chandra and Long, 2013). It might also reflect China's attempt to offset the effect of the import tax cuts implemented in the context of World Trade Organization accession (Garred, 2018). In addition, it corresponds to strategic reductions of rebates on products associated with environmental problems or looming trade disputes (Gourdon et al., 2016). Whereas in 2002 the average export VAT tax rate was only 2 percent, it increased to around 8 percent in 2008. This rate decreased to around 6 percent in 2009 as the global economic crisis induced the authorities to raise the export VAT refund rates on thousands of commodities.[44]

The primary logic of export VAT rebate changes relates to the support for sophisticated high-technology products and the limitation of exports of energy intensive and polluting products (Gourdon et al., 2016; Eisenbarth, 2017). Variations in export VAT rebates also appear consistent with mitigation of trade dispute risks and the pursuit of food security. The financial crisis in 2008 has, however, led authorities to increase export rebates across the board. Reinforced support to export activities applied to a variety of industries including low technology products, such as textiles

[44]The average probability that an adjustment takes place in a given year for a given HS6 product was 34 percent over this period. This figure was over 60 percent in both 2004 and between 2007 and 2009.

Figure B2. Average export VAT tax and dispersion within each HS2 (2002)



Notes: There are in total 97 HS2 categories. Each HS2 category contains between 4 and 509 HS6 products (the median is 29). The export VAT tax rates range between 0 and 17 percent.

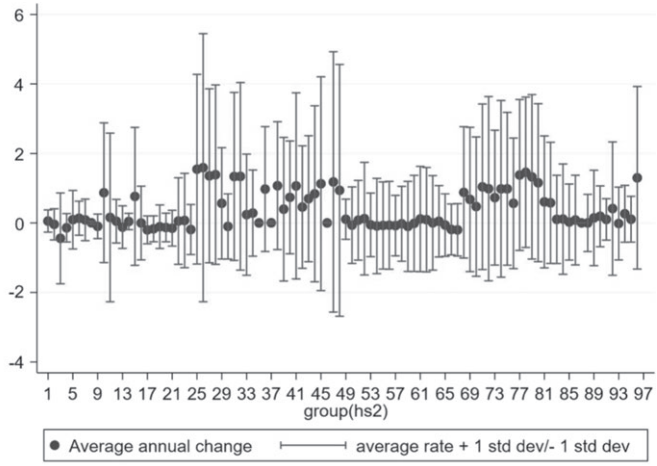
and ceramics (Gourdon et al., 2016). Thus, there is no reason to believe that rebates are disproportionately targeted towards products whose export response is very elastic with respect to rebates so that it drives our findings.

Figure B2 displays, for each of the 97 HS2 categories, the average and standard deviation of export VAT taxes for 2002, the first year of our sample.[45] This shows that export VAT taxes vary substantially across products, even within a sector.

Figure B3 reports for each HS2 category the average annual change between 2002 and 2011 in the export VAT tax at the HS6 level, illustrating the magnitude of changes in the VAT rebates over the period. During our sample period, the export VAT tax increased overall, with only a few sectors experiencing a decline. However, the standard deviations highlight the wide variety of variations in export VAT rebates between products in the same sector, which is consistent with the use of export VAT rebates as a fine industrial policy tool.

[45]In our regressions, we define sectors according to the Chinese four-digit GB/T industry classification. However, because there are more than 400 GB/T sectors, Figures B2 and B3 use the broader HS2 classification, which has only 97 subgroups. An HS2 category regroups up to 509 HS6 products.

Figure B3. Average annual change in export VAT tax and dispersion within each HS2 (2002–2012)



Notes: There are in total 97 HS2 categories. Each HS2 category contains between 4 and 509 HS6 products (the median is 29). The export VAT tax rates range between 0 and 17 percent.

Supporting information

Additional supporting information may be found online in the supporting information section at the end of the article.

Online Appendix
Replication Files

References

Amiti, M. and Freund, C. (2010), An anatomy of China's export growth, in R. Feenstra and S-J. Wei (eds), *China's Growing Role in World Trade*, University of Chicago Press, Chicago.

Bas, M., Mayer, T., and Thoenig, M. (2017), From micro to macro: demand, supply, and heterogeneity in the trade elasticity, *Journal of International Economics 108*, 1–19.

Bouët, A. and Laborde, D. (2011), Food crisis and export taxation: the cost of non-cooperative trade policies, *Review of World Economics 148*, 209–233.

Broda, C., Greenfield, J., and Weinstein, D. E. (2017), From groundnuts to globalization: a structural estimate of trade and growth, *Research in Economics 71*, 759–783.

Chan, A. (2008), An overview of the VAT export refund rules in China, *Tax Notes International 49*, 159 (https://www.china-tax.net/static/upload/files/public/ChinaVAT_ExportRefundRulesOverviewTNI.pdf).

Chaney, T. (2008), Distorted gravity: the intensive and margins of international trade, *American Economic Review 98* (4), 1707–1721.

Chandra, P. and Long, C. (2013), VAT rebates and export performance in China: firm-level evidence, *Journal of Public Economics 102*, 13–22.

Chen, C-H., Mai, C-C., and Yu, H-C. (2006), The effect of export tax rebates on export performance: theory and evidence from China, *China Economic Review 17*, 226–235.
Dai, M., Maitra, M. and Yu, M. (2016), Unexceptional exporter performance in China? The role of processing trade, *Journal of International Economics 121*, 177–189.
di Giovanni, J. and Levchenko, A. A. (2013), Firm entry, trade, and welfare in Zipf's world, *Journal of International Economics 89*, 283–296.
Eisenbarth, S. (2017), Is Chinese trade policy motivated by environmental concerns?, *Journal of Environmental Economics and Management 82*, 74–103.
Evenett, S. J., Fritz, J., and Jing, Y. C. (2012), Beyond dollar exchange-rate targeting: China's crisis-era export management regime, *Oxford Review of Economic Policy 28*, 284–300.
Feenstra, R. C. and Hanson, G. H. (2005), Ownership and control in outsourcing to China: estimating the property-rights theory of the firm, *Quarterly Journal of Economics 120*, 729–761.
Feldstein, M. and Krugman, P. (1990), International trade effects of value-added tax, in A. Razin and J. Slemrod (eds), *Taxation in the Global Economy*, University of Chicago Press, Chicago, 263–282.
Ferrantino, M. J., Liu, X., and Wang, Z. (2012), Evasion behaviors of exporters and importers: evidence from the U.S.–China trade data discrepancy, *Journal of International Economics 86*, 141–157.
Fitzgerald, D. and Hallerb, S. (2018), Exporters and shocks, *Journal of International Economics 113*, 154–171.
Fisman, R. and Wei, S-J. (2004), Tax rates and tax evasion: evidence from "missing imports" in China, *Journal of Political Economy 112*, 471–496.
Fisman, R. and Wei, S-J. (2009), The smuggling of art, and the art of smuggling: uncovering the illicit trade in cultural property and antiques, *American Economic Journal: Applied Economics 1*, 82–96.
Fontagné, L., Martin, P., and Orefice, G. (2018), The international elasticity puzzle is worse than you think, *Journal of International Economics 115*, 115–129.
Garred, J. (2018), The persistence of trade policy in China after WTO accession, *Journal of International Economics 114*, 130–142.
Gourdon, J., Monjon, S., and Poncet, S. (2016), Trade policy and industrial policy in China: what motivates public authorities to apply restrictions on exports?, *China Economic Review 40*, 105–120.
Girma, S., Gong, Y., Görg, H., and Yu, Z. (2009), Can production subsidies explain China's export performance? Evidence from firm-level data, *Scandinavian Journal of Economics 111*, 863–891.
Global Trade Alert (2010), Unequal compliance: the 6th global trade alert report, S. J. Evenett (ed.), Centre for Economic Policy Research, https://www.globaltradealert.org/reports.
Goldberg, P. K. and Pavcnik, N. (2016), The effects of trade policy, in K. Bagwell and R. Staiger (eds), *Handbook of Commercial Policy*, Volume 1A, Chapter 3, Elsevier, Amsterdam, 161–206.
Head, K. and Mayer, T. (2014), Gravity equations: workhorse, toolkit, and cookbook, in G. Gopinath, E. Helpman, and K. Rogoff (eds), *Handbook of International Economics*, Volume 4, Chapter 3, Elsevier, Amsterdam, 131–195.
Jean, S. and Mitaritonna, C. (2010), Determinants and pervasiveness of the evasion of customs duties, CEPII Working Paper, 2010-26.
Kee, H. L. and Tang, H. (2016), Domestic value added in exports: theory and firm evidence from China, *American Economic Review 106* (6), 1402–1436.
Koopman, R., Wang, Z., and Wei, S-J. (2012), Estimating domestic content in exports when processing trade is pervasive, *Journal of Development Economics 96*, 178–189.

Manova, K. and Yu, Z. (2016), How firms export: processing vs. ordinary trade with financial frictions, *Journal of International Economics 100*, 120–137.
Melitz, M. (2003), The impact of trade on intra-industry reallocations and aggregate industry productivity, *Econometrica 71*, 1695–1725.
Naughton, B. (1996), China's emergence and prospects as a trading nation, *Brookings Papers on Economic Activity 2*, 273–344.
Upward, R., Wang, Z., and Zheng, J. (2013), Weighing China's export basket: the domestic content and technology intensity of Chinese exports, *Journal of Comparative Economics 41*, 527–543.
World Trade Organization (2010), Trade policy review: China, Secretariat Report, WT/TPR/S/230/Rev.1, World Trade Organization, Geneva.
Yan, X. (2010), Reforming value added tax in mainland China: a comparison with the EU, *Revenue Law Journal 20*, article 4.

First version submitted April 2020;
final version received June 2021.