Estimating the repercussions from China's export VAT rebate policy

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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 over the 2003-12 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% rise in the export VAT tax leads to a 7.2% relative decrease in eligible export values. This effect is due to an adjustment of quantities while the average unit values of exports remain unchanged. The size of our estimates on the export VAT tax allows us also to better understand the resilience of China's exports during the 2008 global recession and more recently during the trade war with the US.

Keywords: VAT system, policy evaluation, export tax, export performance, trade elasticity, China.

JEL codes: F10, F14, H20, O25.

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1 Introduction

In recent decades, the Chinese government has intervened openly and forcefully to promote the country's export performance while guiding the structural transformation of the economy. China's system of Value Added Tax (VAT) export rebates is considered to be a major instrument of Chinese industrial policy influencing its international competitiveness and export VAT rebates have been a key adjustment variable in supporting Chinese exporters in the turmoil of economic crises. Notably, China's export VAT rebates has been identified as the most important state measure in terms of international trade covered during the recent 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" (Reuters, 2018).[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 however 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 their trading partners' more protectionist policies.

In this paper, we propose a new identification strategy to show how China's system of export VAT rebates has affected the country's export performance for the period 2003-12 using a panel of Chinese cities.[2] We consider different trade margins in terms of volumes, prices and the number of countries served. We find that the policy has strong repercussions on exported volumes but does not affect the unit values of exports at the product level.

[1] https://fr.reuters.com/article/idUSKCN1LN12F

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

These results, combined with the identification of a decrease in the number of countries served, are consistent with the simple model we develop which incorporates export taxation into a standard theoretical trade setting following Chaney (2008). Overall our findings are in line with our theoretical predictions that changes in export VAT taxes 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. This suggests that the granting of higher rebates to exporters by the Chinese government does not benefit foreign consumers of the exported products, but affects the exporters' margins and thus their participation in the export market.

China's VAT policy differs from the standard destination-based VAT system of the OECD countries by not fully refunding the VAT on exports. Instead, exporters may receive VAT rebates that vary across commodities, and range from zero to the full refund of the typical 17% VAT rate. The Chinese VAT system thus imposes a tax on exporters whose goods receive a VAT refund rate lower than the applicable VAT rate.[3] Such incomplete export VAT rebates hence amount to export taxes and are expected to lead to lower exports (Feldstein and Krugman, 1990).[4]

Even though most Chinese exporters face a 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.

[3]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 the EU countries, the US 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 exempt from VAT and exporters will be refunded the VAT paid on their purchases of inputs for the production of their exports. In China, incomplete VAT rebates to exporters make it less advantageous to export a product than to sell it domestically. Section 2 will show that the very name of export VAT rebates is misleading as the repercussions of a certain change in the rebate on exporters are not proportional to their value-added.

[4]We hence use the terms of incomplete export VAT rebate and export VAT tax interchangeably.

First, there is tremendous variation across goods in the levels of and changes to the export VAT rebates. Second, no other country amends its export VAT rebates so often. Over the last decade, export VAT rebate rates have been adjusted frequently, both upwards and downwards (WTO, 2010).[5] 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.

In our empirical analysis we rely on product-level export data for a panel of 329 Chinese cities over the 2003-2012 period. We directly link the rebate at a very detailed product level (HS6) to the quantity, price and number of destination countries of the corresponding exports. Using disaggregated data at the city-level has several advantages. First, it helps to reduce concerns of reverse causality since the variation in export flows at the city level is unlikely to affect changes in the export VAT rebate policy that is established at the national level. Second, breaking down the export data to the city-product-trade regime level of disaggregation allows to explore the different margins of adjustment to the policy even in absence of transaction-level data (Feenstra and Hanson, 2005).[6]

We thus propose a more detailed analysis than the few other existing studies, which focus on averages of rates calculated at the national level (Chen et al., 2006)[7] or at the industry-province level (Chandra and Long, 2013).[8] The latter two studies cover periods ending in

[5]We compute that, over the 2002-12 period, 89% of the products underwent at least one change in their VAT-refund rate.

[6]We are unfortunately not able to study in greater details the margins of adjustment since information on the type of processing trade, which is key to our identification strategy, is available at the firm level only until 2006 and covers therefore only a period in which export VAT tax mostly only increased. By using city data we can rely on a longer time period that includes the recent crisis and allows us to study the intensive and extensive margin of adjustment at the city-product level.

[7]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.

[8]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

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 are likely to have partly restored China's pre-WTO 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 difference-in-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. We hence 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). For this, our empirical approach builds on efforts to address the problem of omitted variables which has 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 which likely affect export performance.

To counter the resulting endogeneity, we use a difference-in-differences estimate which exploits variations in the expected impact of the export VAT rebates by trade 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

over all exporting firms in the same province, 2-digit industry and year. This is instrumented by a proxy for local fiscal conditions.

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.[9] 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 "no collection and no refund" policy 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. We therefore 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 estimation. We notably account via a strict set of fixed effects 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 affects the trade form chosen by firms.

We add to the literature by studying how changes in the export VAT tax affect different margins of China's export performance such as volumes, prices and the number of countries served. 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 elasticity for China, a key parameter to evaluate the welfare impacts

[9] 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.

of trade liberalization. Our results on unit values help infer the impact 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). Our last contribution consists in uncovering differences in the adjustments made by exporters following tax changes according to their type of ownership and the period. We are especially interested in identifying the effect of the export VAT tax cut during the financial crisis.

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). We follow two main strategies to ensure that our findings are not merely reflecting some misreporting. First, 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). Second, we compare trade elasticities of exports to high-income and low-income countries, as we believe that customs evasion will be higher in low-income countries where corruption problems are more severe (Fisman and Wei, 2009; Jean and Mitaritonna, 2010). We find that export values and volumes are more responsive to export VAT tax for high-income destinations, suggesting that our estimates do not only reflect tax evasion practices.

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 difference-in-difference benchmark specification suggests that a one percent rise in the export VAT tax will lead to a 7.2% decline in eligible export values with respect to non-eligible trade. This effect on city-level export values goes uniquely via a change in the quantities and that prices, measured as unit values, are unaffected. Our point

estimates of the effect of the export VAT tax on exports are actually quite similar to the trade elasticity estimates obtained in the recent trade literature (Head and Mayer, 2014; Fontagné et al., 2018). Both our estimates on quantities and prices are consistent with our model.

Overall, our findings suggest that higher rebates granted by the Chinese authorities to exporters do not benefit foreign consumers but benefit companies through increased margins. This allows exporters, particularly the least efficient among them, to maintain and even expand into international markets. Our estimate of 7.2% suggests that if China aligned 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% in 2012), this would lead to a relative increase of 45% in the country's eligible exports.

The remainder of the paper is structured as follows. The next section describes the Chinese export VAT rebate system. Section 3 overviews our empirical specification that directly derives from a simple model that incorporates export taxation from incomplete export VAT rebates into a standard trade model with firm heterogeneity. It also describes the data and construction of variables. Section 4 discusses the results. The last section concludes.

2 The export VAT rebate system

2.1 The export tax formula

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. China started

off with a complete rebate in 1994, but the strong rise in exports during the nineties turned into a heavy fiscal burden for the government, so that it quickly lowered the export VAT rebates and fixed different rates across sectors (Chandra and Long, 2013). In practice VAT applies at a standard rate of 17 percent on goods sold on the domestic and foreign market.[10] Export goods are however subject to the export VAT rebate system, which may lead to a reduced VAT rate. These rebates for exported goods vary by commodity and range from zero to the 17% VAT rate.

The Chinese VAT rebate policy on exports is complex and has changed frequently over time.[11] However, 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. According to Circular No.7 (2002), the official formula used to calculate VAT payable is as follows:

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

where k denotes products and k' the intermediate inputs used to produce k.

Output 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).[12] The tax on exporters

[10] 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.

[11] 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.

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

whose goods receive a VAT rebate rate lower than the applicable VAT rate is captured by the last interaction term in Equation 1. A higher export VAT rebate lowers the fiscal burden for exporters.[13] For exporters that do not use bonded duty-free inputs, a one percentage-point lower VAT rebate rises their tax payment by one percent of their export value. 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.[14]

In contrast to ordinary trade and processing trade with imported materials, processing exports with supplied materials are not entitled to any VAT refund (China Tax & Investment Consultants Ltd, 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 the 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 across regime types for a given product-year pair, while accounting for structural differences across product, cities and the two trade regimes via various sets of fixed effects.

[13] If the VAT payable is negative, the tax bureau will refund it. In fact, the amount of refundable VAT is capped by $\sum_k(\text{Exports}_k - \sum_{k'}\text{BIM}_{k'})$.

[14] There is hence no need to know the share of the 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 defined as the difference between the VAT rate and the export VAT rebate rate, in logs as derived from our model in Appendix B.

2.2 Stylized facts on VAT rebates

Over the 2002-2012 period, only 13% 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 A-1, 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 (Chandra and Long, 2013). It may also reflect China's attempt to offset the effect of the import tax cuts implemented in the context of WTO 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%, it increased to around 8% in 2008. This rate decreased to around 6% in 2009 as the global economic crisis induced the authorities to raise the export VAT refund rates on thousands of commodities.[15]

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 engage in an across the board

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

rise in export rebates. Reinforced support to export activities hence applied to a variety of industries in which China had a comparative advantage including low technology products such as textiles and ceramics (Gourdon et al., 2016). There is hence 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 A-2 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.[16] This shows that export VAT taxes vary substantially across products, even within a sector.

Figure A-3 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. While over our sample period the export VAT tax has overall increased, a number of sectors appear with negative average growth rates. The reported standard deviations also highlight the wide range of magnitudes in the change in the VAT rebate across products, which is consistent with the use of export VAT rebates as an industrial policy tool.

3 Empirical specification and Data

3.1 Empirical specification

While it is expected that an increase in export taxes lowers the number of exporters and the volume of exports for surviving exporters, it is not clear what will be the overall effect on aggregate prices due to potential composition effects. In order to give an interpretation to our estimated trade elasticities for the export quantity and export price at the product

[16] In our regressions, we define sectors according to the Chinese 4-digit GB/T industry classification. However, since there are more than 400 GB/T sectors, Figures A-2 and A-3 use the broader HS2 classification which has only 97 subgroups. A HS2 category regroups up to 509 HS6 products.

level, we derive our estimating equation from a formal trade model. Appendix B presents a simple model of international trade with heterogeneous firms that provides the expressions for the elasticity of the trade volume and price with respect to the export tax resulting from the incomplete VAT rebates.

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 regime. As explained earlier, using disaggregated data at the city-level reduces reverse causality concerns since the variation of export flows at the city level is unlikely to affect changes in the nation-wide VAT rebate policy and allows to explore the different margins by which a city's exports adjust as a result of a variation in export VAT rebates. In later sections, we 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 the following:

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

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 one if the export flow is in the eligible trade regime and zero otherwise.

Our key coefficient of interest, α, captures the differential impact of the export VAT tax on eligible exports relative to non-eligible exports. It includes both the effect on the number of firms and on the value sold by each firm. 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.[17]

[17] In unreported results available upon request we add the contemporaneous export VAT tax variable in

Our preferred specification includes product-year fixed effects ($FE_{k,t}$). This way we appeal to a differential effect of rebates across regime types for a given product-year pair. Product-year dummies account for all factors that affect product-level exports irrespective of the trade regime in a given year. These include world demand and all product-specific policies which have the same expected impact on eligible and non-eligible exports, such as sector-level subsidies, tariffs imposed by China's trading partners and R&D promotion policies, and which are potentially correlated with the VAT rebate (Girma et al., 2009). Our approach allows to fully account for the endogenous choice of export tax rates by the authorities which is at the product-level and not at the product-regime level (Eisenbarth, 2017; Garred, 2018). We are not aware of any other national policy that treats eligible and non-eligible trade flows differently, except for import tariffs which we include explicitly in our regressions.

We account for a city's comparative advantage and export intensity in a given product under a specific regime type with city-product-regime fixed effects, (FE^R_{ck}). The existing literature points to several fundamental differences between the three types of trade (eligible ordinary, eligible processing with imported materials and non-eligible processing with supplied inputs), besides their eligibility to VAT rebates.[18] As these city-product fixed effects vary by regime type, we control for structural differences between eligible and non-eligible regimes and make trade under both trade regimes more comparable.

$FE^R_{cs,t}$ are city-sector-regime-year dummies that capture demand and supply shocks that are common to all products of regime type R in sector s in year t for city c.[19] They control for

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 term.

[18]Several papers highlight the sharp contrast between ordinary and processing regimes notably in terms of their domestic value added, sectoral distribution, production structure, productivity and factor intensity (Dai et al., 2016; Kee and Tang, 2016).

[19]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 4-digit sectors. The match between Chinese GB/T industry codes

potential time varying differences across regime types for a specific sector in a given city. This captures, for example, local shocks impacting the two trade types differently, a potentially differential evolution of exporter characteristics across trade regimes or the average of rebate rates for all the products within the same sector.[20] Further, these fixed effects control for all time varying city and sector characteristics such as labor and capital intensity.

Since it is still possible that local export dynamics for a given product vary by trade regime or city, we add a vector of control variables $X^R_{ck,t-1}$, with coefficient vector λ. Therefore, 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).[21] We further include the change in export values at the city level for products from t-2 to t-1 at the HS6 product level (Export growth$_{ck,t-1}$) to account for export dynamics at the city-product level.[22] Finally, $\epsilon^R_{ck,t}$ is the error term. All regressions cluster standard errors at the product level to account for serial correlation of the error term within products.

One remaining concern of this difference-in-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, i.e. higher export VAT tax for a given product may lead firms to switch from eligible to non-eligible trade. Appendix C provides some suggestive evidence that this is not a major threat to our identification strategy.

and HS codes is taken from Upward et al. (2013). There are a few HS6 for which the GB/T code is not available. In this case we assign missing values with the most common GB/T over coarser HS codes.

[20] In Section **??**, 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.

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

[22] See Appendix B-1 for the construction of these variables.

We find no evidence that non-eligible exports disappear in favour of eligible exports as a result of the decrease in the tax (following the increase in the rebate). Similarly, an increase in the export tax (following the decrease in the refund) does not seem to imply that exports eligible for the rebate are replaced by non-eligible exports.

3.2 Data and Indicators

3.2.1 Data on VAT rates and rebates

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 8-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.[23]

The Chinese 8-digit classification is not consistent over time. To account for these changes which follow the different revisions of the international HS classification in 2002, 2007 and 2012, we aggregate the data to the HS 6-digit level (1996 revision)[24] using the yearly average of these rates.[25] This gives us the VAT rate and export VAT rebate for 5,006 exported HS6 products. Table A-1 presents some descriptive statistics.

3.2.2 Trade data

Customs data

The data collected by Chinese Customs include annual export values and quantities by city at the 8-digit product level and separate trade flows according to transaction type and

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

[24] The correspondence tables from UNCTAD can be found at http://unstats.un.org/unsd/trade/conversions/HS Correlation and Conversion tables.htm.

[25] We use the simple average of all tariff lines within a HS6 product and all sub-periods within the year.

firm ownership.Aggregating the trade flows to the HS6 (1996 revision) level yields a panel of 4,823 products over the 2003-12 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 & assembly).[26] It refers to "the type of inward processing in which foreign suppliers provide raw materials, parts or components under a contractual arrangement for the subsequent reexportation of the processed products. Under this type of transaction, the imported inputs and the finished outputs remain property of the foreign supplier" (General Administration of Customs of the People's Republic of China, 2013).

Combining the trade data and the VAT data leaves us with 4,792 HS6 products and 436 cities.[27] As our empirical strategy appeals to heterogeneous policy responses according to the trade regime, we drop products which are not exported under both the eligible and the non-eligible regime, as well as localities that do not export under both trade regimes.[28]

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% of China's total exports under these two regimes over the sample period.

[26]The other transaction types in the data include international aid, border trade, contracting projects, customs warehousing trade and logistics goods by customs special control area. These other regimes together cover less than 7% 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 A-2 in the Appendix provides robustness checks to ensure that our results remain when this trade category ("others") are included and regarded as eligible.

[27]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.

[28]We exclude exports coming from the so-called "bonded zones" and "export processing zones" in which all processing trade is treated as non-eligible for VAT refund.

Construction of unit value and extensive margin

We construct the average unit value of exports by city c of product k in year t as the weighted sum of the ratio of values over quantities for each destination country. The weight of each observation is the share of this country-product pair in the exports of the city in that year.

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 $\text{FE}_{k,t}$. Following the gravity literature, 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.[29]

Columns 1 and 2 indicate that the effect of the export VAT tax is - as expected - limited

[29]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 Appendix B-1.

Table 1: The impact of the export VAT tax on export flows

Dependent variable	Ln export value$^R_{ck,t}$ (city/product/trade regime/year)				
	(1)	(2)	(3)	(4)	(5)
Trade regime	Eligible	Non-Eligible	All	All Benchmark	All
Ln export VAT tax$_{k,t-1}$	-7.263^a	0.030	0.346		
	(0.524)	(1.076)	(1.074)		
Ln export VAT tax$_{k,t-1}\times$ Elig.^{R}			-7.629^a	-7.178^a	-7.136^a
			(1.118)	(1.180)	(1.187)
Ln export VAT tax$_{k,t-1}\times$ Elig.^{R} $\times$ Fall					0.651^c
					(0.389)
Export growth$_{ck,t-1}$	0.161^a	0.119^a	0.159^a	0.158^a	0.158^a
	(0.002)	(0.007)	(0.002)	(0.002)	(0.002)
Foreign export share$^R_{ck,t-1}$	0.430^a	0.479^a	0.434^a	0.418^a	0.418^a
	(0.010)	(0.024)	(0.010)	(0.009)	(0.009)
State export share$^R_{ck,t-1}$	-0.013^c	0.223^a	0.003	-0.020^a	-0.020^a
	(0.007)	(0.027)	(0.007)	(0.007)	(0.007)
Export growth$_{k,t-1}$	0.133^a	0.094^a	0.129^a		
	(0.011)	(0.028)	(0.010)		
World demand$_{k,t-1}$	2.074^a	1.738^a	2.040^a		
	(0.143)	(0.292)	(0.142)		
Export tax$_{k,t-1}$	-0.010	0.013	-0.010		
	(0.008)	(0.018)	(0.008)		
Import tariff$_{k,t-1}$	-0.031	0.094	-0.144		
	(0.572)	(1.257)	(1.250)		
Import tariff$_{k,t-1}\times$ Elig.^{R}			0.114	1.890	1.896
			(1.179)	(1.157)	(1.158)
Fixed effects					
City-product (FE$_{ck}$)	Yes	Yes			
City-sector-year (FE$_{cs,t}$)	Yes	Yes			
City-product-regime (FE$^R_{ck}$)			Yes	Yes	Yes
City-sector-regime-year (FE$^R_{cs,t}$)			Yes	Yes	Yes
Product-year (FE$_{k,t}$)				Yes	Yes
Observations	1,749,521	188,970	1,938,491	1,938,491	1,938,491
R^2	0.832	0.836	0.832	0.844	0.844

Heteroskedasticity-robust standard errors clustered at the product level appear in parentheses. ^{a}, ^{b} and ^{c} indicate significance at the 1%, 5% and 10% confidence level respectively. 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 4-digit GB/T industry classification and regroup several products.

to the eligible exports. We have a negative and highly significant coefficient of around -7 for eligible trade in column 1, while the coefficient of the export VAT tax for non-eligible trade in column 2 is close to zero and not significant. This latter result confirms that non-eligible trade is 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. We thus 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 exclude the product-year fixed effects $\mathrm{FE}_{k,t}$ to get an estimate of the repercussions of the export VAT tax on exports for both trade regimes. To obtain the effect of a change in the tax for non-eligible exports, we include the interaction of VAT tax with a dummy for non-eligibility.[30] As import tariffs only apply to ordinary trade, we 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.[31]

The negative and highly significant coefficient of the export VAT tax for eligible exports in column 3 confirms 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 *export VAT tax* $\times$ *Non Eligibility*.

Our proxies for world demand and supply side dynamics have all the expected positive and significant impact on our dependent variable. However, other trade policy measures

[30] An alternative specification for these first two columns that gives the same results would be to include the product-specific export VAT tax variable and its interaction term with the Eligibility dummy.

[31] We do not know the corresponding import tariffs on imported inputs for an observed export flow since we do not know which inputs are used in the production of ordinary exports. But we include city-sector-year-regime fixed effects which account for the general level of import tariffs on inputs used by sector s in city c in year t in a way which is specific to each regime type R.

(export tax and import tariffs) fail to be significant. In presence of sector-year dummies ($\text{FE}^R_{cs,t}$) this may 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.[32] 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 one percent increase in the export VAT tax leads to a 7.17% decrease in eligible export values relative to non-eligible exports. This effect is economically significant even in the context of China's average export growth of about 20% 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% in the Chinese exports of eligible activities.[33]

While our estimate is half that of Chandra and Long (2013), it is about the same size as Garred's (2018). By using more disaggregated data at the city and product level than Chandra and Long (2013), we hence obtain a more reasonable impact which is in line with the estimates of aggregate trade elasticities found in the recent trade literature (Fontagné et al., 2018) and in our simple model presented in Appendix B. To illustrate, we can solve Equation 12 of the model for exported value following Chaney (2008) and assuming 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 $dF(c) = f(c) = \gamma c^{\gamma-1}$. This yields an export tax elasticity for the export value equal

[32] This therefore drops also the export VAT tax without the interaction term, as the export VAT tax is account for by the product-year fixed effects.

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

to $\frac{\sigma(1-\gamma)-1}{\sigma-1}$. The literature proposes average estimates of σ for China of about 6 (Broda and Weinstein, 2006). Following di Giovanni and Levchenko (2013) and considering that $\gamma/(\sigma-1)$ can range between 1 and 2, we obtain a range for the elasticity between -5 and -11, which is remarkably consistent with our estimate of -7.17.

Table A-2 in Appendix A shows that our results hold and the magnitude of the export VAT tax coefficients remains highly similar when we modify the sample and add more controls. Column 1 of Table A-2 uses a sample which is no longer limited to ordinary trade and processing trade transactions but adds other types such as include international aid, border trade, contracting projects, customs warehousing trade and logistics goods by customs special control area. These other regimes together cover less than 7% of total exports over the 2003-2012 period. In columns 2 and 3 we use stricter fixed effects. Column 2 uses fixed effects at the HS4 product-level instead of the sector-level. Column 3 replaces the product-year fixed effects with the highly demanding city-product-year fixed effects. The last two columns account for the fact that not all cities export in every year their products in both trade regimes. To make sure that these variations are not driving our results, we check that our estimates remain unchanged when we rely on samples of city-product pairs that export simultaneously under both regimes. Column 4 limits the sample to only city-product combinations ("reduced sample I") that report exports under both types of trade during our sample period. Column 5 uses a very strict sample including only city-product observations ("reduced sample II") that report both types of trade in the same year. Results remain similar.[34]

[34] In unreported results, we also ensure that results hold for the reduced sample I when observations with zero exports are included by adding 1 to the exports inside the log. Due to the high dimensional fixed effects, we cannot provide standard poisson estimates including zero-value trade flows.

4.2 The impact of the export VAT tax on different export margins

In this section, we want to analyse 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. We therefore investigate 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 impact of the tax on quantities, the net effect on prices is ambiguous: the direct negative repercussion of the tax on firm-level export prices may be more than compensated by the composition effect related to the exit of the least productive firms that charge high prices. Furthermore, the repercussions of a change in rebates on export prices depend also on the extent to which exporters pass rebates through to prices. Exporters could well 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 is thus not clear.

Even though we cannot estimate the effect of the export VAT tax on the extensive margin at the firm level,[35] we can look at its impact on the number of destinations served by each firm-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, 4 and 5)

[35] 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.

for each of the three adjustment margins, respectively the quantity exported, the average price and the number of destinations.

Panel A of Table 2 presents the results for export quantities. The coefficient measured on the export VAT policy indicator for export quantities is very similar to that obtained on export values.[36] These results strongly suggest that the policy impact observed on export values is driven by a decrease in the eligible exported quantities.[37]

Panel B of Table 2 reports the estimation results for unit values and confirms this conclusion. We do not seem to detect any important change in unit prices in response to a change in taxes. Hence, 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, 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 substantial entry/exit by inferior firms leads to a compositional change such that there is no change in average prices. Under Pareto, the export tax elasticity for the unit value is $\frac{-1}{\sigma-1}$, 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

[36] The interaction between the export VAT tax and the dummy to determine whether the tax has decreased in the previous period is, however, not significant, in contrast to the results for the exported values.

[37] 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 underreported. 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 the next section.

Table 2: The impact of the export VAT tax on different export margins

	(1)	(2)	(3)	(4)
Panel A Dep. var		Ln Quantities$^R_{ck,t}$		
Subsample	Elig	Non-elig	All	All
Ln export VAT $\text{tax}_{\text{k,t-1}}$	-7.359^a	0.114		
	(0.530)	(1.096)		
Ln export VAT $\text{tax}_{\text{k,t-1}}\times$ Elig.^{R}			-7.172^a	-7.142^a
			(1.249)	(1.255)
Ln export VAT $\text{tax}_{\text{k,t-1}}\times$ Elig.^{R} $\times$ $\text{Fall}_{\text{k,t-1}}$				0.469
				(0.416)
R^2	0.877	0.868	0.885	0.885
Panel B Dep. var		Ln Unit values$^R_{ck,t}$		
Subsample	Elig	Non-elig	All	All
Ln export VAT $\text{tax}_{\text{k,t-1}}$	-0.400^c	-0.123		
	(0.234)	(0.508)		
Ln export VAT $\text{tax}_{\text{k,t-1}}\times$ Elig.^{R}			-0.128	-0.121
			(0.482)	(0.483)
Ln export VAT $\text{tax}_{\text{k,t-1}}\times$ Elig.^{R} $\times$ $\text{Fall}_{\text{k,t-1}}$				0.113
				(0.135)
R^2	0.921	0.927	0.924	0.924
Panel C Dep. var		Ln Nb of countries$^R_{ck,t}$		
Subsample	Elig	Non-elig	All	All
Ln export VAT $\text{tax}_{\text{k,t-1}}$	-2.610^a	0.446		
	(0.228)	(0.359)		
Ln export VAT $\text{tax}_{\text{k,t-1}}\times$ Elig.^{R}			-2.906^a	-2.893^a
			(0.394)	(0.396)
Ln export VAT $\text{tax}_{\text{k,t-1}}\times$ Elig.^{R} $\times$ $\text{Fall}_{\text{k,t-1}}$				0.214
				(0.143)
R^2	0.883	0.851	0.896	0.896
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	Yes
Observations	1,938,491	1,938,491	1,938,491	1,938,491

Heteroskedasticity-robust standard errors clustered at the product level appear in parentheses. ^{a}, ^{b} and ^{c} indicate significance at the 1%, 5% and 10% confidence level respectively. 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 4-digit GB/T industry classification and regroup several products.

are rather in line: 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 the product k. 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 is decreasing by nearly 3% as a result of a one percent rise in export VAT tax. Again, this only applies to eligible exports. As with other margins, ineligible processing trade shows no reaction to a change in export VAT tax.

4.3 The 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 on the world market have been raised in particular during the recent financial crisis, which started in the last quarter of 2008. In 2009, global trade dropped by about 11%. In response to the global recession the average export VAT tax declined from 7.94% in 2008 to 6.72% in 2009. The government increased the VAT rebates even further in 2010 for many of the products concerned by an initial tax cut in 2008 or 2009. In total, between 2008 and 2010, export VAT taxes declined for 2870 HS6-products, while it rose for only 382 products in 2009 and 2010. This steep decline in tax rates came after several years of a steady increase in the average tax rates, as we show in Figure A-1.

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 remain 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 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 (4.198-9.205 = -5.007) in column 1 of Table 2 we compute that this decline of 1.1% in our dependent variable would be responsible for 5.5% higher eligible exports over that crisis year than in the counterfactual of no policy change. Even though this is lower then 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. This suggests the massive rise in Chinese export VAT rebates in 2008 helped to maintain the profitability of domestic exporters amid declining world prices, and resulted in greater Chinese export quantity and value.

When we look at the decomposition of this effect into price and quantity, we see that this effect is again driven by quantities. Firms did not seem to use the decrease in taxes to increase their margins, as prices are unaffected. Interestingly in the year 2009, we see a negative and significant effect on unit values. 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 to 2007) and hence who got particularly hit by the crisis as they were still adapting to the higher costs from the recent raise in

Table 3: The impact of the export VAT tax during the crisis

	(1) Value	(2) Ln Quantity$^R_{ck,t}$	(3) Ln Unit value$^R_{ck,t}$	(4) Ln Nb Countries$^R_{ck,t}$
Ln export VAT tax$_{k,t-1}$× Elig.^{R}	-9.205^a	-8.945^a	-0.022	-3.048^a
	(1.240)	(1.258)	(0.564)	(0.471)
Ln export VAT tax$_{k,t-1}$× Elig.^{R} × 2009	1.967	2.954^c	-1.567^c	0.173
	(1.643)	(1.776)	(0.801)	(0.595)
Ln export VAT tax$_{k,t-1}$× Elig.^{R} × 2010	4.198^b	4.125^b	-0.201	0.180
	(1.820)	(1.900)	(0.821)	(0.674)
Ln export VAT tax$_{k,t-1}$× Elig.^{R} × 2011	3.922^b	2.968	0.426	0.919
	(1.799)	(1.887)	(0.700)	(0.717)
Ln export VAT tax$_{k,t-1}$× Elig.^{R} × 2012	2.398	1.305	0.356	-0.417
	(1.740)	(1.829)	(0.825)	(0.701)
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	1,938,491	1,938,491	1,938,491	1,938,491
R^2	0.844	0.885	0.924	0.896

Heteroskedasticity-robust standard errors clustered at the product level appear in parentheses. ^{a}, ^{b} and ^{c} indicate significance at the 1%, 5% and 10% confidence level respectively. 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 4-digit GB/T industry classification and regroup several products.

export VAT tax. This could have led these firms to either exit or substantially decrease their margins in order to be still able to compete on the international markets.

4.4 Are our results immune from exporters' misreporting practices?

This section asks 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 underreporting 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, rather reassuring. Quantities are more easily observable by customs authorities and hence may be less subject to misreporting. Fisman and Wei (2004) find prevalent underreporting 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 underreported. 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 underreporting 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).

Table 4 reports our baseline results when zooming on the differential effect of the VAT policy between eligible and non-eligible processing trade. Limiting the sample to processing trade also allows to ensure a greater comparability between the two trade regimes by making our sample more homogenous. Ordinary and processing regimes differ in a variety

Table 4: Processing trade

	(1) Ln Value$^R_{ck,t}$	(2) Ln Quantities$^R_{ck,t}$	(3) Ln Unit value$^R_{ck,t}$	(4) Ln Nb Countries$^R_{ck,t}$
Ln export VAT tax$_{k,t-1}$× Elig.^{R}	-3.810^a	-4.663^a	0.551	-1.538^a
	(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	0.949	0.893	0.879

Heteroskedasticity-robust standard errors clustered at the product level appear in parentheses. ^{a}, ^{b} and ^{c} indicate significance at the 1%, 5% and 10% confidence level respectively. 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 4-digit GB/T industry classification and regroup several products.

of dimensions that could affect their sensitivity to changes in export VAT rebates. Ordinary exports notably embody more than twice as much domestic value added per US dollar as do processing exports (Kee and Tang, 2016; Koopman et al., 2012) and are not eligible to duty-free imported material (BIM in Equation 1). Greater duty-free imports means a lower export VAT tax, and lower refunds from any given rise in the export VAT rebate. The focus on processing trade allows us to eliminate this source of potential bias due to differences in foreign value-added content and other structural differences between ordinary and processing trade regimes. Results displayed in column 1 confirm that the negative effect of export VAT tax holds, even though the coefficient is slightly lower compared to our full sample (column 5 in Table 1). We find again a negative and significant effect of the policy on the number of countries served by a firm, while the effect on unit values remains non significant. Even though the number of observations is strongly reduced, the results remain comparable with our overall sample.

Our second approach consists in comparing trade elasticities of exports to high-income and low-income countries. If misclassification or underreporting in order to avoid paying taxes is common, it might be more likely to happen with shipments to less developed countries, where negative consequences after detecting irregularities at border controls may be expected to be less severe (Fisman and Wei, 2009; Jean and Mitaritonna, 2010). If that is the case, we would expect to see a stronger impact of the tax on shipments towards poorer countries.

To test for this hypothesis we split the exports of each city-product-regime triplet by group of country. We then construct for each year two different export flows for each triplet: one to high income and one for lower income countries.[38] In principle this should double our sample size, but not all city-product-regime triplets export to both group of countries. Therefore the increase in the number of observations is much lower. We add to our empirical specification a new interaction variable between the export VAT tax and a dummy for High income countries. Further, we use a different set of fixed effects in order to capture better any potential differential evolution of exports across destinations. Notably, we let the product-year dummies and the city-product-regime dummies vary by the two different destinations d ($\mathrm{FE}_{kd,t}$ and FE^{R}_{kd}). We keep the already very demanding time-varying city-sector-regime dummies, $\mathrm{FE}^{R}_{cs,t}$, as splitting them further up by destination would lead to too many small groups without any variation to exploit. Instead, we add two different subsets that vary by destination: $\mathrm{FE}^{R}_{sd,t}$ which vary by sector, regime type, destination and year and $\mathrm{FE}^{R}_{cd,t}$, which are city-regime type fixed effects that vary by year and destination and control for the fact that cities might evolve differently in their orientation towards specific destinations.

Results for this strict specification for export values and the three margins of adjustment

[38] We follow here 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: The impact of the export VAT tax by group of country

	(1) Ln Value$^R_{ckd,t}$	(2) Ln Unit Value$^R_{ckd,t}$	(3) Ln Quantity$^R_{ckd,t}$	(4) Ln Nb countries$^R_{ckd,t}$
Ln VAT tax$_{k,t-1}$×Elig.^{R}	-5.120^a	0.867	-5.600^a	-2.258^a
	(1.560)	(0.689)	(1.726)	(0.565)
Ln VAT tax$_{k,t-1}$×Elig.^{R}×High Income$_d$	-1.652	-1.047	-1.272	-0.209
	(1.768)	(0.685)	(1.883)	(0.504)
Additional controls$^R_{ck,t-1}$	Yes	Yes	Yes	Yes
Fixed effects				
City-product-regime-group (FE$^R_{ckd}$)	Yes	Yes	Yes	Yes
Product-regime-group-year (FE$^R_{kd,t}$)	Yes	Yes	Yes	Yes
City-sector-regime-year (FE$^R_{cs,t}$)	Yes	Yes	Yes	Yes
Sector-regime-group-year (FE$^R_{ds,t}$)	Yes	Yes	Yes	Yes
City-regime-group-year (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	0.914	0.869	0.874

Heteroskedasticity-robust standard errors clustered at the product level appear in parentheses. ^{a}, ^{b} and ^{c} indicate significance at the 1%, 5% and 10% confidence level respectively. 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 4-digit GB/T industry classification and regroup several products. d distinguishes between high-income and low-income countries.

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 high income dummy is never significant and the negative sign of the coefficient indicates, if anything, that the effect of the tax seems to be stronger in the high income countries. Thus, these results indicate that our estimates are not driven by tax evasion.

4.5 The role of firm ownership

In this final section, we investigate whether the effect of the export VAT tax is the same across all firm types. Our data allows us to decompose the trade flows by firm ownership. China has a very high share of state-owned firms, but over our time period exports from private

firms have increased substantially. As has been shown by a growing literature, state-owned firms face less credit constraints and have better political connections. Compared to private or foreign-owned firms, they might be less sensitive to tax increases. Foreign-owned firms, compared to domestic firms, have been shown to be less integrated into the local economy and as they often rely heavily on their export business, they might be more sensitive to a change in the export VAT tax compared to domestic firms which generally sell mainly on the internal market.

In Panel A in Table 6 we investigate the difference in the impact of the export VAT tax on foreign-owned and domestically-owned firms separately. The odd numbers show results for exports by domestic firms and the even number for trade by foreign-owned firms. In Column 1 and 2 we report results for values and find a strong negative effect of the export VAT tax on export values for eligible trade for both domestic and foreign-owned trade flows. However, the coefficient is about twice as high for foreign owned firms. The difference is even starker when looking at quantities (Columns 3 and 4), while the effect on the number of destinations does not seem to be different according to firm ownership (Columns 7 and 8).

Most interestingly, we see the biggest difference in the coefficient for unit values. Whereas for domestic firms the effect is negative, it is positive for the foreign owned firms. Both coefficients are marginally significant at the 10% level. This indicates that these firms follow different strategies. Foreign firms see themselves constraint to increase prices following an increase in their costs. This is not the case for the domestic firms. The negative coefficient could be explained that it is more likely that the least productive domestic firms stop exporting. As they are generally also serve the domestic market, switching their sales away from the foreign market to the domestic consumer is likely to be much easier then for many of the exporting firms who are mostly mainly focussing on the export market.

Table 6: Domestic vs foreign-owned: Different margins

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dep. var	Ln Value$^R_{ck,t}$		Ln Quantity$^R_{ck,t}$		Ln Unit value$^R_{ck,t}$		Ln Nb Countries$^R_{ck,t}$	
Panel A								
Firm ownership	Dom.	For.	Dom.	For.	Dom.	For.	Dom.	For.
Ln VAT tax$_{k,t-1}$× Elig.^{R}	-4.794^a	-9.407^a	-3.905^a	-10.456^a	-1.140^c	1.275^c	-2.414^a	-2.393^a
	(1.454)	(1.840)	(1.493)	(1.931)	(0.663)	(0.754)	(0.492)	(0.633)
R^2	0.829	0.846	0.880	0.876	0.923	0.917	0.891	0.877
Observations	1,717,477	934,165	1,717,477	934,165	1,717,477	934,165	1,717,477	934,165
Panel B								
Firm ownership	SOE	private	SOE	private	SOE	private	SOE	private
Ln VAT tax$_{k,t-1}$× Elig.^{R}	-5.648^a	-5.304^c	-5.748^a	-6.593^b	-0.266	0.957	-2.527^a	-0.712
	(1.718)	(2.782)	(1.811)	(2.785)	(0.879)	(0.926)	(0.552)	(0.833)
R^2	0.815	0.819	0.871	0.873	0.922	0.919	0.874	0.886
Observations	996,603	1,389,775	996,603	1,389,775	996,603	1,389,775	996,603	1,389,775
Additional controls$^R_{ck,t-1}$	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Fixed effects	City-product-regime (FE$^R_{ck}$),City-sector-regime-year (FE$^R_{cs,t}$) & Product-year (FE$_{k,t}$)							

Heteroskedasticity-robust standard errors clustered at the product level appear in parentheses. ^{a}, ^{b} and ^{c} indicate significance at the 1%, 5% and 10% confidence level respectively. 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 4-digit GB/T industry classification and regroup several products.

Panel B in Table 6 further distinguishes the export flows of domestic firms between those coming from state-owned and those coming from privately owned firms. The results are quite similar for these two types of firms, showing little heterogeneity, expect for the extensive margin at the level of destinations. We do not see any significant effect of the number of destinations. This could however be potentially driven by the fact that there was a strong increase of trade flows by private firms over our sample period or due to a reduced number of observations for non-eligible trade.

5 Conclusion

Our study shows that China's export value added tax (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 2003-12 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. The use of disaggregated data at the city level helps to reduce concerns about a feedback effect of the export performance of localities on the level of export VAT rebates that are established at the national level. Furthermore we counter omitted variables problems by exploiting 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 difference-in-difference results suggest that a 1% rise in the export VAT tax leads to a 7.2% relative decrease in eligible export values. 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. The size of our estimates on the export VAT tax allows us also to better understand the resilience of China's exports during the global recession. Export VAT rebates seem to be an effective tool for boosting a country's international competitiveness in difficult times and when exchange rate devaluations are not an option. Our results hence show the key role of trade policy in China's rising advantage in global markets.

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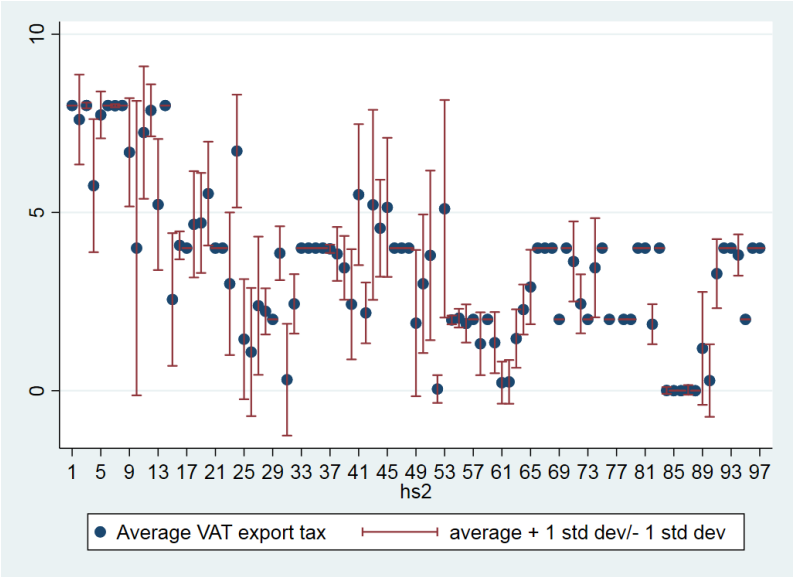
A Additional tables and figures

Figure A-1: Evolution of yearly average export VAT tax 2002-2012

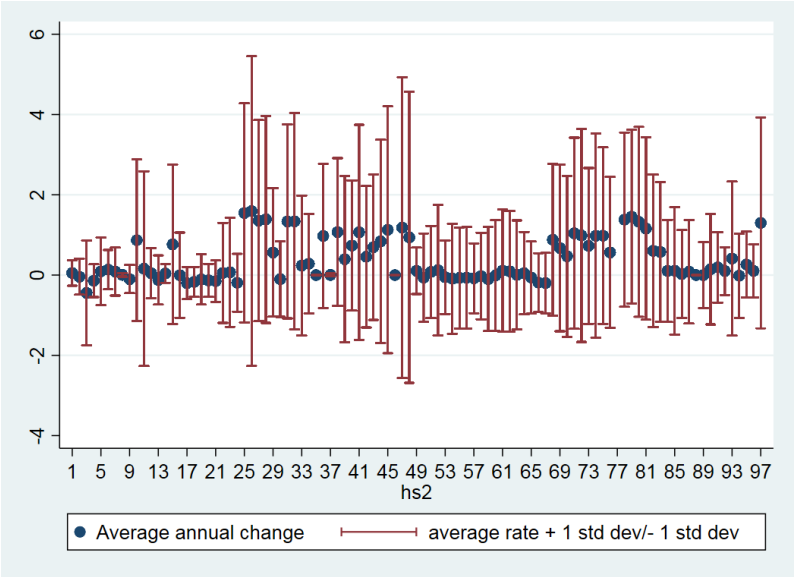
Note: The VAT tax is calculated as the simple average over all products. During our sample period the export VAT tax rates range between 0 and 17%.

Figure A-2: Average export VAT tax and dispersion within each HS2 (2002)



Note: 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%.

Figure A-3: Average annual change in export VAT tax and dispersion within each HS2 (2002-2012)



Note: 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%.

Table A-1: Summary statistics of variables

	Mean	Std. Dev.	Min	Max
Ln exported quantity$^R_{ck,t}$	9.895	3.665	0	24.117
Ln export value$^R_{ck,t}$	11.658	2.892	0	23.956
Ln unit value$^R_{ck,t}$	1.762	2.401	-10.127	19.969
Ln export VAT $\text{tax}_{\text{k,t-1}}$	0.042	0.035	0	0.157
VAT $\text{rebate}_{k,t-1}$ (%)	12.435	3.920	0	17
VAT $\text{rate}_{k,t-1}$(%)	16.835	0.716	13	17
World $\text{demand}_{\text{k,t-1}}$	0.209	0.180	0	0.944
Export $\text{tax}_{\text{k,t-1}}$	0.084	1.391	0	106
Import $\text{tariffs}_{\text{k,t-1}}$	10.808	6.209	0	68
Export $\text{growth}_{\text{k,t-1}}$	0.195	0.326	-2	2
Export $\text{growth}_{\text{ck,t-1}}$	0.261	1.189	-2	2
Foreign export $\text{share}^R{}_{\text{ck,t-1}}$	0.240	0.380	0	1
State export $\text{share}^R{}_{\text{ck,t-1}}$	0.246	0.375	0	1

Refer to Section 3.2 and Appendix B-1 for a detailed description of these variables. The statistics are based on the sample in our difference-in-differences benchmark specification (1938416) (column 4 of Table 1). c stands for city, k for the HS6 product level, t for year and R refers to the two eligibility regimes in the export VAT rebate system: the non-eligible processing trade with supplied inputs and the eligible ordinary and processing trade with imported materials.

Table A-2: Additional results

Dependent variable	Ln export value$^R_{ckt}$				
	(1) including "others"	(2) HS4 FE	(3) city-product year FE	(4) reduced sample I	(5) reduced sample II
Ln export VAT tax$_{k,t-1}$× Elig.^{R}	-6.614^a	-5.039^b	-5.548^a	-5.322^a	-4.996^a
	(1.200)	(2.155)	(1.33)	(1.249)	(1.378)
Additional controls$^R_{ck,t-1}$	Yes	Yes	Yes	Yes	Yes
Fixed effects					
City-sector-regime-year (FE$^R_{cs,t}$)	Yes		Yes	Yes	Yes
Product-year (FE$_{kt}$)	Yes	Yes		Yes	Yes
City-HS4 product-regime-year		Yes			
City-product-year (FE$_{ckt}$)			Yes		
Observations	1,946,369	1,938,491	1,938,491	528,278	348,578
R^2	0.841	0.870	0.948	0.885	0.903

Heteroskedasticity-robust standard errors clustered at the product level appear in parentheses. ^{a}, ^{b} and ^{c} indicate significance at the 1%, 5% and 10% confidence level respectively. 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, indicated by s, are defined following the Chinese 4-digit GB/T industry classification and regroup several products. Reduced sample I only contains the 40,332 city-product pairs that report exports under both types of trade during our sample period. Reduced sample II only includes the 38,678 city-product pairs that report both types of trade in the same year. Additional controls$^R_{ck,t-1}$ include Export growth$_{ck,t-1}$, Foreign export share$^R_{ck,t-1}$, State export share$^R_{ck,t-1}$ and Import tariffs$_{k,t-1}$×Elig.

B 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 get on the tax for the export quantity and export price at the product level.

B-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[39] 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:

$$p_k(c_i) = \frac{\sigma}{\sigma - 1} c_i \tag{3}$$

[39] It 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.

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

The price firm i charges for product k with marginal cost c_i to consumers on market j includes also the export VAT tax:[40]

$$p_{kj}(c_i) = \frac{\sigma}{\sigma - 1} c_i \ (1 + t_k) \tag{4}$$

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:

$$m_{kj}(c_i) = p_{kj}(c_i) \ q_{kj}(c_i) = [p_{kj}(c_i)]^{1-\sigma} \frac{E_j}{P_j^{1-\sigma}} \tag{5}$$

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

B-2 Export tax, trade volume and price

Using profit-maximizing prices (Equation 3), we can write the profit for firm i from exporting good k to country j as:

$$\pi_{kj}(c_i) = \frac{m_{kj}(c_i)}{(1 + t_k)} - c_i q_{kj}(c_i) - C_j = \frac{m_{kj}(c_i)}{\sigma(1 + t_k)} - C_j \tag{6}$$

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 5 and 4 in Equation 6 gives:

[40] For simplicity we abstract from transportation costs.

$$m_{kj} = [\frac{\sigma}{\sigma - 1}\bar{c}_i \ (1 + t_k)]^{1-\sigma} \frac{E_j}{P_j^{1-\sigma}} = C_j \sigma (1 + t_k) \tag{7}$$

Hence the marginal-cost threshold value is:

$$\bar{c}_j = \lambda_j \frac{1}{C_j}^{1/(\sigma-1)} \frac{1}{(1 + t_k)}^{\frac{\sigma}{\sigma-1}}, \tag{8}$$

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

All firms with marginal cost lower or equal to $\bar{c}_j$[41] will export to j a quantity equal to:

$$q_{kj}(c_i) = [\frac{\sigma}{\sigma - 1} c_i \ (1 + t_k)]^{-\sigma} \frac{E_j}{P_j^{1-\sigma}} \tag{9}$$

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:

$$N_j = \int_0^{\bar{c}_j} N f(c) dc \tag{10}$$

with the marginal-cost threshold $\bar{c}_j$ falling with the export tax (Equation 8). A drop in $\bar{c}_j$ corresponds to a higher productivity threshold for exporting and hence fewer exporters.

The exported quantity is:

$$Q_j = \int_0^{\bar{c}_j} N q_{kj}(c_i) f(c) dc \tag{11}$$

It is straightforward to see that the intensive margin (average quantity per exporting firm in Equation 9) and the extensive margin (total number of firms in Equation 10) of the bilateral exported quantity to j, Q_j, are negative functions of the export tax t_k.

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

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

$$V_j = \int_0^{\bar{c}_j} N m_{kj}(c_i) f(c) dc = \int_0^{\bar{c}_j} N [p_{kj}(c_i)]^{1-\sigma} \frac{E_j}{P_j^{1-\sigma}} f(c) dc \tag{12}$$

Our expectation is hence 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 ($\frac{V_j}{Q_j}$) is less clear cut since it concretely 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 4). 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 well more than fully compensate the initial rise in individual prices.

Our empirical analysis of how China's export VAT rebate system has affected the country's export performance will therefore focus on both the quantity and value of exports. We elaborate in our discussion of the results on whether our estimates (for quantity and price elasticity) are consistent with the use of a Pareto distribution for marginal cost as in Chaney (2008).

B Data sources and classifications

B-1 Construction and data sources of control variables

The Customs trade data is used to obtain several of our control variables: Export growth$_{k,t-1}$, Export growth$_{ck,t-1}$, Foreign export share$^R_{ck,t-1}$ and State export share$^R_{ck,t-1}$.

Export growth$_{k,t-1}$ and Export growth$_{ck,t-1}$ are yearly export growth at the product-level and at the city-product level respectively. These proxies of export dynamics are computed using the mid-point growth rate formula using export values from t-2 and t-1. Foreign export share$^R_{ck,t-1}$ and State export share$^R_{ck,t-1}$ measure respectively the share of export quantities by foreign and state-owned firms for each product-city-regime combination.

World demand$_{k,t-1}$ is defined as the share of China's exports in world exports for a given product in a given year. This variable is obtained from the BACI world trade dataset.[42]

Export tax information comes from the General Administration of Customs of the People's Republic of China (www.customs.gov.cn) and the Ministry of Finance of the People's Republic of China (www.gss.mof.gov.cn). We calculate annual export taxes at the HS 6-digit level as the simple average over the various lines. This rate includes the special tax (from 2009) when applicable. The number of HS6 products covered by export taxes rose from 20 in 2002 to 252 in 2012.

Data on import tariffs at the HS6 level come from the World Integrated Trade Solution (WITS). We calculate simple averages of MFN tariffs, which measure the average level of nominal tariff protection applied to imports into China.

[42]This dataset is based on COMTRADE data using an original procedure that reconciles the declarations of exporters and importers (Gaulier and Zignago, 2010). BACI uses the 1996 HS 6-digit product nomenclature. It is downloadable from http://www.cepii.fr/anglaisgraph/bdd/baci.htm.

B-2 Different classifications of products

In Appendix D, we check that our results hold after excluding a number of product categories which have specifically been targeted by the Chinese authorities. Rare-earth products are those listed in the WTO reports (WTO, 2008 and 2010), and products under conflict are a small group of 21 HS6 products of raw materials.[43]

Energy- and emission-intensive products are identified from the European Commission classification which singles out 78 HS6 products as energy- and carbon-emission intensive (Bergmann et al., 2007). High-tech products are defined based on the list established by the OECD of 319 high-tech products (Hatzichronoglou, 1997). The list of high-skilled products comes from the UNCTAD.

[43]Recently the "China Raw Materials dispute" at the WTO highlighted Chinese efforts to restrict its exports of rare-earth products which are key in the production process of many high-value products. China is by far the world's largest producer of the 17 metals known collectively as "rare earths". In the 2000s, Chinese authorities gradually tightened restrictions on these products in an effort to encourage the domestic processing of these metals and secure a better position in the global value chain.

C Evidence on switching of regime types

The main challenge of our baseline regression concerns the switching of regime types as a consequence of a change in the export VAT rebate rate. In this section, we provide several arguments that the regime choice seems to be independent from changes in the export VAT tax.

First, as shown in Column 2 of Table 1, we find no significant association between the export VAT tax and non-eligible exports which suggests that changes in the VAT rebate do not appear to determine the regime in which firms run their operations. By contrast, this confirms that non-eligible exports are indeed an appropriate control group.

Table C-1 addresses more directly the possibility of firms switching from eligible to non-eligible trade after an increase in the export VAT tax. We construct for each city-product-regime triad a time-varying indicator that measures the share of destinations for which a flow appears in regime type R while it disappears for the other regime type. In column 1 we look at the share of destinations that switch from non-eligible to eligible trade. If switching between regimes is common a decrease in the export VAT tax should result in a shift towards the eligible regime. We thus expect a negative coefficient of the export VAT tax. Conversely, in column 2, where we look at the share of destinations which see a switch to non-eligible trade, we expect a positive coefficient since a higher tax makes it less advantageous to export for eligible compared to non-eligible trade.[44] For both types of trade, coefficients are close to zero and we do not find any significant impact of the export VAT tax. We are thus confident that firms modifying their regime type is not driving our results in Section 4.

[44] We rely here on our double-difference specification, detailed in Section 3, which we run separately for the two regime types (and hence do not include the interaction with the Eligibility dummy and product-year fixed effects).

Table C-1: Regime switching

Dependent variable	Share of destinations$^R_{ck,t}$ that switched regime	
	(1) from eligible to non-eligible	(2) from non-eligible to eligible
Ln export VAT $\text{tax}_{\text{k,t-1}}$	0.001	0.065
	(0.003)	(0.045)
Export $\text{growth}_{\text{ck,t-1}}$	0.000	-0.000
	(0.000)	(0.001)
Foreign export $\text{share}^R{}_{\text{ck,t-1}}$	0.001^b	0.019^a
	(0.000)	(0.002)
State export $\text{share}^R{}_{\text{ck,t-1}}$	0.001^a	0.016^a
	(0.000)	(0.002)
Export $\text{growth}_{\text{k,t-1}}$	-0.000	-0.000
	(0.000)	(0.002)
World $\text{demand}_{\text{k,t-1}}$	0.001	-0.002
	(0.001)	(0.010)
Export $\text{tax}_{\text{k,t-1}}$	0.012^c	0.023
	(0.007)	(0.050)
Import $\text{tax}_{\text{k,t-1}}$	0.003	-0.003
	(0.008)	(0.039)
Fixed effects	city-product & city-sector-year	
Observations	1749521	188970
R^2	0.265	0.301

Heteroskedasticity-robust standard errors clustered at the product level appear in parentheses. ^{a}, ^{b} and ^{c} indicate significance at the 1%, 5% and 10% confidence level respectively. 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, indicated by s, are defined following the Chinese 4-digit GB/T industry classification and regroup several products.

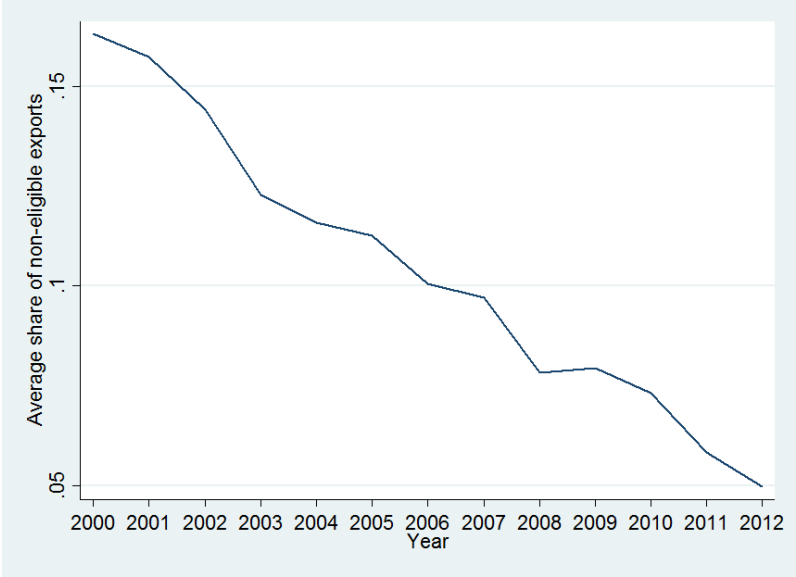
Our results are also consistent with the literature on the specific motives behind the ineligible regime of processing trade with supplied materials in China. Findings are largely unrelated to the VAT rebate system. Manova and Yu (2016) show that the regime type of trade chosen by companies is driven by the importance of financial constraints. Since the ownership of imported intermediates entails high up-front costs, financial constraints restrict firms to processing trade with supplied materials. Fernandes and Tang (2012) show that the choice of form of trade is related to factors that have been suggested by theories of the boundaries of the firm, such as control and hold-up. Their results suggest that control over imported components by international firms is an alternative to asset ownership in alleviating hold-up by export-processing plants. We hence expect the extent of processing trade with supplied materials to depend mostly on the observability of input use or the dominance and power of foreign buyers.[45]

Finally, Brandt and Morrow (2017) investigate another particularity of firms engaged in processing with supplied inputs: their inability to source domestically. As opposed to manufacturers engaged in ordinary trade and processing with imported materials, those in processing trade with supplied inputs are not allowed to buy inputs from China. Their role in China's exports should thus be related to the attraction of Chinese suppliers. The extent of processing trade with supplied inputs should then fall with improvements in the number, diversity, quality or cost advantage of Chinese manufacturers of intermediate inputs and not reflect the ups and downs in the export VAT tax.

To conclude, Figure C-4 shows the share of non-eligible exports between 2000 and 2012.

[45] It could also depend on the degree of relationship specificity of the physical capital used in production (Nunn and Trefler, 2013).

Figure C-4: Share of non-eligible exports over time



Note: The share of non-eligible exports is the export value share of processing trade with supplied inputs.

This exhibits a continuous decline over the period, further suggesting the lack of any direct link between the choice of trade regime and the ups and downs in the VAT rebate policy. The downward trend is however consistent with the relaxation of financial constraints over time (in the spirit of Manova and Yu, 2016) and the growing diversity and quality of China's intermediates (as suggested by Brandt and Morrow, 2017).[46]

[46]One could worry that the decline in trade volumes for the ineligible group makes it unlikely that this is a good benchmark relative to which the performance of eligible exports is measured. In total, non-eligible trade represents only about 10% of the observations in our final sample. However Table A-2 shows that our results hold when we limit our sample to the city-product pairs that export simultaneously under both regimes. Furthermore, our results hold when the sample is limited to processing trade only, where close to 40% of the observations represent non-eligible exports (Table 4).

D Robustness checks

D-1 Sensitivity to specific products

This section checks that the main results from column 4 of Table 1 are robust across various subsamples.

Table C-1: Exports and export VAT taxes: excluding sensitive sectors

Dependent variable	Ln Exported quantity (city/product/regime/year)				
	(1)	(2)	(3)	(4)	(5)
Sample restriction	only manuf	w/o rare earths	w/o energy-int.	w/o high-tech	w/o high-skilled int.
Ln export VAT $\text{tax}_{\text{k,t-1}} \times$ Elig.^{R}	-7.150^a	-7.177^a	-6.969^a	-7.746^a	-7.273^a
	(1.202)	(1.181)	(1.177)	(1.260)	(1.203)
Additional controls$ck, t-1$	Yes	Yes	Yes	Yes	Yes
Fixed effects					
City-product-regime (FE^R_{ck})	Yes	Yes	Yes	Yes	Yes
City-sector-regime-year (FE^R_{cst})	Yes	Yes	Yes	Yes	Yes
Product-regime-year (FE^R_{kt})	Yes	Yes	Yes	Yes	Yes
R^2	0.844	0.844	0.844	0.841	0.842
Observations	1,897,488	1,936,070	1,920,788	1,819,227	1,899,280

Heteroskedasticity-robust standard errors clustered at the product level appear in parentheses. ^{a}, ^{b} and ^{c} indicate significance at the 1%, 5% and 10% confidence level respectively. 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, indicated by s, are defined following the Chinese 4-digit GB/T industry classification and regroup several products. Additional $\text{controls}_{ck,t-1}$ include Export $\text{growth}_{ck,t-1}$, Foreign export $\text{share}^R_{ck,t-1}$, State export $\text{share}^R_{ck,t-1}$.

First, Table C-1 verifies that our estimates do not reflect the specific features of some products which have been targeted by Chinese authorities as either strategic or undesirable. This allows us to address concerns regarding omitted unobserved policies that may be correlated with both VAT rebates and export performance. Our findings of a negative and significant effect of the tax on exports remain throughout.

Column 1 confirms that our estimates do not reflect some particular features of agriculture

Table C-2: Exports and export VAT taxes: alternative samples

Dependent variable	Ln Exported quantity (city/product/regime/year)		
Sample restriction	(1) only VAT rate = 17%	(2) no full VAT rebate	(3) no zero VAT rebate
	(1) est1	(2) est2	(3) est3
Ln export VAT $\text{tax}_{\text{k,t-1}} \times$ Elig.^{R}	-7.128^a	-6.188^a	-6.273^a
	(1.259)	(1.379)	(1.452)
Additional controls$_{\text{ck,t-1}}$	Yes	Yes	Yes
Fixed effects			
City-product-regime (FE^R_{ck})	Yes	Yes	Yes
City-sector-regime-year (FE^R_{cst})	Yes	Yes	Yes
Product-regime-year (FE^R_{kt})	Yes	Yes	Yes
R^2	0.844	0.840	0.847
Observations	1,782,680	1,115,967	1,790,909

Heteroskedasticity-robust standard errors clustered at the product level appear in parentheses. ^{a}, ^{b} and ^{c} indicate significance at the 1%, 5% and 10% confidence level respectively.

by limiting the sample to manufacturing products, as agricultural products have indeed been particularly targeted by Chinese authorities concerned by food security in a context of rising prices, notably in 2006-8. In column 2, the few but very strategic rare-earth products are excluded to make sure that they do not drive our results. The same logic is behind the exclusion of energy and carbon-intensive products in column 3 which might be specifically targeted in the attempt to reduce pollution. Column 4 excludes high-tech products as defined by the OECD to ensure that we do not pick up the many unobserved subsidies granted in this sector.[47] Finally, our results also hold when dropping high-skill intensive products (column 5).[48]

[47]High-tech exporters have likely benefited from a variety of policies such as FDI promotion, production and R&D subsidies and access to preferential-tax high-tech zones as part of the Chinese effort to upgrade exports. Findings are robust to alternative classifications by high-tech products, as e.g. defined by Eurostat.

[48]For details on how we identify the products to drop, see Appendix B-2.

In Table C-2, we make sure that our results are not driven by a specific type of VAT rate or rebate. In column 1 we check that our estimates are not driven by the different VAT rates across products and drop the 165 HS6 products in our sample with the reduced rate of 13% (instead of the basic 17%). In column 2 we exclude products which have enjoyed a full rebate at any time over our sample period, since they may have benefited from other unobserved policies. Column 3 restricts our sample to products that have throughout the whole sample period a positive rebate. Despite the sharp reduction in the number of observations (we drop one third of the products in the second case) the point estimates do not change significantly.

Our main findings remain unchanged in all specifications. Hence, we conclude that our estimated VAT-export tax impact is not simply picking up other aspects of industrial policy or product specific features. Overall, this confirms our claim that changing VAT rebates is an effective policy tool to manage exports in China.