Can export VAT rebate be passed through?

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Abstract

The indirect tax burdens are generally assumed to be shifted fully or predominantly to buyers. Does the same logic apply to export value-added-tax (VAT) rebates? This study examines the tax incidence of export VAT rebates both empirically and theoretically. We take advantage of China's 2004 export VAT rebate reform as a natural experiment, and estimate the pass-through rate by employing the difference-in-differences (DiD) approach. Combining the comprehensive product-level data from China Customs (2003-2005) and detailed export rebate rate information, we find that exporters bear 100% of the export VAT rebate burden. We further show that this reduction of export VAT rebates significantly lowers export quantities and values. This negative effect is more pronounced for products subject to larger rebate cuts and for domestic firms that cannot shift profits. We then develop a theoretical model examining the tax incidence of export rebates from one country. This model rationalizes our empirical finding that the export VAT rebate burden cannot be shifted to foreign buyers. Our paper provides an insight into the distributional effects of export tax rebate policies.

Key words: VAT rebate, tax incidence, exporting.

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1. Introduction

The practice of granting tax rebates upon exportation has a long and distinguished history, with its intellectual foundations traceable at least to the eighteenth century. Adam Smith (1776), for example, endorsed export tax rebates as "the most reasonable" instrument among all policies designed to encourage exportation, and recognized their efficiency in neutralizing domestic tax distortions on internationally traded goods. Theoretically, value-added tax (VAT) rebates should ideally equal the statutory VAT rate levied in the exporting country, thereby ensuring that goods enter international markets unencumbered by domestic indirect taxes (Feldstein & Krugman, 1990). This zero-rating mechanism at the export stage preserves tax neutrality and prevents the transmission of domestic tax burdens into global supply chains.

As an indirect tax, VAT burdens on exported goods may be shifted forward to consumers in importing countries through higher export prices. If the VAT burden is indeed exported to foreign consumers, governments in exporting countries would face a strategic incentive to curtail or eliminate VAT rebates entirely. In practice, however, virtually all countries implement VAT rebate systems for exports. Developed economies typically adhere to full VAT rebates as the dominant paradigm, whereas developing countries, such as Algeria, Argentina, Brazil, China, and Vietnam, implement partial VAT rebates (Pessoa et al., 2021). The presence of partial VAT rebates therefore provides a unique empirical setting that allows researchers to estimate the pass-through rate, defined as the extent to which changes in VAT rebate rates are transmitted to border prices. Understanding this pass-through mechanism is important for both researchers and policymakers, as the magnitude of this rate may affect export competitiveness, change firm-level pricing behavior, and alter production decisions. Unfortunately, despite its importance, the incidence of VAT rebates remains theoretically ambiguous and empirically contested.

In this paper, we exploit a quasi-natural experiment, i.e., the 2004 VAT rebate cut in China, to estimate the incidence of VAT rebates. China's spectacular growth in international trade since the 1980s, particularly following its WTO accession in 2001, led to a rapid expansion of VAT rebate expenditures and mounting fiscal pressure. To attenuate this burden, the Chinese government lowered the average VAT rebate rate by 3.01 percentage points for most export goods, effective January 1, 2004. This reduction significantly increased the effective VAT burden on exported goods, since lower rebate rates implied that exporters could recover less of the VAT paid on inputs used in

the production of export goods. As a result, the 2004 VAT rebate cut can be regarded as an exogenous shock to exporters, because it was driven by domestic fiscal constraints rather than by conditions in export markets (Gao, 2007; Chandra & Long, 2013).

Our research design exploits two dimensions of variation for identification. The first is cross-product variation generated by the exogenous VAT rebate cut in 2004, which differentially affected goods. The second is temporal variation within products. The VAT rebate reform's effective date of January 1, 2004 creates a policy change between the pre- and post-reform periods. By leveraging these two sources of variation, we employ the difference-in-differences (DiD) approach to estimate the causal effect of VAT rebate changes on export outcomes. Our analysis draws on comprehensive product-level customs data from China Customs, merged with detailed export rebate rates for January 2003–April 2005.

We find that exporters bear the entire burden of VAT rebate cuts. To alleviate this burden, firms strategically shift from general trade to processing trade with (imported) supplied materials, which are (partially exempt) exempt from VAT. Nevertheless, this VAT increase still leads to substantial reductions in both export quantity and export value. The effects are concentrated among goods subject to larger rebate reductions, i.e., more pronounced tax increases,[1] and among domestic firms that lack the ability to allocate profits globally. Our findings stand in sharp contrast to the conventional wisdom that firms can generally pass-through indirect tax burdens to other market agents, either fully or partially. To rationalize these empirical findings, we develop a simple theoretical model of VAT rebate incidence. The model considers a setting with N countries exporting homogeneous goods to a single destination and demonstrates that intense international competition erodes exporters' pricing power, making it difficult to pass through VAT rebate burdens to importers. The theoretical predictions align closely with our empirical results, underscoring the importance of market structure in shaping tax incidence.

This paper makes several contributions to the literature. First, this study complements to the literature on indirect tax incidence by providing a systematic analysis of VAT rebates. Existing studies in this literature have examined various indirect taxes, including VAT, sale taxes, and tariffs (Besley, 1999; Kosonen, 2015; Fajgelbaum et al., 2020; Benzarti et al., 2021). Although VAT rebates

[1] The VAT rebate cut effectively increases the tax burden on export firms. Throughout this paper, we use the terms "tax increase" and "rebate cut" interchangeably to describe this policy change.

are technically part of the broader VAT system, they differ fundamentally from domestic VAT in that they apply specifically to cross-border transactions. To this extent, our analysis of VAT rebate incidence expands the domain of the indirect tax incidence literature. Prior research generally finds that firms can pass on a substantial share of indirect tax burdens to consumers or other market participants (Fullerton and Heutel, 2007; Slemrod et al., 2017; Benzarti et al., 2021; Kosonen, 2015), with evidence of complete shifting (Poterba, 1996; Besley, 1999; Lyssiotou and Savva, 2020; Amiti et al., 2019; Fajgelbaum et al., 2020; Jiang et al., 2023) and even overshifting (Besley, 1999; Fray and Haucap, 2024). In contrast, we find that the burden of VAT rebates falls entirely on exporters, with no pass-through to foreign consumers.

Second, this paper provides a precise estimation of VAT rebate incidence that addresses important limitations in the existing literature. Our study aligns closely with the work of Braakmann et al. (2020) and Lee et al. (2021). Braakmann et al. (2020) report a pass-through rate of 47% by using data on 332 products (at the 8-digit HS level) affected by VAT rebate cuts between 2004 and 2006. Similarly, based on VAT rebate cuts introduced in July 2007 for products prone to trade friction and product-month data from 2006 to 2008, Lee et al. (2021) estimate the pass-through rate to be 60%. While these two contributions offer valuable insights into the incidence of VAT rebate adjustments, they present certain limitations: (i) treatment groups in both papers are selective. In Braakmann et al. (2020), the treatment group covers 332 products, of which 234 were affected by the VAT rebate reform in January 2004. However, these 234 products constitute only a small fraction of all products subject to rebate cuts in the 2004 VAT rebate reform. Meanwhile, Lee et al. (2021) focus specifically on products likely to trigger trade friction. Such products may exhibit stronger price competitiveness than the broader set of exported goods, potentially undermining the representativeness of their estimated pass-through rates.

(ii) A portion of the data used in both studies lacks the information required to accurately estimate the VAT rebate pass-through rate, leading to potential calculation bias. Specifically, Braakmann et al. (2020) and Lee et al. (2021) calculate pass-through rates using coefficients derived from export data covering all firms, collected by the Chinese Customs Office. However, the tax base for VAT rebates differs by firm type. For manufacturing firms, the rebate is based on the free-on-board (FOB) export price of their own products, whereas for trading companies, it is calculated using the VAT-exclusive purchase price paid to domestic manufacturers. Since the Chinese Customs data do not report the

purchase prices paid by trading companies to manufacturers, it is not possible to accurately estimate pass-through rates for this subset of firms. Given that transactions involving trading companies accounted for approximately 40% of China's customs data from January 2003 to April 2005, their inclusion without proper adjustment likely distorts the overall pass-through estimates. To address this institutional distinction, our baseline analysis is confined to manufacturing firms, for which the rebate base is directly observable. This approach, combined with the use of a more representative sample, yields more accurate and externally valid estimates of VAT rebate incidence.

The remainder of this paper is organized as follows. Section 2 outlines the institutional background and implementation details of the 2004 VAT rebate reform. Section 3 describes the empirical strategy, including the model specification and dataset. Section 4 presents and discusses the baseline results, followed by a series of robust checks and further analyses. Section 5 provides a theoretical interpretation based on a simple model. Section 6 concludes the paper.

2. Institutional background

2.1 The VAT rebate system in China

According to the destination-based principle in international taxation, indirect taxes on traded goods are generally levied by the country or region where consumption occurs. As a type of indirect taxes, the VAT applicable to imported goods should be imposed by the importing country. Therefore, when goods are exported, governments in exporting countries would refund the VAT borne by those goods to exporters. This VAT export rebate mechanism is permitted under the World Trade Organization (WTO) rules. It ensures that exported goods enter the international market on a tax-neutral basis, allowing products from different countries to compete fairly, while also preserving the capability of importing countries to levy indirect taxes on imported goods according to their domestic tax systems.

Chinese customs statistics classify trade into 18 modes, including general trade, processing trade with imported materials (PTIM), processing trade with supplied materials (PTSM), bonded warehouse trade, barter trade, and border petty trade, among others. The three most significant modes are general trade, PTIM, and PTSM. During our sample period (January 2003 to April 2005), these three modes together accounted for 95.69% of the number of export transactions and 96.29% of total export value. The influences of the VAT rebate system, however, differ significantly across these three trade modes.

VAT rebate adjustments primarily affect general trade, as all materials and intermediate goods used in this trade mode are subject to domestic VAT. Consequently, changes in VAT rebate rates directly alter the effective tax burden on the full VAT content of exported goods of general trade. PTSM, by contrast, involves inputs sourced entirely from abroad, which are exempt from VAT upon import. The resulting export products therefore contain no domestic VAT component and are ineligible for rebates, rendering them insensitive to VAT rebate rate adjustments. PTIM occupies an intermediate position, that is, only domestically procured materials and intermediate goods are subject to VAT, while imported inputs remain VAT-exempt. Upon export, firms may claim refunds solely for the VAT paid on domestic purchases. Since the proportion of domestic inputs varies substantially across firms and products under this trade mode, the exposure of processing trade with imported materials to VAT rebate adjustments is partial and heterogeneous. Overall, general trade exhibits greater responsiveness to VAT rebate adjustments than either mode of processing trade. Since general trade also accounts for the largest share of China’s export transactions, this study focuses exclusively on this mode. We believe that this approach ensures both high policy relevance and strong sample representativeness.

Additionally, the rebate bases differ systematically between manufacturing firms and trading companies within general trade. For manufacturing firms, the VAT rebate is calculated on the FOB export price, which is directly observable in customs data. For trading firms, by contrast, the rebate is based on the VAT-exclusive purchase price paid to domestic manufacturers, which is generally unobserved in administrative records. Consequently, the precise change in rebate amounts resulting from VAT rebate policy adjustments cannot be determined for trading firms. To address this issue, we further restrict our sample to manufacturing firms operating under the general-trade regime.

2.2 The 2004 VAT rebate reform

To promote international trade, China piloted VAT rebates on selected machinery products in 1983, aiming to lower export costs and enhance competitiveness (Xie, 2009). This system was subsequently expanded in 1985 and further broadened in 1994. During 1983–2000, China's exports grew at an annual average rate of 15.3%. Following China's accession to the WTO, export growth accelerated rapidly, reaching 25.4% annually during 2000–2007. Consequently, the export-to-GDP ratio rose sharply, from 7.27% in 1983 to 26.04% in 2003. As exports expanded, the fiscal burden of

refund payments increased substantially. In 2003, total export rebates reached USD 24.025 billion, accounting for 9.93% of total tax revenue.[2] This growing burden placed considerable fiscal pressure on the government and thereby made reform of the VAT rebate system imperative (Gao, 2007).

To ease fiscal pressure, the Chinese central government implemented a broad adjustment of VAT rebate rates. On October 13, 2003, the Ministry of Finance and the State Taxation Administration issued the "*Notice on Adjusting Export Goods Rebate Rates*," (hereafter the *Notice*) effective January 1, 2004. This reform lowered VAT rebate rates for 71% of all 8-digit HS products, while rates for the remaining products were left unchanged.[3] Specifically, VAT rebate rates were lowered for 3,594 HS-8 products, while rates for 2,233 HS-8 products remained unchanged. As shown in Figure 1, VAT rebate reductions ranged from 2 to 13 percentage points. Reductions of 2 and 4 percentage points were the most common, each accounting for approximately 30% of exported goods.

From the identification perspective, the 2004 VAT rebate reform offers two key advantages. First, this reform was motivated primarily by fiscal sustainability concerns rather than by market conditions of specific export products, which strengthens the exogeneity of VAT rebate changes with respect to firm behavior. Second, the exceptionally broad coverage of VAT rebate rate adjustments ensures that affected products are highly representative of China's overall export structure at the time. Overall, the exogenous, wide-ranging nature of the 2004 VAT rebate reform offers a compelling setting for estimating the pass-through rate, which we exploit in the following empirical analysis.

3. Empirical Strategy

3.1 Model specification

We employ a DiD approach to estimate the incidence of the VAT rebate reductions. Our baseline specification is given in Equation (1) below.

$$Price_{ijcdrt} = \beta_0 + \beta_1 \times Policy_j \times Post04_t + \beta_2 \times Policy_j + \beta_3 \times Post04_t + \delta_j + \mu_d + \lambda_r + \gamma_t + \lambda_r \times \sum_{t=1}^{28} time\ indicators + \varphi_c \times \sum_{t=1}^{12} month\ dummies + \varphi_c \times \sum_{t=2003}^{2005} year\ dummies + \varepsilon_{ijcdrt} \quad (1)$$

where i, j, c, d, r, t denote firm, product at the 8-digit HS level, product broadly defined by industry

[2] The data is obtained from the National Bureau of Statistics of China and are available at https://data.stats.gov.cn/english/easyquery.htm?cn=C01.

[3] Furthermore, the *Notice* announced that VAT rebate rates were increased for a small subset of products, accounting for less than 0.2% of the total. These products have been excluded from our sample to maintain a focused analysis on the dominant policy change.

and end-use categories, destination country, region, and time indicators, respectively. The dependent variable, $Price_{ijcdrt}$, denotes the logarithm of export prices of an 8-digit HS product j belongs to category c shipped to country d by firm i located in region r at time t. $Policy_j$ is an indicator, which equal 1 if product j was subject to the 2004 VAT rebate reform, and 0 otherwise. $Post04_t$ is a time dummy, which equals 1 for years 2004 and later, and 0 otherwise. The coefficient on the interaction term $Policy_j \times Post04_t$, which is our regressor of interest, captures the effects of the 2004 VAT rebate reform on export prices. Since the 2004 rebate cuts substantially increased effective VAT rates for exporters, the existence of pass-through would imply higher export prices after January 2004. Consequently, we expect β_1 to be positive.

δ_j denotes 8-digit HS product fixed effects, controlling for time-invariant product characteristics. During our pre-treatment sample period, SARS had a significant impact on economic activities, including exports. Based on the cumulative number of SARS cases, all provinces in mainland China were classified into three categories, i.e., high-case regions, low-case regions, and zero-case regions.[4] The regional dummies, denoted as λ_r, capture these three categories of regions. To account for potential time trends driven by regional differences in SARS impact, we further include interaction terms between λ_r and time indicators. Additionally, we include the interaction terms between broadly-defined product fixed effects φ_c and month dummies, along with those between φ_c and year dummies to capture industry-specific time trends in export prices.[5] μ_d and γ_t are destination country and time fixed effects, respectively. The standard errors are clustered at the 8-digit HS

[4] Following Xu et al. (2014), we classified mainland China into three regions based on the degree of impact from the SARS outbreak. Specifically, Guangdong, Beijing, Tianjin, Hebei, Shanxi, and Inner Mongolia were classified as high-case regions; Heilongjiang, Guizhou, Yunnan, Xizang, Qinghai, and Xinjiang were classified as zero-case regions; and the remaining provinces were classified as low-case regions. The first SARS case in mainland China was identified in Foshan, Guangdong Province, in November 2002. The World Health Organization officially declared the end of the global SARS epidemic in July 2003. The outbreak had a substantial impact on economic activities, including exports. For example, the spring session of the China Import and Export Fair, held in Guangzhou, Guangdong Province, recorded transaction volumes of 16.85 billion, 4.42 billion, and 24.51 billion US dollars in 2002, 2003, and 2004, respectively. Compared to 2002, the transaction volume in 2003 fell by 73.8%. The information is available at: https://www.cantonfair.org.cn/zh-CN/customPages/about#5-3.

[5] Certain HS 2-digit categories consist entirely of treated products. Including their industry fixed effects interacted with year or month dummies would therefore partially capture the impact of the 2004 VAT rebate reform, potentially biasing the estimates. To avoid this issue while still controlling for product-specific time trends, we grouped all products into ten categories: 1. agriculture and food; 2. mining and quarrying; 3. textile, leather and footwear; 4. wood, paper and printing; 5. chemicals, rubber, plastics and fuel products; 6. other non-metallic mineral products; 7. metal and fabricated metal products; 8. machinery and equipment; 9. transport equipment; 10. furniture and other manufacturing according to the Bilateral Trade in Goods by End-Use (BTIGE) database. This classification is from the OECD and is available at https://www.oecd.org/en/data/datasets/bilateral-trade-in-goods-by-industry-and-end-use-category.html.

product level to deal with the potential heteroskedasticity and serial correlation problems induced by the 2004 VAT rebate reform (Bertrand et al., 2004).

Based on the estimate of β_1, we derive the pass-through rate of the VAT rebate reduction. The pass-through rate τ is defined as the percentage change in export price induced by a one-percentage-point change in the VAT rebate rate. Formally, let $VATR_0$ and $VATR_1$ denote the VAT rebate rates before and after January 2004, respectively, and define the rebate change as $\Delta VATR=VATR_1-VATR_0$. The coefficient β_1 from Equation (1) measures the relative change in export price due to a change in the VAT rebate rate ($\Delta VATR$). The pass-through rate is then calculated as follows.[6]

$$\tau = \frac{\Delta P}{\Delta Tax} \approx \frac{\beta_1}{VATR_1 - VATR_0} = \frac{\beta_1}{\Delta VATR} \tag{2}$$

In addition to analyzing price effects, we also examine the impact of the 2004 VAT rebate reform on export quantity and value. The VAT rebate reduction effectively raises the tax burden on exporters, which should, in turn, lead to a decline in both export volume and total export value. Furthermore, because the magnitude of VAT rebate cut varies across products, the resulting increase in cost differs, which may generate heterogeneous trade responses. We therefore hypothesize that products subject to larger VAT rebate reductions would experience a more pronounced decrease in export quantity and value. To test these hypotheses, we replace the dependent variable, $Price_{ijcdrt}$, in Equation (1) with $Quantity_{ijcdrt}$ and $Value_{ijcdrt}$, respectively.

3.2 Data

This study employs monthly product-firm level export data collected by the China Customs Office, along with product-level VAT rebate rates, obtained from the State Taxation Administration (STA) of China. Our sample covers the period from January 2003 to April 2005. The choice of sample period is motivated by two considerations. First, 2002 marked the initial adaptation year for Chinese firms following China's accession to the WTO. By January, 2003, firms had become more familiar with WTO rules and their behavior had stabilized, free from major transitional disturbances. Second, a series of minor tax reforms were subsequently introduced in May, 2005.[7] We truncate the sample in

[6] A detailed derivation of the equation used to calculate the pass-through rate can be found in the Appendix.

[7] On May 25, 2005, the Ministry of Finance (MOF) and the State Administration of Taxation (SAT) jointly issued a

April 2005 to avoid the potential contamination from these later policy changes.

Customs data The customs data are recorded at the transaction level and include the 8-digit HS code, trade direction (export/import), value, quantity, trade mode (e.g., general trade, PTIM, and PTSM), firm name, and destination country. We process this rich dataset as follows:

(i) We retain only export transactions and drop import records.

(ii) We remove observations with zero or missing export values and quantities.

(iii) We focus on major trade modes. Specifically, we keep transactions classified under general trade, PTIM, and PTSM, which account for 74.42%, 14.16%, and 7.11% of China's total export transactions during the sample period, respectively. The remaining 15 minor trade modes are excluded because they represent only a small share of exports and have little relevance to the VAT rebate system.

(iv) We exclude trading firms, because the VAT rebate base for trading firms is the VAT-exclusive purchase price, which is not recorded in the customs data.

(v) The transaction-level data are aggregated to the month–8-digit HS code–trade mode–firm–destination country level.

Finally, our baseline identification relies on general trade, which accounts for around three-fourths of total export transactions and is broadly representative of China's export structure. We subsequently incorporate data on PTIM and PTSM in further analyses. The differential impact of the VAT rebate across trade modes further justifies our focus on general trade. Under general trade, the VAT rebate base is the FOB export price. For PTIM, the base equals the FOB value minus the value of imported materials in the same month, whereas no VAT rebate is granted under PTSM because imported inputs are exempt from VAT. Consequently, if the VAT rebate effect exists, it should be strongest for general trade, partial for PTIM, and absent for PTSM.

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circular, which clarified the tax treatment of the Urban Maintenance and Construction Tax (UMCT) and the Education Surcharge (ES) for manufacturing enterprises utilizing the "Exemption, Credit, and Refund" method for exported goods. The regulation took effect retrospectively from January 1, 2005. Moreover, on May 20, 2005, the Customs Tariff Commission of the State Council decided to adjust some export tariffs on textile and garment products, effective June 1, 2005. This decision came in response to escalating trade tensions following the expiration of the global textile quota system in January 2005, which had led to sharp increases in Chinese textile exports to the United States and European markets. Concurrently, the government reduced or eliminated export VAT rebates on selected mineral products, to curb the rapid growth of exports from high-energy-consumption, highly polluting, and resource-intensive industries.

VAT rebate rate data The VAT rebate rate data is obtained from the STA. We construct a panel dataset of product-level VAT rebate rates covering the period from January 2003 to April 2005. Typically, the STA releases updated VAT rebate rates for the upcoming year at the end of each year or the beginning of the following year. Any changes to these rates are formally announced through specific policy documents. The original rebate rate data are provided at the 8- to 11-digit HS product level. We process the dataset as follows.

(i) We aggregate VAT rebate rates to the 8-digit HS level and exclude products with inconsistent VAT rebate rates within the same 8-digit category. To facilitate merging with the customs data, rates for products originally classified at more disaggregated levels are aggregated to the 8-digit HS level. This approach is feasible because VAT rebate rates are generally uniform within each 8-digit HS category.

(ii) We merge VAT rebate rates with the customs data by year.

(iii) We combine the cross-sectional datasets from 2003, 2004, and 2005 into a single panel dataset. Because a small proportion of HS codes change annually, we drop 8-digit HS products that cannot be consistently matched across years.

The final dataset for general trade contains 7,617,449 observations at the month–8-digit HS code–trade mode–firm–destination country level, spanning January 2003 to April 2005. The 2004 VAT rebate reform reduced rates for 3,594 products, left rates unchanged for 2,233 products, and increased rates for only 8 products. To simplify the analysis, we exclude the 8 products that experienced rate increases. Table 1 presents summary statistics and definitions for key variables. Overall, approximately 71% of 8-digit HS code products were subject to the 2004 VAT rebate reform, and roughly 66.6% of the observations are drawn from the post-reform period.

Table 2 Panels A, B, and C compare summary statistics for treatment and control groups for *Price*, *Quantity*, and *Value*, respectively. Columns (1) and (2) report the means and standard deviations of key variables for the pre- and post-reform periods, while the final column shows the differences between the post- and pre-reform periods. The diff-in-diff rows report the across-period differences between the treatment and control groups. We find that following the 2004 VAT rebate reform, export prices increased significantly in both the treatment and control groups. In contrast, export quantities decreased significantly in both groups. As for export value, it declined in the treatment group after the reform, but increased in the control group.

4. Empirical findings

4.1 Baseline results

Table 3 summarizes the regression results from Equation (1). The dependent variables in Panels A, B, and C are *Price*, *Quantity*, and *Value*, respectively. In column (1), we only include product fixed effects at the 8-digit HS level, along with region, destination country, and time fixed effects. In column (2), we include interactions between regional categories λ_r and time indicators, broadly-defined product fixed effects φ_c and month dummies, as well as those between φ_c and year dummies. The standard errors are clustered at the 8-digit HS level. In Panel A, the estimated coefficients on the interaction term $Policy_j \times Post04_t$ are statistically insignificant in both columns and the magnitudes are close to zero, suggesting that export prices were not significantly affected after the 2004 VAT rebate reform. The pass-through rate of VAT rebate cuts is effectively zero, indicating that the entire incidence of the VAT rebate reduction fell on exporters and was not passed on to foreign importers.

In Panel B, the estimated coefficients on $Policy_j \times Post04_t$ remain negative and statistically significant in two columns, indicating that export quantities declined significantly following the 2004 VAT rebate reform. These results suggest that firms reduced their export volumes in response to an increase in the effective VAT burden on exports. We find a similar pattern in Panel C. Taken together, these findings demonstrate that the 2004 VAT rebate reform led to a significant contraction in both export quantities and values, while leaving export prices unchanged. Hence, the full incidence of the VAT rebate reduction was borne by exporters.

Our empirical results reveal that the burden of the VAT rebate cuts was not passed through to importers, which contrasts with the findings of Braakmann et al. (2020) and Lee et al. (2021). Both studies examine the incidence of VAT rebates in China and report pass-through rates of 47.3% and 60%, respectively. This discrepancy can be attributed to the following three reasons.

First, both earlier studies include trading companies in their samples, which may introduce bias into the estimated pass-through rates. For trading firms, the VAT rebate is calculated based on the purchase price paid to domestic manufacturers, whereas for manufacturing firms, it is based on the FOB export value. However, customs data only report FOB export prices and do not contain information on domestic purchase prices, so it is impossible to accurately estimate pass-through rates

for trading companies. To avoid this bias, we restrict the sample to manufacturing firms, thereby ensuring a more reliable estimation of the pass-through rate.

Second, the sample used by Braakmann et al. (2020) is highly selective, rendering their empirical results not directly comparable to ours. Both their study and this paper exploit VAT rebate rate cuts in China as a policy shock and employ the DiD approach to estimate the reform's impact on export prices. However, the sample compositions differ substantially. In Braakmann et al. (2020), the treatment and control groups consist of 332 and 942 8-digit HS products, respectively, and the analysis covers three separate rebate reforms (January 2004, May 2005, and January 2006). In contrast, our study includes nearly the entire universe of products, that is, 3,594 eight-digit HS products in the treatment group and 2,233 in the control group, and focuses exclusively on the largest VAT rebate reform, which took place in January 2004. Given these marked differences in sample scope and composition, a direct comparison between our empirical findings and those of Braakmann et al. (2020) is not feasible.

Third, the policy shock examined by Lee et al. (2021) may lead to an overestimation of the VAT rebate pass-through rate. Their study analyzes the July 2007 VAT rebate reform, which primarily targeted products involved in international trade friction. These products are likely more price-competitive than others, making it easier for exporters to raise prices following a VAT rebate cut. Thus, the estimated pass-through rate in their setting is likely biased upward. In contrast, the January 2004 reform analyzed in this paper was driven by fiscal pressure rather than product-specific trade conditions (Gao, 2007; Chandra & Long, 2013). As such, the policy shock we exploit is not subject to selection based on price competitiveness, thereby providing a cleaner identification of the incidence of VAT rebate reductions. Overall, the pass-through rate estimated in this paper is more credible for two reasons. First, our sample covers nearly all 8-digit HS code products exported by manufacturing firms. Second, the policy variation we exploit is relatively exogenous, as the 2004 VAT rebate reform was motivated by fiscal pressure rather than product-specific trade considerations.

4.2 Robustness Checks

In this subsection, we perform a series of robustness checks, including an assessment of parallel trends assumption, different sample analyses, and alternative specifications. The results are summarized in Figure 2 and Tables 4 and 5. To save space, we focus on the estimation specifications

in column (2) of Table 3.

Parallel-trends assumption and dynamic effects To obtain an unbiased estimator from the DiD approach, export prices of treatment and control products must follow the same trend up to the point of policy intervention. To assess the validity of the parallel trends assumption and explore the dynamic effects of the 2004 VAT rebate reform, we estimate Equation (3). This specification examines how export prices evolved relative to the reform timing. Since the VAT rebate reform was announced on October 2003, we take July to September 2003 as the baseline months and exclude their dummies from Equation (3).

$$Price_{ijcdrt} = \theta_0 + \sum_{t=200301}^{200504} \theta_t \times Policy_j \times \gamma_t + \delta_j + \mu_d + \lambda_r + \gamma_t + \lambda_r \times \sum_{t=1}^{28} time\ indicators + \varphi_c \times \sum_{t=1}^{12} month\ dummies + \varphi_c \times \sum_{t=2003}^{2005} year\ dummies + \varepsilon_{ijcdrt} \quad (3)$$

where γ_t denotes time indicators. The standard errors are also clustered at the 8-digit HS product level.

The dynamic effects of the 2004 VAT rebate reform on export prices are shown in Figure 2 Panel A. The estimated coefficients on interactions between $Policy_j$ and pre-reform time dummies remain statistically insignificant, affirming the parallel-trends assumption. That is, export prices for treatment and control products followed the same time trends prior to the effective date of the VAT rebate cuts. The estimated coefficients on the interactions between $Policy_j$ and post-reform time dummies are still statistically insignificant. Taken together, these findings are consistent with the statistically insignificant baseline estimates in Panel A of Table 3, suggesting that Chinese exporters did not pass on the increased VAT costs to foreign importers during our sample period. The full economic burden of the VAT rebate cut was borne by the exporters themselves.

We then replace the dependent variable in Equation (3) with *Quantity* and *Value*, respectively, and present the corresponding results in Figure 2, Panels B and C. For export quantities, we continue to find that the estimated coefficients on the interactions between $Policy_j$ and pre-reform time dummies are statistically insignificant. We find a similar pattern for export value, except for February 2003.[8]

[8] The negative and significant coefficients for February 2003 appear exclusively in the value specifications, while the corresponding coefficients for quantity and price are negative but insignificant. This pattern may be attributable to the Chinese Spring Festival effect. First, the festival typically leads to a decline in export quantity, as employees take one to three weeks of vacation, reducing output and exports during the festival month. Second, export prices may also decrease during this period. For certain holiday-related consumer goods, exporters might need to reduce

Given that this deviation is isolated and not part of a systematic pre-trend, we conclude that the parallel trends assumption is supported in our setting.

The estimated coefficients on the interactions between $Policy_j$ and post-reform time dummies remain negative and statistically significant, indicating that both export quantities and values declined persistently after the implementation of the 2004 VAT rebate reform. Our findings suggest that when bear the full incidence of the VAT rebate cut, that is, when their tax burden increases, they respond by reducing export quantities, which in turn leads to a decline in export values. Overall, these results further support the validity of the parallel trends assumption and confirm that our estimations are unbiased.

Different time frequencies Our baseline results are estimated using monthly data. To assess the robustness of our findings, we re-estimate Equation (1) using data aggregated to alternative time frequencies, i.e., quarter, semi-annual, and annual levels. Specifically, we aggregate the transaction-level data into three distinct datasets, i.e., firm–quarter–8-digit HS product level–destination country, firm–semi-annual–8-digit HS product level–destination country, and firm–annual–8-digit HS product level–destination country, to examine whether our baseline findings are byproducts of monthly noise, seasonal patterns, or short–horizon rigidities. The corresponding results are shown in Table 4, Panels A to C, respectively. Columns (1), (2), and (3) present regression results with dependent variable *Price*, *Quantity*, and *Value*, respectively.

In column (1), the estimated coefficients on the interaction term $Policy_j \times Post04_t$ remain statistically insignificant, indicating that the VAT rebate reform did not lead to a significant change in export prices, regardless of the time frequency used. Moreover, the magnitudes of the coefficients are small and comparable to the baseline estimate reported in Column (2) Panel A of Table 3. These results reinforce our main finding that Chinese exporters did not pass on the increased VAT burden to foreign buyers. In columns (2) and (3), the estimated coefficients on $Policy_j \times Post04_t$ are negative and statistically significant across all specifications, indicating that the VAT rebate reform led to a persistent decline in both export quantities and values, irrespective of the time aggregation chosen. The magnitudes of these coefficients are also consistent with the baseline estimates reported in

prices after the festival to clear remaining inventory that was not sold in the pre-holiday period. Although the estimated effects on quantity and price are individually insignificant, their product, i.e., export value, could exhibit a negative and statistically significant effect.

column (2), Panels B and C of Table 3, respectively. These findings demonstrate that the observed reductions in export quantities and values following the 2004 VAT rebate reform are robust to alternative choices of time frequency. This consistency across different levels of temporal aggregation confirms that our main conclusions are not sensitive to the way in which the data are aggregated over time.

Excluding October to December 2003 As discussed in Section 2.2, the Notice was announced on October 13, 2003, and became effective on January 1, 2004, leaving a three-month interval between the announcement and implementation dates. Although we find no evidence of systematic market volatility in prices, quantities, or values during this transition period, we remain concerned that our estimates might be confounded by transitory market reactions to the policy announcement. Hence, we exclude observations from October to December 2003 and re-estimate Equation (1).

The results are presented in Panel A of Table 5. Columns (1), (2), and (3) report the regression results with *Price*, *Quantity*, and *Value* as dependent variables, respectively. In column (1), the estimated coefficient on $Policy_j \times Post04_t$ remains statistically insignificant, indicating that export prices did not increase significantly following the 2004 VAT rebate reform. This finding reinforces our conclusion that the full incidence of the VAT rebate cut was borne by Chinese exporters and was not passed on to foreign importers. In columns (2) and (3), the coefficients on $Policy_j \times Post04_t$ remain negative and statistically significant, with magnitudes closely aligned with the baseline estimates. These results confirm that our main findings are not sensitive to the inclusion or exclusion of the transition period between the announcement and effective dates, and that the reductions in export quantities and values are robust to this sample adjustment.

January 2003 to December 2005 To avoid the confounding effects of a series of minor tax reforms introduced in May 2005, we initially truncate our sample in April 2005. However, to assess whether our main findings persist over a longer time horizon, we extend the sample period through December 2005 and re-estimate Equation (1). The results are presented in Panel B of Table 5. Columns (1), (2), and (3) report the regression results with *Price*, *Quantity*, and *Value* as the dependent variables, respectively.

The estimated coefficients on $Policy_j \times Post04_t$ are qualitatively and quantitatively similar to the baseline results reported in Column (2) of Table 3. In column (1), the coefficient remains statistically insignificant, indicating that Chinese exporters did not pass on the increased VAT burden to foreign

importers, even over the extended sample period. In columns (2) and (3), the coefficients are negative and statistically significant, consistent with the baseline finding that exporters responded to higher effective VAT rates by reducing export quantities rather than adjusting prices, which in turn led to a decline in export values. These results confirm that our core conclusions are robust to the inclusion of additional post-reform months and are not confounded by the minor policy changes introduced in May 2005.

Alternative policy measurement In our baseline specification, we use a binary indicator, $Policy_j$, which equals 1 if an 8-digit HS product was subject to the 2004 VAT rebate reform, and 0 otherwise. However, as illustrated in Figure 1, the magnitude of the VAT rebate reduction varies considerably across products. To account for this heterogeneity, we conduct a robustness check by replacing $Policy_j$ with $Rate\ cut_j$, a continuous variable that captures the size of the VAT rebate rate reduction for each 8-digit HS product, in Equation (1). The results are reported in Panel C of Table 5.

Consistent with our baseline findings, column (1) shows that the estimated coefficient on the interaction term $Rate\ cut_j \times Post04_t$ remains statistically insignificant, confirming that exporters did not pass the increased tax burden on to foreign buyers. In columns (2) and (3), the coefficients are negative and statistically significant, reinforcing the conclusion that exporters adjusted to higher effective VAT rates by reducing export quantities rather than raising prices, ultimately leading to a decline in export values. Given the average rebate reduction is 3.01 percentage points, the magnitudes of these coefficients are similar to their baseline counterparts. These findings demonstrate that our main conclusions are robust to employing a continuous measure of treatment intensity and are not sensitive to the binary classification of treated products.

Excluding northeastern provinces On July 1, 2004, China initiated a pilot reform of its VAT system in three northeastern provinces, i.e., Heilongjiang, Jilin, and Liaoning, covering six broadly defined manufacturing industries.[9] This reform marked a structural transition from a production-based VAT, which disallowed deductions for fixed asset purchases, to a consumption-based VAT that permitted full deduction of input VAT on equipment investments. As demonstrated by Liu and Lu (2015), this VAT policy change substantially reduced firms' cost of capital, stimulated fixed asset investment, and consequently increased firms' propensity to export.

[9] These six broadly defined manufacturing industries were equipment manufacturing, petroleum and chemical manufacturing, metallurgy, shipbuilding, automobile manufacturing, and agricultural product processing

The 2004 VAT pilot reform may confound the estimation of VAT rebate cut effects through two channels. First, if an 8-digit HS product subject to the VAT rebate cuts was exported by a firm that simultaneously benefited from the VAT pilot reform in one of the six pilot sectors across the three northeastern provinces, the estimated export response would conflate both policy effects. This overlap could bias the estimated pass-through rates, since the investment stimulus from the pilot reform might independently affect export pricing behavior. Second, the investment boom induced by the pilot reform might alter firm composition at the 8-digit product level, thereby violating the stable unit treatment value assumption implicit in the DiD framework. To alleviate this concern, we exclude all observations from three northeastern provinces and re-estimate Equation (1).

Panel D of Table 5 reports the estimation results. The coefficient on the interaction term $Policy_j \times Post04_t$ in column (1) remains statistically insignificant, consistent with our baseline finding that exporters absorbed the increased tax burden rather than shifting it to foreign buyers. In columns (2) and (3), coefficients remain negative and statistically significant, further supporting the conclusion that exporters responded to higher effective VAT rates by contracting export quantities instead of raising prices, with consequent reductions in export values. These estimates are quantitatively similar to our baseline results, indicating that the 2004 VAT pilot reform does not confound our main findings.

Balanced panel We are concerned that the VAT rebate cuts might have led to differential patterns of firm entry into or exit from international trade markets between the treatment and control groups before and after the policy change. If such differential responses occurred, our estimates could be contaminated by changes in firm composition. To alleviate this concern, we restrict the sample to firm-product observations that exported in both 2003 and the post-reform period (i.e., January 2004 to April 2005), thereby holding the set of continuing exporters constant.

The results shown Panel E of Table 5 are close to our baseline findings. The estimated coefficient on $Policy_j \times Post04_t$ is statistically insignificant for *Price*, indicating no pass-through of the tax burden to foreign buyers. In contrast, the coefficients for *Quantity* and *Value* are negative and highly significant, with magnitudes of –7.21% and –8%, respectively. These results suggest that, among continuing exporters, the 2004 reform led to a substantial decline in export volumes and values, confirming the intensive-margin effects of the VAT rebate cuts.

4.3 Heterogeneous effects

In this subsection, we adopt the triple difference approach (DDD) to investigate the heterogeneous effects of the VAT rebate cuts via Equation (4).

$$\begin{aligned} Price_{ijcdrt} = {} & \theta_0 + \theta_1 \times Policy_j \times Post04_t \times Heter_{i/j} + \theta_2 \times Policy_j \times Post04_t + \theta_3 \times Policy_j \times Heter_{i/j} + \\ & \theta_4 \times Post04_t \times Heter_{i/j} + \theta_5 \times Policy_j + \theta_6 \times Post04_t + \theta_7 \times Heter_{i/j} + \delta_j + \mu_d + \lambda_r + \gamma_t + \\ & \lambda_r \times \sum_{t=1}^{28} time\ indicators + \varphi_c \times \sum_{t=1}^{12} month\ dummies + \varphi_c \times \sum_{t=2003}^{2005} year\ dummies + \varepsilon_{ijcdrt} \end{aligned} \quad (4)$$

where $Heter_{i/j}$ can be replaced by variables representing firm or product features one by one. The coefficient of the triple interaction term $Policy_j \times Post04_t \times Heter_{i/j}$ captures the heterogeneous effects of the 2004 VAT rebate reform. Table 6 summarizes the regression results. To conserve space, we present only the coefficients on the triple interaction term and $Policy_j \times Post04_t$. Columns (1), (2), and (3) report the regression results with *Price*, *Quantity*, and *Value* as the dependent variables, respectively.

Low- vs. high-reduction group Figure 1 shows that the magnitude of VAT rebate reductions varies considerably across products, with most affected products experiencing VAT rebate cuts of either 2 or 4 percentage points. We have already shown that our main findings are robust to using a continuous measure of treatment intensity based on the size of the VAT rebate reduction at the 8-digit HS product level. Based on this, we expect that products facing larger VAT rebate cuts would exhibit stronger responses in export decisions. To test this hypothesis, we focus on the effects of 2% and 4% VAT rebate reductions on export prices, quantities, and values. Specifically, we replace $Heter_{i/j}$ with $High_j$, which equals 1 if product *j* belongs to the high-reduction group (i.e., subject to a 4% cut) and 0 otherwise. The triple interaction term $Policy_j \times Post04_t \times High_j$ captures heterogeneous responses of the low-reduction and high-reduction groups to the 2004 VAT rebate reform. The results are presented in Panel A of Table 6.

In column (1) of Panel A, the estimated coefficients on $Policy_j \times Post04_t$ and the triple interaction term $Policy_j \times Post04_t \times High_j$ remain statistically insignificant. These findings indicate that, regardless of the magnitude of the VAT rebate cuts, exporters did not pass the tax cut on to foreign importers through higher prices. In contrast, in columns (2) and (3), the estimated coefficients on both $Policy_j \times Post04_t$ and $Policy_j \times Post04_t \times High_j$ are negative and statistically significant, with similar magnitudes. Specifically, the effect of the VAT rebate cut on export quantities and values in the

high-reduction group is twice that in the low-reduction group. These results suggest that the reduction in export quantities and values scales proportionally with the size of the VAT rebate cut, further supporting the causal interpretation of our findings.

FIEs vs. domestic firms As multinational enterprises, foreign-invested enterprises (FIEs) generally engage in profit-shifting behaviors, such as transfer pricing, to reallocate earnings to jurisdictions with lower corporate income tax rates. Consequently, when export prices remain unchanged, variations in VAT rebate rates should exert relatively modest effects on FIE profitability. By contrast, domestic firms during 2003–2005 lacked the capability to invest abroad and rarely employed transfer pricing mechanisms for profit reallocation. Therefore, changes in VAT rebate rates should impose larger impacts on their profit margins, holding export prices constant.

To test this hypothesis, we replace $Heter_i$ with $Domestic_i$, which equals 1 if firm i is a domestic firm, and 0 if firm i is a FIE. Panel B of Table 6 presents the corresponding results. In column (1) of Panel B, the coefficients on $Policy_j \times Post04_t$ and the triple interaction term $Policy_j \times Post04_t \times Domestic_i$ remain statistically insignificant, indicating that neither FIEs nor domestic firms passed the tax burden through to foreign buyers. For export quantities and values, the estimates in columns (2) and (3) reveal statistically significant declines for both ownership types. Notably, domestic firms experienced substantially larger declines, that is, nearly double those of FIEs. This pronounced heterogeneity aligns with differential profit-shifting capabilities across ownership types, thereby reinforcing confidence in our empirical findings.

4.4 Further analysis

As mentioned in Section 2.1, the impacts of the 2004 VAT rebate reform vary across trade modes. Under the existing policy framework, exporters using PTSM are not eligible for VAT rebates. Exporters engaged in PTIM receive VAT rebates based on a portion of the export value, while those in general trade receive rebates based on the full FOB export value. Therefore, a reduction in VAT rebate rates has the strongest impact on general trade, a moderate impact on PTIM, and no direct impact on PTSM. This asymmetry creates an incentive for exporters to shift from general trade toward processing trade, in order to cope with increased effective VAT rates after the 2004 reform. To test this hypothesis, we examine adjustments in trade mode along two dimensions. First, we analyze how the selections of trade modes adopted by exporters are affected by the 2004 VAT rebate

reform. Second, we calculate the share of export value attributable to three major trade modes and estimate how the reform impacts these shares.[10]

Table 7 reports the effects of the 2004 VAT rebate cut on firms' selection of trade modes. The dependent variables in columns (1) through (3) are indicators for whether a firm exported an 8-digit HS level product to a specific country in a given year exclusively through general trade, PTIM, or PTSM, respectively. The dependent variable in column (4) GT+PTIM, is an indicator for whether the firm used both general trade and PTIM (but not PTSM). The dependent variable in the last column, GT+PTIM+PTSM, is an indicator for whether the firm used all three modes simultaneously.

The negative and significant coefficient on the interaction term $Policy_j \times Post04_t$ in column (1) suggests that the 2004 VAT rebate reform led to 0.2 percentage point decrease in the probability of engaging exclusively in general trade. The positive and significant coefficients in columns (3)– (5) suggest that, following the reform, some firms moved away from exclusive reliance on general trade, instead adopting processing trade, particularly combinations of trade modes, to mitigate pressure from the VAT rebate cuts. These findings support our hypothesis and suggest that the reform induced a reallocation across trade modes, consistent with a shift away from exclusive reliance on general trade.

Table 8 examines the effects of the VAT rebate reform on the export value shares of different trade modes. The dependent variables in columns (1), (2), and (3) are the shares of general trade, PTIM, and PTSM, respectively. The estimated coefficient on the interaction term $Policy_j \times Post04_t$ in column (1) remains negative and statistically significant, indicating that the share of general trade declined by 1.13 percentage points following the 2004 VAT rebate reform. The coefficients in columns (2) and (3) are all positive and statistically significant. These patterns confirm that exporters responded to the VAT rebate cut by reallocating export activity from general trade toward processing trade modes, and support our hypothesis.

5. Theoretical model

In general, the pass-through rate tends to be high for indirect taxes but low for direct taxes. However,

[10] The results in Table 8 are estimated using data at the firm–month–8-digit HS product–destination country level. Because the sample in the analyses includes observations from processing trade, the number of observations is larger than in the baseline specifications, which focus exclusively on general trade.

this paper finds that exporters did not pass through the burden of VAT rebate rate reduction to foreign importers. To provide theoretical support for our findings, we develop a simple model that characterizes the effects of the VAT rebate reform on export prices and quantities.

Assume n ($n \geq 2$) countries export a homogeneous product to a common destination market. The exporting country of interest (i.e., home country) is represented by a single, representative exporter (denoted as *h*), which aggregates the total export supply of all firms within that country. The remaining $n-1$ countries are represented analogously by their own representative exporters. Since the *n* export firms produce a homogeneous product, we assume they engage in quantity competition rather than price competition. The cost functions of all exporters are assumed to be linear and symmetric, taking the form $C(q) = cq$.

The home country imposes a VAT at rate t. The export price of the product, denoted by p, is inclusive of VAT. Thus, the exporter's revenue per unit is $\frac{p}{1+t}$, while the government's VAT revenue per unit is $\frac{tp}{1+t} \equiv T$.

The export price is determined by quantity competition in the common destination market. The (inverse) demand function is given by $P(Q) = A - bQ$, where $Q = \sum_i q_{f_i} + q_h$ represents total production supplied by all exporters. The parameters A and b are positive constants, and A is assumed to be sufficiently large to ensure interior solutions.[11] Then the optimal production of home country, the total production of all exporters, and the export price in equilibrium are derived as follows.

$$q_h^*(t) = \frac{A-(nt+1)c}{(n+1)b}, Q^*(t) = \frac{nA-(n+t)c}{(n+1)b}, P^*(t) = \frac{A+(n+t)c}{n+1}$$

Let Δt denote the change in the VAT rate. A reduction in the VAT rebate corresponds to $\Delta t > 0$, while an increase corresponds to $\Delta t < 0$. A change of VAT rebate rate affects both government's VAT revenue and the equilibrium export price. The pass-through rate of the VAT rebate captures the extent to which changes in VAT revenue per unit are reflected in the export price.

The effect of a change in the VAT rate on government VAT revenue is given by:

$$\Delta T = \frac{t}{1+t}\Delta P^* + \frac{P^*}{(1+t)^2}\Delta t \quad (5)$$

where $\Delta P^* = \frac{c}{n+1}\Delta t$. Since $P^* > (1+t)c$, we can rewrite equation (5) as:

[11] Specifically, $A > (nt+1)c$, and then the equilibrium production of every firm is positive.

$$\Delta T = \left[\frac{t}{1+t} + \frac{P^*}{(1+t)c}\frac{n+1}{1+t}\right]\Delta P^* > \frac{1}{1+t}(t+n+1)\Delta P^*$$

hence, we can obtain:

$$\frac{\Delta P^*}{\Delta T} < \frac{1+t}{1+n+t} \tag{6}$$

Equation (6) implies that the pass-through rate decreases when the number of competing firms increases. In addition, the derivative of the home country's optimal production with respect to the VAT rate is:

$$\frac{\mathrm{d}q_h^*(t)}{\mathrm{dt}} = -\frac{n}{n+1}\frac{c}{b} < 0 \tag{7}$$

Hence, we can find the theoretical implications as follows:

First, the incidence of the VAT rebate is characterized by partial pass-through. Based on equation (6), the pass-through rate of the VAT rebate lies between 0 and 1, which is consistent with the standard theoretical prediction for indirect taxation.

Second, and more importantly, the pass-through rate can be very low under certain market structures. We study equation (6) again. The pass-through rate is relatively high, but still below 50%, when the number of competing exporters from other countries is small. However, the pass-through rate becomes low when many exporters compete in the same destination market, making it difficult for any single exporter to pass on the burden of a VAT rebate reduction. For most products, the number of firms (n) producing the same product is large. When n exceeds 10, the pass-through rate falls below 10 percent, which is closely aligns with our empirical findings on the incidence of the VAT rebate rate reduction.

Third, exporters in the home country reduce their production in response to a VAT rebate reduction. Equation (7) indicates that the derivative of optimal output with respect to the VAT rate is negative, that is, home country's exporters decrease production as the effective VAT burden increases. This production response is consistent with our empirical findings that the 2004 VAT rebate rate reduction led to a decline in export quantities. Furthermore, because the pass-through rate is very low, that is, the export price remains nearly unchanged, the reduction in output translates directly into a decline in export sales. This finding is also consistent with our empirical results on the negative effect of the VAT rebate rate reduction on export values.

6. Conclusion

This paper examines the incidence of VAT rebate by using the 2004 VAT rebate reform in China as a natural experiment. We employ the DiD approach to compare changes in export prices between products that experienced a rebate reduction and those that did not, before and after the reform. We further develop a theoretical model to rationalize our empirical findings.

Our empirical results indicate that the 2004 VAT rebate cuts had no statistically significant effect on export prices, implying that the associated tax burden fell entirely on exporters. Importers and consumers in destination countries were shielded from price pass-through. In response to the increased VAT burden, exporters shift from general trade toward processing trade, although the economic magnitude of this adjustment is modest. Meanwhile, products subject to VAT rebate cuts experienced significant declines in both export volume and value. These negative effects are significant not only statistically but also economically.

Overall, the evidence suggests that exporters fully absorbed the VAT burden induced by the 2004 VAT rebate reform. Manufacturing firms mitigated the adverse impacts primarily through substantial reductions in export quantity rather than through price adjustments. These findings underscore the central role of quantity adjustment, as opposed to price pass-through, as the primary channel through which VAT rebate policy affects export behavior in the competitive international market.

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Data availability
The authors do not have permission to share data.

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Table 1. Summary statistics

Variables	Mean	Std. Dev.	Obs.	Definition
Price	1.5948	1.5288	7,617,449	Logarithm of the export price, measured at the 8-digit HS product–firm–destination country–month level.
Quantity	7.6774	2.6932	7,617,449	Logarithm of the quantity of an 8-digit HS product exported by a firm to a destination country in a given month.
Value	8.7054	2.0368	7,617,449	Logarithm of the value of an 8-digit HS product exported by a firm to a destination country in a given month.
Policy	0.7091	0.4542	7,617,449	An indicator variable that equals 1 if the 8-digit HS product's VAT rebate rate decreased between 2003 and 2004, and 0 otherwise.
Post	0.6656	0.4718	7,617,449	An indicator variable that equals 1 after the 2004 VAT rebate reform takes effect, and 0 otherwise.

Data sources: the China Customs Office and the State Taxation Administration (STA) of China

Table 2. Summary statistics, pre- vs. post-reform and treatment vs. control

	(1)	(2)	(2)-(1)
Panel A: Price			
	Post=0	Post=1	Diff.
Treatment	1.5826	1.6679	0.0854***
	(1.4403)	(1.5303)	(0.0013)
Control	1.4136	1.5218	0.1082***
	(1.4996)	(1.6289)	(0.0022)
Diff-in-diff			-0.0228
			(0.0176)
Panel B: Quantity			
	Post=0	Post=1	Diff.
Treatment	7.7861	7.6569	-0.1292***
	(2.6074)	(2.6601)	(0.0024)
Control	7.7002	7.5825	-0.1177***
	(2.8150)	(2.8089)	(0.0041)
Diff-in-diff			-0.0115
			(0.0237)
Panel C: Value			
	Post=0	Post=1	Diff.
Treatment	8.8426	8.8190	-0.0236***
	(1.9393)	(1.9764)	(0.0018)
Control	8.3862	8.4193	0.0331***
	(2.1698)	(2.1792)	(0.0031)
Diff-in-diff			-0.0567***
			(0.0162)

Notes: Panels A-C summarize and compare the means and standard deviation (in parentheses) of treatment and control groups for *Price*, *Quantity*, and *Value*, respectively. Columns (1) and (2) present summary statistics for pre- and post-reform periods. The last column shows the differences between the post- and pre-reform periods. The diff-in-diff rows report the across-period differences between the treatment and control groups. The significance levels of 1%, 5% and 10% are noted by ***, ** and *, respectively.

Table 3. Baseline results, the effects of the 2004 VAT rebate reform

	(1)	(2)
Panel A: Dependent variable, *Price*		
Policy × Post04	0.0071	-0.0136
	(0.0058)	(0.0126)
Obs.	7,617,449	7,617,449
R^2	0.7298	0.7299
Pass-through rate	0%	0%
Panel B: Dependent variable, *Quantity*		
Policy × Post04	-0.0668***	-0.0614***
	(0.0105)	(0.0166)
Obs.	7,617,449	7,617,449
R^2	0.4455	0.4457
Panel C: Dependent variable, *Value*		
Policy × Post04	-0.0652***	-0.0779***
	(0.0095)	(0.0163)
Obs.	7,617,449	7,617,449
R^2	0.2580	0.2583
Control variables	Y	Y
Region × time indicators	N	Y
Broadly-defined product × month dummies	N	Y
Broadly-defined product × year dummies	N	Y

Notes: 1. Dependent variables in Panels A, B, and C are *Price*, *Quantity*, and *Value*, respectively. 2. Control variables include 8-digit HS level product fixed effects, along with region, destination country, and time fixed effects. 3. Column (1) does not include interaction terms between regional categories and time indicators, broadly-defined product categories and month or year dummies, whereas column (2) includes these interaction terms. 4. Standard errors (in parentheses) are clustered at the 8-digit HS product level. 5. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

Table 4. Robust checks, different time frequencies

	(1)	(2)	(3)
Dependent variables	Price	Quantity	Value
Panel A: Quarter			
Policy × Post04	-0.0133	-0.0576***	-0.0751***
	(0.0119)	(0.0168)	(0.0161)
Obs.	5,034,137	5,034,137	5,034,137
R^2	0.7100	0.4280	0.2484
Panel B: Semi-annual			
Policy × Post04	-0.0090	-0.0512***	-0.0612***
	(0.0100)	(0.0136)	(0.0129)
Obs.	3,174,896	3,174,896	3,174,896
R^2	0.7090	0.4153	0.2408
Control variables	Y	Y	Y
Region × time indicators	Y	Y	Y
Broadly-defined product × quarter/ semi-annual dummies	Y	Y	Y
Broadly-defined product × year dummies	Y	Y	Y
Panel C: Annual			
Policy × Post04	-0.0068	-0.0545***	-0.0617***
	(0.0093)	(0.0143)	(0.0139)
Obs.	2,526,719	2,526,719	2,526,719
R^2	0.7094	0.4072	0.2406
Control variables	Y	Y	Y
Region × year dummies	Y	Y	Y
Broadly-defined product × year dummies	Y	Y	Y

Notes: 1. Dependent variables in columns (1)-(3) are *Price*, *Quantity*, and *Value*, respectively. 2. Panels A to C report the regression results based on the data aggregated at quarter, semi-annual, and annual levels, respectively. 3. Control variables include 8-digit HS level product fixed effects, along with time indicators, region, and destination country fixed effects. 4. All regressions include interaction terms between regional categories and time indicators, broadly defined product categories and quarter (or semi-annual) dummies, as well as interaction terms with year dummies. 5. Standard errors (in parentheses) are clustered at the 8-digit HS product level. 6. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

Table 5. Robust checks, alternative samples, and policy measurement

	(1)	(2)	(3)
Dependent variables	Price	Quantity	Value
Panel A: Excluding October to December 2003			
Policy × Post04	-0.0145	-0.0591***	-0.0749***
	(0.0132)	(0.0186)	(0.0193)
Obs.	6,895,264	6,895,264	6,895,264
R^2	0.7305	0.4458	0.2583
Panel B: January 2003 to December 2005			
Policy × Post04	-0.0176	-0.0564***	-0.0800***
	(0.0142)	(0.0173)	(0.0170)
Obs.	10,391,652	10,391,652	10,391,652
R^2	0.7331	0.4465	0.2636
Panel C: Alternative policy measurement			
Rate cut × Post04	0.0034	0.0209***	0.0254***
	(0.0039)	(0.0047)	(0.0044)
Obs.	7,617,449	7,617,449	7,617,449
R^2	0.7299	0.4457	0.2583
Panel D: Excluding three northeastern provinces			
Policy × Post04	-0.0101	-0.0650***	-0.0782***
	(0.0109)	(0.0163)	(0.0158)
Obs.	7,385,209	7,385,209	7,385,209
R^2	0.7294	0.4453	0.2599
Panel E: Balanced panel			
Policy × Post04	-0.0106	-0.0721***	-0.0800***
	(0.0092)	(0.0158)	(0.0147)
Obs.	5,127,644	5,127,644	5,127,644
R^2	0.7459	0.4584	0.2464
Control variables	Y	Y	Y
Region × time indicators	Y	Y	Y
Broadly-defined product × month dummies	Y	Y	Y
Broadly-defined product × year dummies	Y	Y	Y

Notes: 1. Dependent variables in columns (1)-(3) are *Price*, *Quantity*, and *Value*, respectively. 2. Panels A to E report the regression results based on the subsample excluding October to December 2003, the sample including January 2003 to December 2005, the alternative specification using *Rate cut* to replace *Policy*, the sample excluding three northeastern provinces, and the balanced panel, respectively. 3. Control variables include 8-digit HS level product fixed effects, along with region, destination country, and time fixed effects. 4. All regressions include interaction terms between regional categories and time indicators, broadly defined product categories and month dummies, as well as interaction terms with year dummies. 5. Standard errors (in parentheses) are clustered at the 8-digit HS product level. 6. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

Table 6. The heterogeneous effects of the 2004 VAT rebate reform

	(1)	(2)	(3)
Dependent variables	Price	Quantity	Value
Panel A: Low (2%) vs. High (4%) -reduction group			
Policy × Post04 × High	-0.0044	-0.0451***	-0.0528***
	(0.0109)	(0.0141)	(0.0172)
Policy × Post04	-0.0122	-0.0456***	-0.0595***
	(0.0109)	(0.0164)	(0.0175)
Obs.	7,595,257	7,595,257	7,595,257
R^2	0.7297	0.4438	0.2567
Panel B: FIEs vs. Domestic firms			
Policy × Post04 × Domestic	-0.0080	-0.0376**	-0.0582***
	(0.0085)	(0.0186)	(0.0160)
Policy × Post04	-0.0109	-0.0453**	-0.0542***
	(0.0146)	(0.0197)	(0.0192)
Obs.	7,617,449	7,617,449	7,617,449
R^2	0.7336	0.4467	0.2601
Control variables	Y	Y	Y
Region × time indicators	Y	Y	Y
Broadly-defined product × month dummies	Y	Y	Y
Broadly-defined product × year dummies	Y	Y	Y

Notes: 1. Dependent variables in columns (1)-(3) are *Price*, *Quantity*, and *Value*, respectively. 2. Panels A and B report the heterogeneous effects of the VAT rebate cuts with respect to two dimensions, i.e., low- vs. high-reduction groups; and FIEs vs. domestic firms, respectively. 3. Control variables include 8-digit HS level product fixed effects, along with region, destination country, and time fixed effects. 4. All regressions include interaction terms between regional categories and time indicators, broadly defined product categories and month dummies, as well as interaction terms with year dummies. 5. Standard errors (in parentheses) are clustered at the 8-digit HS product level. 6. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

Table 7. The effects of the 2004 VAT rebate reform on the selection of trade modes

	(1)	(2)	(3)	(4)	(5)
Dependent variables	GT	PTIM	PTSM	GT+PTIM	GT+PTIM+PTSM
Policy × Post04	-0.0020***	0.0000	0.0002**	0.0007**	0.0018***
	(0.0007)	(0.0001)	(0.0001)	(0.0003)	(0.0007)
Obs.	1,365,041	1,365,041	1,365,041	1,365,041	1,365,041
R^2	0.0816	0.0101	0.0120	0.0322	0.0710
Control variables	Y	Y	Y	Y	Y
Region × year dummies	Y	Y	Y	Y	Y
Broadly-defined product × year dummies	Y	Y	Y	Y	Y

Notes: 1. Dependent variables in columns (1) through (3) are indicators for whether a firm exported an 8-digit HS level product to a specific country in a given year exclusively through general trade, PTIM, or PTSM, respectively. Dependent variable in column (4) GT+PTIM, is an indicator for whether the firm used both general trade and PTIM (but not PTSM) to exported an 8-digit HS level product to a specific country in a given year. Dependent variable in column (5), GT+PTIM+PTSM, is an indicator for whether the firm used all three modes simultaneously. 2. Control variables include 8-digit HS level product fixed effects, along with region, destination country, and year fixed effects. 3. All regressions include interaction terms between regional categories and year indicators, broadly defined product categories and year dummies. 4. Standard errors (in parentheses) are clustered at the 8-digit HS product level. 5. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

Table 8. The effects of the 2004 VAT rebate reform on the share of trade modes

	(1)	(2)	(3)
Dependent variables	GT_share	PTIM_share	PTSM_share
Policy × Post04	-0.0113***	0.0082***	0.0031*
	(0.0034)	(0.0030)	(0.0018)
Obs.	11,109,634	11,109,634	11,109,634
R^2	0.3159	0.2256	0.1364
Control variables	Y	Y	Y
Region × time indicators	Y	Y	Y
Broadly-defined product × month dummies	Y	Y	Y
Broadly-defined product × year dummies	Y	Y	Y

Notes: 1. Dependent variables in columns (1), (2), and (3) are the shares of general trade, PTIM, and PTSM, respectively. 2. Control variables include 8-digit HS level product fixed effects, along with region, destination country, and time fixed effects. 3. All regressions include interaction terms between regional categories and time indicators, broadly defined product categories and month dummies, as well as interaction terms with year dummies. 4. Standard errors (in parentheses) are clustered at the 8-digit HS product level. 5. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

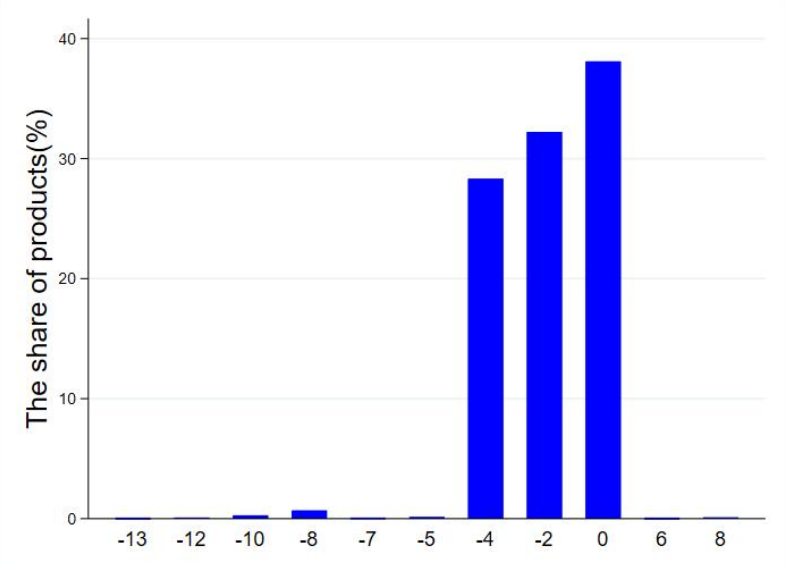


Figure 1 The distribution of the VAT rebate rate cuts in 2004

Data sources: the State Taxation Administration (STA) of China and authors' calculation.

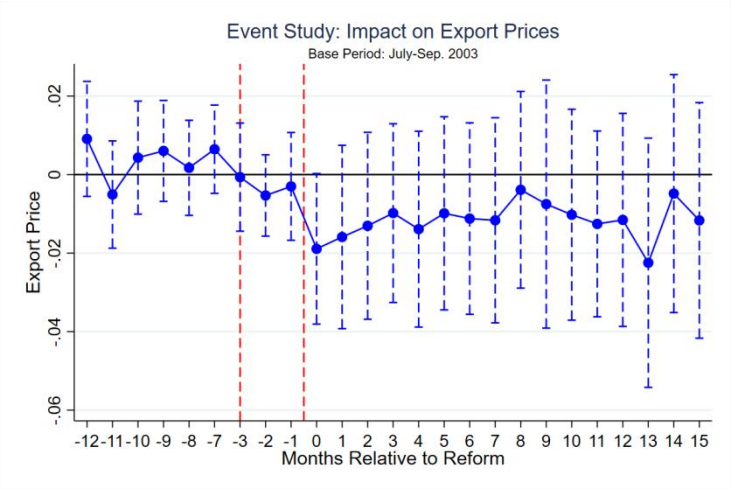


Figure 2 Panel A. Dynamic effects of the 2004 VAT rebate reform on *Price*

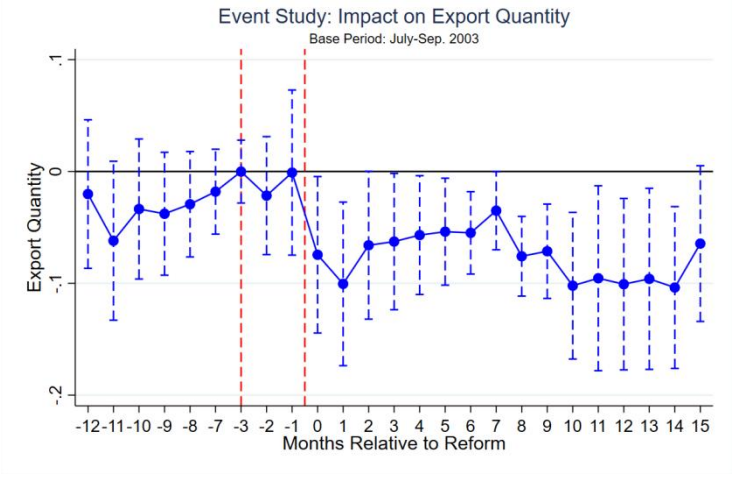


Figure 2 Panel B. Dynamic effects of the 2004 VAT rebate reform on *Quantity*

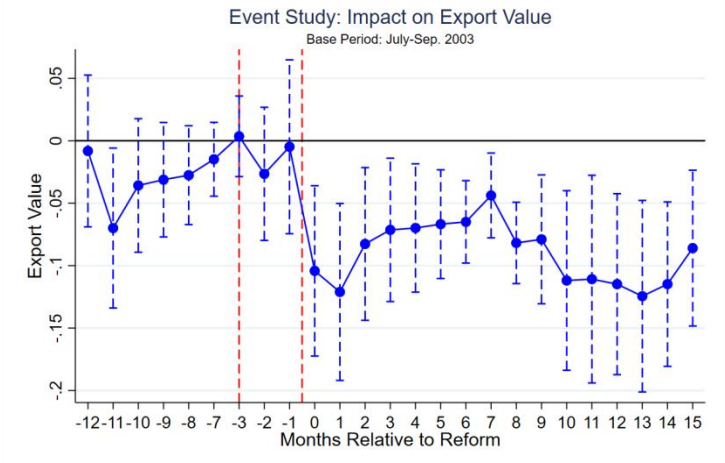


Figure 2 Panel C. Dynamic effects of the 2004 VAT rebate reform on *Value*

Notes: Dependent variables are *Price*, *Quantity*, and *Value* in Panels A to C, respectively. OLS results are from Equation (3). Since the VAT rebate reform was announced on October 2003, we take July to September 2003 as the baseline months. Standard errors are clustered at the 8-digit HS product level. The coefficients and their 95% confidence intervals are plotted month by month.

Appendix A. Calculation of the Pass-Through Rate of VAT Rebate Cuts

For manufacturing firms, the tax base for VAT rebates is the FOB value of exported products. Accordingly, the VAT rebate amount is calculated as:

$$Rebate=FOB\times VAT\ rebate\ rate \tag{1}$$

Let P_0 and P_1 denote the FOB prices before and after the 2004 VAT rebate reform, respectively, and let $\Delta P=P_1-P_0$ represents the price change. Similarly, let Tax_0 and Tax_1 denote the VAT rebate amounts before and after the reform, with $\Delta Tax=Tax_1-Tax_0$. Let $VATR_0$ and $VATR_1$ represent the VAT rebate rates before and after the reform, and define $\Delta VATR=VATR_1-VATR_0$ as the change in the VAT rebate rate.

The coefficient β_1 from our regression captures the percentage change in export price relative to its pre-reform level:

$$\beta_1=\Delta P/P_0 \tag{2}$$

In this study, the pass-through rate of the VAT rebate cut is defined as the ratio of the change in the export price (ΔP) to the change in the VAT rebate amount (ΔTax) induced by the VAT rate reduction. Denoting this pass-through rate by τ, we have

$$\tau=\Delta P/\Delta Tax \tag{3}$$

From equation (2), the price change can be expressed as:

$$\Delta P=P_0\times\beta_1 \tag{4}$$

Thus, ΔP can be directly estimated. The change in the VAT rebate amount is given by:

$$\begin{aligned}\Delta Tax &= Tax_1-Tax_0= P_1\times VATR_1- P_0\times VATR_0\\ &= P_0\times(VATR_1-VATR_0)+(P_1- P_0)\times VATR_1\end{aligned} \tag{5}$$

Substituting (4) and (5) into (3), we obtain

$$\begin{aligned}\tau &= [P_0\times\beta_1]/\ [P_0\times(VATR_1- VATR_0)+(P_1- P_0)\times VATR_1]\\ &=\beta_1/\ [(VATR_1-VATR_0)+ (\Delta P/P_0)\times VATR_1]\end{aligned} \tag{6}$$

Since $(\Delta P/P_0)\times VATR_1$ is typically close to zero, it can be safely ignored. Hence, the pass-through rate can be approximated as:

$$\tau\approx\beta_1/\ (VATR_1-VATR_0)=\beta_1/\Delta VATR \tag{7}$$

Given that β_1 is obtained from the regression and $\Delta VATR$ is the average size of VAT rebate rate cuts, the pass-through rate, that is, the economic incidence of the VAT rebate cut, can be readily computed.