Export credit insurance and Firm export performance: Evidence from China's export promotion program

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December 23, 2025

Abstract

Exporting entails significant risks from trade costs and uncertainties such as payment defaults and political instability. Export credit insurance can mitigate these risks but is often costly and offers limited coverage, discouraging especially credit-constrained SMEs. Governments therefore frequently provide public support through export credit agencies. Export promotion programs, such as China's export credit insurance (ECI) subsidies, aim to alleviate these problems, facilitating smaller and new exporters' entry into foreign markets, by allowing them to buy credit insurance at a reduced cost. We take advantage of discontinuities around the threshold in the two types of eligibility criteria for ECI subsidies introduced in China in 2014 to identify which features of ECI subsidies are connected with better export performance, and to evaluate the causal impact of export credit insurance on firm export performance using a regression discontinuity design (RDD) from 2011-2016 as a natural experiment. We show that using ECI subsidies could increase exports in the subsidized firms. The positive effect of firms' total revenues implies that the financial support has a positive pass-through to the export-intensive and export-extensive, such as the increased number of products and destinations, and receiving ECI subsidies could boost a firm's export value, the number of transactions, products, and destinations significantly. We also show that the ECI subsidies effectively assist subsidized firms in exporting products to destinations with varying economic sizes and can significantly enhance the export volume of products, particularly machinery and transport equipment.

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1 Introduction

Increasing exports from developing countries to the markets of industrialized countries has long been recognized as an essential factor in reducing poverty, promoting sustainable development, and reaping the potential benefits of globalization for the developing world (Gil-Pareja et al., 2014).

Trade cost and uncertainty are two main barriers which may prevent export firms from exporting more products to more destinations and result in export credit risk if exporters have to tolerate late payment (Anderson and Van Wincoop, 2004; Egger and Url, 2006). Export credit risks usually include commercial risks and political risks, such as default payment and regime changes, which may reduce the volume of trade as well as the number of export products and affect the exporter's decision-making on export to foreign market (Amiti and Weinstein, 2011; Manova et al., 2015). Exporters in developing countries face heightened exposure to export credit risk due to a combination of structural and institutional limitations(Engemann et al., 2014). These exporters often rely on Open Account (OA) terms, where goods are shipped before payment is received, leaving them highly vulnerable to non-payment by foreign buyers. In contrast, exporters in developed economies are more likely to use secure financing instruments such as Letters of Credit (LC) or credit guarantees that mitigate such risks. The situation is further exacerbated by weak legal systems in many developing countries, where low institutional quality and poor contract enforcement limit the exporter's ability to recover losses in the event of a dispute (Demir, 2014). Even when exporters recognize these risks, they frequently lack access to adequate financial tools—such as export credit insurance or LC-backed loans—that are more readily available in developed economies. As a result, firms in developing countries not only bear a greater share of the financial burden in cross-border trade, but also have fewer mechanisms to manage or transfer credit risk(Amiti and Weinstein, 2011; Manova et al., 2015).

Export firms can choose to get protection against these risks, with export credit insurance (ECI) being one of the most widely used financial tools to smooth cash flow and decrease the uncertainty against credit risks which result from international transactions (Egger and Url, 2006; ITA, 2008; Yang et al., 2021). Some export firms may buy ECI or other credit financial tools from financial institutions if they export to low-risk destinations, but some export firms may not be able to use ECI because financial institutions don't provide ECI for those export firms who export products to those countries with high risks, or those export firms with financial constraints because the insurance fee of private ECI are not affordable for some SMEs (Moser et al., 2008; Li et al., 2016). The bulk of existing literature focuses on the trade effects of the ECI tool, while there is still no consensus on whether government-provided public ECI effectively facilitates exports by addressing the asymmetric information issue.

To answer the question of how ECI subsidies affect the firm performance in China , we focus on an export credit insurance promotion policy (ECI subsidies) introduced in the Guangdong province in China since 2014, which allows export firms to buy short-term export credit insurance with different levels of discount, aiming to encourage firms to export and protect domestic firms from commercial risk and political risk. The export credit insurance subsidies are an optional policy following a process of non-competitive selection. Firms registered in the Guangdong province have brought short-term export credit insurance from the specific insurance company for their export are eligible to apply

for export credit insurance subsidies since 2014 and they could receive subsidies if they meet one of the subsidies' criteria: 1. an export value in the previous year lower than 3 million dollars; 2. an export value in the previous year between 10 million dollars and 50 million dollars towards emerging economies.

Studies investigating the relationship between ECI subsidies and firm export performance have focused on programs in Japan (Mah, 2006), France (Melitz and Messerlin, 1987), U.S.(Agarwal and Wang, 2018; Matray et al., 2024) and China (Li et al., 2016). Melitz and Messerlin (1987); Agarwal and Wang (2018) find that receiving ECI subsidies could boost a firm's export value, while Mah (2006) and Li et al. (2016) believe that ECI subsidies have a limited effect on facilitating firms to export. The increasing popularity of such programs suggests that these contexts deserve attention as well and we examine the ECI subsidies in China by using the quasi-experiment technique to investigate the causal effect of ECI subsidies on firm export performance, instead of comparing the growth rate of the volume of export only (Li et al., 2016). Research designs that involve assessing firm implications from policy intervention have used different types of methodology, including Difference-in-difference (DiD), propensity score matching (PSM) and regression discontinuity design approach to estimate the effect of public policy on firm performance.

While studies of export credit insurance promotion programs have proliferated with the programs themselves, there are still several knowledge gaps in this literature. First, little is known about the functioning and effectiveness of export credit insurance subsidies in developing economies, where the challenges to the effect of credit insurance are substantial (Mao and Zhuo, 2020). Second, even less is known about the characteristics of these export credit insurance promotion programs that are beneficial for firms, and whether these policies are more effective when targeting different types of firms, industries or foreign markets (Felbermayr and Yalcin, 2013). Third, the existing literature on export credit insurance subsidy programs mainly focuses on country-level data rather than a micro-level analysis of firm export performance, with limitations for the identification of causal effects. This study addresses each of these areas by leveraging transaction-level data and firm-level data in the context of an export credit insurance promotion program in China.

Our empirical strategy compares changes in the export performance of subsidized firms with those of unsubsidized firms in Guangdong. The ECI subsidies program is an optional program for exporters in China , which means that eligible firms can apply for the program based on their own decision-making. This allows us to control for any potentially unobserved product-destination demand shocks. We also apply the matching technique to construct the control group based on firm characteristics, since the number of subsidized firms represents less than 5% of the total number of unsubsidized firms according to the standards for SME subsidies.

Our results show that firms receiving ECI subsidies experience higher export values and a higher likelihood of receiving ECI subsidies in the following year, compared with their export values in the previous year and their subsidized status. This result is consistent with the objectives of the ECI subsidies program. Firstly, we find that ECI subsidies can boost the export performance of subsidized firms, and SMEs receiving ECI subsidies are more likely to receive subsidies again in the future. Furthermore, firms experience an increase in export value if they receive ECI subsidies, as compared with medium-sized firms that did not receive subsidies. Secondly, we find that subsidized firms tend to export a greater variety of products and export to more destinations, with more transactions,

than firms that did not receive subsidies before the policy was implemented. However, we do not observe the reasons why firms receiving ECI subsidies under the 5 standards show significant results, but the estimates from the RD design are significant, and the robustness tests also yield significant results. Our analysis of the impact of ECI subsidies using these data and features contributes to a better understanding of the relationship between firm export performance and public policy.

In the second part of the paper, we examine whether the ECI subsidies can address the issue of financial constraints faced by exporters by reducing trade costs. We find that the support provided by ECI subsidies is not limited to firms around the threshold; it benefits exporters, including those selling machinery and transport equipment with relatively higher fixed costs, across all destinations. These results are consistent with the baseline findings in the first part of the paper.

In the third part of the paper, we provide direct empirical evidence supporting our proposed assumption that ECI subsidies can target and assist firms suffering from financial constraints, thereby reducing market inefficiency. We apply the staggered Difference-in-Differences (DiD) methodology (Callaway and Sant'Anna, 2021) to test the effect of ECI subsidies on supporting these firms. First, we find that SMEs are more financially constrained and are more positively impacted by ECI subsidies because they help alleviate credit constraints, compared to special medium-sized firms. However, the special medium-sized firms do not seem to benefit from the ECI subsidies program as effectively. Second, we show that there are no differential pre-treatment trends, followed by a relative increase in export value and the number of manufacturing products introduced since 2014. Finally, we conclude by discussing how ECI subsidies may function as an industrial tool in the economy.

In this paper, our empirical strategy will investigate (a) the causal effect of export credit insurance on firms export performance, (b) the effectiveness of export credit insurance promotion programs usage, (c) and which characteristics of export credit insurance promotion programs are effective in supporting firms' export performance. We use transaction-level data on export firms from China's custom database, combined with firm-level data on subsidized firms from China's ECI subsidies program, and firm-level data on firms from the Qichacha website[1]. These data include the number of subsidies, the amount of export value and other significant data about export firms registered in Guangdong Province. These data allow us to compare the performance of firms that apply for ECI subsidies successfully with those firms without ECI subsidies, by adopting a fuzzy regression discontinuity (RD) design to identify the causal relationship between ECI subsidies and firm export performance. This fuzzy RD analysis enables us to identify the local average treatment effect (LATE) around the threshold. Although ECI subsidies are not compulsory policies for export firms that may affect firms with different dimensions, we directly evaluate whether the ECI subsidies could boost the exports for the subsidised firms and estimate the firm export performance including firm export value, number of transactions, products and destinations. We also estimate the marginal effect of the ECI subsidies on firm export performance from 2010 to 2016 using the bilateral customs data, which contains each firm's transaction-level exports, products, destinations and other details. After that, we pass three tests of RD design validity, a clear cutoff, the continuous covariates and the non-manipulation of the running score, to examine the effectiveness of

[1]Qichacha is a website in delivers updated data and analytics on China-based private and public companies. These updated data are collected from the National Enterprise Credit Information Publicity System (NECIPS) of China.

the running score, and adopt an appropriate identification strategy for empirical analysis in the first part of the paper.

The rest of this paper is structured as follows. Section 2 introduces the related literature. Section 3 presents the institutional background. Section 4 introduces the data used, and Section 5 discusses the empirical strategy applied. Section 6 presents and discusses the empirical results and provides 3 robustness tests, and Section 7 discusses the empirical results from alternative estimators, while Section 8 concludes.

2 Literature review

2.1 Export credit insurance and firms export performance

Firms face two main barriers when they conduct international trade (Anderson and Van Wincoop, 2004). The first barrier is trade costs, such as transportation costs, tariffs, exchange rate fluctuations, and sunk costs(Egger and Url, 2006). Another main barrier is the uncertainty regarding exporting risks, including commercial risks (Auboin and Engemann, 2014; Muûls, 2015), such as default in payment and insolvency, and political risks, such as policy uncertainty and potential adverse political development (Kesternich and Schnitzer, 2010). Trade risks could result from longer time lags between product dispatch and product arrival, especially for long-distance maritime transportation (Amiti and Weinstein, 2011). In addition, trade risks could also result from political uncertainty and asymmetric information between exporters and importers, due to the limited information that exporters have about the financial situation of importers in an incomplete market (Egger and Url, 2006; Handley and Limão, 2017) and the hidden transaction costs associated with the uncertainty of future trade arrangements (Anderson and Marcouiller, 2002). These trade risks may affect both the extensive margin (Amiti and Weinstein, 2011), such as the number of products and export markets, and the intensive margins of trade (Manova et al., 2015), as the total and average value of exports. As a consequence of those risks, first, firms may limit their exports towards the nearest neighbours, as trade costs, risks and asymmetric information increase with distance (Egger and Url, 2006). These findings could explain one of the reasons firms may delay export market entry and unpredicted sunk cost is another reason (Handley and Limão, 2017). Second, firms may not become real exporter as uncertainty prevent firms from starting to export and decreases the probability of firm internationalization (Bellone et al., 2010). Trade risks and uncertainty can have detrimental effects on firms, exacerbating financial constraints, limiting cash flow(Menichini, 2011), and more generally preventing the participation of firms in foreign markets (Egger and Url, 2006).

To overcome some of these challenges and support export participation (IMF, 2018), ECI ensures exporters against the default risk of foreign buyers (ITA, 2008), to ensure the flow of trade between a supplier and a predetermined set of buyers over a given period if the supplier allows buyers to delay payment for goods or services which are already delivered (Egger and Url, 2006; Matray et al., 2024). ECI could protect exporters both from commercial and political risks. Commercial risks encompass buyer bankruptcy, default, rejection, as well as issuing bank bankruptcy, business suspension, or takeover. It also includes issuing bank default or refusal to accept under the deferred payment credit terms, even if the documents are compliant(Auboin and Engemann, 2014; Muûls,

2015). Political risks include payment restrictions, import bans, license revocations, and conflicts such as war, civil war, rebellion, revolution, or riots in the buyer's or issuing bank's country/region, as well as payment delays caused by a third country (Kesternich and Schnitzer, 2010).

The objectives of ECI is to promote exports and strengthen the export position of domestic companies in international trade, mainly through two mechanisms (Abraham and Dewit, 2000). First, ECI is an important financing tool to ease the burden of illiquidity for export firms (McGuinness and Hogan, 2016; Bussoli and Marino, 2018). Although ECI has an insurance premium fee which leads to extra trade costs, firms still use it in exporting because in this way credit-constrained buyers have easier access to external finance via trade credit (Engemann et al., 2014). For example, the total amount insured of all exported products and services of short-term ECI which is provided by the China Export & Credit Insurance Corporation (Sinosure) has increased from almost $44 billion to $753 billion between 2008 and 2022 (OECD, 2015; Sinosure, 2022), accounting from 3% to 20% of the total amount of export value in China. Second, ECI is a risk management tool to mitigate the negative trade effects from asymmetric market information for export firms (Van der Veer, 2015). Asymmetric information in international markets could be particularly problematic for small and medium enterprises (SMEs) for which the use of ECI would be more beneficial because their limited resources prevent them from receiving bank loans and require them to search for external finance for exporting activities (Heiland and Yalcin, 2021). On the contrary, large multinational enterprises are less likely to require ECI, as their international integration with different branches around the world will allow them to exchange market information, make evidence-based business decisions and solve the issue of information asymmetries by themselves (Badinger and Url, 2013). Therefore, firms are likely to use ECI to protect themselves from export risk when they have limited financing ability, as ECI could reduce potential loss and solve liquidity issues, which may support firms to increase the export volume and expand into new foreign markets (Hu, 2017).

However, adverse selection and moral hazard are two potential issues in the insurance market when insurance companies provide ECI services to export firms in international trade (Cohen and Siegelman, 2010). Adverse selection means that export firms may be better informed about the probability and distribution of a loss than insurance companies when they buy ECI (Rothschild and Stiglitz, 1978), and export firms will tend to choose higher insurance coverage if they have updated information about high risk (Cohen and Siegelman, 2010). Moral hazard means that export firms who are insured by ECI have less incentive to take precautions to reduce risks in international trade (Dionne et al., 2009). Some export firms may not provide some 'hidden information' to insurance companies and take some 'hidden action' due to adverse selection and moral hazard risk (Cohen and Siegelman, 2010). In addition, some export firms with credit constraints may decide to buy public ECI with higher coverage if they are well-informed about their exports with high risk, as these transactions with high risks are not preferred by private financial institutions. Therefore, some inefficient exporting firms may receive funding support to be solvent while they should fail to compete in an efficient market (De Meza et al., 2021).

ECI is usually provided by private financial institutions at the cost of a fee representing on average about 13% of the transaction value (ICISA, 2015)[2]. First, ECI could reduce

[2]The total amount of premium of private ECI are $0.00648 trillion in 2014 (ICISA, 2015) and the forms of trade finance cover an estimated $2.16 trillion of international and domestic trade in 2014 (WTO,

the risk for exporters and allow exporters to learn about the creditworthiness of new importers, reducing the need to use insurance coverage after repeated transactions. Second, ECI could give exporters access to supplier credit, reducing their transaction and financing costs, and finally stimulating firms to explore new export transaction opportunities (Felbermayr and Yalcin, 2013; Van der Veer, 2015). ECI is also provided by export credit agencies (ECA), government organizations aiming to correct the problem of market failure and mitigate the negative consequences of financial market frictions for exporters, which have governmental funding sources to provide lower insurance premiums to reduce export firms' transaction costs and reduce revenue uncertainty (Heiland and Yalcin, 2021; Egger and Url, 2006). Private ECI and public ECI have two main differences, so export firms could adopt to buy private ECI or public ECI based on their firm characteristics. The first difference is that private ECI usually provides short-term credit with a duration between 2 to 6 months, while public ECI provides mainly long-term credit with a duration between 1 to 5 years and less on short-term credit. Another difference is that private ECI usually covers credit risks on exports to developed economies like the OECD countries, while public ECI covers credit risks on exports to countries with high risk like most developing countries (Van der Veer, 2015). Private ECI has higher exposures than public ECI and flexibility in tailoring terms, which make it an attractive choice for large exporting corporations. However public insurance offers standardized terms that align with export policies, and its cost-effectiveness is appealing to exporting firms, particularly SMEs.

To overcome the credit risk (Agarwal and Wang, 2018) and liquidity constraints (Paravisini et al., 2015; Manova, 2013) problems, firms may choose to buy ECI when they export products or services. A wide range of studies analyse the relationship between ECI and export performance using aggregate level data, finding a positive relationship between ECI and exports. For instance, Egger and Url (2006) find that public ECI could increase the volume of export by estimating a gravity model using industry-level data in Austria, and ECI also increases the export to those destinations with high informational barriers and high risks. Moser et al. (2008) finds that public ECI could increase export by estimating a gravity model using country-level data in Germany and political risk constitutes a friction to decrease the export. Less studies investigate the effect of ECI on exports at the micro level using firm-level data, finding that ECI has a positive effect on the total value of exports. Hur and Yoon (2025) finds that Public ECI could increase the export by estimating difference-in-difference approach with propensity score matching using firm-level data in Korea, Badinger and Url (2013) finds that public ECI could increase the export by estimating a two-stage least squares model using firm-level data in Austria, and large firms with high-risk exposure and high RD intensity are more likely to use public ECI compared with multinational enterprise (MNE) because MNE have many integration to address the issue of asymmetric information. (Felbermayr and Yalcin, 2013) finds that public ECI could boost sectoral exports by estimating a transformed model using firm-level data in German and the increase of exports concentrated in the aviation, shipbuilding and transportation sectors because these sectors are characterised by long construction lag and large external financial dependence.

2014).

2.2 Export credit insurance promotion programs

Despite the benefits of export credit insurance, many export firms might decide not to buy ECI mainly because of two reasons. First, export firms may not use ECI if they cannot buy a suitable one based on their export characteristics, because some export firms may not want to buy private ECI with high insurance premiums which may increase their trade cost if they export products to OECD countries, and some export firms may not able to buy public ECI with affordable insurance premium if they export products to specific high-risk destinations which are not insured by public ECI (Moser et al., 2008; Li et al., 2016).

Second, firms might have no experience in using ECI or claiming for their loss before because they export products or services to partners with low-risk and regular customers, so they might not consider buying ECI in these instances(Li et al., 2016). To facilitate firms' exports to expand towards new foreign markets and to enable firms access to affordable financial resources during the process of export (Abgaryan and Rosenthal, 2017), governments provide ECI subsidies program to support domestic firms in international trade via ECA, such as the Nippon Export Insurance (NEXI) in Japan (Mah, 2006), the Compagnie Francaise d'Assurance pour le Commerce Exterieur (COFACE) in France (Melitz and Messerlin, 1987), and the China Export Credit Insurance Corporation (Sinosure) in China (Li et al., 2016). The rationale for public funding support for ECI is to correct some of these market failures for exporters (Heiland and Yalcin, 2021; Egger and Url, 2006), to reduce trade costs for exporters (Li et al., 2016; Branstetter et al., 2023), and to reduce export risk and uncertainty for exporters(Abraham and Dewit, 2000).

ECA subsidized policies are bound by World Trade Organization (WTO) rules. The WTO agreement regulates the provision of ECI by governments or their agencies as export subsidies and demands premia to cover long-term operating costs and losses[3], while this agreement exempts these guarantees if at least 12 members [4] of the General Agreement on Tariffs and Trade (GATT) have acceded to the International Undertaking on Official Export Credits (IOUs), which regulates the use of these guarantees (WTO, 1986). ECI subsidies are permitted by the WTO Subsidy Code and EU competition policy because the orientation of the subsidies policy is to stimulate trade and the positive effect of ECI subsidies on international trade which satisfies those requirements (Abraham and Dewit, 2000).

Recognizing the challenges for firms to export products and services, governments have provided several export promotion programs (EPPs) which could bring information and resources for domestic exports to increase their competitiveness in the international trade (Freixanet, 2022; Matray et al., 2024). Government provide ECI subsidies program for several reasons. Firstly, ECI is a predominant tool of industrial policy on firm performance (Matray et al., 2024). Exporters could reduce their trade cost and reduce their customs exporting barriers by using ECI subsidies from the financial support of government(Freixanet and Churakova, 2018). Secondly, government provide ECI subsidies program based on corresponding short-term ECI services, so export firms could export products with appropriate financial services. However, the degree of economic develop-

[3]See more details in the WTO Agreement on Subsidies and Countervailing Measures, Annex I, articles j and k.

[4]Eligible members are exempt: Australia, Belgium, Brazil, Burma, Canada, Ceylon, Chile, China, Cuba, Czechoslovak, French, India, Lebanon, Luxembourg, Netherlands, New Zealand, Norway, Pakistan, Syria, South Africa, The United Kingdom, The United States of America

ment of a country affects the range of EPPs offered, with advanced economies providing more EPPs services that emerging economies in all of EPPs(Freixanet and Churakova, 2018; Ribeiro et al., 2020), so the output of country determines the range of ECI subsidies and there is less studies investigate the trade effect of ECI subsidies (Ribeiro et al., 2020). Thirdly, ECI subsidies program could increase the awareness of ECI effectiveness of export firms to solve the issue of market failure (Lederman et al., 2010; Freixanet, 2022). Most export firms which have limited export experience may have less knowledge of the function of ECI, while these firms could estimate potential risks and increase their awareness by using ECI subsidies (Kanda et al., 2015). Larger firms and experienced export firms which have frequently communication with other firms use more ECI than SMEs (Wright, 2011), while ECI have significant impact on SMEs than larger firms (Munch and Schaur, 2018).

There are less studies investigate the trade effect of ECI subsidies and the economics mechanism of positive effect of ECI subsidies on firm export performance. Information friction, liquidity constraint and political target are three main factors that determine the ECI subsidies impact. Non-appropriability of benefits form information production with externalities bring market failure, while government ECI subsidies in lieu of deficient financial markets is appropriate benefits , which could solve the issue of market failure (Cadot et al., 2015; Martincus and Carballo, 2008). What's more, ECI could bring benefits that offset its cost, especially ECI subsidies could reduce the trade cost of export firms (Broocks and Van Biesebroeck, 2017). So these export firms could establish new partnership agreements and enhance the capability of risk management (Catanzaro and Teyssier, 2021). Lastly, the EPPs cost is one third of benefits, and the increase of export as well as the government revenue support government to provide more EPPs (Freixanet, 2022; Kinnucan and Cai, 2011).

As part of the wider literature evaluating export promotion policies generally, the effectiveness of ECI subsidies has been investigated by a wide range of studies (Melitz and Messerlin, 1987; Mah, 2006; Mah and Milner, 2005; Manova and Yu, 2016; Li et al., 2016), while there is still limited evidence about the trade effect of ECI subsidies at the firm-level data, and about the mechanisms through which ECI subsidies influence export market entry. ECI subsidies programs are widely used around the world, especially in Japan, France and China. The number of exports insured by ECI represented about 36% of the total value of exports in Japan in the 1990s, which is the highest in the world compared with France (17%)(Mah, 2006) and China, where Sinosure was established by the government in 2001 (Sinosure, 2022). For instance,Melitz and Messerlin (1987) analyzed the 1981 program administered by COFACE providing short-term ECI with cheap insurance fees against cost escalation of 6.5% a year while the inflation rate was close to 10% at the same time, which means export firms could receive a cheap ECI contract. Their research comparing the number of subsidies and the growth rate of total export value using industry-level data finds that the industry of construction and related services occupied more than 66% of the total amount of ECI subsidies by the 1980s, which supports those subsidized industries against the effect of the inflation process, without a higher recessionary price being paid compared with those unsubsidized industries. Similarly, Mah and Milner (2005) analyzed the 1961 program administered by NEXI providing short-term ECI with cheap insurance fees the total value of ECI income is smaller than the total value of claims payment. This study adopted a time series model to estimate the effect of ECI on export supply in Japan, finding that ECI subsidies do not affect export promotion. More recently, Li et al. (2016) investigated the 2011 program administered by

the Zhejiang Branch of Sinosure providing short-term ECI with fully subsidized insurance fees for firms registered in Zhejiang province. This research compares the total amount of subsidies and exports using firm-level data and finds that ECI subsidies do not affect firm export performance because Zhejiang province relies on processing exports and those subsidized manufacturing firms still choose to buy ECI if they don't receive subsidies from the government. These previous studies used industry-level data and firm-level transaction data to compare the growth rate of export values between subsidies industry/firms and unsubsidized industries/firms, and none of them managed to use econometrics technology to identify the causal relationship between ECI subsidies and firm export performance due to the data limitation, not considering endogeneity issues in their estimations which may generate biased results, and neglecting any possible heterogeneity in the effect of ECI subsidies on export performance.

3 Policy Context

Initiated by China's State Council in 2014 as part of a wider export promotion program, the program of ECI subsidies for SMEs and certain medium-size firms (the "ECI subsidies" hereafter) is China's program targeting export credit risk control for Chinese exporters. This government program aims to support firms to export by allowing exporters to buy short-term ECI at a reduced fee. The Chinese ECI subsidies are administrated by the Ministry of Commerce (MOC), responsible for devising measures related to international trade and developing export promotion policies (Nayyar and Sultan, 2009), and funded by the Ministry of Finance (MOF). Starting from some common features dictated by the MOC at the national level, each provincial government in China could adjust their ECI subsidies which are funded by the provincial department of finance (DOF), based on their local needs and to better help local firms, tailoring the provisions to the local comparative advantages, main export industries, the composition of exporting firms, and the most popular export destinations. In our analysis, we will focus on the Guangdong province ECI subsidies. As the sites of the original 'special economic zones' (SEZ) established in 1979 and giving preferential tax and administrative treatment to foreign firms located there, the Guangdong province maintains a dominant position as the most important site of FDI activity(Branstetter and Feenstra, 2002) which attract 30% of the total FDI of China over the past three decades (Huang and Sharif, 2009). The Guangdong province is one of China's leading export provinces, specialising mostly in manufacturing and high-tech exports, accounting for more than 20% of China's total export value (Huang and Sharif, 2009), with the highest value of GDP for two consecutive decades(Statista, 2023).

The ECI subsidies only provide short-term ECI, with a credit term for underwriting business within 1 year, which could cover the commercial risk and political risk for export firms in Guangdong province. All eligible export firms should buy ECI from Sinosure [5] in advance and apply for ECI subsidies to offset the insurance fee.Bellone et al. (2010) finds that public intervention could decrease the sunk entry costs into export markets of

[5]China Export & Credit Insurance Corporation (Sinosure), established in 2001, is a state-owned policy-oriented insurance company. It specializes in providing credit insurance and guarantees for exports and overseas investments, helping enterprises mitigate trade risks and promoting international trade and global projects. Its services include short-term export credit insurance, medium/long-term project insurance, and overseas investment insurance, supporting initiatives like the Belt and Road. It is China's sole policy-backed export credit insurer. Eligible insurance companies that could submit application materials during 2014-2016 are: Sinosure company and People's Insurance

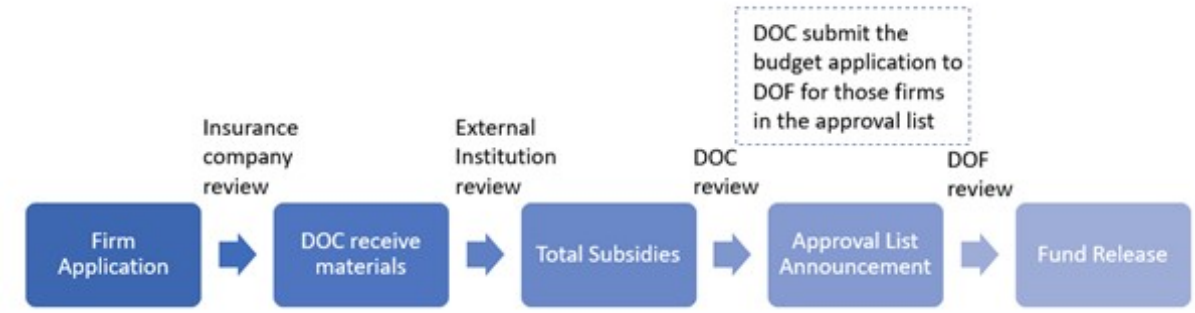


Figure 1: The ECI subsidies review and funding process.

Notes: Data from the Department of Commerce of Guangdong province. Eligible insurance companies that could submit application materials during 2014-2016 are Sinosure Company and People's Insurance Company of China (PICC). Citizens could report any unfair firms in the step of 'Approval list announcement' with evidence. The number of subsidies is calculated by previous experience of firms and updated policy documents. Not eligible firms fail to enter the approval list.

efficient firms to solve the issue of financial constraints and expand their export activities. Our paper will extend this finding and provide estimated results of how public intervention affects the export performance of effective and financial health firms because firms have to pay their insurance premium in advance. The ECI subsidies defined several entry requirements for firms, as eligible firms need to be for-profit businesses that have bought short-term ECI for their exports, which have already been delivered from the port, are registered in Guangdong province and owned by one or more people who are current citizens of the People's Republic of China. The ECI subsidies criteria are fixed, and reviewers followed the policy guidelines to avoid favoritisms and subjective decisions (Branstetter et al., 2023).

An overview of the ECI subsidies granting process appears in Figure 1. The ECI subsidies rely on the corporation with external staff and internal staff to evaluate fund applications. Eligible export firms submit their application materials for each year to insurance companies [6] that provide short-term ECI to export firms for first-time review if those eligible export firms already buy short-term ECI for their export products or services in the current year[7]. Then the insurance company submits those application materials to the Department of Commerce (DOC) of Guangdong province, which recruits external experts to review materials and confirm the total amount of subsidies for each approved applicant. The DOC of Guangdong Province submits the approval list to the DOF of Guangdong Province for budget application and posts the approval list announcement on the government website for public disclosure and transparency. Lastly, the DOF of Guangdong Province releases funds to the firms in the final approval list. However, there are 2 exceptions to this procedure. Firstly, The ECI subsidies panel have the right to veto reviewers' decisions to subsidy a firm if it learns that the firm has fraudulent information in its application. Second, a firm that registers in Guangdong province should hold a valid ECI contract before yearly policy documents are imposed, otherwise, this firm needs to apply for the ECI subsidies in the next year.

[6]Eligible insurance companies that could submit application materials during 2014-2016 are: Sinosure company and People's Insurance Company of China (PICC).

[7]Eligible export firms should submit their application materials based on the deadline of annual announcement, otherwise they need to submit their application materials in next year if they fail to submit their application on time.

The Guangdong ECI subsidies have several eligibility criteria, targeting a diverse set of exporters and export transactions, as summarised in detail in Table 1. First, ECI subsidies have been eligible since 2014 for all small firms that have exported less than 3 million USD in the previous year, covering 80% of the insurance fees in the current year (type 1). Secondly, since 2015, medium firms exporting between 5 and 10 USD million in the previous year are eligible to receive 80% of the insurance fees, only though for export transactions towards emerging economies[8] (type 2). The Guangdong ECI subsidies' eligibility criteria also consider the economic geography of the province (type 3), providing higher subsidies for exporters located in rural areas or for those operating in the Pearl River area, with an additional subsidy from 15% to 40%. In addition, the criteria also target different firms based on the products they export (type 4), with differential additional subsidies for the exports of equipment, machinery, and agricultural products, where the export value of an equipment transaction should have been more than 0.5 million USD, and the export value of a machine export transaction more than 0.1 million USD. Finally, the ECI subsidies are also eligible for any export transactions towards Maritime Silk Road countries in 2015, and towards Belt and Road countries in 2016 (type 5) [9]. These ECI subsidies are cumulative, as eligible firms could receive a subsidy of up to 100% of the insurance fee if their transaction satisfies two or more eligibility criteria[10].

[8]Countries included in the Emerging Economies group are Bahrain, Bangladesh, Brunei, Myanmar, Cambodia, India, Indonesia, Iran, Israel, Jordan, Kuwait, Lao PDR, Lebanon, Malaysia, Oman, Palestine, Qatar, Saudi Arabia, Singapore, Syrian Arab Republic, Thailand, Yemen, Algeria, Angola, Benin, Botswana, Burundi, Cameroon, Canary Islands, Cape Verde, Central African Rep, Ceuta, Chad, Comoros, Congo, Djibouti, Egypt, Eq. Guinea, Ethiopia, Gabon, Gambia, Ghana, Guinea, Guinea Bissau, Cote d'Ivoire, Kenya, Liberia, Libyan Arab Jamahiriya, Madagascar, Malawi, Mali, Mauritania, Mauritius, Morocco, Mozambique, Namibia, Niger, Nigeria, Reunion, Rwanda, Sao Tome & Principe, Senegal, Seychelles, Sierra Leone, Somalia, South Africa, Western Sahara, Sudan, Tanzania, Togo, Tunisia, Uganda, Burkina Faso, Congo DR, Zambia, Zimbabwe, Lesotho, Melilla, Swaziland, Eritrea, Mayotte, Republic of South Sudan, Other Africa nest, Luxembourg, Albania, Bulgaria, Hungary, Monaco, Poland, Romania, Estonia, Latvia, Lithuania, Belarus, Moldova, Russia Federation, Ukraine, Serbia and Montenegro, Slovenia, Croatia, Czech, Slovakia, Bosnia and Montenegro, Antigua and Barbuda, Argentina, Aruba, Bahamas, Bonaire, Curacao, Martinique, Mexico, Montserrat, Nicaragua, Panama, Paraguay, Peru, Puerto Rico, Saba, Saint Lucia, Saint Martin Islands, Martin Islands, Saint Vincent and Grenadines, El Salvador, Suriname, Trinidad and Tobago, Turks and Caicos Islands, Uruguay, Venezuela, Virgin Islands British.

[9]Countries included in the Belt and Road group are Afghanistan, Bahrain, Bangladesh, Brunei, Myanmar, Cambodia, Cyprus, Indonesia, Iran, Iraq, Kuwait, Lao PDR, Lebanon, Malaysia, Maldives, Mongolia, Nepal, FDR, Oman, Pakistan, Philippines, Qatar, Saudi Arabia, Singapore, Korea Rep., Sri Lanka, Thailand, Turkey, United Arab Emirates, Yemen, Viet Nam, China, Timor-Leste, Kazakhstan, Kyrgyzstan, Tajikistan, Uzbekistan, Algeria, Angola, Benin, Botswana, Burundi, Cameroon, Cape Verde, Chad, Comoros, Congo, Djibouti, Egypt, Eq. Guinea, Ethiopia, Gabon, Gambia, Ghana, Guinea, Cote d'Ivoire, Kenya, Liberia, Libyan Arab Jamahiriya, Madagascar, Mali, Mauritania, Morocco, Mozambique, Namibia, Niger, Nigeria, Rwanda, Senegal, Seychelles, Sierra Leone, Somalia, South Africa, Sudan, Tanzania, Togo, Tunisia, Uganda, Congo, Zambia, Zimbabwe, Lesotho, Republic of South Sudan, Italy, Luxembourg, Greece, Portugal, Albania, Austria, Bulgaria, Hungary, Malta, Poland, Romania, Estonia, Latvia, Lithuania, Georgia, Armenia, Azerbaijan, Belarus, Moldova, Russia Federation, Ukraine, Serbia and Montenegro, Slovenia, Croatia, Czech, Slovakia, Macedonia, FYR, Bosnia and Montenegro, Antigua Barbuda, Barbados, Bolivia, Chile, Dominica, Costa Rica, Cuba, Dominican Republic, Ecuador, Grenada, Guyana, Jamaica, Panama, Peru, El Salvador, Suriname, Trinidad and Tobago, Uruguay, Venezuela, Cook Islands, Fiji, Vanuatu, New Zealand, Papua New Guinea, Solomon Islands, Tonga, Samoa, Kiribati. Countries included in the Maritime Silk Road group are Bangladesh, Brunei, Myanmar, Cambodia, India, Indonesia, Lao PDR, Malaysia, Pakistan, Philippines, Singapore, Sri Lanka, Thailand, Viet Nam, Cook Islands, Fiji, Vanuatu, Papua New Guinea, Tonga, Samoa, Micronesia Fs.

[10]Eligible firms only received 100% of insurance premiums as subsidies in 2014, if eligible firms registered in the rural area exported 3 million products in 2013 which applied for 120% of insurance premiums as subsidies.

Table 1: The Guangdong ECI subsidies eligibility criteria.

Subsidy standard		Year 2014	2015	2016
Type 1: Firm size	SMEs	80%	80%	80%
Type 2: Firm size and Destination	Medium size	\	80%	80%
Type 3: Geography	Pearl River area	15%	20%	20%
	Rural area	30%	40%	40%
Type 4: Product	Equipment, machine	10%	30%	30%
	Agricultural product	10%	10%	10%
Type 5: Destination	Belt and Road	\	\	50%
	Maritime Silk Road	\	10%	\

Note : Data from the Department of Commerce of Guangdong province. 8 cities belong to the Pearl River area: Guangzhou, Foshan, Zhuhai, Jiangmen, Zhongshan, Dongguan, Huizhou, and Zhaoqin. 13 cities belong to the province's rural area: Shantou, Shaoguan, Heyuan, Meizhou, Huizhou, Shanwei, Yangjiang, Zhanjiang, Maoming, Qingyuan, Chaozhou, Jieyang. Eligible firms that have an amount of export within 3 million dollars in the previous year, could receive an 80% insurance fee as subsidies in the current year. Eligible firms that have amount of export between 10 million dollars and 50 million dollars in the previous year, could receive an 80% insurance fee as subsidies in the current year. The destination country is an emerging economy. The equipment and machinery products are classified by the China custom Standard Classification (8-digit HS product code belong to [00000001, 15011000]). The agricultural products are classified by the China Custom Standard Classification (8-digit HS product code belong to [84031090, 89031200]). Followed by Manova and Yu (2016),product classification is consistent across countries at the 6-digit HS level. The number of distinct product codes in the Chinese 8-digit HS classification is comparable to that in the 10-digit HS trade data for the U.S. Followed by (Ahn et al., 2011), we classify HS codes into one of 15 unrelated sectors: HS 01–05 "Animal and Animal Products"; HS 06–15 "Vegetable Products"; HS 16–24 "Foodstuffs"; HS 25–27 "Mineral Products"; HS 28–38 "Plastics/Rubbers"; HS 41–43 "Raw Hides, Skins, Leathers & Furs"; HS 44–49 "Wood and Wood Products"; HS 50–63 "Textile"; HS 64–67 "Footwear/Headgear"; HS 68–71 "Stone/Glass"; HS 72–83 "Metals"; HS 84–85 "Machinery/Electrical"; HS 86–89 "Transportation"; HS 90–97 "Miscellaneous"; and HS 98–99 "Service". HS 01-15 denotes agricultural products and HS 84-89 denotes equipment and machinery products. The total subsidy could accumulate up to 100%. Empty cells mean that the ECI subsidy criteria did not apply in that year.

Table 2 reports descriptive information on the Guangdong ECI subsidies' annual funding and exporters' participation during the period 2014-2021. Over 8 years, the program has subsidised more than 20,000 firms, allocating more than 122 million USD overall, with an average subsidy per exporter of about 10,000 USD.

Table 2: The Guangdong ECI subsidies statistics over the period 2014-2021.

year	Total fund ($)	Subsidized Exporters	Average fund size per exporter ($)
2014	42,903,229	1,516	28,300.3
2015	21,366,500	1,278	16,718.7
2016	6,217,571	718	8,659.6
2017	12,390,300	922	13,438.5
2018	7,520,500	1,067	7,048.3
2019	8,893,872	5,997	1,483.1
2020	9,823,097	4,922	1,995.7
2021	13,216,597	3,955	3,341.8
Total	122,331,666	20,375	10,123.25

Note : Data from the Department of Commerce of Guangdong province.

4 Data and descriptive statistics

4.1 Data source

For our analysis, we gather data from 3 different sources for the period 2010-2016. First, we obtain the data about ECI subsidies in the Guangdong province for the years 2014-2016 from the Department of Commerce of Guangdong province, providing information on all firms receiving ECI subsidies during this period, including firms' names, numbers and value of subsidies for each year. We merge this with the China custom database from the Ministry of Commerce, providing detailed transaction-level information, including exporters' names, amount of export value, product classification, export destination, and transaction year up to 2016. We complement this with data from the Qichacha database (QCC)[11] , providing further firm-level information such as establishment date, firm's current and previous names, location, and industrial classification, all information useful to correctly match firms between the different datasets[12].

Table 3 provides basic descriptive information about the merge rate among 3 databases. Firstly, we use the firm name in the subsidized firm database to merge with the firm name or the firm previous name in the Qichacha online database, resulting in an updated subsidized firm database, which has more firm-level information such as establishment date, firm's current and previous names, location, and industrial classification for more than 93% subsidized firms. Secondly, we use the firm name or the firm previous name in the updated subsidized firm database to merge with the firm name in the China custom database, resulting in the final database for all exporters in Guangdong province[13]. Overall, the matched sample covers more than 63% of the total firms reported by the subsidies firm database. This result is consistent with previous studies using the China custom database and matching it with other databases (Manova and Yu, 2016; Yang et al., 2024).

Table 3: Datasets merge rates by year.

Year	2014	2015	2016
The merge rate between SF & QCC	93.3%	95.5%	96%
The merge rate between SF & QCC & CCB	83.8%	83.5%	84.6%

Note : Data collected from China custom database(CCB), Subsidized firm database(SF) and Qichacha online database(QCC).

[11]Qichacha is a website in delivers updated data and analytics on China-based private and public companies. These updated data are collected from the National Enterprise Credit Information Publicity System (NECIPS) of China. We could use API tool to search data and merge data in the Qichacha database rather than NECIPS, because NECIPS didn't allow batch search.

[12]Some studies use the firm identifier and firm name to merge firms of China's custom database with other firm's databases and we use the firm name as the primary matching variable following the matching methods in those studies (Manova and Yu, 2016; Defever et al., 2020; Benguria, 2023). We use the firm name and firm previous name to match firms in 3 databases because of the lack of other identification variables such as address, postcode, and contact number. To increase the merge rate, we use the previous firm's name; and rename part of the city name into the full city name, like changing 'Guangzhou' into 'Guangzhou City' in the database to merge with the firm name in the China custom database. Many firms are named by city name (generally have 3 characteristics) plus specific 4 characteristics due to the naming rule for firms in China. So, we use the left 7 characteristics of the firm name in the updated subsidized firm database to merge with the left 7 characteristics of the firm name in the China custom database.

[13]See Manova and Yu (2016) merge transactions-level data of 2005 for 67% of all firms in China custom database with Annual Survey of Industrial Firms of China.

4.2 Baseline sample descriptive statistics

We keep in our sample only exporting firms registered in the Guangdong province, resulting in 30,836 firms over the period 2010-2016, with more than 1,200 firms receiving ECI subsidies. The descriptive statistics reported in Table A1 in the Appendix show the main variables of interest for the control (unsubsidised) and treated (subsidised) groups of firms in our dataset before and after the initiation of the ECI subsidies. Consistent with the ECI subsidies' aim of supporting SMEs to export, we find that on average firms in both groups have increased their average export value, while the growth rate of export value of subsidized firms increases faster than that of unsubsidized firms after the implementation of the policy, and the average number of transactions of subsidized firms increased from 129 to 130 after the policy between 2014 and 2016, while the average number of transactions of unsubsidized firms increase from 28 to 34 after the policy between 2014 and 2016. The definition of variables is summarised in Table A2 in the Appendix.

As shown in Table 4, we categorised the 30,836 firms into 2 groups by year and found that both groups have an increased value of export, an increased number of destinations and products. Subsidised firms are willing to export more products or services to other destinations, while those firms with no subsidies export less in 2014-2016 compared with their transactions in 2010-2013. The average export value of unsubsidized firms are one-quarter of the average export value of subsidised firms, and the mean number of transactions, the mean number of destinations and mean number of products of unsubsidized firms are smaller than that of subsidized firms, which could be explained by two reasons. First, ECI subsidies aim to support SMEs and special medium firms to export to emerging economies and data may be concentrated on those special firms. Second, the firm size of subsidized firms is smaller than the firm size of unsubsidized firms and only 5% of the sample firms received subsidies. The policy preference and sample size result to the high standard deviations of the treatment group.

The data for ECI subsidies program reported in Table A3 in the Appendix show the main variables of interest for the SMEs, medium size firms and large size firms in our dataset with less risky destinations and risky destinations. Figure 2 shows how the amount of export value varied among two groups with the firms receiving ECI subsidies and firms without ECI subsidies after the implementation of ECI subsidy policy. The gap between those firms in Guangdong province that using ECI subsidies with other firms in Guangdong province that didn't use ECI subsidies in the amount of export value are large since 2014, which means the implementation of the policy may affect treated firms and their business behaviors, which include SMEs and special firms to risky destinations.

Figure 3 shows the location of treated firms in each city om 2014-2016. To provide as fine a level of spatial resolution as possible, we display number of firms in this figure at the city level. There is a closer relationship between location and treated firms and the areas with the largest concentrations of treated firms surround the Pearl River area and the coastal regions. Figure 4 shows the manufacturing firms share in each city in 2014-2016. The manufacturing firms with ECI subsidies share for Foshan, Dongguan and Guangzhou as a whole province was approximately 47% and we see the emergence of industrial agglomerations in the Pearl River area [14]. Comparing with two figures, the location and the manufacturing firms with ECI subsidies are positively correlated. We will investigate the causal relationship between policy and firm export performance in the

[14] See Figure A1 in the Appendix for the details of treated firms by industries.

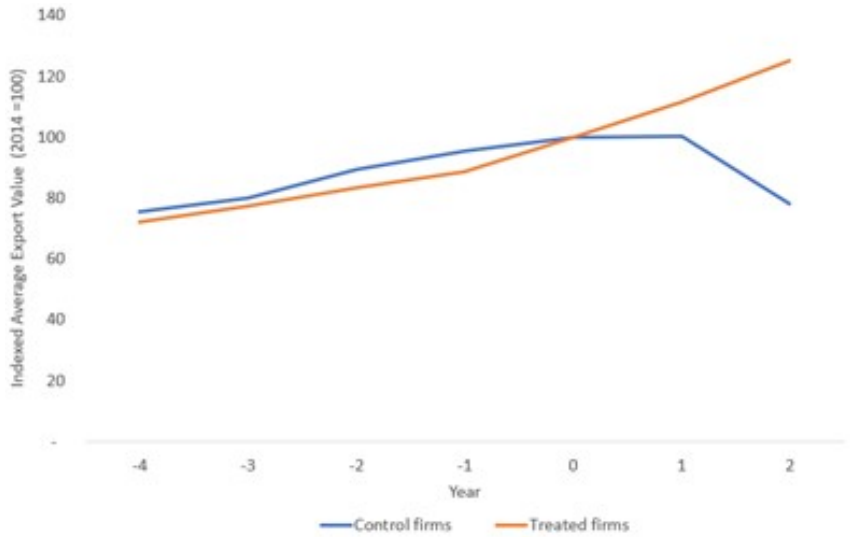


Figure 2: The change in indexed average export value by group

Note: Data collected from China's custom database, Subsidized firm database and Qichacha online database over the period 2010–2016. The number of export values in the current year is reported in billions of US dollars. The blue line represents the number of firms without ECI subsidies, and the orange line represents the number of firms with ECI subsidies. The X-axis represents the indexed average export value and the Y-axis represents the year. 2014 is the first year of policy implementation and serves as the index for this figure. For the Y-axis, the index time for year $Y = Y - 2014$. For the X-axis, the index number for year $Y = \left(\frac{\text{Average export value for year } Y}{\text{Average export value for year 2014}}\right) \times 100$.

following section.

5 Methodology

5.1 Empirical strategy

Previous studies evaluating the effectiveness of different public policies in general, and of subsidies more specifically, have identified several threats, including selection bias and unobserved heterogeneity, which result in endogeneity. To overcome these issues, policy evaluation studies have applied several econometric techniques, including difference-in-difference (DiD) (Munch and Schaur, 2018; Cadot et al., 2015) and propensity score matching (PSM) models (Vanino et al., 2019; Srhoj and Walde, 2020; Martincus and Carballo, 2008). However, both could have limitations because DiD relies on the parallel trends assumption which requires the treatment group and control group to have similar trends before the implementation of the policy and have no restrictions on random assignment. PSM rely on an observable characteristics-matching approach based on large samples and comprehensive observational information. If these assumptions are not met both techniques could be affected by potential bias.

Given the limitations of other methods and the setting of the ECI subsidies, we use regression discontinuity design (RDD) techniques (Imbens and Lemieux, 2008; Lee and Lemieux, 2010) in our analysis by using the discontinuities between treated and control firms based on some of the eligibility criteria previously discussed. RDD is one of the widely use quasi-experimental strategies, which are used to estimate the causal effect of policy treatment that changes discontinuously at a threshold value of a continuous variable (Imbens and Lemieux, 2008; Cattaneo and Titiunik, 2022). By using RDD, we could



Figure 3: The share of treated firms among total firms in each city from 2014 to 2016

Note: Data collected from China custom database, Subsidized firm database and Qichacha online database over the period 2014-2016. Lower panel: Share of manufacturing firms = the number of manufacturing firms in this city/the number of treated firms in this city in the 2014-2016; darker green colors correspond to higher value; lighter blue color corresponds to lower values. The largest three city that include manufacturing firms are Foshan, Dongguan and Guangzhou.



Figure 4: The share of manufacturing treated firms among treated firms in each city from 2014 to 2016

Note: Data collected from China custom database, Subsidized firm database and Qichacha online database over the period 2014-2016. Share of manufacturing firms = the number of manufacturing firms in this city/the number of treated firms in this city in the 2014-2016; darker green colors correspond to higher value; lighter blue color corresponds to lower values. The largest three city that include manufacturing firms are Foshan, Dongguan and Guangzhou.

address several endogeneity issues by comparing the different performance between similar treatment (subsidized) and control groups (unsubsidized), because of the clear cutoff divide between observations in these two groups based on the ECI subsidy criteria, being able in this way to estimate the potential differences in the post-treatment performance between two groups attributed to the ECI subsidies.

A potential threat in the identification of the causal relationship between ECI subsidy and firm export performance is the possible endogeneity bias because participation in the ECI subsidy program is not an exogenous and randomized treatment but is likely to be affected by endogenous factors, such as the information exposure of the firms and the decision-making process of firms (Vanino et al., 2019; Caliendo and Kopeinig, 2008). Then export firms could learn more details about the policy to change their behaviors after the implication of ECI subsidies. To overcome this issue, we employ a propensity score matching (PSM) technique to analyze the differences in performance growth between firms that receive the ECI subsidies and a matched comparator group of firms that received no subsidies based on their probability of participation. Following the previous studies (Abdulkadıroğlu et al., 2022; Vanino et al., 2019), we create a control group of untreated firms which have similar characteristics to the treatment group of treated firms based on the likelihood of receiving the treatment and then adopt PSM-RDD into our model. Lastly, there is no other promotions program implemented over the same periods in the same province.

Our analysis focus on 2 subsidized standards , which allows all types of eligible export firms to apply for ECI subsidies in the current year based on their firm size and destinations, because 2 subsidized standards are provided to export firms simultaneously and both groups share the same policy context, which could address the issue of selection bias and enhance the internal validity. Another reason is that the policy context and the assignment mechanism described above allows us to use RDD by creating the probability of receiving ECI subsidies for observations, using the policy eligibility criteria as the cutoff, the export value in the previous year as the running variable, and the current and future export margins as the outcome variables (Cattaneo and Titiunik, 2022).

The ECI subsidies program supported approximately 1500 firms between 2014 and 2016, but the number of subsidized firms is a small fraction of the full sample, and Figure A2 show a similar trend when the sample of subsidized firms is excluded. For identification purposes, our empirical strategy identifies the effects of ECI subsidies on firm export performance by comparing the outcome variables of the treatment group against the control group in 5 scenarios between 2010 and 2016. Figure A3 shows the sample size of the standards of type 1, the standards of Type 2 lower bound and the standards of Type 2 higher bound. We keep the manufacturing exporter with 30 subindustries [15] only,

[15]There are 30 subindustries that we use: Crop Production; Food Manufacturing; Beverage and Tobacco Products; Other Beverage and Tobacco Products; Textile Mills; Textile Product Mills, Clothing Manufacturing; Leather and Allied Products; Wood Product Manufacturing; Furniture and Related Products; Paper Manufacturing; Printing and Related Support Act; Literary, educational, industrial and aesthetic, sports and recreational goods manufacturing industry; Petroleum coal and other fuel processing industry; Chemical raw materials and chemical products manufacturing; Pharmaceutical Manufacturing; Chemical Manufacturing; Plastics and Rubber Products; Non-metallic mineral products industry; Ferrous metal smelting and rolling processing industry; Non-ferrous metal smelting and rolling processing industry; Fabricated Metal Products; General equipment manufacturing; Machinery Manufacturing; Automobile Manufacturing; Transportation Equipment; Electrical Equipment, Appliance; Computer and Electronic Products; Instrumentation Manufacturing; Miscellaneous Manufacturing; Comprehensive Utilisation of Waste Resources; Metal products machinery and equipment repair industry.

because the proportion of Guangdong's manufacturing exports accounts for one-quarter of the nation's total manufacturing exports and the data for the manufacturing industry is representative [16].

In the type 1 criterium, the treatment group is defined as those subsidized firms with export value below $3 million and the control group consist of those unsubsidized firms with export values below $10 million, because eligible firms could apply for type 1 subsidized standards only when their export values are less than $10 million. In the type 2 criterium lower bound, we keep those subsidized firms that sell between $10 million and $50 million to these special destinations as the treatment group and keep those unsubsidized firms that sell between $3 million and $50 million to these special destinations as the control group, because eligible firms could apply for type 2 subsidized standards only when their export values are between $10 million and $50 million. In the type 2 criterium higher bound, we keep those subsidized firms that sell between $10 million and $50 million to these special destinations as the treatment group and keep those unsubsidized firms that sell between $10 million and $100 million to these special destinations as the control group, because eligible firms could apply for type 2 subsidized standards only when their export values are between $10 million and $50 million. The other three types of criteria [17] will not be analyzed in this paper because firms could only apply for a relatively small amount of subsidy (around 10%) under this item, compared to Type 1 and Type 2, under which firms could apply for over 90% of the subsidy. This implies that Type 1 and Type 2 have a significantly greater impact on firms.

We conduct the PSM-RDD analyses relating ECI subsidies to firm performance. In our initial steps, we adopt propensity score matching (PSM) to create a suitable control group of non-treated firms which is as similar as possible to the group of treated firms based on the likelihood of receiving the ECI subsidies. In the next steps, we use the firm's export value from the previous year as the threshold for determining eligibility for ECI subsidies. We employ a regression discontinuity (RD) design, which assumes that firms just above and just below the cutoff are similar in all respects except for their likelihood of receiving the subsidy. This similarity allows us to treat the difference in the previous year's export value as a quasi-random assignment mechanism, providing a sampling frame within which we can identify the causal impact of ECI subsidies on firm performance (Imbens and Lemieux, 2008; Lee and Lemieux, 2010). Besides, the treatment rule is imperfectly applied in the ECI subsidies, i.e, some export firms below the threshold do not get ECI subsidies because the ECI subsidies program is optional, and we employ a fuzzy RD design rather than a sharp RD design in the subsequent analysis.

[16] Data are collected from Guangdong Statistical Information (https://stats.gd.gov.cn/tjsj186/index.html)

[17] In the type 3 criterium, we keep those subsidized firms in Pearl River area that sell between $50 millin and $100 million as the treatment group and keep those unsubsidized firms in Pearl River area that sell between $50 million and $100 million as the control group, because export firms could not apply for type 1 and type 2 subsidized standards when their export value are above $50 million. Similarly, In the type 4 criterium, we keep those subsidized firms that sell special products with export value between $50 million and $100 million as the treatment group and keep those unsubsidized firms that sell special products with export value between $50 million and $100 million as the control group. In the type 5 criterium, we keep those subsidized firms that sell between $50 million and $100 million to special destinations as the treatment group and keep those unsubsidized firms that sell between $50 million and $100 million special destinations as the control group. See Table A4 in the appendix for more details.

5.2 Application of propensity score matching to the custom data

The considerable imbalance in sample composition, with treated firms representing approximately 5% and untreated firms 95%, raises concerns about selection bias and endogeneity. To address this, we apply a Propensity Score Matching (PSM) technique to construct a control group statistically comparable to the treated firms based on observable characteristics. We estimate the probability of treatment through a logistic regression using firm-level characteristics such as firm age, industry affiliation (captured by industry fixed effects), and other pre-treatment variables.

Matching is conducted within a restricted sample of three firm categories—SMEs, special medium firms with a lower boundary, and special medium firms with a higher boundary—to ensure comparability in firm size and time frame. After estimating propensity scores, we perform one-to-one nearest-neighbor matching with replacement, using a strict caliper of 0.5 and imposing a common support condition to exclude observations outside the overlap region. This ensures that each treated firm is matched only to untreated firms with similar treatment probabilities.

Following matching, we conduct balance tests to assess covariate balance between treated and control groups. Only firms with satisfactory matches are retained. Matched untreated firms are identified via unique identifiers generated during the matching process and merged back into the main dataset. As a result, our final sample consists of treated firms and a closely matched group of untreated firms, enabling credible comparisons and minimizing bias from observable characteristics.

5.3 RD design – assumptions and conditions for analysis

Following previous studies(Wang et al., 2017; Lee and Lemieux, 2010; Yang et al., 2021; Imbens and Lemieux, 2008; Howell, 2017; Agarwal et al., 2023), we test 3 assumptions to assure the validity of our RD design that could identify the causal impact of ECI subsidies on firm export performance. First, there is a clear cutoff between the probability of receiving subsidies and firms' scores, which means that the probability of receiving subsidies is not a continuous function of firms' scores. Second, all covariates are continuous at the cutoff, which means that the firm characteristics of treated and untreated firms are similar. Third, the treatment variables $D_{i,t}$ cannot be manipulated by firms, which means firms cannot change their export in the previous year to satisfy the eligibility criteria and apply for the ECI subsidies in the current year.

We examine the first requirement by plotting the probability of a firm receiving subsidies as a function of the firm's export value in the previous year for three types of subsidies in Figure 5. As shown in Figure 5, for type 1 subsidy, in the left area of the cutoff line, firms are likely to receive subsidies if their export value in the previous year is close to the cutoff, while in the right area of the cutoff line, firms are not likely to receive subsidies if their export value in the previous year is closed to the cutoff. Type 2 lower bound and Type 2 higher bound show a similar trend. Figure 5 shows a clear discontinuity around the cutoff, providing evidence to satisfy the first requirement.

We examine the second requirement by comparing observable features of firms around the cutoff to verify that there is no evidence jump at the cutoff. In the figure 6, one covariate,

age is significantly important and continuous at the cutoff and firms' characteristics are similar, which provides evidence to satisfy the second requirement (Imbens and Lemieux, 2008).

We examine the third requirement by comparing the distribution of firms' scores around the cutoff of subsidies ECI with the McCrary density test (McCrary, 2008) because the non-manipulations assumption requires that firms cannot manipulate their scores to apply for ECI subsidies. ECI subsidies are an optional policy and updated annually since 2014, which requires firms to apply for ECI subsidies based on their export value in the previous year. Those export firms could decide to use policy or not use policy each year, so each firm is independent and not systematically related to any observable or unobservable characteristic determined before the randomisation, while some firms may misreport their export value in the previous year to apply for ECI subsidies since 2015. In Figure 7, we find no statistical difference between the density of scores on the period of pre-policy and the period of policy implementation, which are similar. The differences fall within the 95% confidence interval and provide evidence to satisfy the last requirement.

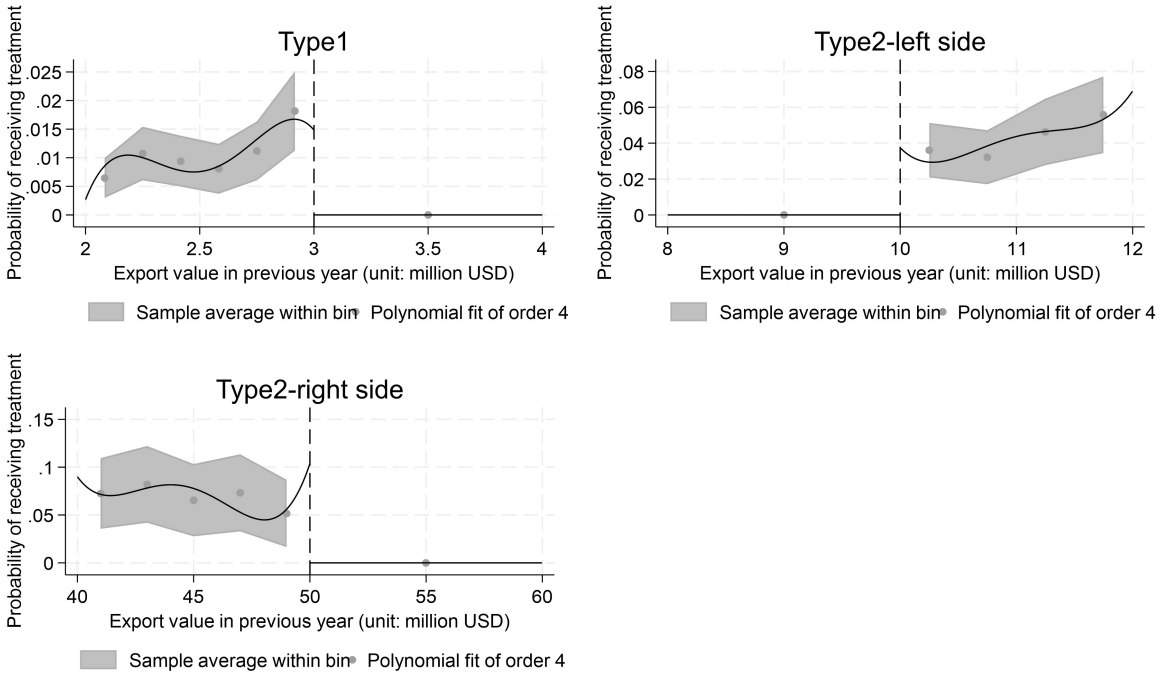


Figure 5: Probability of firms using ECI subsidies as a function of firms' score

Note: Data collected from China's customs database, subsidized firm database, and Qichacha online database over the period 2010–2016. The first-stage plot shows the conditional probability of receiving ECI subsidies using raw data. The X-axis represents the running variable: export value in the previous year. The Y-axis represents the probability of receiving ECI subsidies. The vertical line represents the cutoff: 3 million USD for Type 1, and 10 million USD and 50 million USD for Type 2.

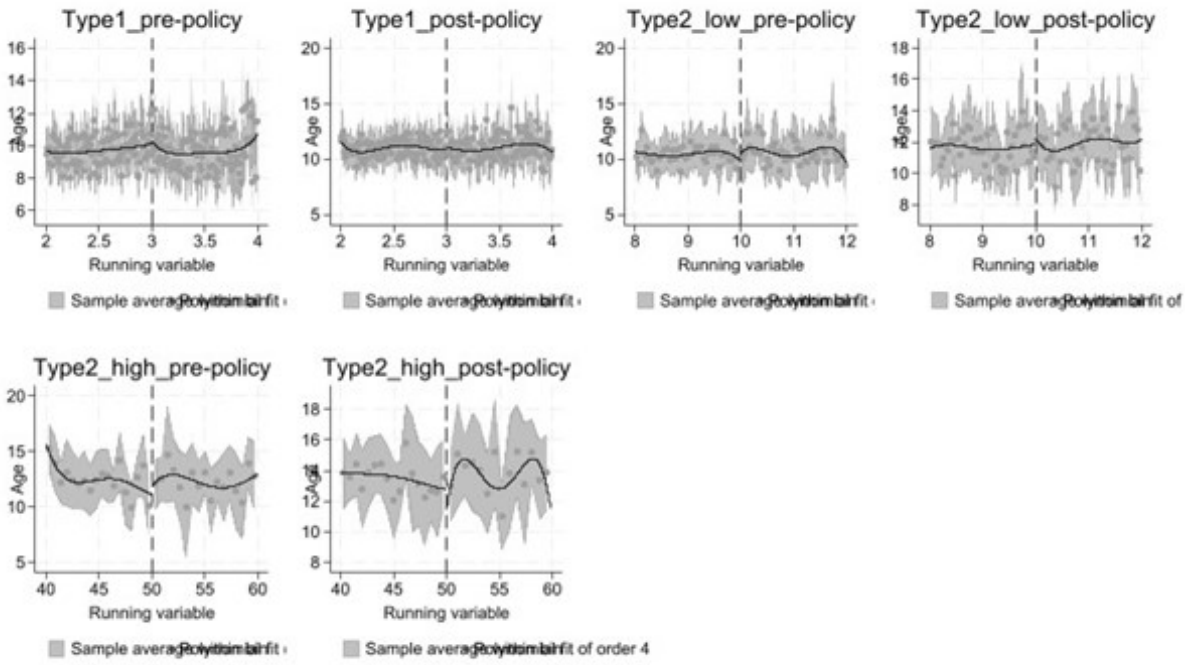


Figure 6: RD plot of firm-level covariates

Note: Data collected from China's customs database, subsidized firm database, and Qichacha online database over the period 2010–2016. The left panel represents the change in firm age during the pre-policy period, and the right panel represents the change in firm age after policy implementation. The vertical line represents the cutoff: 3 million USD for Type 1, and 10 million USD and 50 million USD for Type 2. Robust standard errors are in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

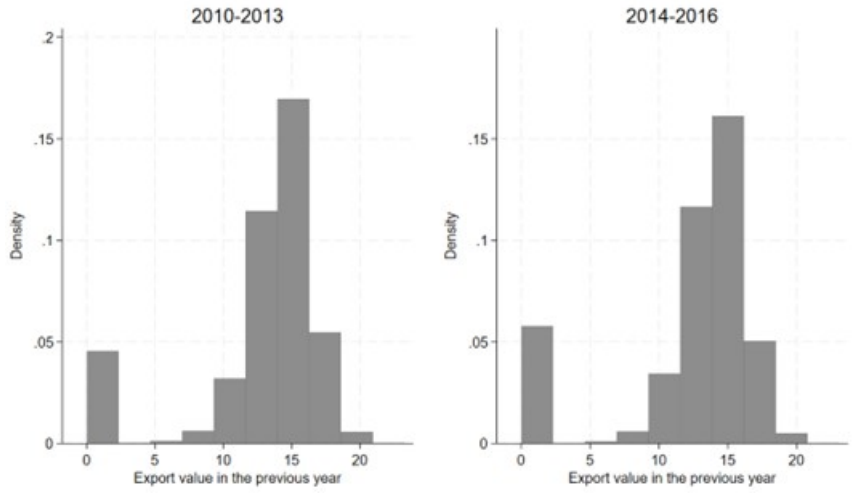


Figure 7: Density of export value in the previous year of the firm

Note: Data collected from China's customs database, subsidized firm database, and Qichacha online database over the period 2010–2016. The figures show the density of the running variable: the logarithm of export value in the previous year. The left panel shows the pre-policy period, and the right panel shows the post-policy period.

5.4 Fuzzy RD design analysis

To ascertain the effect of ECI subsidies on firm performance, our analysis adopts a fuzzy RDD rather than a sharp RDD in our estimation. While there are 5 types of subsidized standards in our context, we don't observe for which types of firms are subsidized, but only the subsidy status in the final list of subsidized firms. Also, Sinosure and the government inform those firms who buy ECI or prefer to buy ECI about the ECI subsidies, because ECI subsidies are an optional policy for those firms registered in Guangdong province since 2014, and we expect that most firms who know this policy will apply for it[18]. So, eligible firms could receive subsidies if they purchase ECI and apply for ECI subsidies to meet the policy's application requirements, otherwise, firms that do not receive subsidies are considered ineligible if they fail to meet these criteria and considered eligible but didn't buy ECI and fail to apply for ECI subsdies. Our identification strategy exploits the fuzzy RDD because we don't observe the reasons why eligible firms didn't use ECI subsidies, and also because we have a clear cutoff determining the eligibility, as in some papers facing similar empirical challenges (Santoleri et al., 2024; Cerqua and Pellegrini, 2014; Bronzini and Iachini, 2014).

In the sharp RDD, the running variable determines whether firms are treated or not based on whether this value exceeds the value of the fixed threshold, and the outcome variable determines the effect of treatment, which follow the rule $Ti = 1(Xi >= c)$, while covariates may influence the effect of treatment (Imbens and Lemieux, 2008). Compared with sharp RDD, imperfect compliance exists in fuzzy RDD, which means that some running variable exceeds the value of the cutoff while failing to receive the treatment (Cattaneo and Titiunik, 2022). In the sharp RDD, the probability of receiving the policy intervention needs to change from 0 to 1 at the threshold, while fuzzy RDD allows for a small jump in the probability of receiving the policy intervention at the threshold without requiring the jump to equal 1 (Imbens and Lemieux, 2008). As shown in Figure 4, the change in the probability of being treated at the cutoff is always less than one, which also provides the graphical evidence to support the fuzzy RDD adoption.

Our empirical strategy could estimate the local average treatment effects (LATE) at the discontinuity point by using the difference in the estimated outcomes for firms above and below the cutoff point (Imbens and Lemieux, 2008), and we could estimate the treatment effect for the subsample by using LATE rather than average treatment effect (ATE), because ATE is to estimate the treatment effect for the whole population (Imbens and Lemieux, 2008; Santoleri et al., 2024). Our estimation only keeps those firms that exported less than $100 million in the previous year as sample observation to narrow the sample size of both groups, because some firms that export more than $100 million in the previous year may not take the benefits of ECI subsidies which aim to support small business and those destinations are high risky countries, which may bring biased results. Because some firms that export more than $100 million in the previous year may not take the benefits of ECI subsidies due to type 1 and type 2 in the Figure 3.

Our analysis uses fuzzy RDD based on a continuity-based approach instead of a local randomization approach to estimate the average observed outcome given the scores for 2 reasons. First, the probability of receiving ECI subsidies is continuous because it takes any value in the [0, 1] interval, which means the running variable, the export value in the previous year, is continuous and all the observations in the dataset have distinct score

[18]See Table 2 for the increasing number of subsidized firms.

values. Second, the local randomisation approach does not impose parametric restrictions, which may introduce estimated errors. The sample size of ECI subsidies is not large enough to omit these estimated errors, so the continuity-based approach is more feasible in our analysis (Cattaneo and Titiunik, 2022).

In this analysis, we conduct the estimations at the firm level. For the treated firms, we have the information on the buyers for whether ECI subsidies were used, without specific subsidy standards, and for the control group, we have no information about the experience of buyers who have purchased ECI before. This means we could contribute to increasing the dimensionality of the analysis and estimate the effect of 2 subsidies standards on firm performance at the same time. In the fuzzy RDD, the average treatment effect is the ratio of the sharp RD effect of assignment variable Ti on outcome variable Yi and the sharp RD effect of assignment variable Ti on treatment variable Di. To assess if the causal effect of ECI subsidies on firm export performance is statistically significant, the estimated equations by two-stage least squares (2SLS) are provided by Equation (1) and Equation (2) .

$$D_{i,t} = \alpha_{0,t} + \alpha_{1,t}T_{i,t} + \varphi(V_{i,t-1} - c) + X_{i,t} + \theta_i + \delta_{s,t} + \mu_{i,t} \tag{1}$$

$$Y_{i,t} = \beta_{0,t} + \beta_{1,t}\hat{D}_{i,t} + \sigma(V_{i,t-1} - c) + X_{i,t} + \theta_i + \delta_{s,t} + \varepsilon_{i,t} \tag{2}$$

Where i denotes firms, t denotes the time period, and $t-1$ indicates the pre-application period. $D_{i,t}$ is a binary treatment variable indicating whether the firm used the policy or not, which equals 1 when the firm used ECI subsidies and 0 otherwise. $T_{i,t}$ is an indicator variable determining whether the firms are eligible to use the policy, with $T_{i,t} = 1$ when $(V_{i,t-1} \leq c)$. The term $(V_{i,t-1} - c)$ indicates the distance between the running variable—the export value in the previous year $V_{i,t-1}$—and the threshold c. $Y_{i,t}$ is the outcome variable, including the total export value of firm i in the current year t, the number of transaction products exported, and countries served. $X_{i,t}$ is a vector of firm-specific characteristics and control variables such as age, capital, and firm existence. $\mu_{i,t}$ and $\varepsilon_{i,t}$ denote the error terms.

The inclusion of the firm fixed effect θ_i ensures that time-invariant heterogeneity across firms is removed. Industry-by-year fixed effects $\delta_{s,t}$ restrict industry heterogeneity by comparing firms within the same sub-industry in each period.

To estimate the effect of ECI subsidies on individual firms, we use the two-stage least squares (2SLS) model for two reasons. First, many subsidized firms have no continuous export record; if we use a logit model, it will drop these groups and potentially introduce bias (Angrist, 2001). Second, we use the natural logarithm of export value in the previous year and the current year, which allows us to calculate marginal effects[19] to interpret elasticity in the 2SLS model. Therefore, we use exogenous assignment to treatment as an instrument for the usage of ECI subsidies to address potential endogeneity issues arising from imperfect compliance. $D_{i,t}$ is the treatment status or probability determined as a discontinuous function of firm size (Lee and Lemieux, 2010). There are four dependent variables in this model: the log value of export value in the current year, the number of destinations, the number of products, and the number of transactions. We adopt a linear approach to estimate the coefficient for export value because it is a continuous variable, and we use a Poisson estimator to estimate coefficients for the number of transactions,

[19]Marginal effect is evaluated at the sample means.

products, and destinations, as these three variables are count variables.

Two potential issues in the standard for type 1 subsidy may bias the estimated results, Eligibility is a weak instrument for the 2SLS model, because the small F value in the first stage is 3.62, which is less than 10 (Olea and Pflueger, 2013). Another issue is that the difference between the number of treated firms and untreated firms is huge, as only a limited number of SMEs apply for ECI subsidies, and the treated firms account for just 0.5% of the total number of firms in the sample. The 2SLS estimator with weak instruments is biased in small samples (Bound et al., 1995) and the estimated standard errors of the 2SLS model may be too small, due to these issues (Young, 2022). Therefore, we use the eligibility and distance as the instruments in the type 11 subsidy because the distance could support the eligibility to avoid the issues of biased results (Keane and Neal, 2023), while the setting of the standard for type two subsidy remains the same, which uses eligibility as the only instrument in the 2SLS model.

Drawing on (Cattaneo and Titiunik, 2022), we model the running variable linearly or quadratically in the local polynomial approach, which means order p equal to 1 or 2, because higher-order may bring estimates with potential bias, and our analysis employs only observations near the cutoff based on type 1 subsidized standard. Then we use the entire sample and two different bandwidths of ± 10 and ± 5 around the cutoff, which means bandwidth h equal to no restriction, 10 or 5, because narrow bandwidths could reduce misspecification error by comparing those firms around the cutoff (Lee and Lemieux, 2010). Also, we use a uniform kernel function only as a uniform kernel could give zero weight to observations outside the bandwidth h and minimizes the asymptotic variance in our analysis (Cattaneo and Titiunik, 2022).

6 Results and discussion

6.1 Baseline estimates

We apply the PSM -RDD strategy to investigate the causal effect of ECI subsidies on firm export performance, after testing the validity of RDD in our analysis. In this section, estimation proceeds by using local linear when only observations whose distance from the cutoff is at most bandwidth h are used for estimation without weights, using local polynomial when observations with a score near the cutoff only are used for estimation (Cattaneo and Titiunik, 2022). We first examine the hypothesis that ECI subsidies primarily boost the export value of SMEs, which exceeds that of medium-sized firms. Our results show that on average, the ECI subsidies have a sizable positive effect on firm export performance including export value, transactions, products and destinations. These effects suggest that ECI subsidies were likely helpful for SMEs, as these firms would be the most susceptible to liquidity constraints arising from default risk without ECI support.

We estimate equation (2) and equation (3) for the same policy windows up to 2016, which means we use 2010-2013 as our baseline pre-policy period and focus on 2014-2016 as full "policy-on" years. Table 5 presents evidence of the direct impact of the ECI subsidies on firm export performance and examines firms in the baseline sample using the PSM-RDD model. The key explanatory variable in column 1 is whether the firms' export value in the last year was below the SMEs threshold of 3 million dollars, and in column 2 is

whether the firms' export value in the last year was above the SMEs threshold of 10 million dollars, and in column 3 is whether the firms' export value in the last year was below the SMEs threshold of 50 million dollars. The running variable is the firms' export value in the previous year. Columns 1 to 3 of Table 5 show the baseline fuzzy RD design across various groups of sub-sample Type 1 (in column 1), Type 2 lower bound (in column 2), and Type 2 higher bound (in column 3).

The coefficient estimates for receiving subsidies, β_1, represent the marginal effect of adopting ECI subsidies on the dependent variables when the firm's export value in the previous year is at the cutoff, thereby capturing heterogeneous treatment effects across the running variable at the threshold. Columns 1 to 3 report the results with firm fixed effects and year-by-industry fixed effects, which account for the mechanical correlation between export shocks and the economic cycle of the subindustry. Panel A reports the estimated effect of ECI subsidies on firm export performance. Panel B reports the estimated effect of ECI subsidies on the number of transactions of export firms. Panel C reports the estimated effect of ECI subsidies on the number of products of export firms. Panel D reports the estimated effect of ECI subsidies on the number of destinations of export firms.

Column 1 of Table 5 shows that the subsidized firms' export value increased by 112% on average, compared to unsubsidized firms' export value during the same period. Receiving ECI subsidies could increase the number of transactions by 77.9% for those subsidized firms, compared with unsubsidized firms, and expand export destinations by 65.2% compared with their previous export record [20].

Column 2 of Table 5 shows that there was a discontinuity in special medium-size firms' export value during the same period that corresponds to the estimate of 0.332 in Panel A, which means that the subsidized firms' export value increased by 39.4% on average compared to unsubsidized firms' export value during the same period. Receiving ECI subsidies allowed subsidized firms to export products to more destinations by 29.4%, compared with those unsubsidized firms [21]. By contrast, this discontinuity did not exist in special medium-sized firms with higher thresholds. The results show a strong relationship between ECI subsidies availability and firm export performance, and the ECI subsidies policy facilitates subsidized firms in exporting. These subsidized SMEs performed well compared with medium-sized firms, while large-size firms may not be affected by the ECI subsidies program.

Figures 8, A4, A5, A6 provide the evidence to show the discontinuity for 4 dependent variables, the log value of export value, the number of transactions, the number of products and the number of destinations in three cutoffs, the subsidy of type 1, the subsidy of Type 2 lower bound and the subsidy of Type 2 higher bound.

Figure 8a shows that there was a sizable discontinuity in SMEs' export value over 2010-

[20] $\hat{\beta}_{1,t}$ is the coefficient of the dummy variable $D_{i,t}$ on the dependent variable $Y_{i,t}$. The exact percentage difference in the predicted Y when $D_{i,t} = 1$ versus when $D_{i,t} = 0$ is given by: $100 \times \left[\exp(\hat{\beta}_{1,t}) - 1\right]$. In Column (1) of Panel A, the coefficient is 1.137. Thus, the estimated percentage by which the export value of firms receiving ECI subsidies exceeds that of firms not receiving subsidies is $100 \times [\exp(1.137) - 1] \approx 112\%$. Similarly, in Column (1) of Panel B and Panel C, the coefficients are 0.576 and 0.502, respectively. The estimated percentage increases are $100 \times [\exp(0.576) - 1] \approx 77.9\%$, $100 \times [\exp(0.502) - 1] \approx 65.2\%$.

[21] In column (2) of Panel A, the coefficient is 0.332. The percentage increase in export value for firms receiving ECI subsidies relative to firms not receiving subsidies is estimated as $100 \times [\exp(0.332) - 1] = 39.4\%$. Similarly, in column (2) of Panel C, the coefficient is 0.258, and the estimated percentage increase is $100 \times [\exp(0.258) - 1] = 29.4\%$.

2016 that corresponds to the estimate of 1.137 in column 1 in Panel A of Table 5, and Figure A4a, Figure A4b shows that there was a discontinuity in SMEs' transactions and destinations that corresponds to the estimate of 0.576 and 0.502 in column 1 in Panel B and Panel C of Table 5. By contrast, Figure A4c shows the discontinuity estimate is 0.294, not statistically significant, as reported in column 1 in Panel D of Table 5.

Figure 8b shows that there was a discontinuity in special medium-size firms export value during the same period that corresponds to the estimate of 0.332 in column 2 in Panel A of Table 5, and Figure A5b shows that there was a discontinuity in special medium-size firms' destinations during the same period which is 0.258, statistically significant, as reported in column 2 in Panel C of Table 5.

Figure 8c shows that there was a discontinuity in the export value of special medium-size firms' threshold with higher boundary during the same period that corresponds to the estimate of -0.51 in column 3 in Panel C of Table 5. It suggests that the support of the policy was significant in the SMEs and special medium-size firms with lower boundary.

6.2 Heterogeneity analysis

In this section, we exploit the variation across destination, and product characteristics to further understand the role of the ECI subsidies in promoting trade. Our results are consistent with the baseline results discussed in our framework. The results below suggest that ECI could support SMEs and special median size firm and benefit exporters that sell certain types of products for which the relative fixed cost is higher.

Tables A5, A6, and A7 provide the estimated results for three subsidy standards with different bandwidths, where we narrow the range of bandwidth to estimate the results. The positive effect of participation in the ECI subsidies program gradually emerges and stabilizes around the baseline result when the bandwidth increases. The coefficient is positive and significant in columns 4 to 6 in the large distance to the SMEs threshold in Panel A of Table A5, and negative in columns 1 to 3 in the small distance to the SMEs threshold in Panel A of Table A5. Focus on the large distance to the SME threshold, the coefficient is positive and significant in columns 4 to 6 in Panel B and C, and negative in columns 1 to 6 in Panel D, which delivers a trend of coefficient almost identical to that in Table A6. Similarly, the coefficient is positive and significant in columns 3 to 6 in the large distance to the special medium-size firm's threshold in Panel A of Table A6. Focus on the large distance to the SME threshold, the coefficient is positive and significant in columns 3 to 6 in Panel B and C, and negative in columns 1 to 6 in Panel D, which delivers a trend of coefficient almost identical to that in Table A7. The coefficient is negative and significant in columns 3 to 6 in Panel C of Table A7, and other coefficients are negative and insignificant. These results, which are robust to a range of robustness tests, indicate the presence of a positive effect from the ECI subsidies in export firms that have a large distance between export value in the previous year from the threshold, and the support of ECI subsidies are not restricted to firms around the threshold.

Table 6 provides the estimated results for three subsidy standards that treated firms exporting products to the region with different economic sizes. The positive effects of ECI subsidies are driven by sales abroad to OECD countries and non-OECD countries, which suggests that they are effective in promoting trade towards all the destinations.

Table 7, Table 8 and Table 9 provide the estimated results for three subsidy standards that treated firms exporting products in different classifications. Accordingly, we employ the product classification to distinguish the type of product. First, we select the first six digits of the HS 8-digit to construct the HS 6-digit. We then convert HS 6-digit products to the SITC Rev. 2 classification of goods. We split the treated firms by the median of this measure and implemented the PSM-RDD estimator separately for each sample. In Table 7 and Table 8, we indeed find larger estimated coefficients in the sample of exporters that sell machinery and transport equipment, suggesting that the ECI subsidies are more important when the relative fixed cost is higher.

7 Robustness test

To check the sensitivity of our results, we conduct robustness and falsification tests using Staggered Difference-in-Differences (Staggered DiD) to provide evidence for an additional robustness check. By comparing its estimates with those derived from the PSM-RDD methodology, we can evaluate the consistency of the findings. We adopt a Staggered DiD approach because this approach allows for estimating treatment effects across different groups and periods, addressing issues of heterogeneity that arise in traditional two-period DiD models. It also provides more granular insights into how treatment impacts vary over 7 years(Callaway and Sant'Anna, 2021). However, we need to satisfy the parallel trends assumption to hold for two groups over 7 years. The estimated equations by two-stage-least squares (2SLS) are provided by Equation (3) and Equation (4).

$$D_{i,t} = \alpha_0 + \sum_{k=-3}^{6} \alpha_k T_{i,t,k} \cdot (V_{i,t-1} - c) + \tau X_{i,t} + \delta_i + \delta_{s,t} + \varepsilon_{i,t} \tag{3}$$

$$Y_{i,t} = \beta_0 + \sum_{k=-3}^{6} \beta_k D_{i,t,k} \cdot (V_{i,t-1} - c) + \rho X_{i,t} + \delta_i + \delta_{s,t} + \varepsilon_{i,t} \tag{4}$$

Where i denotes firms, t denotes the time period, and $t-1$ indicates the pre-application period. $D_{i,t}$ is a binary treatment variable indicating whether the firm used the policy or not, which is equal to 1 when the firm used ECI subsidies and equal to 0 when the firm did not use ECI subsidies. $T_{i,t}$ is an indicator variable determining whether the firms are eligible to use the policy or not, $T_{i,t} = 1 \quad$ when $V_{i,t-1} \leq c$, $(V_{i,t-1} - c)$ is the variable indicating the distance between the running variable (the export value in the previous year $V_{i,t-1}$) and threshold c. $Y_{i,t}$ is the outcome variable, including the total export value of firm i in year t, the number of transactions, products exported, and countries served. $X_{i,t}$ is a vector of firm-specific characteristics and control variables such as age, capital, and status. δ_i controls for firm-fixed effects. $\delta_{s,t}$ controls for industry and year-fixed effects. $\mu_{i,t}$ and $\varepsilon_{i,t}$ denote the error terms. The interaction term is given by $\sum_{k=-3}^{3} \beta_k D_{i,t,k} \cdot (V_{i,t-1} - c)$, which is an interaction between dummy variables and distance, one for each implementation year k. Here, $k < 0$ means the pre-policy period and $k > 0$ means the post-policy period, indicating whether firm i has implemented the policy by year t. $k = -3$ means three years before the implementation of the policy (the year 2011).

Figure 9 plots the yearly coefficients β_k and the 95% confidence intervals when we estimate equation (3) and equation (4). The dependent variables are the export value, the number

of transactions, products, and destinations for SMEs, relative to the year before the shock. Figure9a provides visual evidence of the effect of ECI subsidies on firm performance before and after the policy implementation. The export value, the number of transactions, products, and destinations of treated SMEs increase significantly relative to control firms, while the treated special medium-size firms cannot satisfy the requirement of the parallel trend assumption in Figure9b.

Tables A8,Tables A9,and Tables A10 show that point estimates and patterns of statistical significance differ from the baseline results when we limit the sample to the two narrowest bandwidths around the threshold. Our results hold when adopting alternative criteria to select the bandwidths around the threshold.

8 Conclusions

This paper aims to evaluate the causal effect of ECI subsidies on firm export performance in China by using a reliable RDD approach. Our analysis focuses on the impact of ECI subsidies on the export value, number of transactions, number of products and number of destinations in a fuzzy RDD framework. We take advantage of the quasi-experimental process of the RDD to exploit the discontinuity point of the running variable around the threshold of the eligibility criteria.

The results suggest that this policy could facilitate subsidized SMEs to export over the period 2014-2016 as the export value, number of transactions, and number of destinations are higher in the unsubsidized firms. These estimates are statistically significant and robust to different sensitivity checks. The positive estimated results are derived from the robustness test which is consistent with baseline results. The positive effect of the ECI subsidies policy is also consistent with previous studies, although they investigate the effect of ECI subsidies using country-level data and less advanced econometric techniques (Agarwal and Wang, 2018; Matray et al., 2024; Agarwal et al., 2023).

Our analysis shows that ECI subsidies could increase export sales by risk management and the control for financial constraint. However, it leaves the equation of whether ECI subsidies could support the export firms that have no financial constraint. For example the special medium-size firm with small size could benefit from the program more than those special medium-size firm with small size with large size. In the future steps, we may add the estimator of event studies to control the effect of two-way fixed effects regressions, which may bring more effect from other periods and treatment effects heterogeneity (Sun and Abraham, 2021). We could provide a more precious estimated results to estimate the effect of ECI subsidies, followed by previous studies (Howell, 2017; Santoleri et al., 2024), since firms could apply for ECI subsidies with varying subsidized standards.

As our earlier review of the literature suggests, market failure for SMEs is one of the reasons why the Government subsidize ECI to SMEs and facilitates them to export. If the effect of ECI subsidies on firm export performance takes place by reducing market failure, such as asymmetric information, the additionality is predictable. We will exploit whether the ECI subsidies alleviate market failure using proxies with different aggregation levels, such as firm, industry and year, and explore heterogeneous treatment effects to address the issue of potential bias. Lastly, we will develop a theoretical model which could support empirical results to enhance the credibility of the research and provide a

theoretical analysis for policy implications.

Table 4: Number and average value of export between control group and treatment group by year, 2010-2016

Panel A									
Sample: Control group									
Year	2010	2011	2012	2013	2014	2015	2016	2010-2013 Average	2014-2016 Average
Total No. firms	29,264								
Outcome variables:									
Mean export value	7.74	8.20	9.17	9.77	10.24	10.26	7.99	8.72	9.50
Mean transactions	28.46	27.39	27.70	28.91	31.51	35.70	35.96	28.12	34.39
Mean destinations	8.84	8.81	8.62	8.68	8.87	8.82	8.91	8.74	8.87
Mean products	8.97	8.57	8.43	8.82	9.66	10.70	11.22	8.70	10.53
S.d. of export value	84.25	70.62	89.29	108.15	101.00	103.66	50.84	88.08	85.17
S.d. of transactions	101.83	91.83	94.18	109.7	124.96	186.47	211.81	99.39	174.41
S.d. of destinations	12.36	12.28	12.00	12.06	12.27	12.25	12.36	12.18	12.29
S.d. of products	23.17	21.55	21.84	30.59	31.66	42.61	43.84	24.29	39.37
Panel B									
Sample: Treatment group									
Year	2010	2011	2012	2013	2014	2015	2016	2010-2013 Average	2014-2016 Average
Total No. firms	1,572								
Outcome variables:									
Mean export value	37.73	40.49	43.71	46.43	48.02	49.37	41.03	42.09	46.14
Mean transactions	134.38	129.11	125.10	129.08	131.04	133.46	125.52	129.42	130.01
Mean destinations	26.60	26.66	26.10	26.50	26.54	26.22	26.58	26.46	26.47
Mean products	28.36	26.29	24.89	25.80	25.81	26.70	26.28	26.33	26.26
S.d. of export value	130.54	146.71	155.00	163.51	180.96	193.70	171.72	148.94	182.13
S.d. of transactions	341.94	333.12	319.55	327.53	327.04	330.00	288.47	330.53	315.17
S.d. of destinations	27.83	27.71	27.16	27.23	27.23	27.12	27.26	27.48	27.20
S.d. of products	72.43	67.17	62.09	63.49	61.50	63.22	59.39	66.30	61.37

Note : Data collected from China's custom database, Subsidized firm database and Qichacha online database over the period of 2010-2016. The number of export values in the current year is reported in millions of US dollars. The key outcome variables are export value in the current year, number of transactions, number of products and number of destinations. The unit of export value is million USD.

Table 5: PSM-Fuzzy RDD Estimates the baseline results of the ECI subsidies on firm export performance

	(1) Type 1	(2) Type 2 lower bound	(3) Type 2 higher bound
Panel A: Dependent variable = The log value of Export value in the current year			
Receiving Subsidies $\beta_{1,t}$	1.137*	0.332*	-0.321
	(2.16)	(2.08)	(-0.75)
Distance to cutoff (log value)		0.0655***	-0.0666***
		(8.54)	(-4.19)
R-sq	0.682	0.640	0.637
Panel B: Dependent variable = Number of transactions			
Receiving Subsidies $\beta_{1,t}$	0.576*	0.252	-0.251
	(2.34)	(1.81)	(-0.67)
Distance to cutoff (log value)		0.0354***	-0.0453***
		(5.53)	(-4.04)
R-sq	0.686	0.817	0.825
Panel C: Dependent variable = Number of destinations			
Receiving Subsidies $\beta_{1,t}$	0.502*	0.258*	-0.510*
	(2.39)	(2.52)	(-2.09)
Distance to cutoff (log value)		0.0271***	-0.0283***
		(6.95)	(-4.12)
R-sq	0.550	0.607	0.609
Panel D: Dependent variable = Number of products			
Receiving Subsidies $\beta_{1,t}$	0.294	0.0350	-0.219
	(1.32)	(0.24)	(-0.66)
Distance to cutoff (log value)		0.0246**	-0.0341**
		(3.23)	(-2.81)
R-sq	0.473	0.664	0.670
Year x Industry FEs	Yes	Yes	Yes
Firm FEs	Yes	Yes	Yes
Covariate control	Yes	Yes	Yes
Observation (n)	2855	4512	3752
Kernel (k)	Uniform	Uniform	Uniform
MSE type (MSE)	Common	Common	Common
Bandwidth (h)	All	All	All
Order (p)	1	1	1

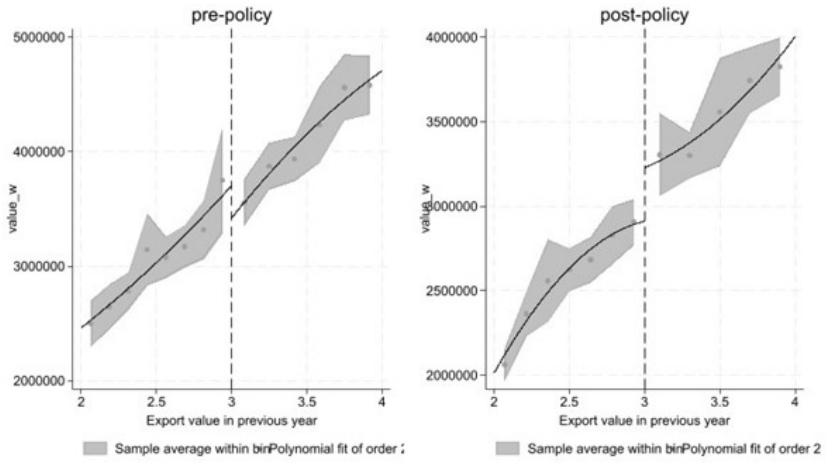
Note: Data are collected from the China custom database, the ECI subsidy database and the qichacha database. Those firms with export value in the previous year no more than 3 million dollars are eligible to apply for type 1 of the ECI subsidies. Those firms with export value in the previous year between 10 million dollars and 50 million dollars are eligible to apply for type two of the ECI subsidies. Results were obtained using different specifications of the equation using 2SLS. There are 4 dependent variables: export value in the current year, transactions, products, and destinations. Standard errors are robust and clustered at the firm level. Covariate control includes age. Robust standard errors are in parentheses. $***$, $**$, $*$ denote statistical significance at the 1%, 5% and 10% levels, respectively.

	(1) Type 1(3)	(2) Type 2 lower bound(5)	(3) Type 2 higher bound(10)
Panel A: DV = log(Export value)			
Receiving Subsidies $\beta_{1,t}$	1.137*	0.332*	-0.321
	(2.16)	(2.08)	(-0.75)
R-sq	0.682	0.640	0.637
Panel B: DV = No.transactions			
Receiving Subsidies $\beta_{1,t}$	0.576*	0.252	-0.251
	(2.34)	(1.81)	(-0.67)
R-sq	0.686	0.817	0.825
Panel C: DV = No.destinations			
Receiving Subsidies $\beta_{1,t}$	0.502*	0.258*	-0.510*
	(2.39)	(2.52)	(-2.09)
R-sq	0.550	0.607	0.609
Panel D: DV = No.products			
Receiving Subsidies $\beta_{1,t}$	0.294	0.0350	-0.219
	(1.32)	(0.24)	(-0.66)
R-sq	0.473	0.664	0.670
Year x Industry, Firm FEs	Yes	Yes	Yes
Observation (n)	2855	4512	3752

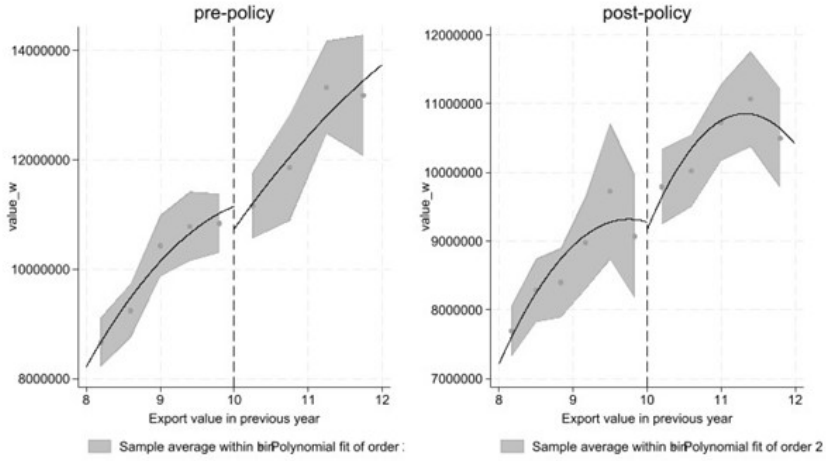
Table 6: Heterogeneity analysis by the use of ECI subsidies across destinations

	Type 1		Type 2 lower bound		Type 2 higher bound	
	(1)	(2)	(3)	(4)	(5)	(6)
	OECD	Non-OECD	OECD	Non-OECD	OECD	Non-OECD
Panel A: Dependent variable = Export value in the current year						
Receiving Subsidies	0.821	0.773	0.429**	0.320*	-0.188	-0.258
	(1.63)	(1.59)	(2.30)	(1.71)	(-0.31)	(-0.43)
R-sq	0.669	0.711	0.673	0.639	0.673	0.640
Panel B: Dependent variable = Number of transactions						
Receiving Subsidies	0.573**	0.485**	3.964***	3.977***	-0.256	-0.178
	(2.28)	(2.00)	(38.66)	(39.24)	(-0.68)	(-0.49)
R-sq	0.651	0.699	0.815	0.817	0.826	0.825
Panel C: Dependent variable = Number of destinations						
Receiving Subsidies	0.513**	0.463**	2.904***	2.888***	-0.475*	-0.490**
	(2.51)	(2.25)	(47.97)	(47.37)	(-1.94)	(-2.01)
R-sq	0.494	0.556	0.599	0.604	0.602	0.607
Panel D: Dependent variable = Number of products						
Receiving Subsidies	0.269	0.274	2.463***	2.497***	-0.223	-0.168
	(1.26)	(1.21)	(19.51)	(20.53)	(-0.66)	(-0.51)
R-sq	0.46	0.488	0.663	0.664	0.670	0.671
FE: Year x Industry, Firm	Y	Y	Y	Y	Y	Y
Covariate control	Y	Y	Y	Y	Y	Y
Bandwidth(h)	All	All	All	All	All	All
Order(p)	1	1	1	1	1	1
Observation (n)	2169	2453	4399	4481	3669	3729

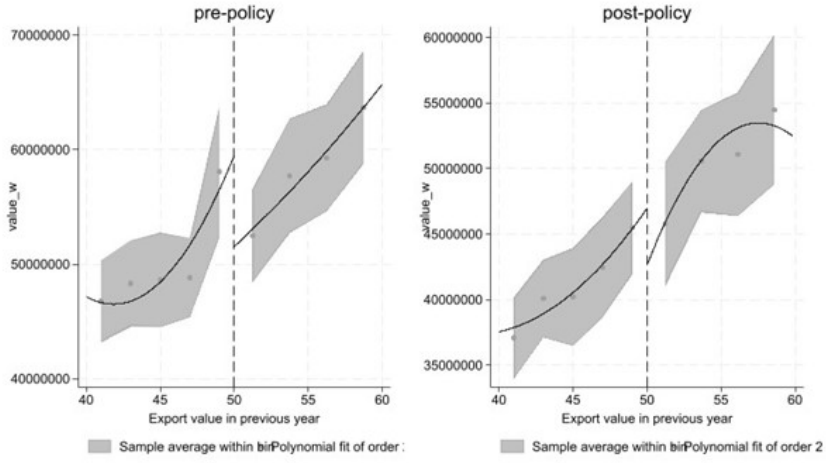
Note: Data are collected from the China custom database, the ECI subsidy database and the qichacha database. Results were obtained using different specifications of the equation using 2SLS. There are 4 dependent variables: export value in the current year, transactions, products, and destinations. Standard errors are robust and clustered at the firm level. Covariates control includes age. OECD means the export firm exports products to destinations of OECD country, and non-OECD means the export firm exports products to destinations of non-OECD country. Robust standard errors are in parentheses. ***, **, * denotes statistical significance at the 1%, 5% and 10% levels, respectively.



(a) SME threshold (3M)



(b) Medium-size lower bound (10M)



(c) Medium-size higher bound (50M)

Figure 8: The discontinuity in the firm's average export value among the three types of subsidies

Notes: Panel A plots the discontinuity in the firm's average export value at the SME threshold of 3 million dollars before and after the policy change. Panel B plots the discontinuity at the special medium-size firm threshold with a lower boundary of 10 million dollars. Panel C plots the discontinuity at the higher boundary of 50 million dollars. The x-axis variable is the firm's export value in the previous year. See Figures A4, A5, A6 in the Appendix for details of treated firms in different dependent variables: the number of export products, destinations and transactions.

Table 7: Heterogeneity analysis by the use of ECI subsidies across products for type 1

	(1) Chemicals and related products	(2) Manufactured goods classified chiefly by material	(3) Machinery and transport equipment	(4) Miscellaneous manufactured articles
Panel A: Dependent variable = Export value in the current year				
Receiving Subsidies	3.017	0.362	1.749***	0.658
	(1.57)	(0.36)	(2.59)	(0.94)
R-sq	0.692	0.688	0.702	0.672
Panel B: Dependent variable = Number of transactions				
Receiving Subsidies	-0.00923	0.0858	1.065***	0.602*
	(-0.02)	(0.26)	(2.94)	(1.70)
R-sq	0.768	0.691	0.726	0.680
Panel C: Dependent variable = Number of destinations				
Receiving Subsidies	-0.247	-0.0837	1.025***	0.747**
	(-0.43)	(-0.28)	(3.30)	(2.51)
R-sq	0.539	0.530	0.572	0.542
Panel D: Dependent variable = Number of products				
Receiving Subsidies	0.530	0.0820	0.724**	-0.0342
	(1.18)	(0.22)	(2.25)	(-0.14)
R-sq	0.560	0.467	0.507	0.482
FE: Year x Industry, Firm	Y	Y	Y	Y
Covariate control	Y	Y	Y	Y
Bandwidth(h)	All	All	All	All
Order(p)	1	1	1	1
Observation (n)	304	1065	1030	1598

Note: Data are collected from the China custom database, the ECI subsidy database and the qichacha database. Results were obtained using different specifications of the equation using 2SLS. There are 4 dependent variables: export value in the current year, transactions, products, and destinations. Standard errors are robust and clustered at the firm level. Covariate control includes age. All the product classifications are as below: Section 0. Food and live animals; Section 1. Beverages and tobacco; Section 2. Crude materials, inedible, except fuels; Section 3. Mineral fuels, lubricants and related materials; Section 4.Animal and vegetable oils, fats and waxes; Section 5. Chemicals and related products, n.e.s.; Section 6. Manufactured goods classified chiefly by material; Section 7.Machinery and transport equipment; Section 8. Miscellaneous manufactured articles; Section 9. Commodities and transactions not classified elsewhere in the SITC. Robust standard errors are in parentheses. ***, **, * denotes statistical significance at the 1%, 5% and 10% levels, respectively.

Table 8: Heterogeneity analysis by the use of ECI subsidies across products for Type 2 lower bound

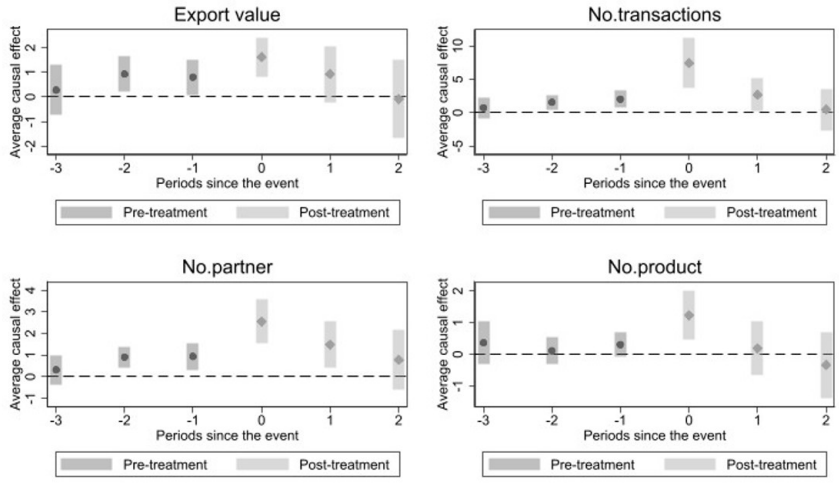
	(1)	(2)	(3)	(4)	(5)	(6)
	Food and live animals	Crude materials, inedible, except fuels	Chemicals and related products	Manufactured goods classified chiefly by material	Machinery and transport equipment	Miscellaneous manufactured articles
Panel A: Dependent variable = Export value in the current year						
Receiving Subsidies	3.378***	0.523	0.0760	0.221	0.735**	0.404*
	(4.90)	(0.33)	(0.15)	(0.86)	(2.52)	(1.86)
R-sq	0.774	0.898	0.718	0.666	0.635	0.683
Panel B: Dependent variable = Number of transactions						
Receiving Subsidies	-1.832***	3.190***	0.0950	0.368**	0.567***	0.322*
	(-3.33)	(5.32)	(0.25)	(2.19)	(3.00)	(1.93)
R-sq	0.860	0.800	0.854	0.823	0.832	0.808
Panel C: Dependent variable = Number of destinations						
Receiving Subsidies	-1.148***	1.816**	-0.0852	0.333***	0.483***	0.364***
	(-3.24)	(2.24)	(-0.47)	(2.59)	(3.19)	(2.87)
R-sq	0.655	0.687	0.640	0.608	0.613	0.598
Panel D: Dependent variable = Number of products						
Receiving Subsidies	2.788***	1.364*	-0.110	0.184	0.298	-0.0504
	(6.96)	(1.92)	(-0.39)	(1.30)	(1.31)	(-0.37)
R-sq	0.482	0.688	0.742	0.660	0.661	0.654
FE: Year x Industry, Firm	Y	Y	Y	Y	Y	Y
Covariate control	Y	Y	Y	Y	Y	Y
Bandwidth(h)	All	All	All	All	All	All
Order(p)	1	1	1	1	1	1
Observation (n)	116	27	839	2468	2329	3060

Note: Data are collected from the China custom database, the ECI subsidy database and the qichacha database. Results were obtained using different specifications of the equation using 2SLS. There are 4 dependent variables: export value in the current year, transactions, products, and destinations. Standard errors are robust and clustered at the firm level. Covariates control includes age. All the product classification are as below: Section 0. Food and live animals; Section 1. Beverages and tobacco; Section 2 Crude materials, inedible, except fuels; Section 3. Mineral fuels, lubricants and related materials; Section 4. Animal and vegetable oils, fats and waxes; Section 5. Chemicals and related products, n.e.s.; Section 6. Manufactured goods classified chiefly by material; Section 7. Machinery and transport equipment; Section 8. Miscellaneous manufactured articles; Section 9. Commodities and transactions not classified elsewhere in the SITC. Robust standard errors are in parentheses. ***, **, * denotes statistical significance at the 1%, 5% and 10% levels, respectively.

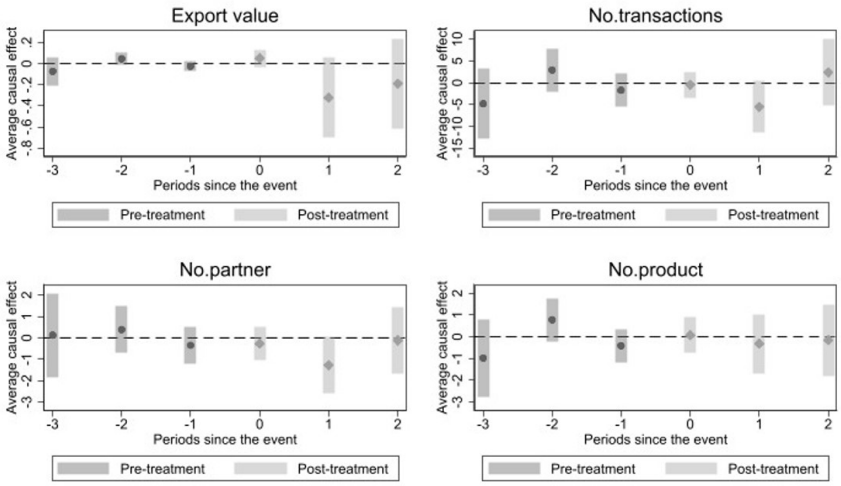
Table 9: Heterogeneity analysis by the use of ECI subsidies across products for Type 2 higher bound

	(1)	(2)	(3)	(4)	(5)	(6)
	Food and live animals	Crude materials, inedible, except fuels	Chemicals and related products	Manufactured goods classified chiefly by material	Machinery and transport equipment	Miscellaneous manufactured articles
Panel A: Dependent variable = Export value in the current year						
Receiving Subsidies	-11.40	-83.18	4.479*	-0.262	0.361	-0.112
	(-0.46)	(-1.41)	(1.82)	(-0.36)	(0.50)	(-0.17)
R-sq	0.674	0.901	0.746	0.666	0.638	0.683
Panel B: Dependent variable = Number of transactions						
Receiving Subsidies	0.0411	78.23***	1.507	0.0249	0.533	0.155
	(0.00)	(4.63)	(1.56)	(0.06)	(.)	(0.43)
R-sq	0.812	0.803	0.842	0.829	0.835	0.818
Panel C: Dependent variable = Number of destinations						
Receiving Subsidies	10.80	-22.17	1.203**	-0.284	0.0820	-0.267
	(0.81)	(-1.19)	(1.97)	(-0.91)	(.)	(.)
R-sq	0.691	0.714	0.633	0.608	0.610	0.603
Panel D: Dependent variable = Number of products						
Receiving Subsidies	-15.00***	91.41***	0.621	0.186	-0.0226	0.0618
	(-2.86)	(10.73)	(0.76)	(0.59)	(.)	(.)
R-sq	0.521	0.796	0.725	0.661	0.660	0.655
FE: Year x Industry, Firm	Y	Y	Y	Y	Y	Y
Covariate control	Y	Y	Y	Y	Y	Y
Bandwidth(h)	All	All	All	All	All	All
Order(p)	1	1	1	1	1	1
Observation (n)	80	15	712	2167	2144	2545

Note: Data are collected from the China custom database, the ECI subsidy database and the qichacha database. Results were obtained using different specifications of the equation using 2SLS. There are 4 dependent variables: export value in the current year, transactions, products, and destinations. Standard errors are robust and clustered at the firm level. Covariates control includes age. All the product classification are as below: Section 0. Food and live animals; Section 1. Beverages and tobacco; Section 2. Crude materials, inedible, except fuels; Section 3. Mineral fuels, lubricants and related materials; Section 4. Animal and vegetable oils, fats and waxes; Section 5. Chemicals and related products, n.e.s.; Section 6. Manufactured goods classified chiefly by material; Section 7. Machinery and transport equipment; Section 8. Miscellaneous manufactured articles; Section 9. Commodities and transactions not classified elsewhere in the SITC. Robust standard errors are in parentheses. ***, **, * denotes statistical significance at the 1%, 5% and 10% levels, respectively.



(a) The parallel trend at the SMEs threshold



(b) The parallel trend at the special medium-size firm threshold

Figure 9: Pre-policy versus post-policy effects on firm export performance by using DiD design

Note: These figures plot the discontinuity in the firm's average export value, and average number of transactions, destinations, and products before and after the policy change. These discontinuities are estimated using a year-specific coefficient on the DiD estimator in equation (3) and Equation (4).

Table A1: Descriptive statistics: regression sample

	Control group					Treatment group					T-test
Variable	N	Mean	SD	Min	Max	N	Mean	SD	Min	Max	
Panel A: Pre-ECI subsidy (2010-2013)											
Export value	112672	8.750	89.33	0	12674	5624	42.39	150.5	0	2769	***
Export value in the previous year	86415	8.010	80.51	0	10790	4413	37.55	139.9	0	2632	***
No. Products	112672	8.690	24.61	1	1604	5624	26.23	66.04	1	674	***
Agricultural products	112672	0.0800	1.230	0	80	5624	0.120	1.10	0	32	**
Machines	112672	2.070	7.710	0	423	5624	8.090	21.11	0	254	***
No. Destinations	112672	8.730	12.17	1	151	5624	26.45	27.45	1	172	***
Emerging Economies	112672	3.340	6.280	0	86	5624	12.55	15.57	0	101	***
Martine Silk Road	112672	1.300	2.140	0	18	5624	3.53	3.82	0	18	***
Belt and Road	112672	4.360	7.830	0	112	5624	15.95	19.40	0	121	***
No. Transactions	112672	28.11	99.62	1	10926	5624	129.2	329.9	1	4176	***
Age	112672	4.970	3.760	0	13	5624	5.31	3.64	0	13	***
Panel B: Post-ECI subsidy (2014-2016)											
Export value	84397	9.510	88.78	0	11727	4562	46.24	182.5	0	3731	***
Export value in the previous year	84397	9.850	100.5	0	12674	4562	48.55	181.5	0	3731	***
No. Products	84397	10.52	39.71	1	2380	4562	26.26	61.41	1	630	***
Agricultural products	84397	0.0800	1.320	0	102	4562	0.12	1.29	0	40	**
Machines	84397	2.790	13.16	0	798	4562	8.64	21.08	0	223	***
No. Destinations	84397	8.870	12.29	1	211	4562	26.44	27.2	1	181	***
Emerging Economies	84397	3.470	6.430	0	115	4562	12.52	15.45	0	103	***
Martine Silk Road	84397	1.480	2.310	0	21	4562	3.76	3.95	0	19	***
Belt and Road	84397	4.560	8.060	0	134	4562	16.04	19.31	0	124	***
No. Transactions	84397	34.38	177.9	1	17011	4562	130.1	316.2	1	4795	***
Age	84397	6.530	4.590	0	16	4562	7.80	4.16	0	16	***
Subsidy	0	0	0	0	0	2947	0.02	0.08	0	2.68	
Type1	84397	0.660	0.470	0	1	4562	0.22	0.41	0	1	***
Type2	84397	0.0900	0.290	0	1	4562	0.14	0.35	0	1	***
Type3	84397	0.940	0.230	0	1	4562	0.97	0.17	0	1	***
Type4	84397	0.420	0.490	0	1	4562	0.62	0.49	0	1	***
Type5	84397	0.720	0.450	0	1	4562	0.92	0.27	0	1	***

Note: Data collected from China custom database, Subsidized firm database and Qichacha online database over the period of 2010-2016. The number of export values in the current year, the number of export values in the previous year and the number of total subsidies reported in millions of US dollars. To test whether the means of the control group and treatment groups are equal, we use T-test to compare the difference between these 2 groups. T-test is calculated by that the means of not subsidies firms' observation minus the means of subsidies firms' observation. The results of the T-test indicate whether the mean of the unsubsidized groups' observations and subsidized groups' observations are statistically different at the following confidence levels. These differences provide a rough comparison between the group of firms without subsidies and the group of firms with subsidies. $*p < 0.10, **p < 0.05, ***p < 0.01$.

Table A2: Definition of main variables included in the analysis

Name	Description
Firm characteristics (reported by China custom database)	
Export value	The total export value generated by the firm in the current year
The export value in last year	The total export value generated by the firm in the last year
Products	Total types of export products in the current year
Agricultural products	Total types of agricultural products in the current year
Machines	Total types of machines in the current year
Destinations	Total number of destinations in the current year
Emerging Economies	The number of destinations related to Emerging Economies
Martine Silk Road	The number of destinations related to the Martine Silk Road
Belt and Road	The number of destinations related to Belt and Road
Transactions	The number of transactions
Age	The export age of firms since 2000
Industry	The register industry of firms
Postcode	The register location of firms
Employee	The number of employees
Establishment date	The establishment date of firms
Nominal capital	The nominal capital of firms, unit is 10 thousand of RMB
Real capital	The real capital of firms, unit is 10 thousand of RMB
Application characteristics (reported by subsidies firm database)	
Subsidies	The number of subsidies in the current year ($)
Type1	The number of eligible firms for the type 1 standard? 0=No, 1= Yes
Type2	The number of eligible firms for the type 2 standard? 0=No, 1= Yes
Type3	The types of eligible firms for the type 3 standard? 0=Rural area, 1=Pearl river area
Type4	The number of eligible firms for the type 4 standard? 0=No, 1= Yes
Type5	The number of eligible firms for the type 5 standard? 0=No, 1= Yes

Table A3: Receiving ECI subsidies by type

	Treatment group					Control group				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	T1	T2	T3	T4	T5	T1	T2	T3	T4	T5
Total number of firms	514	726	326	285	320	31059	4916	1117	912	1036
Total amount of export value (million USD)	5,120	34,600	163,000	153,000	159,000	191,000	269,000	417,000	352,000	374,000
Total amount of subsidy (million USD)	4.01	13.60	35.40	32.00	34.20	0.00	0.00	0.00	0.00	0.00
Average number of destinations	9.64	28.43	57.05	61.23	58.98	6.79	20.45	28.86	31.05	32.33
Average number of products	6.90	19.24	87.23	98.70	89.71	7.98	21.70	52.85	63.31	57.98
Average number of transactions	23.96	95.98	458.33	512.41	472.61	22.23	89.07	226.09	261.60	251.55

Note: Data collected from the China custom database, Subsidised firm database over the period of 2014-2016. There are five subsidised standards in our ECI subsidies program and eligible firms could apply for their subsidies with more than 1 subsidy standard. T1 means the type of small business. T2 means the type of special medium-sized firm that exports products to specific destinations. T3 means the type of Pearl River area. T4 means the type of special products, agricultural products or machines. T5 means the type of special destinations. 1 means yes and 0 means no.

Table A4: The distribution of subsidy standards

	(1) Type 1 subsidy	(2) Type 2 subsidy	(3) Type 3 subsidy	(4) Type 4 subsidy	(5) Type 5 subsidy
Treatment group	The export value in the previous year is [0, 3 million USD], with ECI subsidies	The export value in the previous year is [10 million USD, 50 million USD], with ECI subsidies	The export value in the previous year is more than 50 million USD, with ECI subsidies, register city is on Pearl River area	The export value in the previous year is more than 50 million USD, with ECI subsidies, the eligible products is ¿0	The export value in the previous year is more than 50 million USD, with ECI subsidies, the eligible destinations is ¿0
Control group	Export value in the previous year is [0, 7.5 million USD], without ECI subsidies	The export value in the previous year is [7.5 million USD, 50 million USD], without ECI subsidies	The export value in the previous year is more than 50 million USD, without ECI subsidies	The export value in the previous year is more than 50 million USD, without ECI subsidies	The export value in the previous year is more than 50 million USD, without ECI subsidies
Cutoff	3 million USD	10 million USD	50 million USD	50 million USD	50 million USD
Method1	Sharp RDD	Sharp RDD	Sharp RDD	Sharp RDD	Sharp RDD
Running variable or Score	The distance between the cutoff and export value in the previous year	The distance between the cutoff and export value in the previous year	The distance between the cutoff and export value in the previous year	The distance between the cutoff and export value in the previous year	The distance between the cutoff and export value in the previous year
Method2	Fuzzy RDD	Fuzzy RDD	Fuzzy RDD	Fuzzy RDD	Fuzzy RDD
Treatment variable	Treat	Treat	Treat	Treat	Treat
Assignment variable	Eligible t1	Eligible t2	Eligible t3	Eligible t4	Eligible t5
Running variable or Score	The distance between the cutoff and export value in the previous year	The distance between the cutoff and export value in the previous year	The distance between the cutoff and export value in the previous year	The distance between the cutoff and export value in the previous year	The distance between the cutoff and export value in the previous year

Table A5: RD Estimates of the effect of ECI subsidies on firm export performance with different bandwidths for type 1

	(1) 1 million	(2) 2 million	(3) 3 million	(4) 4 million	(5) 5 million	(6) 6 million
Panel A: Dependent variable = Export value in the current year						
Receiving Subsidies	-0.395	-1.183***	-0.790*	1.367**	1.200**	1.146**
	(-0.79)	(-2.66)	(-1.82)	(2.48)	(2.24)	(2.14)
R-sq	0.507	0.516	0.728	0.677	0.678	0.680
Panel B: Dependent variable = Number of transactions						
Receiving Subsidies	0.171	-0.209	-0.144	0.711***	0.638**	0.633**
	(0.85)	(-1.00)	(-0.54)	(2.64)	(2.56)	(2.55)
R-sq	0.690	0.682	0.700	0.687	0.686	0.686
Panel C: Dependent variable = Number of destinations						
Receiving Subsidies	0.116	-0.0775	0.0130	0.635**	0.552**	0.550**
	(0.55)	(-0.38)	(0.06)	(2.87)	(2.61)	(2.61)
R-sq	0.580	0.559	0.560	0.551	0.550	0.550
Panel D: Dependent variable = Number of products						
Receiving Subsidies	0.0853	-0.275	-0.318	0.384	0.320	0.334
	(0.41)	(-1.19)	(-1.43)	(1.63)	(1.41)	(1.48)
R-sq	0.548	0.498	0.477	0.470	0.472	0.472
FEs: Year x Industry, Firm	Y	Y	Y	Y	Y	Y
Covariate control	Y	Y	Y	Y	Y	Y
Bandwidth(h)	1,000,000	2,000,000	3,000,000	4,000,000	5,000,000	6,000,000
Order(p)	1	1	1	1	1	1
Observation (n)	522	1273	2468	2813	2830	2844

Note: Data are collected from the China custom database, the ECI subsidy database and the Qichacha database. Those firms with export value in the previous year no more than 3 million dollars are eligible to apply for type 1 of the ECI subsidies. Results were obtained using different specifications of the equation using 2SLS. There are 4 dependent variables: export value in the current year, transactions, products, and destinations. Standard errors are robust and clustered at the firm level. Covariate control includes age. Robust standard errors are in parentheses. $***, **, *$ denotes statistical significance at the 0.1%, 1%, 5% levels, respectively.

Table A6: RD Estimates of the effect of ECI subsidies on firm export performance with different bandwidths of Type 2 lower bound

	(1) 2 million	(2) 3 million	(3) 4 million	(4) 5 million	(5) 6 million	(6) 7 million
Panel A: Dependent variable = Export value in the current year						
Receiving Subsidies	0.185	0.399	0.447*	0.459*	0.327	0.402*
	(0.66)	(1.82)	(2.26)	(2.37)	(1.74)	(2.09)
R-sq	0.571	0.545	0.544	0.515	0.507	0.505
Panel B: Dependent variable = Number of transactions						
Receiving Subsidies	0.369	0.456**	0.329*	0.400**	0.351*	0.328*
	(1.87)	(2.92)	(2.32)	(3.12)	(2.58)	(2.42)
R-sq	0.832	0.802	0.790	0.782	0.779	0.773
Panel C: Dependent variable = Number of destinations						
Receiving Subsidies	0.152	0.240	0.254*	0.309**	0.288**	0.297**
	(0.95)	(1.91)	(2.40)	(3.12)	(2.96)	(2.87)
R-sq	0.606	0.593	0.595	0.587	0.587	0.584
Panel D: Dependent variable = Number of products						
Receiving Subsidies	-0.00752	-0.112	-0.00515	0.162	0.134	0.0592
	(-0.04)	(-0.65)	(-0.02)	(0.83)	(0.74)	(0.34)
R-sq	0.689	0.664	0.651	0.648	0.646	0.640
FEs: Year x Industry, Firm	Y	Y	Y	Y	Y	Y
Covariate control	Y	Y	Y	Y	Y	Y
Bandwidth(h)	2,000,000	3,000,000	4,000,000	5,000,000	6,000,000	7,000,000
Order(p)	1	1	1	1	1	1
Observation (n)	497	912	1306	1655	1979	2252

Note: Data are collected from the China custom database, the ECI subsidy database and the qichacha database. Those firms with export value in the previous year larger than 10 million dollars and the exporting partners are in the targeted list are eligible to apply for Type 2 lower bound. Results were obtained using different specifications of the equation using 2SLS. There are 4 dependent variables: export value in the current year, transactions, products, and destinations. Standard errors are robust and clustered at the firm level. Covariates control includes age. Robust standard errors are in parentheses. $***, **, *$ denotes statistical significance at the 0.1%, 1%, 5% levels, respectively.

Table A7: RD Estimates of the effect of ECI subsidies on firm export performance with different bandwidths of Type 2 higher bound

	(1) 20 million	(2) 30 million	(3) 40 million	(4) 50 million	(5) 60 million	(6) 70 million
Panel A: Dependent variable = Export value in the current year						
Receiving Subsidies	1.064	0.168	-0.235	-0.196	-0.327	-0.337
	(1.34)	(0.29)	(-0.38)	(-0.32)	(-0.54)	(-0.55)
R-sq	0.588	0.589	0.635	0.636	0.636	0.635
Panel B: Dependent variable = Number of transactions						
Receiving Subsidies	0.700	0.346	-0.191	-0.221	-0.178	-0.179
	(1.86)	(1.04)	(-0.49)	(-0.58)	(-0.47)	(-0.47)
R-sq	0.858	0.845	0.825	0.825	0.825	0.825
Panel C: Dependent variable = Number of destinations						
Receiving Subsidies	0.00692	-0.240	-0.545*	-0.535*	-0.513*	-0.513*
	(0.02)	(-1.04)	(-2.14)	(-2.13)	(-2.08)	(-2.09)
R-sq	0.659	0.637	0.609	0.609	0.609	0.609
Panel D: Dependent variable = Number of products						
Receiving Subsidies	0.655	0.259	-0.0485	-0.135	-0.0920	-0.0916
	(1.36)	(0.73)	(-0.14)	(-0.41)	(-0.28)	(-0.27)
R-sq	0.688	0.673	0.669	0.670	0.670	0.670
Year x Industry FE, Firm YE	Y	Y	Y	Y	Y	Y
Covariate control	Y	Y	Y	Y	Y	Y
Bandwidth(h)	20,000,000	30,000,000	40,000,000	50,000,000	60,000,000	70,000,000
Order(p)	1	1	1	1	1	1
Observation (n)	647	1558	3736	3741	3745	3746

Note: Data are collected from the China custom database, the ECI subsidy database and the qichacha database. Those firms with export value in the previous year larger than 10 million dollars and the exporting partners are in the targeted list are eligible to apply for Type 2 lower bound. Results were obtained using different specifications of the equation using 2SLS. There are 4 dependent variables: export value in the current year, transactions, products, and destinations. Standard errors are robust and clustered at the firm level. Covariate control includes age. Robust standard errors are in parentheses. $***, **, *$ denotes statistical significance at the 0.1%, 1%, 5% levels, respectively.

Table A8: PSM-DiD Estimates the baseline results of the ECI subsidies on firm export performance for type 1

	(1)	(2)	(3)	(4)
Dependent variable	ln(export value)	Number of transactions	Number of destinations	Number of products
Pre avg	0.669**	1.442***	0.717***	0.265*
	(3.04)	(3.71)	(4.19)	(2.11)
Post avg	0.823	3.535**	1.608***	0.363
	(1.65)	(3.05)	(3.56)	(1.02)
Tm3	0.270	0.739	0.318	0.368
	(0.52)	(0.94)	(0.93)	(1.05)
Tm2	0.930*	1.558**	0.902***	0.117
	(2.49)	(2.92)	(3.55)	(0.56)
Tm1	0.806*	2.029**	0.933**	0.311
	(2.20)	(3.00)	(2.85)	(1.54)
Tp0	1.616***	7.426***	2.552***	1.237**
	(4.04)	(3.86)	(4.92)	(3.08)
Tp1	0.933	2.690*	1.488**	0.191
	(1.61)	(2.11)	(2.74)	(0.44)
Tp2	-0.0798	0.488	0.786	-0.340
	(-0.10)	(0.30)	(1.12)	(-0.63)

Note: Data are collected from the China custom database, the ECI subsidy database and the qichacha database. There are 4 dependent variables: export value in the current year, transactions, products, and destinations. Standard errors are robust and clustered at the firm level. Covariate control includes age. Robust standard errors are in parentheses. $***, **, *$ denotes statistical significance at the 0.1%, 1%, 5% levels, respectively.

Table A9: PSM-DiD Estimates the baseline results of the ECI subsidies on firm export performance for Type 2 lower bound

	(1)	(2)	(3)	(4)
Dependent variable	ln(export value)	Number of transactions	Number of destinations	Number of products
Pre avg	-0.0270	-2.662	-0.484	-0.123
	(-0.99)	(-1.43)	(-1.23)	(-0.32)
Post avg	-0.201*	0.0315	-0.458	0.345
	(-2.04)	(0.01)	(-0.97)	(0.71)
Tm3	-0.0881	-7.112	-0.600	-1.006
	(-1.23)	(-1.65)	(-0.59)	(-1.05)
Tm2	0.0215	0.535	-0.385	0.666
	(0.69)	(0.21)	(-0.74)	(1.26)
Tm1	-0.0142	-1.409	-0.466	-0.0287
	(-0.56)	(-0.72)	(-1.07)	(-0.07)
Tp0	0.0198	-0.474	-0.473	0.00146
	(0.51)	(-0.32)	(-1.18)	(0.00)
Tp1	-0.358	-4.164	-0.992	0.279
	(-1.93)	(-1.45)	(-1.51)	(0.43)
Tp2	-0.264	4.733	0.0900	0.754
	(-1.28)	(1.29)	(0.12)	(0.98)

Note: Data are collected from the China custom database, the ECI subsidy database and the qichacha database. There are 4 dependent variables: export value in the current year, transactions, products, and destinations. Standard errors are robust and clustered at the firm level. Covariate control includes age. Robust standard errors are in parentheses. $***, **, *$ denotes statistical significance at the 0.1%, 1%, 5% levels, respectively.

Table A10: PSM-DiD Estimates the baseline results of the ECI subsidies on firm export performance for Type 2 higher bound

	(1)	(2)	(3)	(4)
Dependent variable	ln(export value)	Number of transactions	Number of destinations	Number of products
Pre avg	-0.0161	-1.216	0.0563	-0.207
	(-0.59)	(-0.68)	(0.14)	(-0.56)
Post avg	-0.154	-1.205	-0.549	-0.133
	(-1.48)	(-0.54)	(-1.16)	(-0.25)
Tm3	-0.0727	-4.831	0.127	-0.981
	(-1.03)	(-1.16)	(0.13)	(-1.08)
Tm2	0.0481	2.912	0.388	0.779
	(1.51)	(1.14)	(0.70)	(1.55)
Tm1	-0.0238	-1.728	-0.347	-0.418
	(-0.95)	(-0.89)	(-0.81)	(-1.08)
Tp0	0.0519	-0.471	-0.262	0.0692
	(1.26)	(-0.31)	(-0.66)	(0.16)
Tp1	-0.323	-5.552	-1.270	-0.310
	(-1.67)	(-1.85)	(-1.88)	(-0.45)
Tp2	-0.190	2.407	-0.117	-0.158
	(-0.88)	(0.62)	(-0.15)	(-0.19)

Note: Data are collected from the China custom database, the ECI subsidy database and the qichacha database. There are 4 dependent variables: export value in the current year, transactions, products, and destinations. Standard errors are robust and clustered at the firm level. Covariate control includes age. Robust standard errors are in parentheses. $***, **, *$ denotes statistical significance at the 0.1%, 1%, 5% levels, respectively.

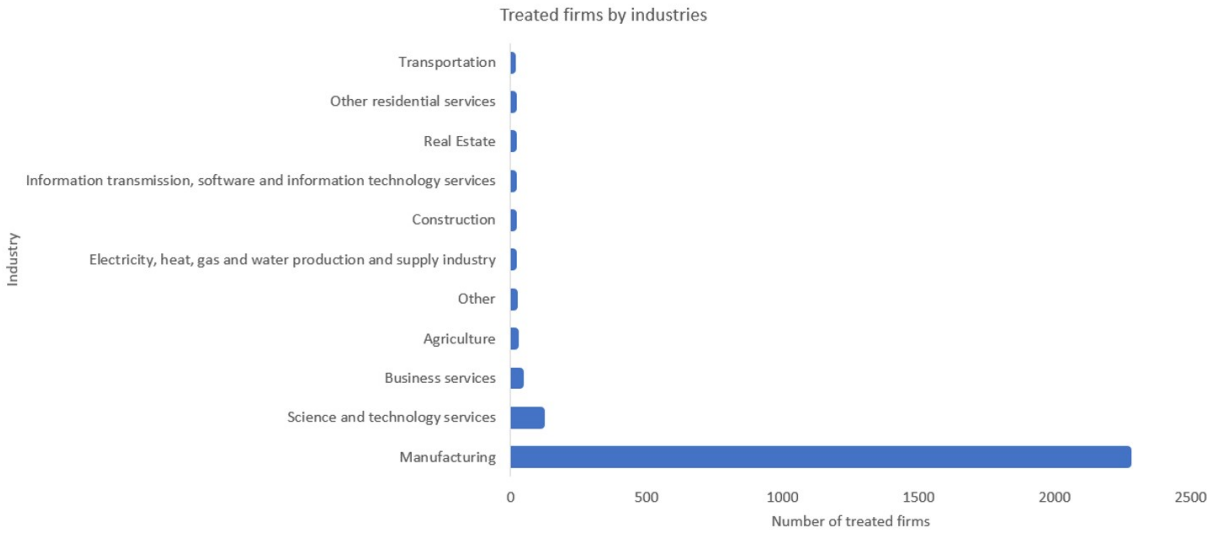


Figure A1: Treated firms by industries

Notes: Data collected from Subsidised firm database over the period of 2014-2016.



Figure A2: The change in dependent variables by year

Note: Data collected from the China customs database, Subsidised firm database for 2014-2016. The blue line represents the full sample, and the orange line represents the restricted sample that excludes all the treated firms.

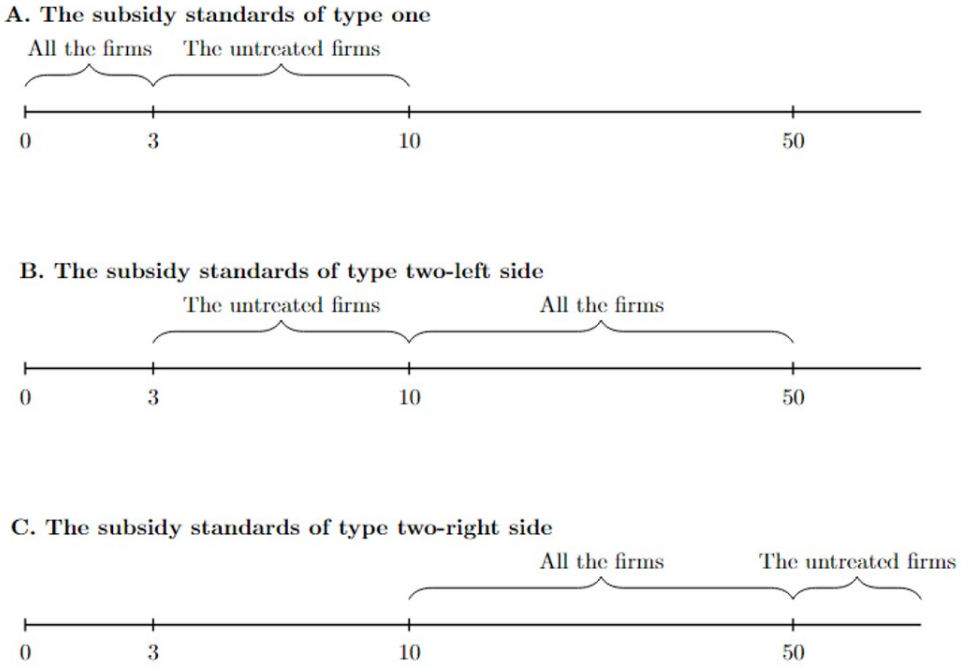
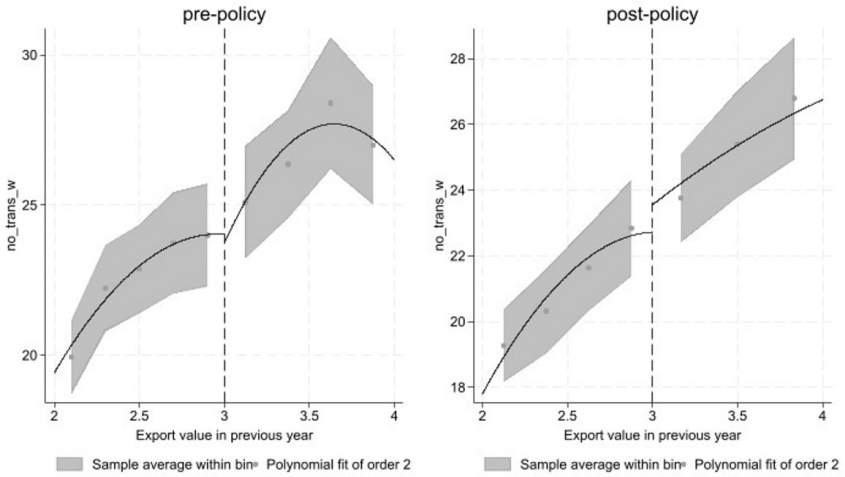
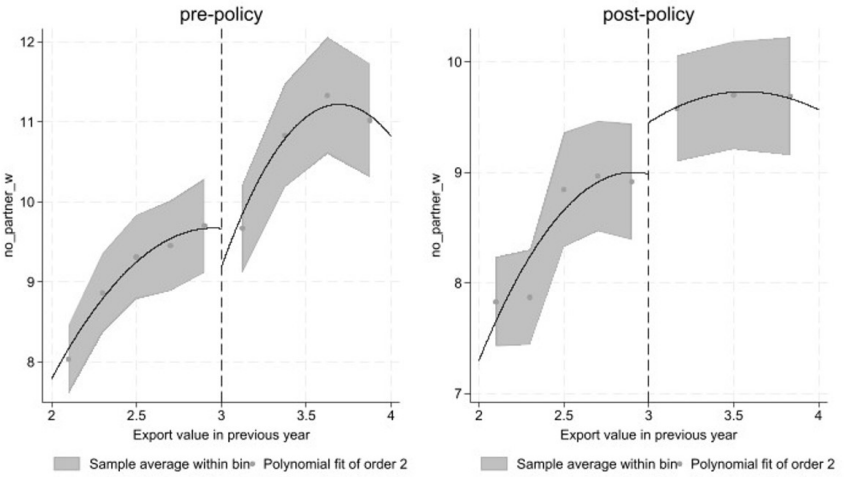


Figure A3: The description of sample size

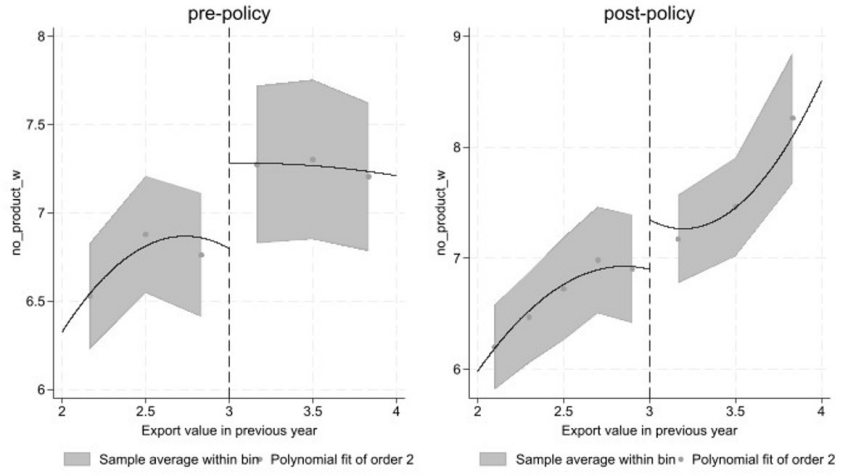
Note: Data collected from China's custom database, Subsidized firm database and Qichacha online database over the period 2010-2016. Unit is million USD.



(a) The number of transactions



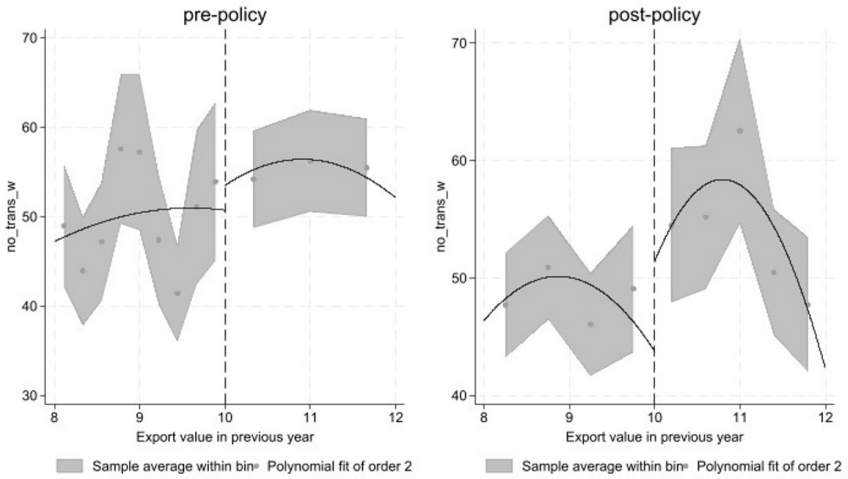
(b) The number of destinations



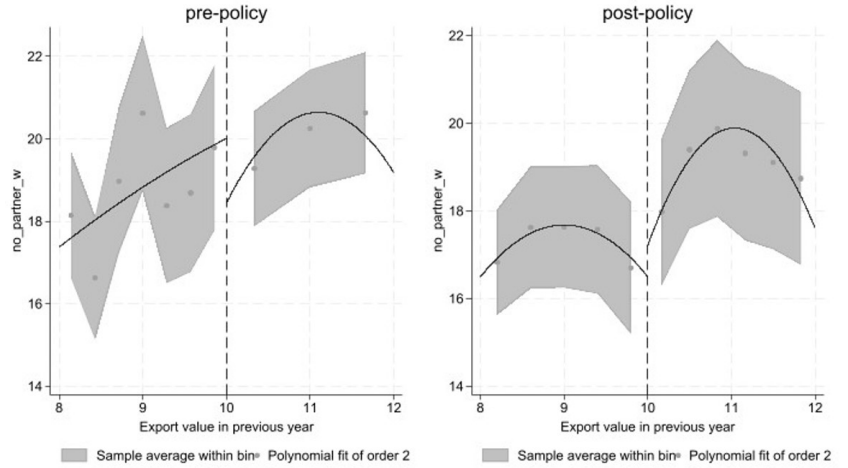
(c) The number of products

Figure A4: Discontinuity in firm export performance at SME threshold

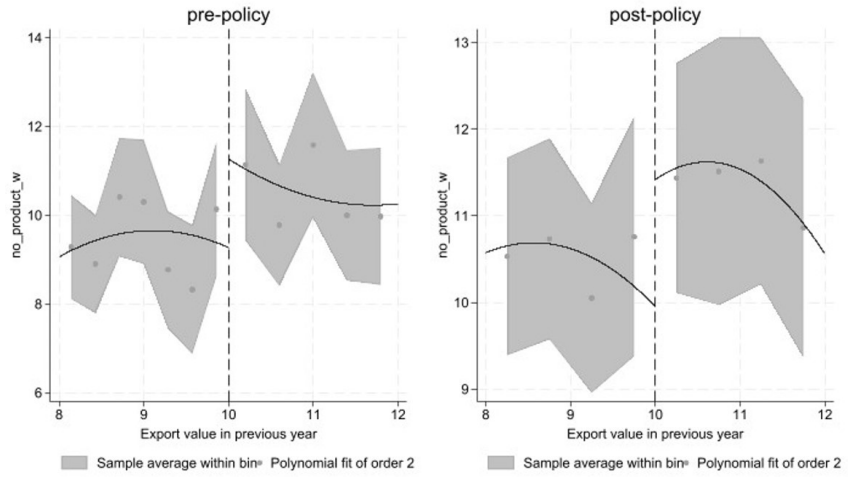
Note: This figure plots the discontinuity in the firm's average number of transactions, destinations, and products at the SME threshold of 3 million dollars before and after the policy change. The x-axis variable is the firm's export value in the previous year.



(a) The number of transactions



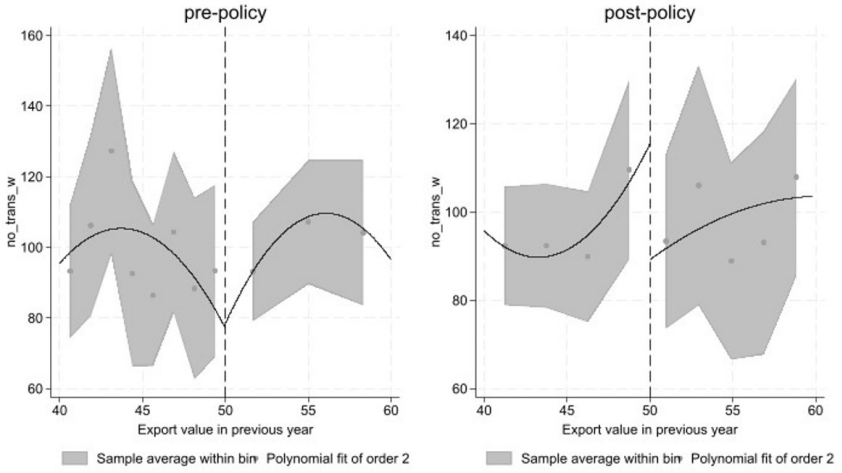
(b) The number of destinations



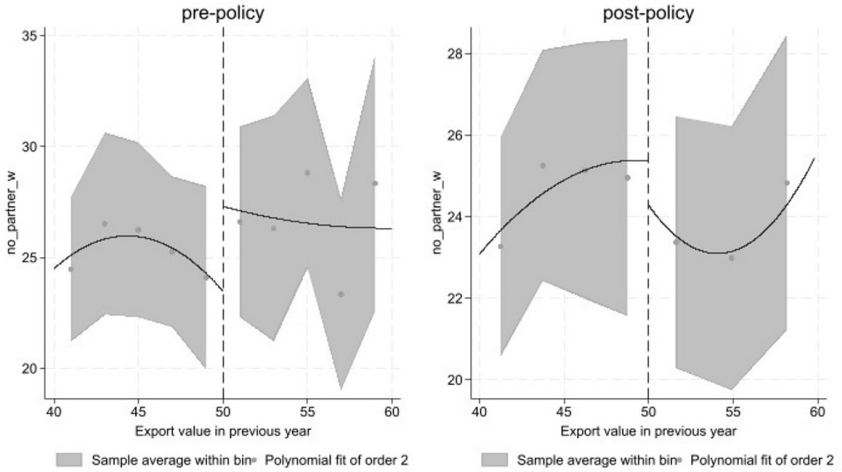
(c) The number of products

Figure A5: Discontinuity in firm export performance at the special medium-size firm threshold with lower boundary

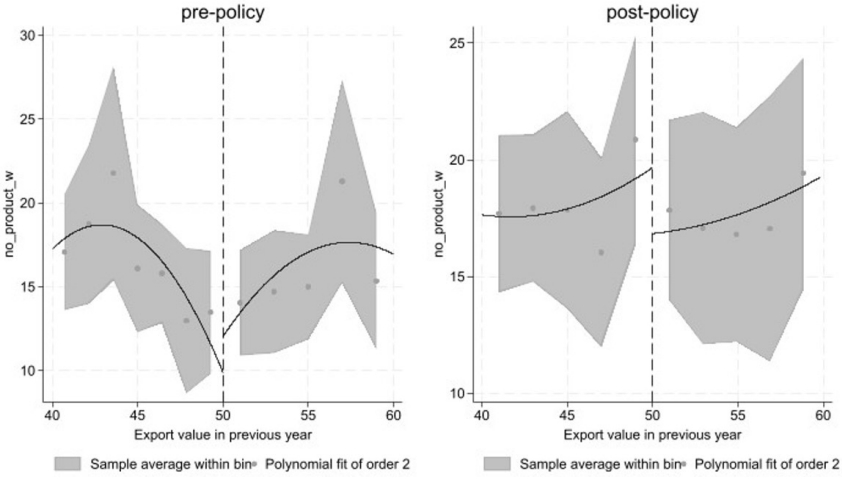
Note: This figure plots the discontinuity in the firm's average export value, average number of transactions, destinations, and products at the special medium-size firm threshold with a lower boundary of 10 million dollars before and after the policy change. The x-axis variable is the firm's export value in the previous year.



(a) The number of transactions



(b) The number of destinations



(c) The number of products

Figure A6: Discontinuity in firm export performance at the special medium-size firm threshold with higher boundary

Note: This figure plots the discontinuity in the firm's average export value, average number of transactions, destinations, and products at the special medium-size firm threshold with a higher boundary of 50 million dollars before and after the policy change. The x-axis variable is the firm's export value in the previous year.

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