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**Protectionism through Exporting: Subsidies with Export
Share Requirements in China**

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Abstract

We study the effect of subsidies subject to export share requirements (ESR) - that is, conditioned on a firm exporting at least a given fraction of its output - on exports, the intensity of competition and welfare, through the lens of a two-country model of trade with heterogeneous firms. Our calibrated model suggests that this type of subsidy boosts exports more and provides greater protection for domestic firms than a standard unconditional export subsidy, albeit at a substantial welfare cost.

Keywords: export share requirements, export subsidies, trade policy, heterogeneous firms, China
JEL Classifications: F12; F13; O47

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1 Introduction

China's ascent to become the world's largest exporter has been nothing short of spectacular, and has naturally attracted considerable attention among economists and policymakers alike.¹ Although China's strong reliance on subsidies to promote exports is well established, the fact that a large number of these incentives are subject to export share requirements (ESR) — i.e. that they are only available to firms that export more than a certain share of their output — has so far been overlooked.² Thus, our objective in this paper is to shed light on the effects of using subsidies with ESR on a country's exports, intensity of competition and welfare from a quantitative standpoint.

Understanding the implications of using this class of subsidies is of paramount importance for two key reasons: first, trade policy instruments featuring ESR such as export processing zones and duty drawback schemes are widely popular not only in China, but also across a large number of developing countries.³ Second, we show that utilizing subsidies with ESR engenders large distortions. These subsidies boost a country's exports at the expense of sizable welfare losses. However, unlike unconditional export subsidies, they decrease the level of competition, thereby increasing protection for domestic firms there.

Subsidies with ESR encompass a wide range of fiscal instruments, including direct monetary transfers, tax holidays and concessions, the provision of utilities at below-market rates, among others. For instance, the 2004 Transitional Review Mechanism conducted by the World Trade Organization (WTO) on subsidy practices in China noted that firms operating in several special economic zones and exporting at least 50% of their production enjoyed tax deductions, access to soft loans and priority access to infrastructure and land. The same document also stated that firms exporting more than 70% of their output benefitted from local income tax exemptions and a reduction in their corporate income tax rate.⁴ Another example pertains to the restriction faced by

¹See e.g. [Naughton \(2007\)](#), [Branstetter and Lardy \(2008\)](#), [Feenstra and Wei \(2010\)](#), [Rodrik \(2010\)](#), [Song et al. \(2011\)](#), [Hanson \(2012\)](#), [World Bank \(2013\)](#), among many others.

²[Naughton \(1996\)](#) and [Feenstra \(1998\)](#) are exceptions; they however, only offer anecdotal evidence documenting the use of these subsidies in China.

³Table 2 lists twelve large countries (i.e. with population above 30 million) that offer subsidies with ESR according to the U.S. State Department's Investment Climate Statements. Additionally, 19 small developing countries were required to eliminate incentive programmes subject to ESR by December 2015 in order to comply with disciplines in the Agreement on Subsidies and Countervailing Measures of the WTO ([Creskoff and Walkenhorst, 2009](#); [Waters, 2013](#); [World Bank, 2014](#)).

⁴Questions by the European Communities with regard to China's Transitional Review Mechanism on Subsidies and Countervailing Measures, September 30, 2003 (references G/SCM/Q2/CHN/5 and G/SCM/Q2/CHN/7).

foreign firms until 2002, which forbade them to produce a wide range of consumer goods (e.g. digital watches, bikes, washing machines and refrigerators) unless their exports accounted for more than 70% of their production. Similar restrictions have only been lifted in 2013 for the domestic sale of video game consoles such as Nintendo’s Wii and Sony’s Playstation, which have been manufactured in China for more than a decade.⁵

The large number of exporters in China that are eligible to benefit from subsidies with ESR based on their export intensity is staggering. Figure 1 presents the distribution of export intensity — the share of total sales accounted for by exports — for Chinese manufacturing exporters between 2000 and 2006. Half of all exporting firms in China export more than 70% of their output, and half of these in turn, are ‘pure exporters’, i.e. firms selling all their output abroad.⁶ In contrast, [Bernard et al. \(2003\)](#) and [Eaton et al. \(2011\)](#) report a negligible share of high-intensity exporters in the U.S. and France respectively.⁷ It is important to note that none of the workhorse models of trade with heterogenous firms such as [Melitz \(2003\)](#), [Melitz and Ottaviano \(2008\)](#) or [Arkolakis \(2010\)](#) can easily reproduce the heavy right tail of the export intensity distribution displayed in Figure 1. Figure 1 suggests that the availability of subsidies with ESR in China could affect substantially the distribution of export intensity.

We investigate the consequences of subsidies with ESR in the context of a two-country model of trade in which firms are heterogeneous in their productivity as in [Melitz \(2003\)](#), but also in terms of firm-destination-specific demand shifters as in [Eaton et al. \(2011\)](#).⁸ Thus, in the absence of subsidies, each exporter in our model has a unique optimal export intensity — what we call ‘natural’ export intensity — which is determined both by aggregate and idiosyncratic demand shifters and transport costs. In contrast, in the workhorse [Melitz \(2003\)](#) model, all exporters would have the same export intensity. Heterogeneity in firms’ demand across different markets is crucial for our purposes because it accommodates a wide range of reasons why a firm would choose to export the majority of its output in the absence of subsidies with ESR — e.g. producing a sophisticated good that is not demanded locally, belonging to a global value chain, or having a well-developed

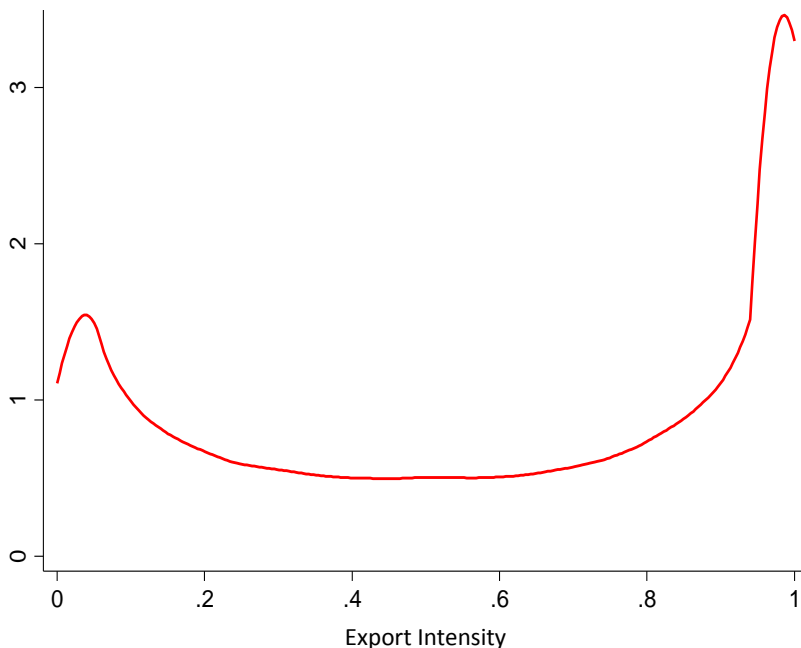
⁵See: <http://www.reuters.com/article/2014/01/07/us-china-gamesconsoles-idUSBREA0606C20140107>.

⁶The pervasiveness and distinct features of high-intensity exporters in China has also been studied by [Lu \(2010\)](#), [Dai et al. \(2011\)](#) and [Lu et al. \(2014\)](#).

⁷More precisely, only 0.7% of U.S. exporters display an export intensity greater than 90%. Using data from the *Enquete Annuelle Entreprises*, SESSI, for the year 2000, we find that the corresponding figure for France is 1.9%.

⁸Other models that feature firm-destination heterogeneity in demand are [Crozet et al. \(2012\)](#) and [Cherkashin et al. \(2015\)](#).

Figure 1: Export Intensity Distribution for Chinese Manufacturing Exporters, 2000-2006



The figure depicts the kernel density of export intensity, defined as the share of exports in total sales, for Chinese manufacturing firms reporting a positive value of exports. Data are for the period 2000-2006 and are described in detail in Appendix A.

network of foreign customers, among many others. The magnitude of the distortions produced by a given subsidy with ESR is fundamentally determined by the share of firms that are induced to change their behavior when the policy is available; and this in turn is intimately connected to a country’s natural distribution of export intensity.

We next allow one country to unilaterally offer subsidies (these can be based on firms’ sales and/or fixed costs) subject to an ESR; that is, these are only available to firms with an export intensity greater than or equal to a threshold $\eta \in (0, 1]$. For firms with a natural export intensity above η , the subsidy with ESR works in the same way as an unconditional subsidy; since these high-intensity exporters already satisfy the requirement, they do not need to alter their behavior to enjoy the incentives. Conversely, firms that do not fulfill the ESR need to weight the financial windfall provided by the subsidies against the profit loss associated with distorting their optimal export intensity. We identify two types of ‘constrained exporters’, i.e. firms that either change the prices they charge or the markets they serve to gain access to subsidies, namely, regular and pure constrained exporters. The former sell both domestically and abroad, and set prices so as to achieve

an export intensity exactly equal to the ESR threshold, while pure constrained exporters choose instead to only export in order to satisfy the export requirement by saving on domestic fixed costs.

Two key results emerge from our model. Firstly, the introduction of a subsidy with a single ESR strictly below 1 generates *both* pure and regular constrained exporters simultaneously — that is, the mass of firms with an export intensity equal to the ESR and 1 both rise vis-à-vis the laissez-faire equilibrium. Given that the available incentives in China feature several different ESR thresholds, ranging from 50 to 100%, our model is consistent with an export intensity distribution that displays a majority of pure exporters. Secondly, we show that although regular and pure constrained exporters follow different pricing strategies in response to subsidies, these ultimately lower the level of competition in the country enacting the policy, increasing the protection of the least profitable firms. More precisely, regular constrained exporters increase domestic prices and lower export prices so that their export intensity exactly reaches the ESR threshold. Constrained pure exporters, on the other hand, do not distort their export price (over and above the direct reduction in the price due to the sales subsidy), but eliminate their variety altogether from the domestic consumption basket. Under monopolistic competition both these responses increase the domestic price index, since this variable is increasing on the average price charged by firms and decreasing in the number of varieties available for consumption. In contrast, an unconditional export subsidy lowers the price index in the country providing subsidies. This happens both because average prices fall — as the least profitable domestic firms exit the market in response to the expansion of local exporters — and because of tougher import competition, which occurs as trade partners increase their exports to achieve balanced trade ([Demidova and Rodríguez-Clare, 2009](#); [Felbermayr et al., 2012](#)).

In order to assess the general equilibrium consequences of utilizing subsidies with ESR in our model, we investigate the effect of one country offering an 8.7% ad-valorem export sales subsidy subject to a 70% ESR. We choose this specific policy experiment because the magnitude of the export subsidy is broadly equivalent to one of the best documented fiscal incentives subject to an ESR in China, the corporate income tax rate discount — from 30 to 10% — offered to foreign-invested enterprises and Chinese-owned firms located in free trade zones with an export intensity of at least 70% in place between 1991 and 2008. Since China imposes ESR on a wide range of policy instruments (which we describe in great detail in [Section 2](#)), and since there is extremely limited

systematic data on the size and scope of subsidies offered to exporters in China (Lardy, 1992; Claro, 2006; Girma et al., 2009; Haley and Haley, 2013), carrying out a comprehensive quantitative evaluation of all subsidies with ESR available in China is beyond the scope of our paper.⁹ We instead shed light on how subsidies with ESR operate, by comparing them with the laissez-faire equilibrium and with an equivalent unconditional subsidy on export sales in terms of the behavior of price indices (a measure of the intensity of competition), the distribution of export intensity, the probability of firms' exit and welfare.

We calibrate our model's parameters to reflect the share of exporters and the distribution of export intensity in a hypothetical developing country that *does not* provide subsidies with ESR, with the view to approximate a counterfactual scenario in which China does not offer this type of subsidies. We construct this undistorted distribution of export intensity by combining information on the use of subsidies with ESR gathered from the U.S. State Department's Investment Climate Statements and cross-country firm-level data on firms' export intensity from the World Bank's Enterprise Surveys over the period 2002-2012. As a robustness check, we also use the export intensity distribution observed in China in 2013, when the corporate income tax deduction subject to ESR had been phased out.

Our quantitative exercise reveals that given our conjectured natural export intensity distribution, introducing a subsidy with ESR with the characteristics defined above (which amounts to a total expenditure in subsidies of 0.19% of GDP in our model) explains 43% of the share of exporters with an export intensity above 70% observed in China between 2000 and 2006, with approximately two thirds of the increase in high-intensity exporters accounted for by pure exporters.

Subsidies with ESR produce a substantially greater boost to aggregate exports in the enacting country than the equivalent unconditional export subsidy (the exports/GDP ratio increases by 6.3% with the former compared to 2.3% with the latter). At the same time, the intensity of competition and the probability of firms' exiting the market are further reduced when subsidies are subject to export requirements. The combination of these effects implies that the use of subsidies with ESR can be characterized as 'protectionism through exporting'. Of course, it follows that such a strategy

⁹For instance, China did not provide the required subsidy rates or annual amount budgeted for export-related subsidies in either of their notifications to the WTO Committee on Subsidies and Countervailing Measures in 2006 and 2011. The notifications were also silent about the extent of subsidies provided at the provincial and local level. See "Request from the United States to China," October 11, 2011, reference G/SCM/Q2/CHN/42.

comes at a hefty cost in terms of efficiency; imposing an ESR constraint can induce firms to distort their prices or the number of markets they operate in. While both types of export subsidy reduce welfare in the enacting country, the subsidy with ESR that we investigate in our policy experiment lowers real income by 0.83% instead of 0.1% when no requirements are imposed.

A strong reliance on encouraging exports while at the same time protecting the domestic market has been a key objective of the Chinese Communist Party along China’s transition towards a market economy (Rodrik, 2014). This dual trade policy regime in which a system of export-oriented enclaves coexists with a highly protected domestic economy has been aptly described by Feenstra (1998) as ‘one country, two systems’. Although the rationale motivating the initial implementation of subsidies with ESR has long subsided, China’s regionally-decentralized governance has enabled their long-lasting permanence. Because of their positive effect on exports and domestic profitability, the use of these subsidies is closely aligned with the objectives of local officials who enjoy a considerable degree of autonomy and for whom career progression is tied to the aforementioned indicators of economic performance (Branstetter and Feenstra, 2002; Xu, 2011). Additionally, because subsidies with ESR hinder the market selection effects of trade liberalization, they can be rationalized as an instrument aimed at achieving a ‘reform without losers’ (Lau et al., 2000).

Related Work. Despite their widespread use, the existing literature on subsidies with ESR is rather sparse, with no quantitative work available. Export share requirements have previously been studied as a second-best policy instrument by Davidson et al. (1985) and Rodrik (1987). We depart from this earlier theoretical literature in two key respects. Firstly, our heterogeneous-firm model allows us to investigate the endogenous choice of firms to operate facing an export requirement, while both Davidson et al. and Rodrik assume that ESR are exogenously imposed on a subset of firms. Secondly, our quantitative model sheds light on the magnitude of the distortions engendered by the imposition of export requirements relative to equivalent unconditional export subsidies.

Our paper adds to several strands of literature. It contributes to the growing body of research that quantifies the welfare and productivity effects of China’s “unorthodox” trade and investment policies (Bajona and Chu, 2010; Khandelwal et al., 2014; Holmes et al., Forthcoming). Our analysis of subsidies with ESR is also related to the literature studying trade policy in models with heteroge-

neous firms (Chor, 2009; Demidova and Rodríguez-Clare, 2009; Davies and Eckel, 2010; Felbermayr et al., 2012; Cherkashin et al., 2015; Costinot et al., 2015), as well as to the body of work investigating the welfare implications of free trade zones and trade-related investment measures (TRIMs) (Hamada, 1974; Miyagiwa, 1986; Chao and Yu, 2014; Yücer and Siroën, forthcoming).

The rest of the paper is organized as follows. Section 2 provides an overview of fiscal incentives featuring export share requirements in China. Section 3 presents our quantitative general equilibrium model, and Section 4 spells out our strategy to calibrate the model’s parameters. Section 5 presents the results of our counterfactual experiments. Section 6 concludes.

2 Subsidies with Export Share Requirements in China

In this section we provide a concise overview of policy measures available in China between 2000 and 2006 featuring incentives available to firms conditional on their export intensity exceeding a stated threshold.

These subsidies were a key innovation introduced in the first wave of opening-up reforms launched in 1979. Their objective was to facilitate China’s interaction with the rest of the world without disrupting its socialist economy.¹⁰ Despite clearly outgrowing their original purpose, subsidies with ESR have remained ubiquitous in China, even after it joined the WTO in 2001. They target three types of firms primarily: Chinese-owned firms located in Free Trade Zones (FTZ), foreign-invested enterprises (FIE) and establishments devoted to export processing activities (PTE). The online Appendix provides a detailed description of the laws and regulations discussed below. It is important to note that Free Trade Zones and duty drawback schemes such as China’s processing trade regime are permitted under WTO agreements. However, if a policy measure is conditioned on export performance (e.g. setting minimum export targets for firms) such as in the examples provided below, it would then violate Article 3 of the Agreement on Subsidies and Countervailing Measures (ASCM) and the Trade-Related Investment Measures (TRIMs) Agreement.¹¹

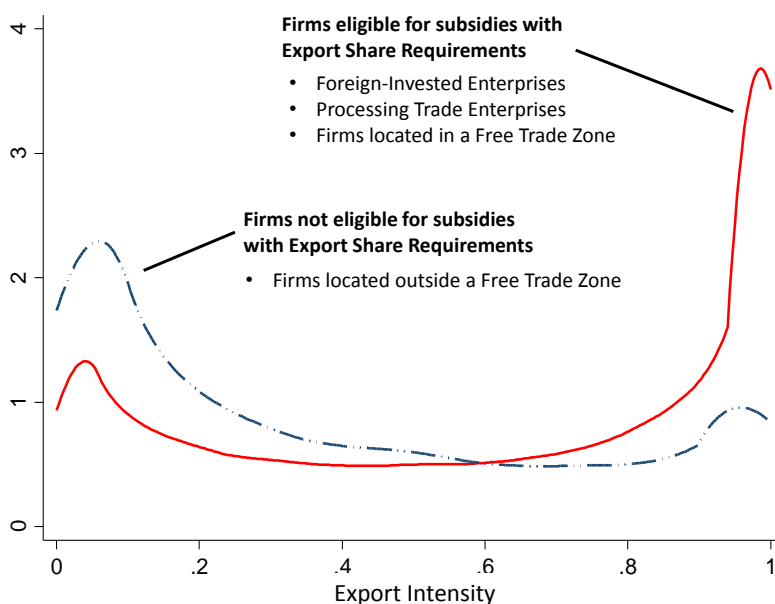
Figure 2 decomposes the export intensity distribution according to whether exporters belong or

¹⁰This policy objective was explicitly mentioned in the ideological justification for the establishment of the first special economic zones in Guangdong and Fujian. Borrowing from ideas first developed by Lenin, it was argued that a communist country could not exist without having ties with the rest of the world. This exchange however, had to operate based on capitalist relations, at least in its early stages (Chan et al., 1986).

¹¹We thank Petros Mavroidis and Luca Rubini for clarifying this point from a legal perspective.

not to one of the three types of firms for which subsidies with ESR are more likely to be available. The contrast between the two groups is again striking. The vast majority of high intensity exporters are eligible — based on their mode of operation — to benefit from these subsidies; low-intensity exporters, on the other hand, are more likely to be Chinese-owned firms operating outside a FTZ and not exporting through the processing regime. See Appendix A for further details.

Figure 2: Export Intensity Distribution according to Eligibility to Receive Subsidies with ESR



The figure depicts the kernel density of export intensity, defined as the share of exports in total sales, for Chinese manufacturing firms reporting a positive value of exports. Data are for the period 2000-2006 and are described in detail in Appendix A.

Free Trade Zones. Free Trade Zones are export-oriented enclaves designed to attract both foreign and domestic investors by providing tax concessions, streamlined regulations, duty-free imports of materials and equipment used for exporting, among other allowances. For the purposes of the paper, FTZs include Special Economic Zones, Coastal Development Zones, the Yangtze and Pearl River Delta Economic Zones as well as smaller industrial parks such as Economic and Technological Development Zones, High-Technology Industrial Development Zones and Export Processing Zones. FTZs vary tremendously in terms of their size, ranging from small enclosed areas to entire prefecture-cities. Appendix B provides the complete list of prefecture-cities considered.

A crucial objective ascribed to FTZs is to be ‘laboratories’ to test market-oriented policies before their potential implementation in the rest of the economy (Wang, 2013). The Chinese government initially designated four counties in Guangdong and Fujian provinces as Special Economic Zones in 1979 as one of the components of Deng Xiaoping’s package of economic reforms aimed at reintegrating China into the world economy. The following two decades witnessed the establishment of a large number of FTZs in cities located primarily along the coastal regions (see Figure B.1 in Appendix B), where a vast majority of China’s export-oriented industrial production is concentrated.

China’s corporate income tax regime provides a prime example of the type of incentives available to firms operating in FTZs which are conditioned on ESR. The statutory corporate income tax rate prevailing in China between 1991 and 2008 was 30%.¹² Chinese-owned firms could reduce their tax rate to 10% if they were located in an FTZ and exported more than 70% of their output. As a result of several complaints by the European Union, U.S. and Canada at the WTO, China modified its corporate income tax legislation substantially in January 2008. Under the new law, a corporate tax rate of 25% applies both to domestic and foreign companies, and incentives conditioned on ESR have been scrapped. A five-year transition period was established so that the new tax law became fully operational in 2013.

Provincial and local managers of FTZs compete fiercely with each other, particularly in seeking to attract FIEs, and therefore offer a wide array of additional incentives linked to export performance such as tax deductions, access to soft loans and priority access to infrastructure and land. For instance, Standard Chartered Bank (2007) reports that the city of Shenzhen, China’s first special economic zone with a total area of 493 km^2 , offers firms that have paid all their value-added taxes on inputs and that export the entirety of their production, a 5% sales cash subsidy. The Shenzhen Special Economic Zone also halves the land use fee charged on certified ‘enterprises-for-export’. Similarly, most Export Processing Zones specify strict requirements for firms’ domestic sales allowance – usually 30% of the total volume of sales. The first 15 pilots of this new type of zone were set up in 2000, and their number has more than tripled over the last decade. Chinese provincial and local governments seem keen to continue experimenting with new strategies to develop geographically-enclosed areas in which high export intensity firms are encouraged to locate.

¹²Corporate Income Tax Law of the People’s Republic of China, 16 September 1991, Article 5.

Foreign Invested Enterprises. The ‘Twenty-two regulations’, established in 1986 with the objective of attracting foreign investment, defined an ‘export-oriented’ firm as a manufacturing enterprise whose export volume accounts for 50% or above of its annual sales.¹³ FIEs exceeding this threshold benefitted from preferential land-use policies, easier access to finance and exemptions from industrial and commercial consolidated tax. Until 2001, being an export-oriented firm was a requirement for foreign investments in China and FIEs had to specify their share of domestic sales by contract.¹⁴ Firms that did not comply with this requirement faced steep penalties; for instance, FIEs that did not meet the targets set for export-oriented enterprises within three years from the day they began production, were required to repay 60% of the tax refunded.¹⁵ After China’s accession to the WTO, the law on Foreign Capital Enterprises revised in October 2000, lifted the requirement for FIEs to export the majority of their production. Nevertheless, financial incentives conditional on export intensity have remained in place after 2001.

The first paragraph of the 1991 corporate income tax law stated that “The establishment of enterprises with foreign investment which export all or the greater part of their production should be encouraged.”¹⁶ Similarly to Chinese-owned firms, FIEs that export more than 70% of their output lower their corporate income tax rate from 30 to 10%. However, unlike domestically-owned firms, FIEs are not restricted to be located in FTZ to enjoy this incentive.¹⁷

The 1995 regulations entitled “Guiding the Direction of Foreign Investment” also featured restrictions on local sales for FIEs. According to this law, all foreign investment projects were classified in one of four categories: encouraged, permitted, restricted and prohibited. However, restricted projects that exported at least 70% of their total sales were automatically considered as permitted.¹⁸ This regulation is still in place today, despite China substantially revising the list of restricted products after joining the WTO. The 2002 regulation has introduced a new project category named “all-for export projects”, which includes any project exporting all its production. Such projects are treated as encouraged projects automatically and therefore enjoy preferential

¹³Enforcement of the Provisions of the State Council on Encouraging Foreign Investment, January 1, 1987.

¹⁴Circular of the Ministry of Foreign Trade and Economic Cooperation on Submission of Import and Export Plans for Enterprises with Foreign Investment, October 25, 2000.

¹⁵Corporate Income Tax Law of the People’s Republic of China, 30 June 1991, Article 8.4.4.

¹⁶Corporate Income Tax Law of the People’s Republic of China’, 9 April 1991, Basic Regulations. 8.1.

¹⁷‘Corporate Income Tax Law of the People’s Republic of China’, 30 June 1991, Article 8.3.5.

¹⁸Regulations for Guiding the Direction of Foreign Investment, June 7, 1995, Article 11.

treatment,¹⁹ e.g. all-for export projects are entitled to a 20% refund of import duty and import value-added tax.²⁰

The generous tax concessions available to FIEs has driven local Chinese entrepreneurs to engage in what is known as “round-tripping” — i.e. setting up shell companies in Hong Kong, Macau and Taiwan (HMT), which produce and export goods from China, thereby enjoying tax breaks — in a massive scale (Prasad and Wei, 2007). HMT-based foreign-invested firms account for approximately half of all FIEs and more than half of Processing Trade Enterprises operating in China.

Processing Trade Enterprises. China established the legal framework for processing trade in 1979, thus allowing the duty-free importation of inputs and components needed for the production of goods for export (Naughton, 1996; Fernandes and Tang, 2012). Since the early 1990s, assembling and processing has consistently accounted for approximately half of China’s export volume. From a legal standpoint, Processing Trade Enterprises (PTEs) are production enterprises or factories established by business enterprises but with independent accounting and their own business licence.

Enterprises engaged in processing are required to obtain a production capability certification as well as a processing trade approval certificate granted by government authorities; they also face strict controls over their domestic sales. These enterprises are allowed to import inputs duty-free as long as they are not used for domestic consumption; if any output is sold in the domestic market, firms must promptly pay the tariffs and VAT on the imported materials. More importantly, they must obtain approval from both the provincial commerce authorities and customs for an import licence; failing to do so translates into a penalty ranging from 30 to 100% of the declared value of the imported materials and parts.²¹ In practice, firms engaged in export processing either become fully export-oriented or are forced to set up segregated production facilities to sell domestically in order to reduce the leakage of tariff-free intermediate goods (Hong Kong Trade Development Council, 2009; Brandt and Morrow, 2013).

In order to enjoy autonomy regarding domestic sales, a processing trade enterprise has to

¹⁹Regulations for Guiding the Direction of Foreign Investment, February 11, 2002.

²⁰General Administration of Customs and State Administration of Taxation, 4 September 2002.

²¹Hong Kong Trade Development Council (2003), Guide to Doing Business in China, Chapter on Processing-Trade. Based on the circular concerning issuance of “Interim Measures on Administration of the Examination and Approval of Processing Trade” and “Interim Measures on Administration of the Examination and Approval of Domestic Sale of Bonded Materials and Parts Imported for Processing Trade”, Ministry of Foreign Trade and Economic Cooperation (1999, WJMGF. No. 314 and No. 315).

change its registration and become a FIE, which requires it to temporarily stop its production for a customs auditing. The consulting company [Li & Fung Group \(2012\)](#) estimates that this production disruption takes approximately 9 to 12 months. Furthermore, the transformation from PTE to FIE involves the work of more than 10 government departments and can potentially result in a substantial tax repayment.

PTEs can also import equipment provided by a foreign client to be used in processing duty-free. To obtain this benefit, the PTE has to be an independent factory devoted to export processing, which in turn requires it to export all its production. If the PTE does not count with a processing-oriented facility, it needs to specify in the terms of their processing trade contract that at least 70% of its output must be exported.

3 Model

Preferences. Consider a world with two countries, Home (H) and Foreign (F). Each country $i \in \{H, F\}$, is inhabited by L_i identical consumers who supply one unit of labor inelastically. The representative consumer in each country has Dixit-Stiglitz preferences with elasticity of substitution $\sigma > 1$. Utility in country i is given by:

$$u_i = \left[\sum_j \left(\int_{\omega \in \Omega_{ji}} [z_{ji}(\omega)^{\frac{1}{\sigma-1}} q_{ji}(\omega)]^{\frac{\sigma-1}{\sigma}} d\omega \right) \right]^{\frac{\sigma}{\sigma-1}}, \quad i, j \in \{H, F\}, \quad (1)$$

where Ω_{ji} is the set of varieties produced in country j which are available to consumers in country i , $q_{ji}(\omega)$ is the quantity of good ω consumed and $z_{ji}(\omega)$ is a demand shifter for variety ω , with a higher value of $z(\omega)$ corresponding to higher demand for good ω .

[Eaton et al. \(2011\)](#) show that firm-destination heterogeneity in demand is necessary to reconcile the observed variation in firms' export sales relative to domestic sales with the [Melitz \(2003\)](#) model; along the same lines, [Munch and Nguyen \(2014\)](#) find that firm-destination effects explain half of the variation in export sales across narrowly defined product-destination markets using Danish data.²² In addition to cross-country variation in the taste for a specific variety, [Crozet et al. \(2012\)](#) argue

²²[Cherkashin et al. \(2015\)](#) develop a similar model to ours to assess the effect of preferential access granted to Bangladeshi exporters to the U.S. and EU markets. Like ours, their model features differences across firms in terms of their productivity and firm-destination-specific demand shifters. Unlike their model, ours investigates the general equilibrium consequences of trade policy.

that these demand shifters can also represent a firm’s network of connections with purchasers in each market. This dimension is particularly important for affiliates of multinational corporations and firms producing goods specifically customized to individual clients within a global value chain.

These preferences yield the following iso-elastic demand function in country i for variety ω produced in j :

$$q_{ji}(\omega) = A_{ji}(\omega)p_{ji}(\omega)^{-\sigma}, \quad \text{with } A_{ji}(\omega) \equiv E_i P_i^{\sigma-1} z_{ji}(\omega), \quad (2)$$

where E_i denotes aggregate expenditure in country i , and P_i , the ideal price index in country i , is defined as:

$$P_i = \left[\sum_j \left(\int_{\omega \in \Omega_{ij}} z_{ji}(\omega) p_{ji}(\omega)^{1-\sigma} d\omega \right) \right]^{\frac{1}{1-\sigma}}, \quad i, j \in \{H, F\}. \quad (3)$$

Production. Firms in country i incur an initial investment f_i^e to learn their idiosyncratic productivity, φ , and demand shifters (z_{ii}, z_{ij}) .²³ We assume that domestic and export demand shifters are drawn from the same distribution, F_z and are independent from each other. Productivity is drawn from a distribution F_φ , and is also assumed to be independent of demand shifters. With a slight abuse of notation, let $\omega \equiv (\varphi, z_{ii}, z_{ij})$ denote a firm’s state vector. Based on their knowledge about ω , firms first choose whether to stay in or exit the market. If a firm decides to operate, it produces using a linear technology with labor as the sole input, $q = \varphi l$; thus, the marginal cost for a firm with productivity φ located in country i is w_i/φ , where w_i is the wage prevailing in that country.

We assume that firms face a location-specific fixed cost to sell their output in each country (Eaton et al., 2011) — e.g. a Home-based firm pays f_{HH} when selling domestically and f_{HF} when it exports to Foreign.²⁴ Moreover, exporters from country i selling in market j incur a transport cost $\tau_{ij} \geq 1$ on their export sales, whereas there are no transport costs involved in selling domestically, i.e. $\tau_{ii} = 1$, $i, j \in \{H, F\}$. The combination of location-specific fixed costs with firm-destination-specific demand shifters means that in the absence of subsidies with ESR there will be three types of firms operating in equilibrium: firms that sell only domestically (indexed by d), ‘pure’ exporters, i.e. producers that export all their output (indexed by x), and ‘regular’ exporters, selling their output both domestically and abroad (indexed by dx).

Heterogeneity in terms of productivity and demand shifters also implies that firms’ choice

²³All fixed costs in the model are denominated in units of labor.

²⁴Notice that our assumption of location-specific fixed costs implies that these incorporate both production and “market access” costs.

regarding which markets to operate in is not fully characterized by a set of productivity cutoffs as in the standard [Melitz \(2003\)](#) model. For instance, highly productive firms that experience low demand draws abroad may not find profitable to export, while the converse can also happen — some exporters will be less productive than domestic firms. Nevertheless, since regular exporters face the highest fixed cost ($f_{ii} + f_{ij}$), they are, on average, the most productive type of firm.

As it is well known, all firms set optimal prices that feature a constant mark-up above marginal cost, which is augmented by the transport cost when a firm exports. Letting $k \in \{d, x, dx\}$ index firms' mode of operation, profits for firm ω , located in country i and using production mode k , are given by:

$$\pi_i^k(\omega) = \sum_j \left[\kappa \tau_{ij}^{1-\sigma} A_{ij}(\omega) \left(\frac{\varphi}{w_i} \right)^{\sigma-1} - w_i f_{ij} \right] \cdot 1_{ij}(\omega), \quad i, j \in \{H, F\}, \quad (4)$$

where $\kappa \equiv (\sigma - 1)\sigma^{-1}\sigma^{-\sigma}$ and $1_{ij}(\omega)$ is an indicator function taking the value 1 when firm ω in country i sells some of its output in market j and zero otherwise.

Conditional on a firm selling a positive quantity abroad, we define an exporter's 'natural' export intensity, $\eta_i^k(\omega)$, as the share of its total sales accounted for by exports in the absence of subsidies:

$$\eta_i^k(\omega) = \begin{cases} \frac{\tau_{ij}^{1-\sigma} A_{ij}(\omega)}{A_{ii}(\omega) + \tau_{ij}^{1-\sigma} A_{ij}(\omega)} & \text{if } k = dx \\ 1 & \text{if } k = x. \end{cases} \quad (5)$$

Notice that although a firm's natural export intensity is independent of its productivity — since the elasticity of demand and markups in each market are constant — it varies across regular exporters due to firm-destination-specific demand shifters. Without the latter, not only all regular exporters would sell the same share of their revenue abroad, but pure exporters would not be able to coexist alongside domestic firms and regular exporters in equilibrium.

The fact that our model delivers a non-degenerate distribution of firms' natural export intensity is critical for our objective of assessing the consequences of subsidies with ESR. Firms choose to export the majority of their output for a wide variety of reasons besides the availability of subsidies conditioned on ESR. For instance, they could produce goods for which there is little domestic demand (what [Díaz de Astarloa et al. \(2013\)](#) call "orphan industries", e.g. woolen sweater producers in Bangladesh), or they might operate as links in a global value chain, assembling components into a new product that is exported in order to continue in the following stage of production. Such

naturally-occurring high-intensity exporters certainly benefit from the availability of subsidies with ESR in our model, but as will become clear below, do not need to distort their behavior to receive these subsidies.

Subsidies with Export Share Requirements. We now introduce a set of subsidies featuring an export share requirement (ESR) at Home. Exporters with an export intensity of at least $\eta \in (0, 1]$, receive an ad-valorem subsidy s_r on their total sales and/or a subsidy s_f on their total fixed cost bill. It is important to note that several of the incentives conditioned on an ESR summarized in Section 2 involve tax deductions rather than direct cash outlays. Following Bauer et al. (2014), it is straightforward to show that a sales subsidy for firms operating subject to an ESR is equivalent to a reduction in the corporate income tax rate on their gross profit (i.e. before incurring fixed costs).²⁵

Let us now consider the profit maximization problem of a regular exporter at Home facing a vector of subsidies (s_r, s_f) subject to an ESR with export intensity threshold η :

$$\max_{p_{HH}^\eta, p_{HF}^\eta} \left\{ (1+s_r) [A_{HH}(\omega)(p_{HH}^\eta)^{1-\sigma} + A_{HF}(\omega)(p_{HF}^\eta)^{1-\sigma}] - \left(\frac{w_H}{\varphi}\right) [A_{HH}(\omega)(p_{HH}^\eta)^{-\sigma} + \tau_{HF} A_{HF}(\omega)(p_{HF}^\eta)^{-\sigma}] - (1-s_f)(f_{HH} + f_{HF})w_H \right\} \quad \text{subject to:} \quad \frac{A_{HF}(\omega)(p_{HF}^\eta)^{1-\sigma}}{A_{HH}(\omega)(p_{HH}^\eta)^{1-\sigma} + A_{HF}(\omega)(p_{HF}^\eta)^{1-\sigma}} \geq \eta. \quad (6)$$

Using the first-order necessary conditions to solve problem (6), we can readily establish that,

Lemma 1 *If $\eta_H^{dx}(\omega) < \eta$, then the ESR constraint is binding.*

Proof. See Appendix C.

In other words, a regular exporter with natural export intensity below the ESR threshold seeking to receive these subsidies, would choose its domestic and export prices so that its export intensity is exactly equal to η . We can now use Lemma 1 to solve problem (6), and characterize the optimal prices charged by exporters benefiting from subsidies with ESR. The solution involves two cases. First, consider a firm for which $\eta_H^{dx}(\omega) < \eta$ — that is, a firm which finds the ESR constraint binding.

²⁵If the corporate income tax was levied on net profits (including fixed costs), then a tax deduction subject to an export requirement would be equivalent to a combination of a sales subsidy and a fixed cost tax for firms operating subject to an ESR. We discuss this in more detail in Section 5.

In order to reach the export intensity threshold, this firm sets prices

$$p_{HH}^\eta(\omega) = \left[\frac{(1 - \eta)^{\frac{\sigma}{\sigma-1}} A_{HF}(\omega)^{\frac{1}{\sigma-1}} + \eta^{\frac{\sigma}{\sigma-1}} \tau_{HF} A_{HH}(\omega)^{\frac{1}{\sigma-1}}}{(1 - \eta)^{\frac{1}{\sigma-1}} A_{HF}(\omega)^{\frac{1}{\sigma-1}}} \right] \frac{1}{1 + s_r} \frac{\sigma}{\sigma - 1} \left(\frac{w_H}{\varphi} \right), \quad (7)$$

$$p_{HF}^\eta(\omega) = \left[\frac{(1 - \eta)^{\frac{\sigma}{\sigma-1}} A_{HF}(\omega)^{\frac{1}{\sigma-1}} + \eta^{\frac{\sigma}{\sigma-1}} \tau_{HF} A_{HH}(\omega)^{\frac{1}{\sigma-1}}}{\eta^{\frac{1}{\sigma-1}} A_{HH}(\omega)^{\frac{1}{\sigma-1}}} \right] \frac{1}{1 + s_r} \frac{\sigma}{\sigma - 1} \left(\frac{w_H}{\varphi} \right), \quad (8)$$

which result in profits:

$$\pi_H^\eta(\omega; s_r, s_f, \eta) = \kappa(1 + s_r)^\sigma \Theta(A_{HH}(\omega), A_{HF}(\omega), \eta, \tau) \left(\frac{\varphi}{w_H} \right)^{\sigma-1} - (1 - s_f)(f_{HH} + f_{HF})w_H, \quad (9)$$

where Θ , which is a profit-shifter term, is given by:

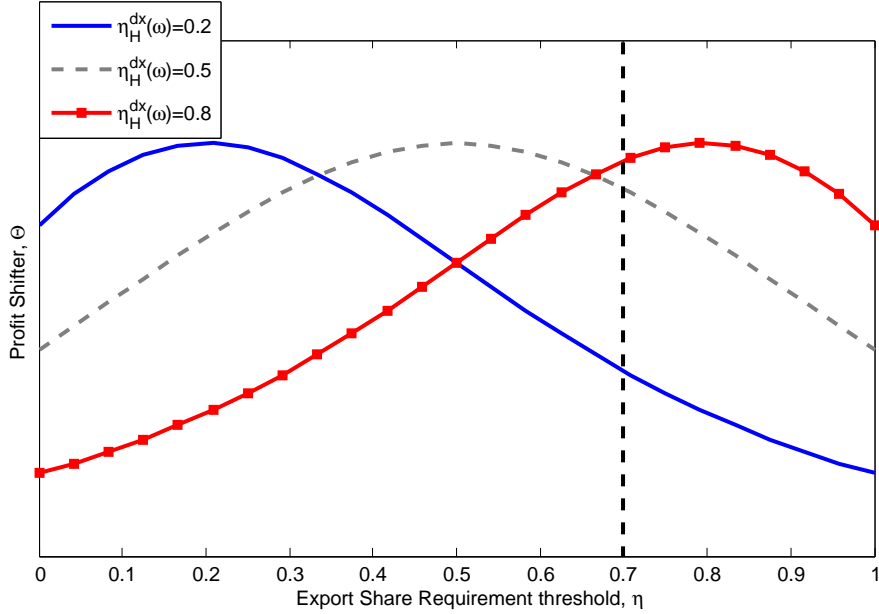
$$\Theta \equiv \frac{A_{HH}(\omega)A_{HF}(\omega)}{\left[(1 - \eta)^{\frac{\sigma}{\sigma-1}} A_{HF}(\omega)^{\frac{1}{\sigma-1}} + \eta^{\frac{\sigma}{\sigma-1}} \tau_{HF} A_{HH}(\omega)^{\frac{1}{\sigma-1}} \right]^{\sigma-1}}. \quad (10)$$

Appendix D shows that Θ is a concave function of η , reaching a global maximum at a firm's natural export intensity $\eta = \eta_H^{dx}(\omega)$, with $\Theta(\eta_H^{dx}) = A_{HH} + \tau_{HF}^{1-\sigma} A_{HF}$. Notice that this result implies that firms with natural export intensity of at least η — the second case characterizing the solution of (6) — will choose to maintain their natural export intensity, since $\Theta(\eta_H^{dx}(\omega)) \geq \Theta(\eta)$. Appendix E shows that optimal prices and profits only need to be modified marginally if the ad-valorem sales subsidy s_r is granted based on firms' export sales instead of total sales. We will investigate the effect of imposing an ESR on export sales subsidies in order to facilitate the comparison with a standard, unconditional export subsidy in Section 5.

Figure 3 illustrates the consequences of imposing an export share requirement on firms' profitability, by plotting the profit-shifter term Θ as a function of the ESR threshold, η , for three, equally profitable regular exporters that differ only in their natural export intensity. The first thing to notice is that in the absence of subsidies, only firms with a natural export intensity greater than or equal to the ESR threshold would choose to operate facing an export share requirement. Secondly, for a given set of subsidies, firms with higher natural export intensity are more likely to change their prices to receive the subsidies than firms that sell the majority of their output domestically. This can be clearly seen in Figure 3, by noticing that for a given ESR (70% for instance), the value of the profit shifter term Θ is higher for the firm with natural export intensity

of 0.5 than for the firm with a lower natural export intensity. Lastly, Figure 3 shows that firms with natural export intensity above the ESR threshold would not find it profitable to change their export intensity when subsidies are introduced.

Figure 3: Profit-Shifter Θ and Export Share Requirement



Firm Types when Subsidies with ESR are available. Once subsidies with ESR are offered, we can now identify six types of firms operating in the country enacting the subsidies:

1. Domestic firms ($k = d$). These firms do not receive subsidies by definition. Their profits are still given by equation (4).
2. Ineligible Regular exporters ($k = dxn$), i.e. firms selling both domestically and abroad which are not eligible to receive subsidies with ESR. The natural export intensity for these firms is below the ESR threshold $\eta_H^{dx}(\omega) < \eta$, and given the prevailing subsidies, they do not find profitable to distort their prices to satisfy the export requirement, i.e. $\pi_H^{dx}(\omega) \geq \pi_H^\eta(\omega)$. Their profit is also given by equation (4).
3. Unconstrained regular exporters ($k = dxu$), i.e. firms selling domestically and abroad with a natural export intensity above the ESR threshold, $\eta_H^{dxu}(\omega) \in (\eta, 1)$. These firms set the usual

constant markup above marginal cost under laissez-faire but lower their prices in proportion to the magnitude of the subsidy on sales, s_r . They set domestic and export prices $p_{HH}^{dxu} = \frac{1}{1+s_r} \frac{\sigma}{\sigma-1} \frac{w_H}{\varphi}$ and $p_{HF}^{dxu} = \tau_{HF} p_{HH}^{dxu}$ respectively, and realize profits:

$$\pi_H^{dxu}(\omega; s_r, s_f, \eta) = \kappa(1+s_r)^\sigma [A_{HH}(\omega) + \tau_{HF}^{1-\sigma} A_{HF}(\omega)] \left(\frac{\varphi}{w_H} \right)^{\sigma-1} - (1-s_f)(f_{HH} + f_{HF})w_H. \quad (11)$$

They maintain their natural export intensity after the introduction of the subsidies.

4. Pure exporters ($k = xu$) that would only serve the export market even in the absence of subsidies. These firms export all their output and therefore meet the export share requirement by definition. Subsidies with ESR are equivalent to unconditional subsidies for them. It is straightforward to show that pure exporters lower their export prices, $p_{HF}^{xu} = \frac{1}{1+s_r} \frac{\sigma}{\sigma-1} \frac{\tau_{HF} w_H}{\varphi}$ in response to the sales subsidy, and achieve profits

$$\pi_H^{xu}(\omega) = \kappa(1+s_r)^\sigma \tau_{HF}^{1-\sigma} A_{HF}(\omega) \left(\frac{\varphi}{w_H} \right)^{\sigma-1} - (1-s_f) f_{HF} w_H, \quad (12)$$

which are higher than in the absence of subsidies with ESR.

5. Constrained regular exporters ($k = dxc$). These firms, which would have a natural export intensity below the ESR under laissez-faire, choose to sell domestically and abroad and set prices in order to achieve an export intensity exactly equal to η . For these firms, the gain due to the subsidies exceeds the profit loss produced by the distortion of their prices.
6. Constrained pure exporters ($k = xc$). These firms would not have chosen to operate as pure exporters had the subsidies with ESR not being in place. These firms set the same export prices and obtain the same profits as unconstrained pure exporters.

Firms choose their type in order to maximize profits with full information of both their productivity and demand shifters. Table 1 summarizes the different firm types that can potentially coexist in the country offering subsidies with ESR.

Differences between Pure and Regular Constrained Exporters. Firstly, we want to emphasize the fact that a single ESR threshold $\eta \in (0, 1)$ generates *both* pure exporters and regular

Table 1: Firm Types Operating in a Country that Offers Subsidies with Export Share Requirements

Firm type	Export Intensity	Does the firm receive subsidies with ESR?	Does the firm distort its prices/mode of operation to obtain subsidies?
Domestic ($k = d$)	–	No	No
Ineligible regular exporters ($k = dxn$)	$(0, \eta)$	No	No
Unconstrained regular exporters ($k = dxu$)	$(\eta, 1)$	Yes	No
Unconstrained pure exporters ($k = xu$)	1	Yes	No
Constrained regular exporters ($k = dxc$)	η	Yes	Yes
Constrained pure exporters ($k = xc$)	1	Yes	Yes

exporters exactly satisfying the ESR threshold. Constrained exporters can either choose to sell both at home and abroad with an export intensity of η — as established in Lemma 1 — by altering their prices in response to subsidies with ESR, or can decide to export all their output. Although variable profits are lower in the latter option — since $\Theta(1) - \Theta(\eta) < 0$ — firms can avoid incurring the domestic fixed cost f_H if they become constrained pure exporters.

Pure and regular constrained exporters also follow different pricing strategies. A constrained regular exporter sets prices (7) and (8) in order to achieve export intensity η . In so doing, it increases its gross (before subsidies) domestic price and lowers the price it charges abroad. The optimal prices set by a constrained regular exporter are therefore linked across destinations and are also dependent on the market size of both countries. More precisely,

Proposition 1 *A constrained regular exporter receiving subsidies with ESR sets a higher price in the domestic market and a lower price in the foreign market than if the ESR were not binding.*

Proof. This result follows directly from the fact that the terms in brackets in equations (7) and (8)

are respectively greater than 1 and lower than τ_{HF} when $\eta \in (\eta_H^{dx}(\omega), 1)$.

Thus, a binding ESR constraint induces exporters to reduce domestic sales and to increase the output exported in order to achieve export intensity η . Conversely, a constrained firm that decides to give up its domestic sales does not distort the markup it charges on export sales beyond the direct effect of the sales subsidy. However, if the mass of constrained pure exporters increases, the number of varieties available to home consumers falls, thereby increasing the domestic price index and lowering the level of competition domestically. Thus, as the level of subsidies subject to an ESR increase and the share of constrained exporters rises accordingly, the level of competition in the country enacting the subsidies falls and protection for the least profitable firms heightens. This result follows from the fact that the price index defined in (3) is increasing in the average price charged by firms, but decreasing in the number of varieties available for consumption. Solving for the general equilibrium in our model when one country makes use of subsidies with ESR allows us to provide a magnitude of the distortions generated by this policy.

General Equilibrium. We now describe the conditions that characterize the general equilibrium in our model. As noted above, we assume that only Home offers subsidies with ESR — this is the only difference between the two countries in our benchmark. We assume that the Home government runs a balanced budget and finances subsidies by imposing a lump-sum tax on households.

Choosing labor at Home as the numeraire ($w_H = 1$), and given a vector of subsidies (s_r, s_f) , equilibrium in the model is characterized by a vector of seven endogenous variables,

$$\{M_H, M_F, P_H, P_F, E_H, E_F, w_F\},$$

all of which have been defined above, with the exception of M_H and M_F , which denote the mass of operating firms at Home and Foreign respectively. Equilibrium is such that in each country,

- (i) the labor market clears,
- (ii) expected profits of entering the market exactly cover entry costs,
- (iii) Total expenditure in country i is given by: $E_i = w_i L_i - T_i$, where T_i is the aggregate tax revenue used to finance export subsidies,

and international trade is balanced. Appendix F describes the algorithm used to solve the model numerically, and spells out in detail the market-clearing equations listed above.

4 Calibration

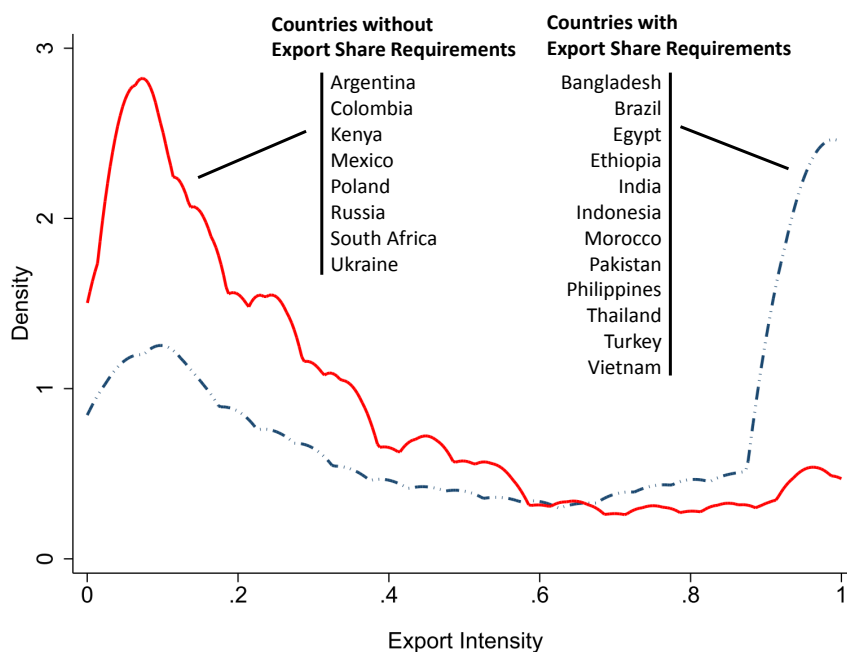
This section describes the procedure used to assign values to the endowments, preferences and technology parameters of our model economy. We calibrate our model so as to reproduce salient features of the distribution of export intensity of a developing country that does not provide subsidies with ESR.

Natural Export Intensity Distribution. As we discussed in Section 3, the consequences of subsidies conditioned on ESR depend crucially on the natural distribution of export intensity that would have prevailed in a country had such subsidies not been available. For instance, relatively few firms would choose to change their mode of operation — to become either constrained pure or regular exporters — in response to a given subsidy and ESR threshold combination if the natural export intensity distribution was highly skewed to the left. Conversely, in a country where high-intensity exporters are more prevalent, fewer firms would choose to distort their prices to receive the subsidy. However, it is possible that the aggregate expenditure in subsidies would be higher in the latter scenario — potentially making a given subsidy more distortive — because there are more firms eligible to receive subsidies.

We utilize cross-country firm-level data drawn from the World Bank’s Enterprise Surveys (WBES) for the years 2002-2012 to construct a natural export intensity distribution that is not distorted by subsidies with ESR and that will serve as the benchmark for our quantitative exercise. Our sample consists of manufacturing exporters operating in the twenty largest developing and transition countries in terms of population (i.e. those with at least 30 million inhabitants), for which there are at least 100 exporters available in WBES. Since our objective is to infer the counterfactual distribution that would have prevailed in China in the absence of subsidies with ESR, we therefore choose to use relatively large countries to construct our natural export intensity distribution; moreover, Defever and Riaño (2015b) find that the share of high-intensity exporters observed in a country is crucially influenced by its size.

We collect information on whether a country provides or not subsidies with ESR from the Investment Climate Statements produced by the U.S. State Department.²⁶ Table 2 presents the countries included in our sample, as well as the number of exporters and the share of high-intensity (i.e. those with export intensity above 70%) exporters operating in each country. The last three columns of the table indicate whether subsidies with ESR are also conditioned on a firm’s location or ownership status. The column “Everywhere” indicates that any firm can benefit from subsidies with ESR regardless of their location; “within a FTZ” indicates that the subsidies are only available to firms located in a Free Trade Zone, and the last column “FIE” indicates that only Foreign-Invested Enterprises are eligible. Since countries often implement several policy measures subject to ESR at the same time, these categories are not mutually exclusive.

Figure 4: Export Intensity Distribution According to Availability of Subsidies with ESR in Large Developing Countries



The figure depicts the kernel density of export intensity, which is defined as the share of exports in total sales for firms reporting a positive value of exports. Data are from the World Bank’s Enterprise Surveys (WBES) for the period 2002-2012.

Table 2 highlights the prevalence of ESR across developing countries; twelve out of the twenty

²⁶The Investment Climate Statements are publicly available for the years 2005 to 2012 at <http://2001-2009.state.gov/e/eeb/ifd/2005/> and <http://www.state.gov/e/eb/rls/othr/ics/>. The information on the availability of subsidies with ESR is found in the sections on “Performance Requirements and Incentives” and “Foreign Trade Zones/Free Trade Zones”.

countries in our sample offer incentives to firms conditioned on fulfilling an explicit export share requirement. Figure 4 presents the distribution of export intensity for exporters based on the availability of subsidies with ESR. Once again, the difference between the two distributions is remarkable — on average half of exporters in countries offering subsidies with ESR export 70% or more of their output, while only 12% do so in countries that do not offer these subsidies (the distribution for the latter group of firms closely resembles the one for domestically-owned Chinese firms located outside FTZ presented in Figure 2). This marked contrast provides further suggestive evidence regarding the role of subsidies with ESR in distorting the distribution of export intensity. Thus, we will use the export intensity distribution for exporters located in non-ESR countries — the solid line in Figure 4 — as the natural export intensity distribution when calibrating our model. It is important to note that when computing both the densities in Figure 4 and the moments targeted in the calibration, each firm-level export intensity observation is weighted so that each country receives an equal weight. This ensures that the distributions are not driven by outliers, or sample size and population differences across countries.

Assigned Parameters. In order to calibrate our model, we assume that both Home and Foreign countries are identical in terms of their labour endowments and model parameters. Thus, firms in both countries draw productivity and destination-specific demand shifters from the same distributions. This assumption also implies that the fixed costs of entry and operation in each market are such that $f_i^e = f_j^e = f^e$, $f_{ii} = f_{jj} = f^d$ and $f_{ij} = f_{ji} = f^x$ for $i, j \in \{H, F\}$ and $i \neq j$. Since scaling up or down all fixed costs by the same amount does not affect the aggregate variables of interest — just as in Melitz and Redding (2015) — we normalize the domestic fixed cost f^d to 1.

We assume that both Home and Foreign have the same population, so that $L = 1$. If one considers Home (i.e. the country enacting subsidies with ESR) to be China, then this assumption implies that Foreign in our model corresponds to a country with the combined population of the U.S., Canada and the EU (Khandelwal et al., 2014).

We set the elasticity of substitution, σ , equal to 3, based on Broda and Weinstein (2006).²⁷

²⁷We have also experimented with an elasticity of substitution of 3.5, which is the average value of the median import demand elasticities at the SITC 3-digit level for Argentina, Colombia, Mexico and Poland, the four countries belonging to our undistorted benchmark for which Broda et al. (2006) have estimates available, and which is in turn very close to China’s estimate of 3.42, and our results remain robust. Table H.1 presents further robustness checks in which we perturb our calibrated parameters one at a time.

Table 2: Summary Statistics - WBES

		World Bank Enterprise Surveys (WBES)				Investment Climate Statements (ICS)			
	# of exporters	Period of observation	Export Intensity $\in [0.7, 1)$ (%)	Pure exporters (%)	Export Share Requirement Everywhere ^a	Within FTZ ^b	FIE ^c		
Argentina	751	2006-2010	6	2	-	-	-		
Colombia	508	2006-2010	5	2	-	-	-		
Kenya	302	2003-2007	7	7	-	-	-		
Mexico	557	2006-2010	8	6	-	-	-		
Poland	351	2002-2009	11	7	-	-	-		
Russia	475	2002-2012	3	2	-	-	-		
South Africa	558	2003-2007	4	2	-	-	-		
Ukraine	293	2002-2008	15	9	-	-	-		
Average			7	5					
Bangladesh	903	2002-2007	5	82	Yes	Yes	-		
Brazil	739	2003-2009	4	7	Yes	-	-		
Egypt	946	2004-2008	9	11	-	Yes	-		
Ethiopia	117	2002-2011	17	21	Yes	-	Yes		
India	902	2002-2004	7	36	Yes	Yes	Yes		
Indonesia	522	2003-2009	16	34	-	Yes	-		
Morocco	745	2004-2007	8	69	-	Yes	-		
Pakistan	323	2002-2007	4	59	Yes	Yes	-		
Philippines	604	2003-2009	11	59	Yes	Yes	Yes		
Thailand	1303	2004-2006	22	27	-	Yes	-		
Turkey	1525	2002-2008	16	14	-	Yes	-		
Vietnam	995	2005-2009	21	34	Yes	Yes	Yes		
Average			12	38					

Note: ^a indicates that firms can benefit from subsidies with ESR regardless of their location. ^b indicates that subsidies with ESR are only available to firms located in a Free Trade Zone (FTZ). ^c indicates that only Foreign-Invested Enterprises (FIE) can benefit from subsidies with ESR.

Firms in both countries draw their productivity realizations from a Pareto distribution with lower bound 1 and shape parameter a . Following [Helpman et al. \(2004\)](#), we estimate $a - (\sigma - 1)$ by regressing the logarithm of a firm’s employment ranking on the logarithm of its employment level using data from our sample of countries not offering subsidies with ESR. The estimated coefficient of 0.713 implies a value of $a = 3.213$, given our choice of σ .

Similarly to other model parameters, the iceberg transport cost incurred is assumed to be the same for both countries, i.e. $\tau_{HF} = \tau_{FH} = \tau$. In models that do not feature firm-destination-specific demand shifters (e.g. [Melitz and Redding, 2015](#)), transport costs are usually calibrated to match a country’s mean export intensity.²⁸ In our model, however, changes in transport costs or in the mean of demand shifters both affect the export intensity distribution. The only difference between transport costs and the mean of export demand shifters, is that the former affects the price of exports relative to the domestic market price while the latter does not. Since we do not have information on prices that allows us to separately identify the two parameters, we set τ equal to 1.7 following [Anderson and van Wincoop \(2004\)](#).

Calibrated Parameters. There are 5 parameters that remain to be calibrated, which we choose so as to minimize the distance between a number of moments in the model and in the data. These are the sunk cost of entry, f^e , the fixed cost of exporting, f^x , and the parameters governing the distribution of firm-specific domestic and export demand shifters. We assume that the latter are both drawn from lognormal distributions with parameters (μ_d, σ_d^2) and (μ_x, σ_x^2) , which denote the mean and variance of the underlying normal distribution for each demand shifter. We set $\mu_d = -0.5\sigma_d^2$ so that domestic demand shifters have a mean of 1. The moments we target are the share of exporting firms (37.42%) and the 10th, 50th, 75th and 90th percentiles of the distribution of export intensity in countries that do not provide subsidies with ESR.

Table 3 summarizes the parameters used to solve the model. Our model fits the distribution of export intensity quite well, as Figure 5 shows, although we overstate the share of pure exporters, which is not a targeted moment. The model implies an employment size premium for exporters vis-à-vis domestic firms of 1.17 log points (relative to 1.31 in our sample of non-ESR countries),

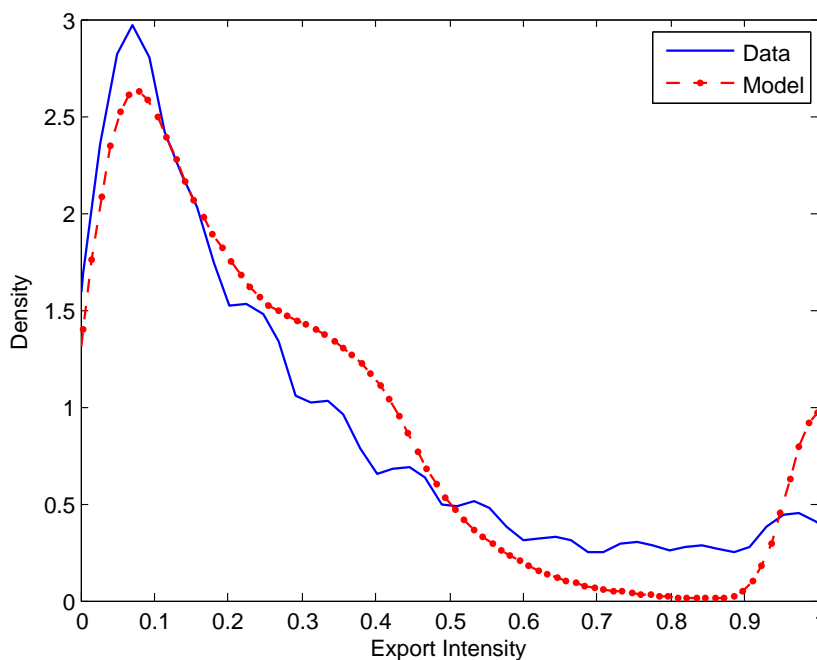
²⁸Recall that in the [Melitz \(2003\)](#) model with identical countries, all exporters have the same export intensity, $\tau^{1-\sigma}/(1 + \tau^{1-\sigma})$.

which is very close to the estimates by [Bernard et al. \(2007\)](#) and [Mayer and Ottaviano \(2007\)](#) for U.S. and European firms (1.19 and 1.21) respectively.

Table 3: Parameter Values

Description	Value
Assigned parameters:	
Country size (L)	1
Elasticity of substitution (σ)	3
Shape parameter productivity distribution (a)	2.713
Scale parameter productivity distribution ($\underline{\varphi}$)	1
Fixed cost — domestic sales (f^d)	1
Transport cost (τ)	1.7
Calibrated parameters:	
Fixed cost — entry (f^e)	10.342
Fixed cost — exporting (f^x)	0.637
Domestic demand shifters ($\ln(z_{ii}) \sim \mathcal{N}(\mu_d, \sigma_d^2)$)	(-0.634, 1.267)
Export demand shifters ($\ln(z_{ij}) \sim \mathcal{N}(\mu_x, \sigma_x^2)$)	(-1.807, 0.507)

Figure 5: Model Fit — Export Intensity Distribution in Countries without Subsidies with ESR



The figure depicts the probability density function of export intensity (conditional on exporting) after simulating the model 1,000 times and compares it with the empirical density calculated for the sample of countries that do not provide subsidies with ESR.

5 The Effect of Subsidies with Export Share Requirements

We now investigate the effect of introducing subsidies with export share requirements on prices, the distribution of export intensity, the intensity of competition and welfare in our model economy.

As we have documented in Section 2, there is a large number of policy measures that provide subsidies subject to ESR in China. Besides differences in the underlying policy (e.g. tax holidays, access to soft loans, subsidized utilities), these incentives also differ in terms of their specific ESR thresholds (in some cases these can even be firm-specific), additional location and/or ownership requirements and administrative scope (i.e. the available incentives vary at the national, provincial and prefecture-city level). Thus, carrying out a comprehensive quantitative assessment of the consequences of subsidies with ESR in China is beyond the scope of this paper.

We instead choose to pursue a more modest objective. In order to investigate the effect of subsidies with ESR we focus on the corporate income tax deduction available to firm with an export intensity above 70% to anchor our quantitative exercise. To be precise, FIEs and Chinese-owned firms located in FTZ satisfying the aforementioned ESR enjoyed a reduction of their corporate income tax rate from 30 to 10% between 1991 and 2008. This policy is appealing because is set at the national level and has a broad coverage (Figure B.1 in Appendix B shows that the FTZ location requirement is not unduly restrictive).

As it is well known, the gross profit of a firm under monopolistic competition facing iso-elastic demand is proportional to its revenue. Hence, profits after corporate income tax, t , are given by $\pi(\omega) = (1-t)[r(\omega)/\sigma - f]$, where $r(\omega)$ denotes a firm's total sales revenue and f its total fixed cost bill. Thus, reducing the corporate income tax rate faced by firms satisfying a 70% ESR from 30% to 10% implies a 28.6% ($=0.9/0.7$) increase in both gross profits and the fixed cost bill compared to firms that do not comply with the export requirement. Given the vector of sales and fixed cost subsidies analyzed in the previous section, the aforementioned corporate income tax deduction would be equivalent to an ad-valorem sales subsidy $s_r = 8.7\%$ (since this subsidy increases gross profits by a factor $(1 + s_r)^\sigma$, it follows that $0.087 \approx 1.286^{1/3} - 1$, given our choice of $\sigma = 3$) and a fixed cost tax, $s_f = -28.6\%$ vis-à-vis firms that do not fulfill the requirement. Notice, however, that if the corporate income tax was levied on gross profits, this would entail setting the fixed cost subsidy equal to zero.

In order to elucidate how subsidies with ESR operate, we assume that the sales subsidy is granted based on a firm's *export sales* rather than on its total sales, while also abstracting from the fixed cost subsidy.²⁹ Doing so, allows us to compare the subsidy subject to an ESR with an equivalent (in the sense of the total expenditure on subsidies being the same in both scenarios) unconditional export subsidy and *laissez-faire*. Thus, in our benchmark experiment, we assume that the government at Home offers an 8.7% ad-valorem subsidy to export sales for firms with an export intensity of at least 70%.

We first investigate how the use of a subsidy with ESR affects the mode of operation choice for firms at Home. As Figure 5 shows, 10.2% of exporters, the majority of which are pure exporters, have a natural export intensity above 70%. Following the introduction of the export sales subsidy with ESR, the share of exporters with an export intensity above the ESR threshold doubles. To put this figure in context, the export sales subsidy subject to an ESR that we consider in our experiment would account for 43% of the exporters with an export intensity of 70% or above observed in China between 2000 and 2006. Notably, the greatest change takes place at the upper bound of the export intensity distribution, as the share of pure exporters increases by 6.88 percentage points, while 4.3% of exporters choose to operate as constrained regular exporters, achieving exactly a 70% export intensity. As we noted in Section 3 above, more firms choose to operate as constrained pure exporters instead of at the ESR threshold when their domestic demand is small compared to that faced abroad and also when the fixed cost of operating domestically is high relative to that associated with exporting. Nevertheless, our quantitative exercise is likely to overestimate the mass point in the distribution of export intensity at 70%, since we are not taking into account the potential administrative burden that firms subject to ESR face when selling domestically. For instance, firms need to demonstrate that they effectively sell less than 30% of their output on the domestic market, for instance by using different production establishments or separated production lines for their export and domestic sales production; pure exporters, on the other hand, are likely to be less affected by these.

Firms that go on to operate facing an ESR while selling both at Home and Foreign have a mean natural export intensity of 54%, which is approximately twice as large as the overall average

²⁹Offering an 8.7% total sales subsidy in addition to a 28.6% fixed cost tax as discussed above yields similar qualitative results as those produced by our benchmark policy experiment discussed below. From a quantitative standpoint, the effect of the policy on aggregate exports, the intensity of competition and welfare is less pronounced.

natural export intensity under laissez-faire. This follows because the distortion in profits caused by the ESR is lower the closer a firm's natural export intensity is to the ESR threshold, and is therefore more easily compensated by a given subsidy. Maintaining the natural export intensity constant, we find that constrained regular exporters are 35% more productive than the average Home exporter when there are no subsidies in place, while constrained pure exporters are 25% less productive than the same reference group. Thus, we can see that the selection pattern induced by the ESR constraint is heterogeneous with respect to firms' productivity. On the one hand, firms that operate at the ESR threshold are sufficiently productive to incur the fixed costs involved in selling at home and abroad. On the other hand, relatively less productive firms prefer instead to become constrained pure exporters, since by doing so they gain access to the export subsidies and economize the fixed cost required to selling domestically.

Table 4 presents the impact of export subsidies, both unconditional and with ESR, vis-à-vis laissez faire on several equilibrium variables such as exports/GDP, price indices, the unconditional probability of firm exit and welfare. In this exercise, we contrast the 8.7% subsidy on export sales granted to firms with an export intensity of at least 70% with a 2.9% ad-valorem export sales subsidy made available to all exporters regardless of their export intensity, both of which result in Home's aggregate expenditure on export subsidies being 0.19% of GDP.

We begin by noting that subsidies with ESR share several key features with unconditional export subsidies. Both policy instruments increase aggregate exports in the enacting country, deteriorate its terms-of-trade, reduce welfare and produce qualitatively similar effects on its trade partners. More precisely, the provision of export subsidies at Home lowers the price of (at least some of) Home's export varieties, intensifying import competition in Foreign and lowering the price index there. Restoring trade balance, in turn, requires Foreign's wage to fall so that firms operating there become more competitive, and ultimately, increase their exports to Home. The fall in the price index in Foreign more than compensates the fall in its nominal wage, and thus welfare (i.e. real income) in Foreign increases at the expense of Home (Felbermayr et al., 2012).³⁰

Unlike unconditional export subsidies, however, Table 4 shows that subsidies with ESR increase

³⁰Demidova and Rodríguez-Clare (2009) also find that unconditional export subsidies lower Home's terms-of-trade and welfare. Since they model a small economy, however, Home's export subsidies do not affect price indices or welfare in the rest of the world.

Table 4: Comparison of Export Subsidies

Variable	Subsidy with Export Share Requirements (1)	Unconditional Export Subsidy (2)
	% change w.r.t. laissez-faire	
Wage, Foreign	-2.180	-1.157
Price index, Home	0.137	-0.092
Price index, Foreign	-2.422	-1.274
Probability of exit, Home	-6.537	-0.872
Probability of exit, Foreign	-1.155	-0.556
Welfare, Home	-0.829	-0.096
Welfare, Foreign	0.406	0.118
Exports/GDP	6.322	2.263
	percentage point change w.r.t. laissez-faire	
Share of Home Exporters with export intensity		
$\in [0.7, 1)$	4.300	-0.400
$= 1$	6.880	0.106

Column (1) compares an 8.7% ad-valorem subsidy to export sales granted to firms with an export intensity of at least 70% with the laissez-faire equilibrium. Column (2) compares a 2.9% ad-valorem subsidy to export sales made available to all exporting firms regardless of their export intensity with the laissez-faire equilibrium. Both subsidy schemes result in aggregate subsidy expenditure accounting for 0.19% of Home's GDP. Neither Home nor Foreign conducts any trade policy under laissez-faire, but trade costs in both directions are maintained at their calibrated level (1.7) across all scenarios.

the price index in the enacting country. Recall that in order for a constrained exporter to satisfy the 70% ESR, it needs to reduce its local sales, thereby increasing the price it charges domestically. On average, constrained regular exporters set a 23.8% higher markup on domestic prices relative to what they would have charged without subsidies. Similarly, albeit more extremely, as more firms decide to become pure exporters, their varieties stop being available to Home consumers altogether. Both channels contribute to increase the price index at Home, which increases by 0.13%. Conversely, when unconditional export subsidies are in place, the lower price of imports from Foreign as well as the selection effect induced by tougher import competition put downward pressure on Home's price index. The higher profitability of operating domestically for Home firms when ESR are in place also results in firms being more likely to remain in operation after learning the realization of their productivity and demand shifters relative to the laissez-faire and unconditional export subsidies

scenarios.

We find that the subsidy with ESR has a quantitatively important effect on aggregate outcomes. The subsidy with ESR boosts exports (as a share of GDP) by 6.32%, while the unconditional subsidy only increases this share by 2.26%. The imposition of an export requirement also reduces the likelihood of firm exit more than the unconditional subsidy — a 6.5% reduction relative to laissez-faire instead of the 0.87% fall produced by the latter. Crucially, the additional distortions introduced by the ESR result in a substantially larger welfare loss for the enacting country; real income at Home falls by 0.83% with ESR, while the equivalent unconditional export subsidy results in a 0.096% welfare loss. Foreign, on the other hand, benefits from the availability of cheaper imported goods from Home, but its perceived welfare gain is always lower than Home’s loss.

Using an Alternative Natural Export Intensity Benchmark. One concern regarding our calibration strategy is that the undistorted distribution of export intensity is based on countries that are too different from China in terms of their openness to trade and attractiveness as a location to set up multinational affiliates.³¹ Since the corporate income tax deduction conditioned on a 70% ESR in China was terminated in 2008, and fully phased out by 2013, we explore the robustness of our results by using the export intensity distribution observed in China in 2013 as the ‘undistorted’ scenario to recalibrate our model parameters using the same target moments as in our benchmark above.³² It is important to keep in mind, however, that other policy measures featuring export requirements are likely to remain in place in 2013, and these can bias our estimation of China’s natural export intensity distribution toward high export intensity levels.

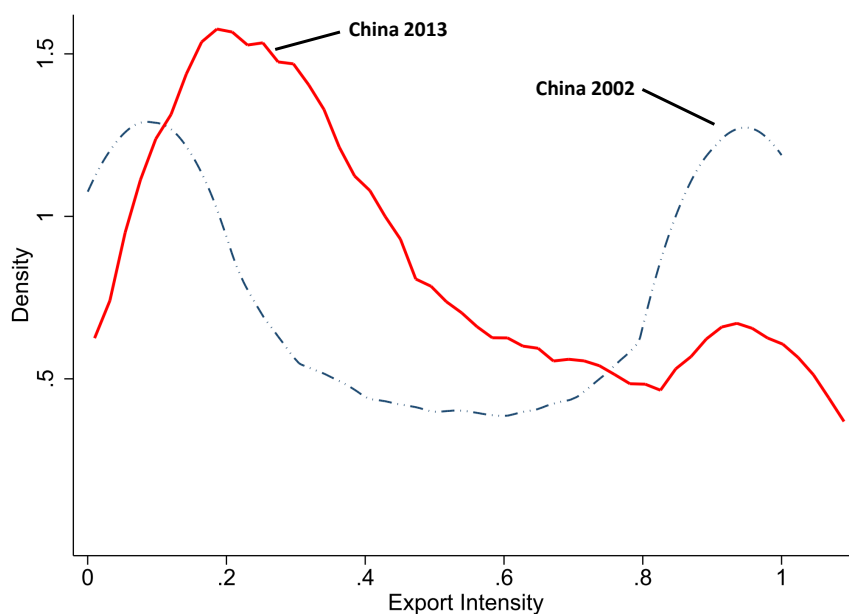
Figure 6 presents the distribution of export intensity for Chinese manufacturing firms sampled by the WBES in 2002 and 2013. Crucially, the distribution in 2002 is quite similar to the one calculated with the more representative survey carried out by the Chinese National Bureau of Statistics (NBS) and presented in Figure 1 — more precisely, the shares of regular exporters with an export intensity of at least 70% and pure exporters in the 2002 wave of WBES are 23% and 17.3% respectively; the same shares in the NBS survey are 24.9% and 24.5%. The similitude displayed

³¹As [Antràs and Yeaple \(2014\)](#) note, multinational firms’ affiliates tend to be larger, more productive, and crucially, more export-oriented than non-multinational firms.

³²In a *Papers & Proceedings* article ([Defever and Riaño, 2015a](#)), we have used the distribution of export intensity observed in China in 2013 to illustrate the effect of a subsidy with a 100% ESR in a simplified version of our model without firm-destination-specific demand shifters.

by the NBS and WBES surveys in 2002 is reassuring when interpreting the distribution based on the latter wave of the WBES survey as a suitable proxy for the distribution of export intensity prevailing in China in 2013. Figure 6 reveals that high-intensity exporters are considerably less prevalent in 2013 than in the 2000-2006 period (firms with export intensity above 70% account for 20.2% of exporters in 2013). The share of exporters in China in 2013 — the other moment used to calibrate our model — is 32.6, a similar figure to that observed in the 2000-2006 period (27.90%), and in our benchmark sample of countries not offering subsidies with ESR (37.42%).

Figure 6: Export Intensity Distribution in China in 2002 and 2013 (WBES data)



The figure depicts the kernel density of export intensity — the share of exports in total sales — for Chinese manufacturing firms reporting a positive value of exports. Data are drawn from the World Bank’s Enterprise Survey carried out in China in the years 2000 and 2013.

Table G.1 in Appendix G presents the parameters calibrated under this alternative scenario, and Table G.2 reports the results of our comparison. From a qualitative standpoint, the findings obtained under our benchmark specification remain unaltered. Quantitatively, the aggregate expenditure on subsidies increases substantially — from 0.19 to 0.67% of GDP — when Home offers an 8.7% subsidy rate on export sales conditioned on a 70% ESR. This happens both because there are more exporters that are naturally eligible to receive subsidies, but also due to a larger number

of firms choosing to become constrained exporters. Under this parametrization the overall effect of subsidies on the strength of domestic competition, exports and welfare is considerably larger than in our benchmark.

Further Robustness Analysis. We investigate further the robustness of our results by perturbing individual model parameters in our benchmark scenario to ensure that our conclusions are not unduly driven by our chosen parametrization. Thus, we increase one parameter of interest at a time by 10% relative to its value in the benchmark calibration and report the comparison between equilibria with subsidies conditioned on ESR and laissez-faire. The results of this exercise are presented in Table H.1 in Appendix H. Our quantitative results are indeed remarkably robust to changes in the parametrization of the model.

6 Conclusions

China’s successful insertion into the global economy has spurred great interest in the economic policies that made this feat possible. In this paper we have documented the widespread use of subsidies subject to export share requirements in China implemented after the opening-up reforms in the late 1970s, and yet, still in place after China joined the WTO in 2001 — a practice that has proven to be a contentious issue with other member countries. We have studied how this policy affects individual firms’ pricing and production decisions as well as its effects on the level of competition and aggregate welfare through the lens of a two-country model of trade with firm heterogeneity across productivity and demand appeal.

Our model shows that offering subsidies with ESR distorts the distribution of export intensity (conditional on exporting) in a country, skewing it towards the right. Crucially, the imposition of a single ESR strictly below 100% can induce firms to either increase their domestic prices and decrease their export prices so as to satisfy the constraint threshold, or, to stop producing for the domestic market altogether becoming pure exporters. In our quantitative exercise, we evaluate the impact of one country offering an 8.7% ad-valorem export sales subsidy subject to a 70% ESR — a policy of similar magnitude to a corporate income tax rate reduction available to foreign-owned firms and domestically-owned firms located in free trade zones between 1991 and 2008. Our results

show that a subsidy with ESR of this magnitude can account for approximately 43% of the share of exporters in China exhibiting an export intensity of at least 70%, with the majority of these being pure exporters, a feature which is consistent with the data. We find that subsidies with ESR increase aggregate exports more and provide greater protection to low-profitability firms than an equivalent unconditional export subsidy — resulting in protectionism through exporting. The distortions induced by the subsidy subject to ESR, however exacerbate the welfare losses produced by the standard textbook export subsidy.

Our findings open up exciting avenues for future research. It would be interesting, for instance, to understand the political economy objectives that have motivated China and other developing countries to employ incentives subject to export requirements. These policies could provide a politically-feasible alternative to full unilateral trade liberalization by eliciting the support of domestic producers, which are likely to be negatively affected by greater trade openness. Another interesting line of inquiry has to do with the dynamic consequences of subsidies subject to ESR. Our current analysis has shown that they produce substantial static welfare losses; however it is possible that if these subsidies help to foster rapid industrialization, their dynamic gains could more than compensate the distortions that we have identified in this paper.

References

- ANDERSON, J. E. AND E. VAN WINCOOP (2004): “Trade Costs,” *Journal of Economic Literature*, 42, 691–751.
- ANTRÀS, P. AND S. R. YEAPLE (2014): “Multinational Firms and the Structure of International Trade,” in *Handbook of International Economics*, ed. by G. Gopinath, E. Helpman, and K. Rogoff, Elsevier, vol. 4, 55 – 130.
- ARKOLAKIS, C. (2010): “Market Penetration Costs and the New Consumers Margin in International Trade,” *Journal of Political Economy*, 118, 1151 – 1199.
- BAJONA, C. AND T. CHU (2010): “Reforming State Owned Enterprises in China: Effects of WTO Accession,” *Review of Economic Dynamics*, 13, 800–823.
- BAUER, C., R. B. DAVIES, AND A. HAUFLER (2014): “Economic Integration and the Optimal Corporate Tax Structure with Heterogeneous Firms,” *Journal of Public Economics*, 110, 42–56.
- BERNARD, A. B., J. EATON, J. B. JENSEN, AND S. KORTUM (2003): “Plants and Productivity in International Trade,” *American Economic Review*, 93, 1268–1290.
- BERNARD, A. B., J. B. JENSEN, S. J. REDDING, AND P. K. SCHOTT (2007): “Firms in International Trade,” *Journal of Economic Perspectives*, 21, 105–130.

- BRANDT, L. AND P. M. MORROW (2013): “Tariffs and the Organization of Trade in China,” Manuscript, University of Toronto.
- BRANDT, L., J. VAN BIESEBROECK, AND Y. ZHANG (2012): “Creative Accounting or Creative Destruction? Firm-level Productivity Growth in Chinese Manufacturing ?” *Journal of Development Economics*, 97, 339–351.
- (2014): “Challenges of Working with the Chinese NBS Firm-Level Data,” *China Economic Review*, 30, 339–352.
- BRANSTETTER, L. G. AND R. C. FEENSTRA (2002): “Trade and Foreign Direct Investment in China: a Political Economy Approach,” *Journal of International Economics*, 58, 335–358.
- BRANSTETTER, L. G. AND N. R. LARDY (2008): “China’s Embrace of Globalization,” in *China’s Great Economic Transformation*, ed. by L. Brandt and T. G. Rawski, Cambridge: Cambridge University Press.
- BRODA, C., J. GREENFIELD, AND D. WEINSTEIN (2006): “From Groundnuts to Globalization: A Structural Estimate of Trade and Growth,” NBER Working Papers 12512, National Bureau of Economic Research.
- BRODA, C. AND D. E. WEINSTEIN (2006): “Globalization and the Gains from Variety,” *The Quarterly Journal of Economics*, 121, 541–585.
- CHAN, T., E. K. Y. CHEN, AND S. CHIN (1986): “China’s Special Economic Zones: Ideology, Policy and Practice,” in *China’s Special Economic Zones: Policies, Problems and Prospects*, ed. by Y. C. Jao and C. K. Leung, Oxford: Oxford University Press.
- CHAO, C.-C. AND E. S. H. YU (2014): *Trade-Related Investment Measures: Theory and Applications*, London: Imperial College Press.
- CHERKASHIN, I., S. DEMIDOVA, H. L. KEE, AND K. KRISHNA (2015): “Firm Heterogeneity and Costly Trade: A New Estimation Strategy and Policy Experiments,” *Journal of International Economics*, 96, 18–36.
- CHOR, D. (2009): “Subsidies for FDI: Implications From a Model with Heterogeneous Firms,” *Journal of International Economics*, 78, 113–125.
- CLARO, S. (2006): “Supporting Inefficient Firms with Capital Subsidies: China and Germany in the 1990s,” *Journal of Comparative Economics*, 34, 377–401.
- COSTINOT, A., A. RODRÍGUEZ-CLARE, AND I. WERNING (2015): “Micro to Macro: Optimal Trade Policy with Firm Heterogeneity,” Manuscript, MIT.
- CRESKOFF, S. AND P. WALKENHORST (2009): “Implications of WTO Disciplines for Special Economic Zones in Developing Countries,” World Bank Policy Research Working Paper 4892.
- CROZET, M., K. HEAD, AND T. MAYER (2012): “Quality Sorting and Trade: Firm-level Evidence for French Wine,” *Review of Economic Studies*, 79, 609–644.
- DAI, M., M. MAITRA, AND M. YU (2011): “Unexceptional Exporter Performance in China? The Role of Processing Trade,” Manuscript, Columbia University.

- DAVIDSON, C., S. J. MATUSZ, AND M. E. KREININ (1985): “Analysis of Performance Standards for Direct Foreign Investments,” *Canadian Journal of Economics*, 18, 876–90.
- DAVIES, R. B. AND C. ECKEL (2010): “Tax Competition for Heterogeneous Firms with Endogenous Entry,” *American Economic Journal: Economic Policy*, 2, 77–102.
- DEFEVER, F. AND A. RIAÑO (2015a): “Gone for Good? Subsidies with Export Share Requirements in China: 2002-2013,” *World Bank Economic Review Papers & Proceedings*, 29, S125–S144.
- (2015b): “Twin Peaks,” Manuscript, University of Nottingham.
- DEMIDOVA, S. AND A. RODRÍGUEZ-CLARE (2009): “Trade Policy Under Firm-level Heterogeneity in a Small Economy,” *Journal of International Economics*, 78, 100–112.
- DÍAZ DE ASTARLOA, B., J. EATON, K. KRISHNA, B. Y. AW-ROBERTS, A. RODRÍGUEZ-CLARE, AND J. TYBOUT (2013): “Born-to-Export Firms: Understanding Export Growth in Bangladesh,” International Growth Centre Working Paper.
- EATON, J., S. KORTUM, AND F. KRAMARZ (2011): “An Anatomy of International Trade: Evidence From French Firms,” *Econometrica*, 79, 1453–1498.
- FEENSTRA, R. C. (1998): “One Country, Two Systems: Implications of WTO Entry for China,” Manuscript, University of California, Davis.
- FEENSTRA, R. C. AND S.-J. WEI (2010): “Introduction to “China’s Growing Role in World Trade”,” in *China’s Growing Role in World Trade*, National Bureau of Economic Research, 1–31.
- FELBERMAYR, G., B. JUNG, AND M. LARCH (2012): “Optimal Tariffs, Retaliation and the Welfare Loss from Tariff Wars in the Melitz Model,” *Journal of International Economics*, 89, 13–25.
- FERNANDES, A. P. AND H. TANG (2012): “Determinants of Vertical Integration in Export Processing: Theory and Evidence from China,” *Journal of Development Economics*, 99, 396–414.
- GIRMA, S., Y. GONG, H. GÖRG, AND Z. YU (2009): “Can Production Subsidies Explain China’s Export Performance? Evidence from Firm-level Data,” *Scandinavian Journal of Economics*, 111, 863–891.
- HALEY, U. C. V. AND G. T. HALEY (2013): *Subsidies to Chinese Industry: State Capitalism, Business Strategy and Trade Policy*, Oxford: Oxford University Press.
- HAMADA, K. (1974): “An Economic Analysis of the Duty Free Zone,” *Journal of International Economics*, 4, 225–241.
- HANSON, G. H. (2012): “The Rise of Middle Kingdoms: Emerging Economies in Global Trade,” *Journal of Economic Perspectives*, 26, 41–64.
- HELPMAN, E., M. J. MELITZ, AND S. R. YEAPLE (2004): “Export Versus FDI with Heterogeneous Firms,” *American Economic Review*, 94, 300–316.
- HOLMES, T. J., E. R. MCGRATTAN, AND E. C. PRESCOTT (Forthcoming): “Quid Pro Quo: Technology Capital Transfers for Market Access in China,” *Review of Economic Studies*.

- HONG KONG TRADE DEVELOPMENT COUNCIL (2003): *Guide to Doing Business in China*, HK-TDC Business Edition, available at www.hktdc.com.
- (2009): *Turning from Export Processing to Domestic Sales*, HKTDC Business Edition, available at www.hktdc.com.
- KHANDELWAL, A. K., P. K. SCHOTT, AND S.-J. WEI (2014): “Trade Liberalization and Embedded Institutional Reform: Evidence from Chinese Exporters,” *American Economic Review*, 103, 2169–2195.
- LARDY, N. R. (1992): *Foreign Trade and Economic Reform in China, 1978-1990*, Cambridge: Cambridge University Press.
- LAU, L. J., Y. QIAN, AND G. ROLAND (2000): “Reform without Losers: An Interpretation of China’s Dual-Track Approach to Transition,” *Journal of Political Economy*, 108, 120–143.
- LI & FUNG GROUP (2012): *What do Experts Say? Ten Highlights of China’s Commercial Sector, 2011-2012*, Li & Fung Research Centre, available at www.funngroup.com.
- LU, D. (2010): “Exceptional Exporter Performance? Evidence from Chinese Manufacturing Firms,” Manuscript, University of Chicago.
- LU, J., Y. LU, AND Z. TAO (2014): “Pure Exporter: Theory and Evidence from China,” *The World Economy*, 37, 1219–1236.
- MANOVA, K. AND Z. YU (2012): “Firms and Credit Constraints along the Value-Added Chain: Processing Trade in China,” Manuscript, Stanford University.
- MAYER, T. AND G. OTTAVIANO (2007): *The happy few: the internationalisation of European firms New facts based on firm-level evidence*, Brussels: Bruegel.
- MELITZ, M. J. (2003): “The Impact of Trade on Intra-Industry Reallocations and Aggregate Productivity,” *Econometrica*, 71, 1695–1725.
- MELITZ, M. J. AND G. I. P. OTTAVIANO (2008): “Market Size, Trade, and Productivity,” *Review of Economic Studies*, 75, 295–316.
- MELITZ, M. J. AND S. J. REDDING (2015): “New Trade Models, New Welfare Implications,” *American Economic Review*, 105, 1105–46.
- MIRANDA, M. J. AND P. L. FACKLER (2004): *Applied Computational Economics and Finance*, The MIT Press.
- MIYAGIWA, K. F. (1986): “A Reconsideration of the Welfare Economics of a Free-trade Zone,” *Journal of International Economics*, 21, 337–350.
- MUNCH, J. R. AND D. X. NGUYEN (2014): “Decomposing Firm-level Sales Variation,” *Journal of Economic Behavior & Organization*, 106, 317–334.
- NAUGHTON, B. (1996): “China’s Emergence and Prospects as a Trading Nation,” *Brookings Papers on Economic Activity*, 27, 273–344.
- (2007): *The Chinese Economy: Transitions and Growth*, Cambridge, MA: MIT Press.

- PRASAD, E. AND S.-J. WEI (2007): “The Chinese Approach to Capital Inflows: Patterns and Possible Explanations,” in *Capital Controls and Capital Flows in Emerging Economies: Policies, Practices and Consequences*, ed. by S. Edwards, Chicago, IL: Chicago University Press.
- RODRIK, D. (1987): “The Economics of Export-Performance Requirements,” *The Quarterly Journal of Economics*, 102, 633–50.
- (2010): “Making Room for China in the World Economy,” *American Economic Review*, 100, 89–93.
- (2014): “When Ideas Trump Interests: Preferences, Worldviews, and Policy Innovations,” *Journal of Economic Perspectives*, 28, 189–208.
- SCHMINKE, A. AND J. VAN BIESEBROECK (2011): “Using Export Market Performance to Evaluate Regional Preferential Policies in China,” Center for Economic Studies Discussion Paper 11.33, Katholieke Universiteit Leuven.
- SONG, Z., K. STORESLETTEN, AND F. ZILIBOTTI (2011): “Growing Like China,” *American Economic Review*, 101, 196–233.
- STANDARD CHARTERED BANK (2007): “On the Ground, China,” Standard chartered research paper.
- WANG, J. (2013): “The Economic Impact of Special Economic Zones: Evidence from Chinese Municipalities,” *Journal of Development Economics*, 101, 133–147.
- WANG, Z. AND Z. YU (2012): “Trading Partners, Traded Products, and Firm Performance: Evidence from China’s Exporter-Importers,” *The World Economy*, 35, 1795–1824.
- WATERS, J. J. (2013): “Achieving World Trade Organization Compliance for Export Processing Zones while Maintaining Economic Competitiveness for Developing Countries,” *Duke Law Review*, 63, 481–524.
- WORLD BANK (2013): *China 2030: Building a Modern, Harmonious, and Creative Society*, Washington, DC: World Bank.
- (2014): *How to Sustain Export Dynamism by Reducing Duality in the Dominican Republic*, Washington, DC: World Bank.
- XU, C. (2011): “The Fundamental Institutions of China’s Reforms and Development,” *Journal of Economic Literature*, 49, 1076–1151.
- YÜCER, A. AND J.-M. SIROËN (forthcoming): “Trade Performance of Export Processing Zones,” *The World Economy*.

Protectionism through Exporting: Subsidies with Export Share Requirements in China

Appendix

A Data used to Construct Figures 1 and 2

Figure 1 is constructed using data drawn from the annual survey of Chinese manufacturing firms compiled by the National Bureau of Statistics (NBS). Figure 2, requires merging the NBS firm-level survey with transaction-level customs data from the Chinese General Administration of Customs so as to identify firms which based on their type, location and export intensity are more likely to be eligible to receive subsidies with ESR.

The NBS firm-level data includes state-owned enterprises and private firms with sales above 5 million Chinese Yuan; it contains detailed balance sheet information as well as firms' ownership status and total export sales. Firms in the survey account for approximately 95% of China's industrial output and 98% of its manufacturing exports.

The unit of observation in the NBS manufacturing survey is the firm, i.e. a legal unit (*faren danwei*). These need to satisfy the following requirements: (i) be established legally, having their own names, organization, location and being able to take civil liability; (ii) possess and use their assets independently, assume liabilities and be entitled to sign contracts with other units; and (iii) be financially independent and compile their own balance sheets (Brandt et al., 2014). This is the same level of aggregation at which the subsidies with ESR we document in the paper are defined.

Using the firm as our unit of analysis means that all variables of interest are calculated at the *firm-level*. For instance, the export intensity of multi-plant firms is calculated using total exports and total sales across all establishments that belong to the same firm. Again, this is coherent with the subsidies being defined at the firm- rather than at the establishment-level. Multi-plant firms however, constitute a minority in the NBS manufacturing survey; Brandt et al. (2012) document that single-plant firms account for more than 95% of the observations in the NBS manufacturing survey over the 1998-2007 period.

While the NBS data records firms' ownership status and their headquarters' physical address (which we use to determine if a firm is foreign-owned and whether or not is located in a FTZ respectively), it does not allow us to identify processing trade enterprises (PTE) because it does not record the value of exports sold through different customs regimes. To obtain information about a firm's reliance on processing exports, we merge the NBS dataset with transaction-level customs data.

To clean the data and rule out outliers, we follow Brandt et al. (2012). We drop observations that report missing, null or negative values for total output, employment, intermediate inputs, fixed capital, value-added or if export intensity exceeds 1. We also exclude firms with operation status recorded as 'inactive', 'bankrupt' or 'closed'. Lastly, we drop a small number of observations in which firms report zero exports in the manufacturing survey but show positive export transactions in the customs data for that particular year. In order to ensure a coherent and comparable industry classification over time we use the industry concordances suggested by Brandt et al. (2012).

Table A.1 presents summary statistics for the NBS firm-level and matched data. After cleaning the data, the NBS firm-level sample consists of 1,100,600 firm-year observations with exporting firms accounting for 28% of observations. We follow Manova and Yu (2012) and match the firm-level and customs data using firms' names as a common variable. By doing so, we are able to match approximately half of the observations reporting a positive value of exports in the NBS sample with their respective customs records. A detailed description of the matching procedure

is provided in the appendix of Wang and Yu (2012). Although each dataset uses different firm identifiers, a firm’s name is a reliable match variable because by law two firms are not allowed to have the same name in the same administrative region. The matched firms account for 47% of export volume for 2002-2006. Despite the loss of a large number of observations for exporters in the matching process, Table A.2 below shows that the export intensity distribution of our matched sample is almost identical to that produced by the NBS data.

Table A.1: Summary Statistics

	NBS Manufacturing Survey, 2000-2006		Matched Data, 2000-2006	
	Number of observations	Percentage	Number of observations	Percentage
Domestic firms	793,494	72.10	793,494	83.90
Exporting firms	307,106	27.90	152,217	16.10
Total	1,100,600	100	945,711	100

Firm Type and Location. We classify firms as processing trade enterprises based on how much they rely on the processing regime to sell abroad. We find that the distribution of export processing share exhibits a clear bimodal pattern: 72.1% of exporters use the processing regime for less than 10% of their export sales, while 15.5% sell more than 90% of their exports through processing. Thus, we define **Processing Trade Enterprises** (PTE) as firms selling more than 90% of their exports through processing trade. Based on this definition, PTEs may include firms that export all their output as well as firms selling domestically and abroad. We next identify **Foreign-Invested Enterprises** (FIE) as firms with a positive amount of foreign capital but that do not satisfy the criteria to be considered PTEs, and **Firms located in a Free Trade Zone** (FTZ) are firms situated in prefecture-level cities that feature Special Economic Zones, Coastal Development Zones or that belong to the Yangtze and Pearl River Delta Economic Zones. Our definition of FTZ excludes smaller industrial parks such as ‘Economic and Technological Development Zones’, ‘New and High-Tech Industrial Development Zones’ and ‘Export Processing Zones’, which also benefit from preferential treatment conditioned on ESR. Many of these have been set up along the coastline within prefecture-level cities already classified as FTZ in our definition.³³ Based on their location, ownership and customs status, more than 90% of all exporters in our sample are likely to be eligible to receive subsidies with ESR.

Table A.2 shows that half of exporters have an export intensity below 70%, while the group of high-intensity exporters is evenly split between exporters with an export intensity of at least 70% but that also sell their output domestically and pure exporters, each accounting for approximately a quarter of all exporting firms. Since Chinese-owned PTEs represent less than 0.7% of exporters, we dropped them, and group exporters based on their ownership status in order to compare the shares of regular and high-intensity exporters across firm types. High-intensity exporters are more prevalent among foreign-owned firms, and within this group, the subset of firms primarily engaged in export processing exhibit the highest share of high-intensity exporters. Interestingly, more than

³³Using a word search on firms’ addresses, Schminke and van Biesebroeck (2011) report 891 new firms established in ‘Economic and Technological Development Zones’ between 1999 and 2005, and 47% of them were located either in the Yangtze or Pearl River Delta Economic zone, already accounted as a FTZ in our definition. Tracking firms located in an ‘Export Processing Zone’ in our data is easier since the customs data provides a special coding identifying them. However, in 2006, only 166 firms can be classified as being located in any of these zones, and among them, 85% are located in a city which is already classified as a FTZ in our definition.

a third of PTEs sell 30% or more of their output domestically. This challenges the commonly held view that firms engaged in processing activities are fully specialized in production for exporting (Brandt and Morrow, 2013).

Table A.2: Percentage of Exporters by Export Intensity, Firm Type and Location

	Export Intensity		
	(0, 0.7)	[0.7, 1)	1
NBS Manufacturing Survey	50.49	24.94	24.56
Matched Data	50.82	25.56	23.62
• Chinese-owned firms (neither PTE nor FIE)	65.30	21.53	13.18
- In a Free Trade Zone (neither PTE nor FIE)	61.47	23.67	14.85
- Outside a Free Trade Zone (neither PTE nor FIE)	76.25	15.37	8.37
• Foreign-owned firms (FIE or PTE)	43.20	27.68	29.12
- Processing Trade Enterprises (PTE)	31.36	29.78	38.86
- Foreign-Invested Enterprises (FIE)	50.07	26.46	23.47

B List of Free Trade Zones

Special Economic Zones: They include six prefectures: Haikou, Sanya, Shantou Shi, Shenzhen, Xiamen, Zhuhai and the entire province of Hainan.

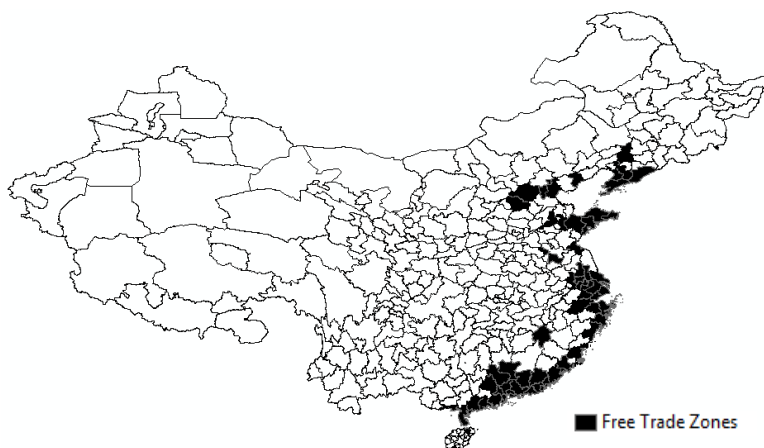
Coastal Development Zones: They include the Shanghai Economic area established in 1982. This zone does not cover entirely the Shanghai prefecture, and does not include the city center of Shanghai. We make use of firm’s postcode to exclude firms located in the city center from our definition of FTZ, i.e. postcodes starting with “2000”.

Coastal Development Zones also include the prefecture-cities of Anshan, Baoding, Beihai, Dalian, Dandong, Fuzhou, Guangzhou, Jinan, Langfang, Lianyungang, Nantong, Ningbo, Qingdao, Qinhuangdao, Quanzhou, Shenyang, Shijiazhuang, Tianjin, Weifang, Wenzhou, Weihai, Yantai, Yingkou, Zhanjiang, Zhangzhou, Zibo.

Yangtze River Delta Economic Zone: It includes cities located in the Yangtze River Delta but also some cities located outside the area due to mutual economic development. In 1982, the Chinese government set up the Shanghai Economic Area. Besides Shanghai, 4 cities in Jiangsu (Changzhou, Nantong, Suzhou, Wuxi) and 5 cities in Zhejiang (Hangzhou, Huzhou, Jiaying, Ningbo, Shaoxing) were included. In 1992, a 14-city cooperative joint meeting was launched. Besides the previous 10 cities, the members included Nanjing, Yangzhou and Zhenjiang in Jiangsu, and Zhoushan in Zhejiang. In 1998, Taizhou became a new member.

Pearl River Delta Economic Zone: The boundaries of the Pearl River Delta economic zone differ from those associated with the geographic boundaries of the delta. In 1985, the State Council designated the Pearl River Delta as an open economic zone. It contained three Special Economic Zones that were established earlier: Shantou, Shenzhen and Zhuhai. Other leading cities in the open zone are: Dongguan, Foshan, Guangzhou, Huizhou, Jiangmen and Zhongshan. ‘Peripheral’ cities that were declared open cities include: Chaozhou, Heyuan, Jieyang, Maoming, Meizhou, Qingyuan, Shanwei, Shaoguan, Yangjiang, Zhanjiang and Zhaoqing.

Figure B.1: Free Trade Zones Established Between 1979 and 2000



C Proof of Lemma 1

The Lagrangian of program (6) is:

$$\mathcal{L} = (1+s_r)(A_{HH}(\omega)(p_{HH}^\eta)^{1-\sigma} + A_{HF}(\omega)(p_{HF}^\eta)^{1-\sigma}) - \left(\frac{w_H}{\varphi}\right) (A_{HH}(\omega)(p_{HH}^\eta)^{-\sigma} + \tau_{HF}A_{HF}(\omega)(p_{HF}^\eta)^{-\sigma}) - (1-s_f)(f_{HH} + f_{HF})w_H + \lambda \left[\frac{A_{HF}(\omega)(p_{HF}^\eta)^{1-\sigma}}{A_{HH}(\omega)(p_{HH}^\eta)^{1-\sigma} + A_{HF}(\omega)(p_{HF}^\eta)^{1-\sigma}} - \eta \right], \quad (\text{C.1})$$

where $\lambda \geq 0$ is the multiplier associated with the ESR constraint. The first-order conditions (FOC) are given by:

$$[p_{HH}^\eta]: \quad -(\sigma-1)(1+s_r)A_{HH}(\omega)(p_{HH}^\eta)^{-\sigma} + \sigma(w_H/\varphi)A_{HH}(\omega)(p_{HH}^\eta)^{-\sigma-1} + \lambda(\sigma-1) \left[\frac{A_{HH}(\omega)A_{HF}(\omega)(p_{HH}^\eta)^{-\sigma}(p_{HF}^\eta)^{1-\sigma}}{(A_{HH}(\omega)(p_{HH}^\eta)^{1-\sigma} + A_{HF}(\omega)(p_{HF}^\eta)^{1-\sigma})^2} \right] = 0, \quad (\text{C.2})$$

$$[p_{HF}^\eta]: \quad (\sigma-1)(1+s_r)A_{HF}(\omega)(p_{HF}^\eta)^{-\sigma} + \sigma(\tau_{HF}w_H/\varphi)A_{HF}(\omega)(p_{HF}^\eta)^{-\sigma-1} - \lambda(\sigma-1) \left[\frac{A_{HH}(\omega)A_{HF}(\omega)(p_{HF}^\eta)^{-\sigma}(p_{HH}^\eta)^{1-\sigma}}{(A_{HH}(\omega)(p_{HH}^\eta)^{1-\sigma} + A_{HF}(\omega)(p_{HF}^\eta)^{1-\sigma})^2} \right] = 0, \quad (\text{C.3})$$

and,

$$[\lambda]: \quad \frac{A_{HF}(\omega)(p_{HF}^\eta)^{1-\sigma}}{A_{HH}(\omega)(p_{HH}^\eta)^{1-\sigma} + A_{HF}(\omega)(p_{HF}^\eta)^{1-\sigma}} - \eta \geq 0. \quad (\text{C.4})$$

Assume by way of contradiction that when $\eta_H^{dx}(\omega) = \frac{\tau_{HF}^{1-\sigma}A_{HF}(\omega)}{A_{HH}(\omega) + \tau_{HF}^{1-\sigma}A_{HF}(\omega)} < \eta$, the ESR constraint is not binding. This implies that $\lambda = 0$. Solving the system of equations given by (C.2) and (C.3), it follows that $p_{HH}^\eta = \frac{1}{1+s_r} \frac{\sigma}{\sigma-1} \frac{w_H}{\varphi}$ and $p_{HF}^\eta = \tau_{HF} p_{HH}^\eta$. This in turn implies that a firm's export intensity is equal to $\eta_H^{dx}(\omega)$, which does not satisfy the ESR constraint. Therefore, the ESR constraint is binding for a firm that chooses to sell at home and abroad and receives subsidies with ESR. ■

D Properties of $\Theta(\eta)$

The profit-shifting term for an exporter selling a share η of its output abroad is given by:

$$\Theta(\eta) \equiv \frac{A_{HH}A_{HF}}{\left[(1-\eta)^{\frac{\sigma}{\sigma-1}} A_{HF}^{\frac{1}{\sigma-1}} + \eta^{\frac{\sigma}{\sigma-1}} \tau_{HF} A_{HH}^{\frac{1}{\sigma-1}} \right]^{\sigma-1}}, \quad (\text{D.1})$$

where is understood that both A_{HH} and A_{HF} are firm-specific demand shifters which depend on a firm's state vector ω .

It is straightforward to verify that $\Theta(0) = A_{HH}$ and $\Theta(1) = \tau_{HF}^{1-\sigma} A_{HF}$.

We now establish that Θ is maximized at a firm's natural export intensity, η_H^{dx} .

$$\frac{d\Theta}{d\eta} = -\sigma(A_{HH}A_{HF}) \left[(1-\eta)^{\frac{\sigma}{\sigma-1}} A_{HF}^{\frac{1}{\sigma-1}} + \eta^{\frac{\sigma}{\sigma-1}} \tau_{HF} A_{HH}^{\frac{1}{\sigma-1}} \right]^{-\sigma} \cdot \left(-(1-\eta)^{\frac{1}{\sigma-1}} A_{HF}^{\frac{1}{\sigma-1}} + \tau_{HF} \eta^{\frac{1}{\sigma-1}} A_{HH}^{\frac{1}{\sigma-1}} \right) = 0, \quad (\text{D.2})$$

Solving for η in (D.2) yields:

$$(\eta_H^{dx})^* = \frac{\tau_{HF}^{1-\sigma} A_{HF}}{A_{HH} + \tau_{HF}^{1-\sigma} A_{HF}} = \eta_H^{dx}. \quad (\text{D.3})$$

Substituting (D.3) into (D.1) verifies that $\Theta(\eta_H^{dx}) = A_{HH} + \tau_{HF}^{1-\sigma} A_{HF}$. The second-order sufficient condition reads:

$$\begin{aligned} \frac{d^2\Theta}{d\eta^2} = & -\frac{\sigma}{\sigma-1}(A_{HH}A_{HF}) \left\{ \sigma \left(\tau_{HF} \eta^{\frac{1}{\sigma-1}} A_{HH}^{\frac{1}{\sigma-1}} - (1-\eta)^{\frac{1}{\sigma-1}} A_{HF}^{\frac{1}{\sigma-1}} \right)^2 + \right. \\ & \left. \left(\tau_{HF} \eta^{\frac{\sigma}{\sigma-1}} A_{HH}^{\frac{1}{\sigma-1}} + (1-\eta)^{\frac{\sigma}{\sigma-1}} A_{HF}^{\frac{1}{\sigma-1}} \right) \cdot \left(\tau_{HF} \eta^{\frac{2-\sigma}{\sigma-1}} A_{HH}^{\frac{1}{\sigma-1}} + (1-\eta)^{\frac{2-\sigma}{\sigma-1}} A_{HF}^{\frac{1}{\sigma-1}} \right) \right\} < 0, \quad (\text{D.4}) \end{aligned}$$

which proves that Θ is a concave function of η , and therefore, that $(\eta_H^{dx})^*$ is a global maximum. ■

E Subsidies with ESR Granted only on Export Sales

In this case, the ad-valorem subsidy s_r is only granted to a firm's export sales. Thus, the problem of a firm a vector of export subsidies (s_r, s_f) with an export share requirement $\eta \in (0, 1]$ is

$$\begin{aligned} \max_{p_{HH}^\eta, p_{HF}^\eta} \left\{ A_{HH}(\omega)(p_{HH}^\eta)^{1-\sigma} + (1+s_r)A_{HF}(\omega)(p_{HF}^\eta)^{1-\sigma} - \left(\frac{w_H}{\varphi} \right) [A_{HH}(\omega)(p_{HH}^\eta)^{-\sigma} + \tau_{HF}A_{HF}(\omega)(p_{HF}^\eta)^{-\sigma}] \right. \\ \left. - (1-s_f)(f_{HH} + f_{HF})w_H \right\} \quad \text{subject to:} \quad \frac{A_{HF}(\omega)(p_{HF}^\eta)^{1-\sigma}}{A_{HH}(\omega)(p_{HH}^\eta)^{1-\sigma} + A_{HF}(\omega)(p_{HF}^\eta)^{1-\sigma}} \geq \eta. \end{aligned} \quad (\text{E.1})$$

Since Lemma 1 still holds, we know that the ESR constraint is binding, and can substitute $(1+s_r)A_{HF}(\omega)(p_{HF}^\eta)^{1-\sigma} = (1+s_r)[\eta/(1-\eta)]A_{HH}(\omega)(p_{HH}^\eta)^{1-\sigma}$ and $\tau_{HF}A_{HF}(\omega)(p_{HF}^\eta)^{-\sigma} = \tau_{HF}A_{HF}(\omega)[\eta A_{HH}(\omega)/(1-\eta)A_{HF}(\omega)]^{\sigma/(\sigma-1)}(p_{HH}^\eta)^{-\sigma}$ into the objective function in (E.1), so that it becomes an unconstrained maximization problem with respect to one variable, p_{HH}^η :

$$\max_{p_{HH}^\eta} \left\{ \left(\frac{1+\eta s_r}{1-\eta} \right) A_{HH}(\omega)(p_{HH}^\eta)^{1-\sigma} - \left(\frac{w_H}{\varphi} \right) \left[\frac{(1-\eta)^{\frac{\sigma}{\sigma-1}} A_{HF}(\omega)^{\frac{1}{\sigma-1}} + \tau_{HF} \eta^{\frac{\sigma}{\sigma-1}} A_{HH}(\omega)^{\frac{1}{\sigma-1}}}{(1-\eta)^{\frac{\sigma}{\sigma-1}} A_{HF}(\omega)^{\frac{1}{\sigma-1}}} \right] A_{HH}(\omega)(p_{HH}^\eta)^{-\sigma} \right\} \quad (\text{E.2})$$

Solving the first-order conditions associated with (E.2) for p_{HH}^η yields:

$$p_{HH}^\eta(\omega) = \left[\frac{(1-\eta)^{\frac{\sigma}{\sigma-1}} A_{HF}(\omega)^{\frac{1}{\sigma-1}} + \eta^{\frac{\sigma}{\sigma-1}} \tau_{HF} A_{HH}(\omega)^{\frac{1}{\sigma-1}}}{(1-\eta)^{\frac{1}{\sigma-1}} A_{HF}(\omega)^{\frac{1}{\sigma-1}}} \right] \frac{1}{1+\eta s_r} \frac{\sigma}{\sigma-1} \left(\frac{w_H}{\varphi} \right), \quad (\text{E.3})$$

and since $p_{HF}^\eta = \left(\frac{(1-\eta)A_{HF}(\omega)}{\eta A_{HH}(\omega)} \right)^{\frac{1}{\sigma-1}} p_{HH}^\eta$, we have:

$$p_{HF}^\eta(\omega) = \left[\frac{(1-\eta)^{\frac{\sigma}{\sigma-1}} A_{HF}(\omega)^{\frac{1}{\sigma-1}} + \eta^{\frac{\sigma}{\sigma-1}} \tau_{HF} A_{HH}(\omega)^{\frac{1}{\sigma-1}}}{\eta^{\frac{1}{\sigma-1}} A_{HH}(\omega)^{\frac{1}{\sigma-1}}} \right] \frac{1}{1+\eta s_r} \frac{\sigma}{\sigma-1} \left(\frac{w_H}{\varphi} \right). \quad (\text{E.4})$$

Notice that since the terms in brackets in equations (E.3) and (E.4) are respectively greater than 1 and lower than τ_{HF} when $\eta \in (\eta_H^{dx}, 1)$, Proposition 1 still holds. Plugging (E.3) into (E.2) results in optimal profits,

$$\pi_H^\eta(\omega; s_r, s_f, \eta) = \kappa(1+\eta s_r)^\sigma \Theta(A_{HH}(\omega), A_{HF}(\omega), \eta, \tau) \left(\frac{\varphi}{w_H} \right)^{\sigma-1} - (1-s_f)(f_{HH} + f_{HF})w_H, \quad (\text{E.5})$$

with $\Theta(A_{HH}(\omega), A_{HF}(\omega), \eta, \tau)$ defined in equation (10).

F Solution Algorithm

In this section we outline the algorithm used to solve the general equilibrium model presented in Section 3. Recall that we have assumed in our benchmark that both countries are identical in terms of preferences, endowments and the distributions of productivity and demand shifters and the parameters governing these objects.

1. Approximate the distributions of firm-destination-specific demand shifters using the Gaussian quadrature procedure described in Miranda and Fackler (2004). This produces grids $Z_{ii} = [z_{ii,1}, \dots, z_{ii, N_z}]$ and $Z_{ij} = [z_{ij,1}, \dots, z_{ij, N_z}]$, as well as cumulative density functions $F_{z_{ii}}$ and $F_{z_{ij}}$, where $i, j \in \{H, F\}$, such that domestic and export demand shifters are log-normally distributed with underlying parameters (μ_d, σ_d^2) and (μ_x, σ_x^2) respectively.
2. For each possible combination of domestic and export demand shifters (z_{ii}, z_{ij}) , determine the minimum productivity level necessary for a firm at Home to operate in each one of the available modes of operation. At Home (the country utilizing subsidies with ESR) these are summarized in Table 1; at Foreign, the modes of operation available are: domestic, regular exporter and pure exporter. The minimum productivity necessary for a firm of type k in country i to operate profitably is given by:

$$\varphi_i^*(z_{ii}, z_{ij}) = \min_k \left\{ \varphi_i^{*,k} \right\},$$

where $\varphi_i^{*,k} = \{\varphi : \pi_i^k(\varphi; z_{ii}, z_{ij}) = 0\}$.

3. For each $\varphi_i^*(z_{ii}, z_{ij})$, approximate the Pareto distribution of productivity conditional on survival, i.e. a Pareto distribution with shape parameter a and scale parameter $\varphi_i^*(z_{ii}, z_{ij})$, again

using Gaussian quadrature. This produces a productivity grid $\Phi_i = [\varphi_1, \dots, \varphi_{N_\varphi}]$ and a cumulative density function F_φ . Construct a grid of size $N_\varphi \times N_z^2$ for firms' state vector ω_i , given by the tensor product of the productivity and demand shifter grids, $\Omega_i = \Phi_i \otimes Z_{ii} \otimes Z_{ij}$. Since productivity draws and demand shifters are independent from each other, the corresponding cumulative density function for $\omega \in \Omega_i$ is given by $\mathcal{F}_i(\omega) = F_{\varphi,i} \otimes F_{z_{ii}} \otimes F_{z_{ij}}$. Notice that when subsidies are in place, equilibrium will not be symmetrical and therefore the distribution of productivity differs across countries.

4. For each element $\omega \in \Omega_i$, we solve firms' problem, i.e. we determine the production mode k that maximizes profits, and we record firms' optimal prices $\{p_{ij}^k(\omega)\}$, quantities $\{q_{ij}^k(\omega)\}$, sales revenue (net of subsidies) $\{r_{ij}^k(\omega)\}$, profits $\{\pi_i^k(\omega)\}$ and labor demand $\{l_i^k(\omega)\}$, in each country $i, j \in \{H, F\}$.
5. The general equilibrium $(M_H, M_F, P_H, P_F, E_H, E_F, w_F)$ of this economy is found as the solution to the following system of 7 non-linear equations:

- Labor market clearing:

$$M_i \left[\sum_k \int l_i^k(\omega) d\mathcal{F}_i(\omega) \right] = L_i, \quad i \in \{H, F\} \quad (\text{F.1})$$

- Free entry:

$$\left[\int \int [1 - F_{\phi,i}(\varphi^*(z_{ii}, z_{ij}))] dF_{z_{ii}}(z_{ii}) dF_{z_{ij}}(z_{ij}) \right] \cdot \left[\sum_k \int \pi_i^k(\omega) d\mathcal{F}_i(\omega) \right] = w_i f_e, \quad i \in \{H, F\} \quad (\text{F.2})$$

- Aggregate income consistency:

$$E_i = w_i L_i - T_i, \quad i \in \{H, F\} \quad (\text{F.3})$$

where,

$$T_H = \sum_{k \in \{dxu, dxc, xu, xc\}} \left[M_H \left\{ \frac{s_r}{1 + s_r} \int [r_{HH}^k(\omega) + r_{HF}^k(\omega)] 1_H^k(\omega) d\mathcal{F}_H(\omega) + s_f \int 1_H^k(\omega) d\mathcal{F}_H(\omega) \right\} \right],$$

and $T_F = 0$, and,

- Balanced trade:

$$M_H \left[\int r_{HF}^{dx}(\omega) d\mathcal{F}_H(\omega) + \sum_{k \in \{dxu, dxc, xu, xc\}} \frac{1}{1 + s_r} \int r_{HF}^k(\omega) 1_H^k(\omega) d\mathcal{F}_H(\omega) \right] = M_F \left[\sum_{k \in \{dx, x\}} \int r_{FH}^k(\omega) d\mathcal{F}_H(\omega) \right], \quad (\text{F.4})$$

where $1_i^k(\omega)$ is the indicator function taking the value 1 when a firm in country i with state vector ω uses operation mode k .

G Calibrating the Model Using the Export Intensity Distribution of China in 2013

In this section we present the model's parameters (Table G.1) and the subsidy comparison results (Table G.2) when the export intensity distribution of China in 2013 (drawn from the World Bank Enterprise Surveys) is used to calibrate the natural export intensity distribution prevailing under laissez-faire.

Table G.1: Parameter Values — China 2013 Export Intensity

Description	Value
Assigned parameters:	
Country size (L)	1
Elasticity of substitution (σ)	3
Shape parameter productivity distribution (a)	2.713
Scale parameter productivity distribution (φ)	1
Fixed cost — domestic sales (f^d)	1
Transport cost (τ)	1.7
Calibrated parameters:	
Fixed cost — entry (f^e)	3.458
Fixed cost — exporting (f^x)	0.719
Domestic demand shifters ($\ln(z_{ii}) \sim \mathcal{N}(\mu_d, \sigma_d^2)$)	(-0.685, 1.371)
Export demand shifters ($\ln(z_{ij}) \sim \mathcal{N}(\mu_x, \sigma_x^2)$)	(-1.538, 0.898)

Table G.2: Comparison of Export Subsidies — China 2013 Export Intensity

Variable	Subsidy with Export Share Requirements (1)	Unconditional Export Subsidy (2)
	% change w.r.t. laissez-faire	
Wage, Foreign	-4.484	-2.170
Price index, Home	1.403	-0.280
Price index, Foreign	-5.477	-2.546
Probability of exit, Home	-2.363	-0.626
Probability of exit, Foreign	-0.912	-0.403
Welfare, Home	-3.314	-0.383
Welfare, Foreign	1.044	0.107
Exports/GDP	9.550	2.701
	percentage point change w.r.t. laissez-faire	
Share of Home Exporters with export intensity		
$\in [0.7, 1)$	9.800	-0.180
$= 1$	9.100	0.410

Column (1) compares an 8.7% ad-valorem subsidy to export sales granted to firms with an export intensity of at least 70% with the laissez-faire equilibrium. Column (2) compares a 5.35% ad-valorem subsidy to export sales made available to all exporting firms regardless of their export intensity with the laissez-faire equilibrium. Both subsidy schemes result in aggregate subsidy expenditure accounting for 0.67% of Home's GDP. Neither Home nor Foreign conducts any trade policy under laissez-faire, but trade costs in both directions are maintained at their calibrated level (1.7) across all scenarios.

H Sensitivity Analysis

Table H.1: Sensitivity Analysis of Model Parameters

Variable	8.7% Export Sales Subsidy with ESR						
	Benchmark	Δ 10% from benchmark parametrization					
	σ	f^d	f^e	L_f	φ_F	τ	
	% change w.r.t. laissez-faire						
Wage, Foreign	-2.18	-2.41	-2.22	-2.20	-2.31	-2.35	-1.85
Price index, Home	0.14	0.19	0.05	0.05	0.11	0.14	0.12
Price index, Foreign	-2.42	-2.62	-2.47	-2.48	-2.54	-2.59	-2.00
Probability of exit, Home	-6.54	-4.47	-7.25	-9.38	-7.73	-7.08	-4.42
Probability of exit, Foreign	-1.15	-0.65	-1.14	-2.50	-1.14	-1.20	-0.34
Welfare, Home	-0.83	-0.63	-0.64	-0.67	-0.67	-0.71	-0.33
Welfare, Foreign	0.41	0.19	0.33	0.41	0.25	0.25	0.03
Exports/GDP	6.32	6.29	5.33	6.28	5.32	5.31	3.10
	percentage point change w.r.t. laissez-faire						
Share of Home Exporters with export intensity							
$\in [0.7, 1)$	4.30	3.80	3.50	4.10	3.40	3.70	2.70
$= 1$	6.88	7.30	7.40	6.50	7.00	6.90	6.70

The table reports a comparison between the equilibrium value of a given variable when Home offers an 8.7% ad-valorem subsidy to export sales to firms with an export intensity of at least 70% relative to laissez-faire.

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