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Special Economic Zones and WTO Compliance: Evidence from the Dominican Republic

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Special economic zones (SEZ), one of the most important instruments of industrial policy used in developing countries, often impose export share requirements (ESR). That is, firms located in SEZ are required to export more than a certain share of their output to enjoy a wide array of incentives—a practice prohibited by the World Trade Organization (WTO) Agreement on Subsidies and Countervailing Measures. In this paper we exploit the staggered removal of ESR across products and over time in the SEZ of the Dominican Republic—a reform driven by external commitments to comply with WTO disciplines on subsidies—to evaluate how ESR affect export performance at the product and firm levels. Using customs data on international trade transactions from the period 2006 to 2014, we find that making the Dominican SEZ regime WTO-compliant made SEZ more attractive locations for exporters to be based in. The reform, however, did not have a significant effect on the country's exports or on the share of export value originating from SEZ.

Introduction

On 31 July 2007, the General Council of the World Trade Organization (WTO) set 31 December 2015 as the final deadline for the elimination of prohibited export subsidies in the Dominican Republic and 18 other developing countries that had previously been exempted from complying with the WTO disciplines on subsidies.[1] The majority of programmes to be eliminated or reformed (if the prohibited export subsidy component was removed) were fiscal incentives provided to firms operating in special economic zones (SEZ)—geographically-bounded areas in which customs, tax and investment regulations are more liberal than in the rest of the country (Farole and Akinci 2011). Although SEZ are not forbidden by the WTO, they often impose export share requirements (ESR)—i.e. firms located there are required to export at least a certain share of their output to receive the subsidies provided by the SEZ regime (Defever and Riaño 2017a). Doing so makes the subsidies provided in SEZ contingent on export performance, and therefore prohibited under the rules stipulated by the Agreement on Subsidies and Countervailing Measures (ASCM).

In this paper we investigate how the removal of ESR in SEZ affected export performance at the product and firm levels in the Dominican Republic. To do so, we exploit the staggered elimination of ESR across industries and over time. Before 2007, all firms located in SEZ faced an 80% ESR. The first wave of reform implemented in August 2007 (Law 56-07), eliminated ESR only for SEZ firms producing leather, textiles, and apparel and footwear products—the so-called 'national priority' sectors—while in June 2011, Law 139-11 lifted ESR for all firms in SEZ regardless of their sector of operation. Crucially for our purposes, both the timing and the selection of sectors that experienced the removal of ESR first were largely determined by external factors—namely, the decision by the Dominican Republic to join the Central American Free Trade Agreement

(CAFTA-DR) in 2004, the end of the Multi-Fibre Arrangement (MFA) in 2005, and, ultimately, the 2015 deadline to comply with the ASCM.

To the best of our knowledge, this is the first paper to study how achieving compliance with WTO disciplines on subsidies—specifically through the elimination of export requirements in SEZ—affects export performance at the microeconomic level. This is an issue of tremendous importance because SEZ are ubiquitous across the world, account for a large share of exports in many countries and are one of the most important tools of industrial policy in developing countries (Rodrik 2004). *The Economist* (2015) reports the existence of 4300 SEZ across the world—accounting for approximately 200 billion US dollars worth of exports. Additionally, the inherent difficulty in defining and measuring export subsidies, combined with a lack of comparable data across countries and industries, has resulted in fewer empirical studies investigating them than any other instrument of commercial policy (WTO 2006).

Our empirical analysis is underpinned by a stylized model in which firms are heterogeneous in terms of the demand that they face for their exports. Given their type, firms choose whether to locate in the SEZ or in the national customs territory. Operating in the SEZ involves paying a fixed registration cost, but provides firms with a subsidy that is conditioned on them exporting more than a share $\underline{\eta} \in (0,1]$ of their sales. Firms in the national customs territory do not face a registration cost or any restrictions on their domestic sales, but do not receive any subsidy either. Firms' location choice is determined by their 'natural' export intensity—the share of revenues that would have been accounted for by exports if they were based in the national customs territory. Firms that would naturally export most of their output choose to operate in the SEZ, whereas firms for which domestic demand is more important locate outside the zones. Firms with a natural export intensity below the ESR threshold face a trade-off: operating in the SEZ lowers their profitability because they need to distort their optimal mix of domestic sales and exports to satisfy ESR, but on the other hand, it allows them to receive a subsidy.

We use our model to derive predictions regarding how the elimination of ESR affects the number of exporters based in the SEZ and their export sales. As the distortion associated with ESR is eliminated, more firms find it profitable to operate in the SEZ. This effect operates both through the relocation of firms from the national customs territory towards the SEZ but also through entry of new firms. The effect of the reform on exports sales originating from the SEZ is ambiguous, however, because firm-level export responses differ along the distribution of natural export intensity. On the one hand, firms that enter the SEZ increase their exports because they are now subsidized. On the other hand, firms that were already based in the SEZ—and which found ESR binding—lower their exports in response to the policy change. Unconstrained SEZ exporters—those that would have operated at an export intensity greater than ESR even without incentives—and firms that remain in the national customs territory are not affected by the reform.

We use customs transactions data for the period 2006–14 to verify the predictions obtained from our model. We find that within narrowly-defined products (HS 6-digit), the removal of ESR had a positive and significant effect on the share of firms exporting from the SEZ, whereas we do not find a significant change in the share of export value originating from the zones. At the firm level, we find a positive and significant effect of the reforms on export entry (extensive margin), defined at both firm level and firm–product level for firms located in the SEZ, while for firms in the national customs territory we observe the opposite response. At the intensive margin, we find a significant reduction in the value of export shipments for firms that remained in the SEZ—which suggests that a substantial number of these producers found the ESR constraint binding.

We also investigate if a tariff reduction for key inputs used in the production of priority sectors led to higher imports among firms in the national customs territory. This policy—which was implemented only in the first wave reforms in 2007—had the objective of levelling the playing field between firms across locations. Despite its intentions, our results show that this tariff liberalization was largely ineffective.

Our main conclusion is that lifting ESR in the SEZ—while maintaining the subsidies offered there—made the SEZ more attractive locations to export from, but without significantly increasing the value of export originating from the SEZ or from the country as a whole.

The rest of the paper is organized as follows. Section I explains how our paper relates to existing literature. Section II summarizes the rules on subsidies established in the ASCM; it also describes the regulations governing the SEZ in the Dominican Republic and the changes introduced by Laws 56-07 and 139-11, which eliminated ESR. Section III sketches our model and outlines predictions about how the elimination of ESR affects export performance at the product and firm level. Section IV presents our data and provides descriptive statistics regarding export patterns in the Dominican Republic. Section V discusses our empirical strategy and presents our results. Section VI concludes and discusses the policy implications of our results.

I. Related Literature

Our paper lies at the intersection of two literatures that, despite being closely related, rely on very different methodological approaches. On the one hand, Rose (2004), Subramanian and Wei (2007), and Eicher and Henn (2011) explore whether belonging to the GATT/WTO (i.e. adopting all relevant legal provisions incorporated in the different articles of the agreements) increases a country's exports. Our paper contributes to this literature by focusing specifically on the disciplines regarding export subsidies. On the other hand, Bagwell and Staiger (2006), DeRemer (2013) and Lee (2016) study instead the normative consequences of WTO subsidy rules from a theoretical standpoint. We complement this work by exploring the effect of complying with WTO rules on subsidies from a positive—and empirical—perspective.

Export performance requirements and SEZ have been studied as second-best trade policy instruments that can help to reduce the anti-export bias of a trade policy regime (Davidson *et al*. 1985; Rodrik 1987; Hamada 1974; Devereux and Chen 1995). More recently, Defever and Riaño (2015, 2017a) study the welfare consequences of imposing ESR on subsidies using a quantitative model calibrated to the Chinese experience with this type of policy. Our paper contributes to this literature by investigating how the elimination of ESR affects export performance at the firm and product levels. The reforms undertaken by the Dominican Republic offer two clear advantages relative to the case of China in terms of understanding the consequences of ESR. First, we can readily identify in the data the firms that are subject to a single ESR; in China, in contrast, several often overlapping policies are subject to different ESR thresholds. Second, the variation in the elimination of ESR across sectors and over time allows us to identify their effect on export performance at the microeconomic level. Our paper also contributes to the growing literature that investigates how special economic zones affect export performance (Wang 2013; Davies and Mazhikeyev 2015; Yücer and Siroën 2017).

The Dominican Republic stands at the heart of a long-standing debate on the role of SEZ as an industrial policy to foster economic development (Volpe Martincus 2010). One side argues that overreliance on SEZ has led to the country's specialization in unskilled

labour production, which has in turn resulted in immiserizing growth (Kaplinsky 1993). The other side claims that SEZ have been very successful in promoting exports without threatening local producers (Willmore 1995). Our paper speaks to this discussion by evaluating how policy efforts aimed at promoting a new kind of SEZ—one in which firms are not precluded from selling domestically—affect exports, one of the key performance dimensions for SEZ.

II. Compliance with WTO Subsidy Disciplines in the Dominican Republic

This section provides a brief summary of the WTO Agreement on Subsidies and Countervailing Measures (ASCM), and its definition of subsidy. It also describes both the incentives and requirements incorporated in the Dominican SEZ regime at the beginning of our period of study and the reforms introduced by Laws 56-07 and 139-11 in 2007 and 2011, respectively, which made the regime compliant with the WTO rules on subsidies.

The ASCM and Article 27.4

The ASCM was put into place in 1995 following the Uruguay round of multilateral trade negotiations. It provides a precise definition of subsidy and determines the contingencies under which specific practices are actionable—i.e. the conditions under which a member country can use countervailing measures to offset injury caused by subsidized imports (Sykes 2005). Actionable subsidies may be challenged if they cause adverse effects to a WTO member country. Adverse effects include injury to a domestic industry, export displacement in third markets or 'nullification' of market access gains (Hartigan 1996).

A subsidy is defined as a financial contribution by a government or public body conferring a benefit to a recipient. Examples include direct transfers of funds such as grants and loans, foregone government revenue (fiscal incentives) and provision of goods other than infrastructure by the government. In order for a subsidy to be subject to the disciplines of the ASCM, it must be considered 'specific'—i.e. it has to be explicitly limited to a subset of enterprises, in terms of either their industry or their geographic location. The argument is that this class of subsidies has the greatest potential to distort the allocation of resources within an economy (Creskoff and Walkenhorst 2009). Crucially, the ASCM establishes that subsidies contingent in law or in fact on export performance, or those that are conditioned on local content requirements, are prohibited.

Developing countries not covered by Annex VII of the ASCM[2] had an eight-year grace period since the inception of the agreement to phase out or reform prohibited export subsidies. Nevertheless, due to economic, financial and development reasons, the Dominican Republic and the other countries listed in note 1 were allowed to apply for an extension to certain subsidy programmes subject to notification and prior approval requirements under Article 27.4 of the ASCM.[3] This extension was initially granted until December 2007 and was subject to annual reviews. In July 2007, however, the WTO General Council approved a final, irrevocable extension to December 2013, with a final two-year phase-out period ending no later than 31 December 2015.

The SEZ regime in the Dominican Republic

The Dominican Republic is one of the world's pioneers in the use of SEZ with a programme that has been in operation for more than 40 years (Burgaud and Farole

2011). Law 8-90 of January 1990 established the regulatory framework governing special economic zones (*Zonas Francas*) in the Dominican Republic. The objectives of SEZ are to attract local and foreign investment, provide training, and encourage the transfer of technology and know-how in order to create employment, particularly in deprived areas such as the border with Haiti.

Law 8-90 establishes a generous array of fiscal incentives to firms located in the SEZ. These include duty-free access to imported inputs and capital goods, and a 15-year (20 years for firms located in border zones) 100% exemption of registration, construction, corporate income, gross sales and value-added taxes. The World Bank (2014) estimates that the value of tax breaks offered to SEZ companies in 2014 stands at approximately 540 million US dollars, or 0.9% of the Dominican Republic's GDP—a substantial cost in terms of foregone government revenue.

Firms located in Dominican SEZ were subject to an 80% export share requirement.[4] This made the SEZ regime a prohibited subsidy under the ASCM because the incentives described above were contingent on export performance. Firms located outside the SEZ and exporting through the national customs territory, on the other hand, were not subject to any performance obligations regarding their export behaviour.

Until 2007, ESR applied equally to all firms in the SEZ regardless of their sector of operation, as can be seen in the first row of Table 1. Law 56-07, which was signed on 4 May 2007 and started being implemented on 27 August 2007, amended Law 8-90 and declared leather, textiles and apparel and footwear to be 'national priority' sectors. The second and fifth rows of Table 1 summarize the changes brought about by Law 56-07 for SEZ and non-SEZ firms in priority and non-priority sectors. SEZ firms in priority sectors saw the full removal of ESR, which meant that they could now sell all their output in the Dominican Republic; moreover, these domestic sales were not subject to import duties. Priority-sector firms located outside the SEZ received tax concessions similar to those available to their SEZ counterparts, and enjoyed duty-free access to 126 HS 6-digit key imported inputs.

The 2007 reform maintained the 80% ESR for SEZ firms producing non-priority goods, but offered them duty-free access to the domestic market—provided that either the good in question was not produced in the Dominican Republic, or it incorporated at least 25% of locally-sourced intermediate inputs in value terms. The incentives available to SEZ firms in priority and non-priority sectors did not change with this reform. Firms located outside the SEZ producing non-priority goods were not directly affected by Law 56-07.

Law 139-11 (implemented on 24 June 2011) completely eliminated ESR for all SEZ firms, regardless of their sector of operation, in accordance with the compromises signed under the CAFTA-DR free trade agreement. SEZ firms in priority sectors retained their duty-free access to the Dominican market, whereas their non-priority counterparts were required to pay the customary import tariffs. All SEZ firms are now required to pay a 3.5% gross sales tax and 18% VAT on their domestic sales (see the third row of Table 1), while non-SEZ firms were not affected by this reform.

Timing of the reforms

Although the need to make the SEZ regime compliant with ASCM disciplines was clear since 1995, there is suggestive evidence that the timing and implementation of the removal of ESR in the Dominican Republic was largely unexpected and precipitated by external factors.

TABLE 1
CHANGES IN THE SEZ REGULATIONS IN THE DOMINICAN REPUBLIC, 2006–14

	Period	National priority sectors	Non-priority sectors
SEZ firms			
(1)	2006–7	80% ESR; duty-free imports of intermediate inputs and capital goods; full exemption of gross sales, registration, construction, corporate income and value-added (ITBIS) tax for 15 years (20 years for firms in border SEZ)	
	Law 56-07 signed on 4 May 2007; started being implemented on 27 August 2007		
(2)	2008–11	ESR fully removed; duty-free access to domestic market	80% ESR remains; duty-free access on domestic sales if product is not produced in DR or has at least 25% of local input content
	Law 139-11 signed on 24 June 2011; started being implemented on same date		
(3)	2012–14	Domestic sales remain free of import duties but are subject to a 3.5% tax on gross sales and 18% VAT	ESR fully removed; domestic sales are subject to import duty, 3.5% tax on gross sales and 18% VAT
Non-SEZ firms			
(4)	2006–7	No ESR; subject to national customs regime	
	Law 56-07 signed on 4 May 2007; started being implemented on 27 August 2007		
(5)	2008–11	Duty-free access to 126 'priority' intermediate inputs; exemption of VAT (ITBIS)	No change
	Law 139-11 signed on 24 June 2011; started being implemented on same date		
(6)	2012–14		No change

Notes
Sources: Law 56-07 (available in Spanish at https://www.dgii.gov.do/legislacion/leyesTributarias/Documents/56-07.pdf, accessed 13 May 2018);
Law 139-11 (available in Spanish at https://www.dgii.gov.do/legislacion/leyesTributarias/Documents/139-11.pdf, accessed 13 May 2018).
National priority sectors are leather goods (HS 2-digit codes 41–43), textiles and textile articles (HS 2-digit codes 50–63) and footwear (HS 2-digit code 64).
The legislation regulating the activity of the SEZ before 2007 is given by Law 8-90 of January 1990 (available in Spanish at https://www.dgii.gov.do/legislacion/leyesTributarias/Documents/8-90.pdf, accessed 13 May 2018).

Since 1983, 92% of Dominican exports entered the USA duty-free, while the remaining exports faced an average effective tariff of 1.1% under the Caribbean Basin Initiative (MEPyD 2015). Following the implementation of the North American Free Trade Agreement in 1994, Costa Rica, El Salvador, Guatemala, Honduras and Nicaragua began to negotiate with the USA to achieve a free trade agreement that would provide them with a level of market access similar to that of Mexico. However, the Dominican Republic joined the negotiations only in 2004, a point at which all countries but Costa Rica had already reached a consensus about the general terms of the agreement. This limited the Dominican Republic's involvement to ratify what other countries had already negotiated, including the complete elimination of performance requirements by 2010.[5]

Thus the removal of ESR for the SEZ was underpinned by explicit deadlines determined by the Dominican Republic's external commitments with the CAFTA-DR free trade agreement and the WTO. The decision to eliminate ESR for priority sectors in 2007 was primarily a response to the dramatic loss of market share that Dominican exporters experienced in the US market following China's accession to the WTO and the

end of the MFA. Law 56-07 was also seen as a gradual first step forward towards achieving compliance of the SEZ regime with the dispositions of CAFTA-DR and the ASCM.

Compliance with the ASCM after the reforms

From the standpoint of compliance with WTO disciplines, the reforms implemented under Laws 56-07 and 139-11 eliminate the prohibited subsidy component of the SEZ regime. Nevertheless, maintaining the fiscal incentives for firms in priority sectors regardless of their location, and for firms based in the SEZ, makes these programmes *specific* under the ASCM. Therefore the Dominican Republic can maintain these programmes in their current form as long as no WTO member country raises a complaint about them in the Committee on Subsidies and Countervailing Measures. The SEZ regime in its current form is also in line with the rules governing special regimes under CAFTA-DR.

III. Theoretical Framework

To fix ideas, consider an industry populated by a continuum of firms each producing a unique differentiated good ω. Firms produce using a linear technology in which one unit of labour (the only production input) yields one unit of output. Since ours is a partial equilibrium analysis, we assume that the wage, and therefore the marginal cost of all firms, is equal to 1.

Firms can sell their output in two markets, home (H), which we consider to be the Dominican Republic, and foreign (F), which represents the rest of the world. The demand functions faced by a firm selling good ω are

$$(1) \qquad q_H(\omega) = p_H(\omega)^{-\sigma} \quad \text{and} \quad q_F(\omega) = A_F(\omega) \cdot p_F(\omega)^{-\sigma},$$

where $\sigma > 1$ is the elasticity of demand, and $p_i(\omega)$ is the price charged by the firm in market $i \in \{H,F\}$. We differ from standard models of trade with heterogeneous firms (e.g. Melitz 2003) in that we assume that firms are heterogeneous in terms of the relative appeal of their product in the foreign market—which we denote by $A_F(\omega)$—instead of productivity. This is because we want our model to produce a non-degenerate distribution of export intensity in the most parsimonious way possible.[6] This implies that some firms will find the ESR constraint binding, while others naturally export most of their output even without the imposition of ESR. Besides this, there is ample empirical evidence showing that heterogeneity in firms' sales across different markets is as important as differences in productivity to explain firm-level variation in export values (Eaton *et al*. 2011; Crozet *et al*. 2012; Munch and Nguyen 2014; Defever and Riaño 2017b). As will become clear below, our assumption implies that firms in the SEZ are larger—in terms of export value—than their counterparts outside the zones, a feature that is consistent with the data.

We assume that a competitive fringe of potential entrants draw their export appeal from a known distribution after paying an entry cost $f^E(M)$ that is an increasing and convex function of the mass of firms M operating in the industry. This assumption implies that when expected profits increase, the higher mass of operating firms drives up the cost of entry, for instance, because of congestion forces. This is a reduced-form way

of incorporating entry into the model that allows us to determine how the elimination of ESR affects the mass of operating firms.[7]

Home firms can be based in one of two locations: the special economic zone (z) or the national customs territory (n). Firms choose their location $\ell \in \{n,z\}$ in order to maximize profits, after having observed the realization of their export demand shifter. We model the SEZ as a location that offers a sales subsidy s that is a stand-in for the wide range of incentives offered in the SEZ relative to the national customs territory, subject to an export share requirement $\underline{\eta} \in (0,1]$—following Defever and Riaño (2017a). Firms that choose to locate there face a fixed cost f^z that encompasses, among other things, the administrative cost of application (i.e. obtaining approval from the *Consejo Nacional de Zonas Francas de Exportación*, the public-private body that regulates the SEZ), land rental fees, procedures involved in selling goods domestically, and setting up production facilities in disadvantaged zones (e.g. near the border with Haiti) (FIAS 2008). Producers in the national customs territory, on the other hand, can sell as much as they choose in the domestic market but do not receive any incentives. We assume that firms do not face any costs of selling their output domestically or abroad, and therefore—given the demand functions specified in (1)—all firms export some of their output. We now proceed to discuss the profit-maximization problem faced by firms in the national customs territory and the SEZ.

National customs territory

The profit-maximization problem for a firm located in the national customs territory is

$$\max_{\{p_H(\omega),p_F(\omega)\}} [p_H(\omega) - 1]p_H(\omega)^{-\sigma} + [A_F(\omega)p_F(\omega) - 1]\ p_F\ (\omega)^{-\sigma}.$$

It is straightforward to show that a firm based in this location charges the same price for its product in each market, i.e. $p_H^n(\omega) = p_F^n(\omega) = \sigma/(\sigma - 1)$. Therefore sales for firm ω in each market are given by

$$r_H^n(\omega) = \left(\frac{\sigma - 1}{\sigma}\right)^{\sigma-1} \quad \text{and} \quad r_F^n(\omega) = A_F(\omega) \cdot r_H^n(\omega).$$

Export intensity—the share of total sales accounted for by exports—for firm ω is given by

$$\eta^n(\omega) \equiv \frac{r_F^n(\omega)}{r_H^n(\omega) + r_F^n(\omega)} = \frac{A_F(\omega)}{1 + A_F(\omega)}.$$

We refer to $\eta^n(\omega)$ as firm ω's 'natural' export intensity—i.e. the export intensity that a firm would choose if it were located in the national customs territory. Note that since there is a strictly increasing relationship between the export demand shifter $A_F(\omega)$ and natural export intensity $\eta^n(\omega)$, we can write all firm-level variables in terms of the latter. Thus profit for a firm with export intensity η^n based in the national customs territory is

$$\pi^n(\eta^n) = \frac{r_H^n(\omega) + r_F^n(\omega)}{\sigma} = \frac{\kappa}{1 - \eta^n},$$

where $\kappa \equiv (\sigma-1)^{\sigma-1}\sigma^{-\sigma} > 0$ is a constant term.

Special economic zones

The profit maximization problem of a firm located in the SEZ is

$$\max_{\{p_H(\omega),p_F(\omega)\}} [(1+s)p_H(\omega)-1]p_H(\omega)^{-\sigma}+[(1+s)p_F(\omega)-1]A_F(\omega)p_F(\omega)^{-\sigma}-f^z \tag{2}$$

$$\text{s.t.} \quad \frac{A_F(\omega)p_F(\omega)^{1-\sigma}}{p_H(\omega)^{1-\sigma}+A_F(\omega)p_F(\omega)^{1-\sigma}} \geq \underline{\eta}, \tag{3}$$

where (3) is the export share requirement constraint. We show in Appendix A that this problem has two solutions that depend on a firm's natural export intensity. Firms with a natural export intensity at least equal to the threshold $\underline{\eta}$ are directly eligible to operate in the SEZ and receive the incentives available there. Since these producers do not need to distort their export intensity to locate in the SEZ, we refer to them as unconstrained SEZ exporters. Firms with natural export intensity strictly lower than $\underline{\eta}$ (i.e. constrained SEZ exporters) have to change their allocation of sales across markets to satisfy ESR. More specifically, Defever and Riaño (2017a) show that they simultaneously reduce domestic sales and increase exports in order to exactly reach the ESR threshold. Doing so lowers the before-subsidy profits for these firms, because they cannot operate at their optimal export intensity. Nevertheless, for firms with a relatively high natural export intensity, this profit loss is more than compensated for by the subsidy that they receive when they locate in the SEZ.

Profits for a firm in the SEZ are given by

$$\pi^z(\eta^n,\underline{\eta}) = \begin{cases} \kappa(1+s)^{\sigma}\Theta(\eta^n,\underline{\eta})-f^z & \text{if } \eta^n(\omega)<\underline{\eta}, \\ (1+s)^{\sigma}\pi^n(\eta^n)-f^z & \text{otherwise,} \end{cases}$$

where the firm-specific revenue shifter for constrained SEZ exporters, $\Theta(\eta^n,\underline{\eta})$, is given by

$$\Theta(\eta^n,\underline{\eta}) = \frac{\eta^n}{[(1-\underline{\eta})^{\sigma/(\sigma-1)}(\eta^n)^{1/(\sigma-1)}+\underline{\eta}^{\sigma/(\sigma-1)}(1-\eta^n)^{1/(\sigma-1)}]^{\sigma-1}}.$$

We now show that a firm's location choice is determined by its natural export intensity and the level of incentives offered in the SEZ. More precisely, we establish the following result.

Proposition 1. If the subsidy granted in the SEZ lies in the range

$$s \in \left(\left[1+\frac{(1-\underline{\eta})f^z}{\kappa}\right]^{1/\sigma}-1, \left[1+\frac{f^z}{\kappa}\right]^{1/\sigma}-1\right),$$

then there exists a unique export intensity cut-off $\hat{\eta}(s,\underline{\eta},f^z) \in (0,\underline{\eta})$, implicitly defined by $\pi^n(\hat{\eta}) = \pi^z(\hat{\eta},\underline{\eta})$, such that the following hold.

- Firms with $\eta^n \in (0, \hat{\eta})$ locate in the national customs territory.
- Firms with $\eta^n \in [\hat{\eta}, 1)$ locate in the SEZ. Among these, firms with natural export intensity $\eta^n \in [\hat{\eta}, \underline{\eta})$ operate as constrained SEZ exporters, while firms with $\eta^n \in [\underline{\eta}, 1)$ operate as unconstrained SEZ exporters.

Proof See Appendix A.

We are interested in a situation in which the imposition of ESR induces some firms to alter their natural export intensity in order to locate in the SEZ; otherwise, the elimination of ESR in the SEZ would have no impact on the number of firms located in the SEZ or on export sales. Therefore we assume that the subsidy granted to firms in the SEZ satisfies the condition established in Proposition 1, so that a subset of firms based in the SEZ are constrained by ESR.

Intuitively, Proposition 1 shows that the profit of constrained SEZ exporters increases with natural export intensity. Thus, given a subsidy rate s, firms with natural export intensity below $\hat{\eta}$ are better off foregoing the subsidy and operating at their natural export intensity. It also follows that as the subsidy offered in the SEZ increases, firms with lower natural export intensity would prefer to locate there. In terms of Figure 1, this means that the export intensity cut-off $\hat{\eta}$ shifts to the left in response to an increase in s. Conversely, a higher fixed cost of setting up a firm in the SEZ increases $\hat{\eta}$.

Eliminating ESR in the SEZ

Based on the characterization of firms' production and location choices described above, we now establish a set of predictions regarding the effect that eliminating ESR in the SEZ has on the number of exporters and export sales.

Suppose that the initial requirement prevailing in the SEZ is $\underline{\eta}_0 > 0$, but a reform eliminates the requirement (i.e. sets $\underline{\eta}_1 = 0$), while maintaining the subsidy provided in the SEZ unchanged. This intervention makes locating in the SEZ more attractive to firms with export intensity below the initial cut-off $\hat{\eta}_0$, since by joining the zone they now get to operate at their natural export intensity and enjoy the subsidy as well. The existence of a fixed cost of operating in the SEZ, however, ensures that not all firms move to the SEZ. For firms with the lowest export intensity, the subsidy windfall is not sufficient to compensate them for incurring the fixed cost to locate in the zones. Thus, following the reform, there is a new export intensity cut-off $\hat{\eta}_1 \in (0, \hat{\eta}_0)$ such that firms with natural export intensity below $\hat{\eta}_1$ export from the national customs territory, while firms with export intensity above $\hat{\eta}_1$ operate from the SEZ. The two location cut-offs, $\hat{\eta}_0$ and $\hat{\eta}_1$, and the initial requirement $\underline{\eta}_0$, define four regions of natural export intensity that characterize a firm's response to the policy change, as follows.

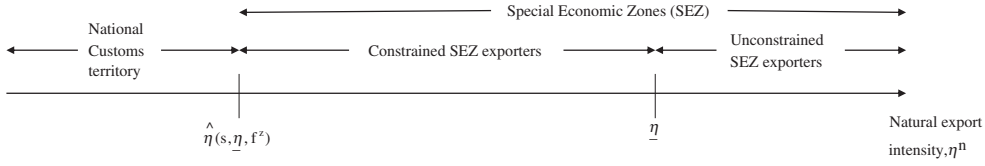

FIGURE 1. Firm's location choice

(i) Firms with $\eta^n \in (0, \hat{\eta}_1)$ operate in the national customs territory before and after the policy change.
(ii) Firms with $\eta^n \in [\hat{\eta}_1, \hat{\eta}_0)$ move from the national customs territory to the SEZ, where they operate as unconstrained SEZ exporters after the reform.
(iii) Firms with $\eta^n \in [\hat{\eta}_0, \underline{\eta}_0)$ were constrained SEZ exporters initially but become unconstrained after the ESR are removed.
(iv) Firms with $\eta^n \in [\underline{\eta}_0, 1)$ are unconstrained SEZ exporters both before and after the policy change.

Therefore the first prediction from our model is that removing ESR from the SEZ while keeping the subsidy constant, induces some of the existing firms initially based in the national customs territory to relocate to the SEZ.

We now show that the removal of ESR also generates entry of new firms into the SEZ. First, note that firms in groups (i) and (iv) are unaffected in terms of their production, location or profits by the elimination of ESR. New SEZ firms (firms in group (ii)) operate at their natural export intensity—just as they did when they were based outside the SEZ—but now receive a subsidy, which in turn induces them to export more, thereby increasing their profits. Formerly constrained SEZ exporters also achieve higher profits following the reform, but unlike new SEZ firms, they do so by exporting less. Eliminating ESR allows these firms to operate at their natural export intensity, which is lower than $\underline{\eta}_0$, the intensity imposed by the export requirement. Profits for formerly constrained SEZ firms increase because the distortion in the allocation of sales across markets disappears with the reform. Since profits for all firms either increase or remain unchanged, it follows that the expected value of operating in the industry increases, thereby inducing entry of new firms. Thus our prediction regarding the effect of the elimination of ESR on the number of exporters based in the SEZ reads as follows.

Prediction 1. Assuming that the SEZ subsidy lies in the range established in Proposition 1, eliminating ESR in the SEZ—everything else equal—increases entry into the industry and induces firms to relocate from the national customs territory to the SEZ.

Proof See Appendix A.

Figure 2 shows how the removal of ESR affects export sales based on the response of each of the four groups of firms identified above. New SEZ exporters increase their export sales because they maintain their natural export intensity but now receive the SEZ subsidy. Formerly constrained SEZ exporters reorient their sales towards the domestic market after ESR are removed instead. Thus our model's prediction regarding the response of export values to the elimination of ESR can be summarized as follows.

Prediction 2. Assuming that the SEZ subsidy lies in the range established in Proposition 1, eliminating ESR in SEZ—everything else equal—has an ambiguous effect on the share of export value originating from the SEZ. New SEZ exporters increase their exports, while previously constrained SEZ exporters reduce theirs. The exports of firms that remain in national customs territory after the reform, and those of originally unconstrained SEZ exporters, do not change when ESR are removed.

Proof See Appendix A.

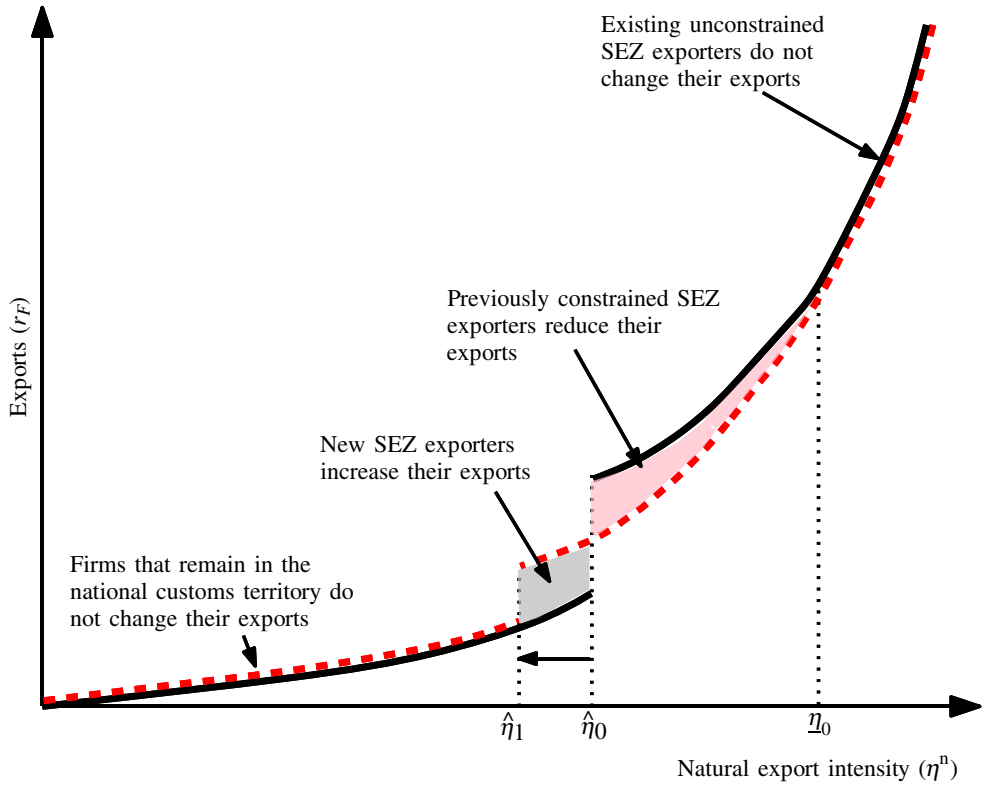

FIGURE 2. Effect of the elimination of ESR on export sales. [Colour figure can be viewed at wileyonlinelibrary.com]
Notes: The figure depicts the profile of export sales as a function of natural export intensity, before (solid line) and after (dashed line) ESR $\underline{\eta}_0 \in (0, 1]$ are removed. The natural export intensity cut-offs that characterize entry into the SEZ before and after the policy change are denoted $\hat{\eta}_0$ and $\hat{\eta}_1$, respectively.

IV. DATA

This section describes the data used in our empirical analysis and provides summary statistics on export and import performance according to firms' location (in the national customs territory or the SEZ) and sector of operation (priority and non-priority).

We utilize transaction-level customs data provided by the Dominican Republic Customs Agency (*Dirección General de Aduanas*, DGA). The data contain all export and import transaction values by product at the HS 6-digit level and by origin/destination for the period 2006–14.[8] The universe of firms consists of 29,682 firms reporting at least one positive export transaction in at least one of 4466 HS 6-digit products during our period of analysis. Crucially for our purposes, the data identify trade flows that originate or reach firms located in the SEZ.

The SEZ are critical for aggregate trade flows in the Dominican Republic. They account for more than 60% of the country's exports and 15% of its exporters throughout our period of analysis. Although they are less prominent in terms of imports (they account for 20% of total imports and 1.5% of importing firms), this difference underscores their importance at the macroeconomic level—the foreign exchange earnings generated by exports from firms in the SEZ play a key role in enabling the imports required by the rest of the economy.

We now consider the sectoral composition of exports. The importance of leather goods, textiles and apparel and footwear—the national priority sectors—in the Dominican export basket has declined secularly since 2000, because of both the erosion of trade preferences in the USA and the more intense competition by low-wage producers at the regional and global level. Priority products account for one-fifth of total exports throughout the period of study—almost all of which originate from the SEZ. In non-priority sectors, SEZ firms account for approximately half of export value. Table 2 presents the top 10 HS 2-digit export sectors over our sample period, as well as the number of exporting firms and the share of exports originating in the SEZ. For only one out of the ten sectors is the average share of SEZ exports below 40%, and for seven of them, this share exceeds 90%. This shows that although the Dominican export basket has gradually diversified over the last decade (World Bank 2014), its main comparative advantage sectors are still highly reliant on the SEZ.

Tables 3 and 4 shift the focus from aggregate to firm-level export and import performance, comparing firms in the SEZ with those located in the national customs territory. Firms in the SEZ are larger, export and import more products, sell to more markets, and acquire inputs from a larger number of countries than non-SEZ firms. SEZ firms also exhibit lower turnover rates in foreign markets. These figures are in line with those reported by Fernandes *et al*. (2016) for countries at a similar stage of development.[9]

A crucial difference between the two waves of SEZ reform was that Law 56-07 provided duty-free access for 126 key inputs used in the production of priority products, whereas Law 139-11 did not include a similar concession. This tariff liberalization affected only firms in the national customs territory, because firms in the SEZ were already able to import inputs without paying tariffs. Table 5 presents the top 10 HS 6-digit products (in terms of import value) whose import tariffs were set to zero, along with their share of import value destined for the SEZ and the percentage of imports purchased by firms exporting priority products from outside the SEZ. Since the most important inputs liberalized were almost exclusively imported by SEZ firms, as Table 5 shows, it is likely that the tariff reductions mandated by Law 56-07 had only a minor impact on firms

TABLE 2
CHANGES IN SEZ REGULATIONS IN THE DOMINICAN REPUBLIC, 2006–14

	HS 2-digit sector	Export value	No. of firms	% Exported from SEZ
(1)	Optical and medical instruments	690.33	368.00	96
(2)	Precious metals and jewelry	615.27	390.22	42
(3)	Electrical machinery and equipment	539.83	492.11	94
(4)	Iron and steel	526.37	150.22	5
(5)	Tobacco	450.96	233.56	95
(6)	Apparel and clothing	396.13	336.67	99
(7)	Plastics	263.41	591.33	61
(8)	Cotton	263.32	88.56	99
(9)	Knitted goods	251.70	266.22	99
(10)	Footwear	225.77	114.67	98

Notes
Source: Authors' calculations based on customs transaction data from the DGA.
Export and import transaction values are denominated in millions of US dollars. Figures are averaged across the period 2006–14. Rows 6, 8, 9 and 10 indicate priority sectors.

TABLE 3
EXPORT AND IMPORT PERFORMANCE BY FIRM'S LOCATION

		SEZ		National customs territory	
		Exports	Imports	Exports	Imports
Transaction value per firm	Mean	44.98	54.05	5.62	3.32
	Median	0.27	4.99	0.05	0.04
Products per firm	Mean	6.38	46.32	4.03	9.91
	Median	1.00	20.00	1.00	2.00
Destinations/origins per firm	Mean	2.58	4.82	1.61	1.47
	Median	1.00	2.00	1.00	1.00

Notes
Source: Authors' calculations based on customs transaction data from the DGA.
Export and import transaction values are denominated in hundreds of thousands of US dollars. Figures are averaged across the period 2006–14.

TABLE 4
AVERAGE EXPORT ENTRY AND EXIT RATES FOR FIRMS BY LOCATION

	Firm		Firm–HS-6-digit product	
	% Entry	% Exit	% Entry	% Exit
Special economic zones	11.83	14.32	54.3	54.10
National customs territory	35.60	32.40	72.56	68.75
All locations	29.82	27.57	68.12	64.83

Notes
Source: Authors' calculations based on customs transaction data from the DGA.
Entry measures the percentage of firms observed conducting an export transaction for the *first time* in our data after 2006. Figures for entry are averaged across HS 6-digit products and years over the period 2007–14. Exit measures the percentage of firms that stop exporting for the *last time* before 2014. Figures for exit are averaged across HS 6-digit products and over the period 2006–13.

outside the SEZ in priority sectors. Moreover, the last column shows that most of the value of imported products purchased by non-SEZ firms is accounted for by firms exporting non-priority products.

V. EMPIRICAL ANALYSIS AND RESULTS

Our identification strategy relies on the fact that ESR were eliminated in the SEZ at different points in time for different sectors—namely, August 2007 for products belonging to the leather, textiles and apparel and footwear industries, and June 2011 for all other products. Since both reforms were carried out in the second half of the year, we assume, for the purposes of constructing our main variable of interest, that the elimination of ESR took place in 2008 for priority sectors and 2012 for all other products in our benchmark specification, which uses yearly data.[10] Nevertheless, we also estimate all our regressions aggregating the data at a biannual frequency. In the latter, the start periods for the two waves of reform are identified as the second semesters of 2007 and 2011, respectively. The results, which are reported Appendix C, show that the

TABLE 5
TOP 10 HS 6-DIGIT 'PRIORITY INPUT' IMPORTS

	HS 6-digit product	HS 6-digit code	Import value	% SEZ imports	% of non-SEZ imports used in priority sectors
(1)	White spirit	271011	1437.24	1	4
(2)	Plastic articles (not elsewhere specified)	392690	278.8	90	2
(3)	Soles and heels for footwear of rubber or plastic	640620	22.71	96	2
(4)	Bovine leather, vegetable pre-tanned	410411	18.1	99	0
(5)	Cartons, boxes & cases, of corrugated paper	481910	16.12	78	2
(6)	Other bovine leather, vegetable pre-tanned	410449	14.26	98	1
(7)	Footwear uppers and parts thereof, except stiffeners	640610	12.64	99	0
(8)	Ammonium sulfate	310221	12.4	0	52
(9)	Pigments and preparations based on titanium dioxide	320611	11.63	2	15
(10)	Cotton sewing thread for retail	520420	11.56	99	1

Notes
Source: Authors' calculations based on customs transaction data from the DGA.
Import values are denominated in millions of US dollars. Figures are averaged across the period 2006–14. Rows 1, 8 and 9 indicate HS 6-digit products that are primarily imported by non-SEZ firms.

conclusions from our benchmark analysis are robust to this change in the aggregation of the data.

As we discussed in Section II, the choice of timing and sectors facing the removal of ESR was largely driven by external factors that can be considered exogenous when assessing the effect of the elimination of ESR on firm- and product-level exports. Therefore the well-known endogeneity problem that arises when estimating the effect of changes in trade policy on export performance (Trefler 1993; Harrigan and Barrows 2009) is less likely to contaminate our estimates. Since the decision to eliminate ESR first in priority sectors was a response to China's accession to the WTO and the end of the MFA, it follows that controlling for the secular changes in the demand for Dominican exports should allay concerns regarding endogeneity due to an omitted variable problem.

It is also important to remark that since ESR were removed for all products at some point during our period of study, there is no 'control' group of products or firm–product combinations that was unaffected by the policy change—a necessary condition to utilize a difference-in-differences design. Instead, since we have a panel of narrowly-defined products that were affected by the policy at different points in time, we identify the effect of the reform by relying on within (product, product–location, firm or firm–product–location, depending on the specification) variation in the outcome variable before and after the reform, controlling for aggregate changes—captured by time and location–year fixed effects—and HS-2-digit-specific linear trends.

Did the elimination of ESR affect exports and the number of exporters?

We first investigate if the removal of ESR in the SEZ affected the level of exports and the number of exporters at the product level. We also use this first regression to explore the effect of adding progressively richer arrays of fixed effects to our estimating regression. We aggregate our data at the HS 6-digit product level (j), location (either SEZ or the national customs territory, indexed by ℓ) and year (t) level, to estimate

$$\ln \text{EXP}_{j\ell t} = \beta \text{ Reform}_{jt} + \theta X_j + \delta T_t + \text{Trend}_{\tilde{j}t} + \varepsilon_{j\ell t}. \tag{4}$$

The dependent variable $\ln \text{EXP}_{j\ell t}$ is either the log of the value of exports, or the log of the number of firms exporting product j originating from location ℓ in year t. Reform_{jt}—our main variable of interest—is a dummy variable that takes the value 1 when SEZ exporters of HS 6-digit product j are no longer subject to ESR, and 0 otherwise. More precisely,

$$\text{Reform}_{jt} = \begin{cases} 1 & \text{if } [j \in \text{ Priority and } t \geq 2008] \text{ or } [j \notin \text{ Priority and } t \geq 2012], \\ 0 & \text{otherwise.} \end{cases}$$

Priority products are those HS 6-digit products that belong to HS 2-digit sectors 41–43 (leather goods), 50–63 (textiles and apparel) and 64 (footwear). A caveat regarding the definition of Reform_{jt} is in order. As Table 1 shows, the two waves of reform involved the elimination of ESR, but also different policy changes. For instance, while the 2007 reform eliminated ESR for priority products and gave full access to the domestic market to firms selling them, the 2011 reform increased the taxes faced by SEZ firms on domestic sales. Nevertheless, estimating our regressions with separate dummies for the two waves of reform leaves the results unchanged. The remaining explanatory variables included in regression (4) are product-specific variables X_j (e.g. whether a given HS 6-digit product is a priority product or not), time-specific variables T_t, that account for the timing of the reforms, and $\text{Trend}_{\tilde{j}t}$, which denotes a linear trend specific to HS 2-digit sector $\tilde{j}$, that seeks to account for differences in the secular behaviour of exports across broadly-defined industries. Standard errors are clustered at the HS 6-digit product level.

Table 6 reports the results of estimating this set of regressions. The dependent variable in regressions (1)–(4) is the log of export value, while in regressions (5)–(8) it is the log of the number of exporters. Before focusing our attention on the Reform_{jt} variable, we first discuss the other explanatory variables reported in columns (1) and (5), and how they are gradually replaced by fixed effects in the regressions presented in columns (2)–(4) and (6)–(8).

The variable Priority_j takes the value 1 if product j belongs to a priority sector, and 0 otherwise; this variable captures the importance of leather goods, textiles and apparel and footwear in the export basket of the Dominican Republic, and is replaced by a full set of HS 6-digit product and product–location fixed effects in columns (3), (4), (7) and (8) of Table 6. The estimates presented in columns (1) and (4) reveal that exports of priority products, which constituted the cornerstone of the Dominican export basket over the last four decades, are more important—in terms of both value and number of exporters—than those of non-priority products.

Post08_t and Post12_t are dummies that turn on after each wave of reform (2008 and 2012, respectively), absorbing aggregate shocks affecting Dominican exporters in the

TABLE 6
EFFECT OF THE ELIMINATION OF EXPORT SHARE REQUIREMENTS ON EXPORT VALUE AND NUMBER OF EXPORTERS AT THE HS 6-DIGIT PRODUCT LEVEL

Dependent variable	ln export value				ln number of exporters			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$Reform_{jt}$	0.161	0.163	0.158		0.201***	0.200***	0.171***	
	(0.112)	(0.112)	(0.116)		(0.037)	(0.037)	(0.037)	
$Reform_{jt} \times SEZ_{\ell}$				−0.106				0.159***
				(0.196)				(0.056)
$Reform_{jt} \times Non\text{-}SEZ_{\ell}$				0.125				−0.018
				(0.187)				(0.060)
$Priority_{j}$	1.375***	1.378***			0.479***	0.481***		
	(0.194)	(0.194)			(0.071)	(0.071)		
Linear trend $priority_{\tilde{j}t}$	−0.071***	−0.153***			−0.019**	−0.072***		
	(0.027)	(0.029)			(0.009)	(0.010)		
Linear trend $non\text{-}priority_{\tilde{j}t}$	0.075***	−0.006			0.054***	0.002		
	(0.016)	(0.017)			(0.005)	(0.005)		
$Post08_{t}$	0.234***				−0.142***			
	(0.061)				(0.020)			
$Post12_{t}$	−0.887***				−0.285***			
	(0.123)				(0.039)			
Year FE		✓	✓			✓	✓	
HS 6-digit FE			✓				✓	
HS 2-digit linear trends			✓	✓			✓	✓
Year–location FE				✓				✓
HS-6-digit–location FE				✓				✓
Observations	28,046	28,046	28,046	28,046	28,046	28,046	28,046	28,046
R^2	0.013	0.014	0.534	0.736	0.010	0.010	0.545	0.797

Notes
Robust standard errors clustered at the HS 6-digit product level.
***, **, * indicate significance at the 1%, 5%, 10% level, respectively.

aftermath of the removal of ESR, and are replaced by year fixed effects in columns (2) and (6) of Table 6. Finally, the variables 'Linear trend priority$_{\tilde{j}t}$' and 'Linear trend non-priority$_{\tilde{j}t}$' are linear trends specific to priority and non-priority sectors; these are replaced by HS-2-digit-specific linear trends in columns (3), (4), (7) and (8), which intend to control for time-varying shifts in the world's demand and supply of a given sector. The coefficients of the priority/non-priority sector-specific trends show a significant recomposition of the Dominican export mix throughout our period of study. On the one hand, there is a marked secular decline in the export value and number of exporters of priority sectors, while the non-priority sector as a whole—which includes primary products like gold, rum and cigars as well as more sophisticated goods such as medical instruments and electric machinery—exhibits the opposite pattern.

Focusing now on the coefficient associated with Reform$_{jt}$, shows that the elimination of ESR in SEZ did not have a significant effect on export value at the product level in any of our specifications (columns (1) to (3)). The number of exporters per product, on the other hand, increased significantly after the removal of ESR. The results in our most stringent specification in column (7) indicate that the reform of SEZ is associated with an 18 percent increase in the number of exporters vis-à-vis the sectoral trend.

In our last set of regressions, reported in columns (4) and (8) of Table 6, we decompose the effect of ESR reform on export outcomes according to the location from which exports originate—i.e. SEZ or the national customs territory. These regressions include HS 2-digit trends as well as year–location and HS 6-digit location fixed effects that control for differential effects of aggregate shocks and time-invariant differences in product characteristics across the two locations. Similarly to our previous results, we do not find any significant impact of the elimination of ESR on export values in either location. The results reported in column (8) show that—consistent with our theoretical prediction—the positive impact of the elimination of ESR in terms of the number of exporters is fully concentrated in the SEZ.

Did the elimination of ESR affect the importance of exports originating from the SEZ?

Promoting exports by means of the SEZ can be a costly strategy from both a fiscal and efficiency standpoint. We now move to investigate the effect that lifting ESR had on the shares of export value and exporters originating from the SEZ across products.

Our model delivers two predictions regarding the effect that the elimination of ESR would have on the importance of exports originating from the SEZ. Prediction 1 states that the share of exporters based in the SEZ should univocally increase following a reform that relaxes the export requirement imposed in the SEZ, given that the incentives provided to firms located in the zones do not change. This rise can happen both because firms in the national customs territory relocate to SEZ, or due to entry of new firms. Prediction 2 instead shows that the effect of the reform on the share of export value accounted for by the SEZ is ambiguous. Firms that join the SEZ increase their exports as they become subsidized, while previously constrained exporters relocate their sales away from the foreign market.

We aggregate the data at the HS 6-digit product and year level, and estimate the following regression by OLS:

$$\text{ShareExpSEZ}_{jt} = \beta_0\ \text{Reform}_{jt} + f_j + f_t + \ \text{Trend}_{\tilde{j}t} + \varepsilon_{jt}. \tag{5}$$

The dependent variable ShareExpSEZ_{jt} is either the share of export value originating from the SEZ, or the share of the number of exporters based in the SEZ for a given product j in year t (columns (1) and (3) of Table 7, respectively). As in the previous set of regressions, Reform_{jt} is our key variable of interest, capturing the impact of the elimination of ESR. We also investigate if the two waves of reform had differential effects on the importance of exports from the SEZ. To do so, we split Reform_{jt} into its two components: $\text{Priority}_j \times \text{Post08}_t$ and $\text{Non-priority}_j \times \text{Post12}_t$, which capture the effects of Law 56-07 and Law 139-11, respectively. Thus the regressions reported in columns (2) and (4) of Table 7 are

$$\text{ShareExpSEZ}_{jt} = \beta_1(\text{Priority}_j \times \text{Post08}_t) + \beta_2(\text{Non-priority}_j \times \text{Post12}_t) + f_j + f_t + \text{Trend}_{\tilde{j}t} + \varepsilon_{jt}. \quad (5')$$

Both specifications include HS 6-digit product (f_j) and year (f_t) fixed effects, which control for time-invariant characteristics that affect the attractiveness of exporting a product from the SEZ and aggregate shocks. $T_{\tilde{j}t}$ denotes a set of HS 2-digit linear trends that absorb broad, time-varying secular factors that determine the attractiveness of the SEZ as an export location at the sectoral level. Robust standard errors are clustered at the HS 6-digit product level.

Table 7 presents our estimates of regressions (5) and (5′). Column (1) shows a positive but only marginally significant effect of ESR reform on the share of export value originating from the SEZ, although this effect dissipates when we examine the two waves of reform separately in column (2). The results presented in column (3), however, strongly confirm Prediction 1. The share of firms exporting a given HS 6-digit product from the SEZ increases by 6.2 percentage points on average relative to the situation prior to the reform. As we noted before, the increase in the share of firms exporting from the SEZ can be due to relocation from existing firms or entry of de-novo firms into the SEZ.

TABLE 7
SHARE OF SEZ IN EXPORT VALUE AND NUMBER OF EXPORTERS AT THE HS 6-DIGIT PRODUCT LEVEL

	Share of export value		Share of no. of exporters	
	(1)	(2)	(3)	(4)
Reform_{jt}	0.036*		0.062***	
	(0.020)		(0.015)	
$\text{Priority}_j \times \text{Post08}_t$		0.033		0.070***
		(0.027)		(0.022)
$\text{Non-priority}_j \times \text{Post12}_t$		0.039		0.054**
		(0.035)		(0.029)
Year FE	✓	✓	✓	✓
HS 6-digit FE	✓	✓	✓	✓
HS 2-digit linear trends	✓	✓	✓	✓
Observations	19,141	19,141	19,141	19,141
R^2	0.669	0.669	0.669	0.669

Notes
Robust standard errors clustered at the HS 6-digit product level.
***, **, * indicate significance at the 1%, 5%, 10% level, respectively.

The data suggest that the latter is the dominant effect, since there are, on average, 4.47 new firms for every existing firm relocating to the SEZ. The estimates presented in column (4) show a slightly stronger impact of the reform on products in priority sectors —although the two coefficients are not significantly different from each other. Our results suggest that extending the incentives available in the SEZ to firms in the national customs territory in priority sectors—the main feature distinguishing the two waves of reform—was largely ineffective. We provide further evidence of this interpretation below when we investigate if firms outside the SEZ increased their imports after the tariff liberalization of key priority inputs mandated by Law 56-07. Overall, the results reported in Table 7 indicate that opening the domestic market to firms located in the SEZ has fostered the consolidation of the SEZ as a cornerstone of Dominican exports.

Firm-level effects

Having investigated the impact of the elimination of ESR on exports at the product level, we now focus on its consequences at the firm level. We first examine how within-firm export sales—i.e. the intensive margin of exports—were affected by the reform. Prediction 2 suggests that exports of firms that remained in the SEZ should either fall—if they were constrained by ESR—or remain unchanged, while the exports of firms outside the SEZ should not be affected.

Intensive margin In order to evaluate the effects of the reform on the intensive margin of firms' exports, we aggregate our data at the firm–product–location–year level, and estimate the following regression by OLS:

$$\ln \text{ Intensive}_{ij\ell t} = \beta_0 \text{ Reform}_{jt} + f_{ij} + f_t + \text{Trend}_{\tilde{jt}} + \varepsilon_{ij\ell t}. \tag{6}$$

The dependent variable is the log of export sales by firm i exporting HS 6-digit product j from location ℓ in year t. As in our previous regressions, we include year fixed effects and HS-2-digit-specific linear trends to control for aggregate and sectoral shocks, while the use of firm–product (f_{ij}) fixed effects, in turn, means that we rely on changes in a firm's exports of the same product over time to identify the effect of the reform. Standard errors are, once again, clustered at the HS 6-digit product level. When we investigate the differential effect of the reform on firms' exports in the SEZ and the national customs territory (Non-SEZ$_\ell$), our estimating equation then becomes

$$\begin{aligned} \ln \text{ Intensive}_{ij\ell t} = {} & \beta_1(\text{Reform}_{jt} \times \text{SEZ}_\ell) + \beta_2(\text{Reform}_{jt} \times \text{Non-SEZ}_\ell) \\ & + f_{ij\ell} + f_{\ell t} + \text{Trend}_{\tilde{jt}} + \varepsilon_{ij\ell t}. \end{aligned} \tag{6'}$$

Notice that since we include firm–product–location and location–year fixed effects in (6′), we now identify the impact of the reform on firms that export the same product from the same location.

The estimates of regression (6)—which are presented in column (1) of Table 8—show that the reform in the SEZ is associated with a significant reduction in firm-level export sales. Decomposing the overall effect by location in column (2) reveals that there is a large, negative and significant response of the intensive margin of exports for firms located in the SEZ—exports of a given product for firms that remain in the SEZ fall by

TABLE 8
FIRM-LEVEL INTENSIVE AND EXTENSIVE MARGINS OF EXPORTS' RESPONSE TO ESR REMOVAL

	Intensive margin		Extensive margin							
			Entry at the firm–HS-6-digit level				Entry at the firm level			
	OLS	OLS	OLS	OLS	Probit	Probit	OLS	OLS	Probit	Probit
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
$Reform_{jt}$	−0.120**		0.022*		0.042***		0.048***		0.035***	
	(0.055)		(0.013)		(0.014)		(0.009)		(0.010)	
$Reform_{jt} \times SEZ_\ell$		−0.227***		0.048***		0.058***		0.022**		0.035**
		(0.070)		(0.016)		(0.016)		(0.010)		(0.014)
$Reform_{jt} \times Non\text{-}SEZ_\ell$		0.141		−0.016		−0.032**		−0.031		−0.027
		(0.089)		(0.013)		(0.016)		(0.020)		(0.018)
$Priority_j$			−0.120***		−0.144***		−0.171***		−0.159***	
			(0.027)		(0.031)		(0.029)		(0.028)	
$Priority_j \times SEZ_\ell$				−0.170***		−0.177***		−0.057***		−0.066***
				(0.028)		(0.032)		(0.019)		(0.021)
$Priority_j \times Non\text{-}SEZ_\ell$				0.007		0.013		0.011		0.015
				(0.024)		(0.031)		(0.022)		(0.022)
Firm–HS-6-digit FE	✓									
Year FE	✓		✓		✓		✓		✓	
Firm–HS-6-digit–location FE		✓								
Year–location FE		✓		✓		✓		✓		✓
HS 2-digit linear trends	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Observations	203,137	203,137	188,623	188,623	188,623	188,623	188,623	188,623	188,623	188,623
R^2	0.812	0.812	0.074	0.104	0.0844	0.0867	0.043	0.088	0.0860	0.0866

Notes
Robust standard errors clustered at the HS 6-digit product level. The coefficients reported under Probit are marginal effects evaluated at the mean of other covariates. R^2 in the columns reporting probit estimates denotes McFadden's pseudo R-squared measure.
***, **, * indicate significance at the 1%, 5%, 10% level, respectively.

20% (≈1− exp (−0.227)) on average following the removal of ESR. Conversely, the reform did not have a significant impact on exporters based in the national customs territory. These two results are consistent with our theoretical framework. The strongly negative response of the intensive margin observed among firms based in the SEZ suggests that a substantial number of them were constrained by the export share requirement.

Extensive margin The estimating equations that we use to evaluate the response of the extensive margin are as follows:

$$\text{Extensive}_{ij\ell t} = \beta_0\ \text{Reform}_{jt} + \beta_1\ \text{Priority}_j + f_t + \text{Trend}_{\tilde{jt}} + \varepsilon_{ij\ell t} \tag{7}$$

and

$$\begin{aligned}\text{Extensive}_{ij\ell t} = {} & \beta_1(\text{Reform}_{jt} \times \text{SEZ}_\ell) + \beta_2(\text{Reform}_{jt} \times \text{Non-SEZ}_\ell) + \\ & \beta_3(\text{Priority}_j \times \text{SEZ}_\ell) + \beta_4(\text{Priority}_j \times \text{Non-SEZ}_\ell) + \\ & f_{\ell t} + \text{Trend}_{\tilde{jt}} + \varepsilon_{ij\ell t}.\end{aligned} \tag{7$^{\text{w}}$ell$\prime$}$$

Once again, our specifications include HS-2-digit-specific linear trends, and standard errors are clustered at the HS 6-digit level. Since the model's predictions are framed in terms of entry, we focus on this dimension of the extensive margin.[11] We define the extensive margin at the firm–HS-6-digit-product level (columns (3)–(6) of Table 8) as well as at the firm level (columns (7)–(10)), as a robustness check for our results. More precisely, entry is a dummy that takes the value 1 when either a firm or firm–product combination appears for the *first time* in our export data.[12]

Specification (7) includes time fixed effects but also a priority product dummy to control for time-invariant differences between products that experienced the reform at different points in time. Similarly, regression (7′) has both location–year fixed effects and a product's priority status dummy in each of our two locations. We report estimates using a linear probability model (columns (3), (4), (6) and (7) of Table 8) and a probit model. The two set of estimates produce qualitatively similar results.[13] In so doing, we estimate the probability of observing a new firm or firm–product exporting product j from location ℓ at time t for the first time. Within a given location, these new firms can be either existing firms relocating from the other location (national customs territory or the SEZ) or completely new firms that choose to produce from location ℓ.

The results reported in columns (3)–(10) of Table 8 show that the removal of ESR had a positive impact on export entry relative to the broad sectoral trends during our period of study. The aggregate effect, however, masks important differences among firms depending on their location. Consistent with Prediction 1, we find that the positive effect on entry following the lifting of ESR is observed only among firms in the SEZ. The estimates reported in columns (4) and (8) imply that exports of new firm–product combinations increase by 4.8 percentage points relative to sectoral trends, while entry of new exporters rises by 2.2 percentage points in the SEZ following the reform.

We find that export entry fell among firms in the national customs territory, although this effect is only significant in one case (column (6) of Table 8). Our model's prediction about the response of the number of new firms outside the SEZ to the elimination of ESR is ambiguous. On the one hand, the fall in the export intensity cut-off implies that firms

relocate towards the SEZ. On the other hand, the higher expected profitability that follows from the removal of ESR should foster entry in both locations. The results regarding the exit margin, although less precisely estimated, paint a similar picture—the probability that a firm–product combination stops being exported falls for firms located in the SEZ, while increasing for firms in the national customs territory (see Table A1 in Appendix B).

Did the input tariff liberalization of 2007 help non-SEZ firms in priority sectors?

A key difference between the 2007 and 2011 reforms was that the former extended some of the incentives available in the SEZ to firms exporting priority products from the national customs territory. In our last exercise we investigate if the tariff cuts for key inputs in the production of priority products mandated by Law 56-07 increased the imports of these products among firms outside the SEZ. To this end, we estimate the following regression by OLS:

$$\text{ShareImpSEZ}_{jt} = \beta_0(\text{Post08}_t \times \text{Priority input}_j) + f_j + f_t + \text{Trend}_{\tilde{jt}} + \varepsilon_{jt}. \tag{8}$$

The dependent variable is the share of imports accounted for by the SEZ in HS 6-digit product j in year t—in terms of either value or the number of importing firms. Priority input$_j$ takes the value 1 if imports of product j were made duty-free by Law 56-07, and 0 otherwise. Notice that since Law 139-11 did not extend any import tariff reductions, equation (8) does not include an interaction term for liberalized inputs after 2012.

As we discussed in Section IV, the most important goods for which tariffs were liberalized were either imported almost exclusively by firms in the SEZ or general-purpose inputs imported by a large number of firms in priority and non-priority sectors alike. With this in mind, we also explore whether the response to the tariff reduction depends on the importance of a product as an input in the production of priority goods. Ideally, we would rely on an input–output table to categorize products as specific to priority sectors or general-purpose inputs, but unfortunately these data are not available for the Dominican Republic for our period of study. Instead, we pursue the following alternative strategy: we classify each of the 126 HS 6-digit products liberalized as specific to priority sectors if the first two digits of their product nomenclature correspond to those of a priority product. For instance, the HS 6-digit product 'bovine leather' is classified as a *priority product* because its first two digits correspond to the leather goods sector. 'White spirit', which is also a priority input, is instead considered a *non-priority product*. Columns (3) and (4) of Table 9 present estimates of the following OLS regression that modifies equation (8):

$$\begin{aligned}\text{ShareImpSEZ}_{jt} = {} & \beta_1(\text{Post08}_t \times \text{Priority input}_j \times \text{Priority product}_j) + \\ & \beta_2(\text{Post08}_t \times \text{Priority input}_j \times \text{Non-priority product}_j) + \\ & f_j + f_t + \text{Trend}_{\tilde{jt}} + \varepsilon_{jt}.\end{aligned} \tag{8'}$$

Column (1) of Table 9 shows an insignificant reduction in the share of liberalized inputs imported by SEZ firms after 2008; similarly, column (2) reveals an insignificant change in the share of SEZ firms importing these goods. Column (3), however, shows a marginally significant reduction in the share of imports destined for the SEZ for products

TABLE 9
SHARE OF SEZ IN IMPORT VALUE AND NUMBER OF FIRMS AT THE HS 6-DIGIT PRODUCT LEVEL

	Import value (1)	No. of firms (2)	Import value (3)	No. of firms (4)
$Post08_t \times Priority\ input_j$	−0.033	−0.004		
	(0.021)	(0.015)		
$Post08_t \times Priority\ input_j \times Priority_j$			−0.019	0.034
			(0.043)	(0.036)
$Post08_t \times Priority\ input_j \times$ Non-priority$_j$			−0.040*	−0.022
			(0.022)	(0.013)
Year FE	✓	✓	✓	✓
HS 6-digit FE	✓	✓	✓	✓
HS 2-digit linear trends	✓	✓	✓	✓
Observations	40,770	40,770	40,770	40,770
R^2	0.018	0.029	0.018	0.029

Notes
Robust standard errors clustered at the HS 6-digit product level.
***, **, * indicate significance at the 1%, 5%, 10% level, respectively.

that are not specific to firms operating in the leather, textiles and apparel and footwear industries. If—as the results in Table 9 imply—firms in the national customs territory did not receive a sufficient boost in incentives after the removal of ESR, tougher competition from SEZ firms in the domestic market could have also contributed to the increase in the share of exporters based in the SEZ after the elimination of ESR.

VI. CONCLUSIONS AND POLICY IMPLICATIONS

For more than four decades, the Dominican Republic has relied extensively on providing generous fiscal incentives in special economic zones to promote exports. A central feature of this policy was the imposition of an export share requirement, which made the subsidies provided in the SEZ contingent on export performance, and therefore prohibited under the Agreement on Subsidies and Countervailing Measures. In this paper we exploit the staggered removal of ESR across products and over time to evaluate how making the SEZ compliant with WTO disciplines on export subsidies affected export performance at the product and firm levels.

Our results are consistent with a model in which the imposition of ESR induces a subset of firms to alter their optimal export intensity in order to be able to locate in the SEZ and enjoy the subsidies available there. We find that the removal of ESR had a positive effect on export entry and in the share of exporters located in the SEZ within narrowly-defined products. On the other hand, we do not find any significant effect on export sales or on the share of export value originating from the SEZ. At the firm-level intensive margin, however, we find that exporters in the SEZ lowered the value of their export shipments after the reform—which suggests that a significant number of them found the ESR constraint binding. The main takeaway message from our analysis is that eliminating ESR made the SEZ a more desirable location for firms to be based in, thereby reinforcing the central role played by the SEZ in the Dominican Republic.

Although our analysis has focused on the response of exports to the removal of ESR at the microeconomic level, it is clear that the SEZ reform had important macroeconomic

implications for the Dominican Republic. On the one hand, our results suggest that the already substantial fiscal cost of the SEZ regime is likely to have increased after the reform, without having achieved a significant increase in aggregate exports. On the other hand, the general equilibrium analysis of Defever and Riaño (2017a) shows that removing the ESR distortion has the potential to deliver substantial welfare gains—particularly if a large number of firms were constrained by the export requirement—as our results suggest. It is also possible that fostering entry of local firms into the SEZ could also boost the diffusion of knowledge spillovers originating from large exporters based in the zones. Further research is necessary to determine which of these effects is ultimately stronger, and whether the SEZ can contribute to the industrial strategy of the Dominican Republic and other developing countries while at the same time adhering to the rules of the world trade system.

APPENDIX A: PROOFS

Profit function in the SEZ

Defever and Riaño (2017a, Prop. 1) show that the ESR constraint (3) is binding only for firms with $\eta^n < \underline{\eta}$. Thus unconstrained SEZ exporters—i.e. firms with $\eta^n \geq \underline{\eta}$—solve the unconstrained maximization problem (2) by choosing optimal prices:

$$p_H^{z,u}(\omega) = p_F^{z,u}(\omega) = \frac{1}{1+s} \cdot \frac{\sigma}{\sigma - 1}.$$

Plugging these back into the profit function (2) and replacing $A_F(\omega) = \eta^n/(1-\eta^n)$ yields the optimal profit for unconstrained SEZ exporters:

$$\pi^{z,u}(\eta^n) = \frac{\kappa(1+s)^{\sigma}}{1-\eta^n} - f^x = (1+s)^{\sigma}\pi^n(\eta^n) - f^x.$$

When $\eta^n < \underline{\eta}$, the ESR constraint (3) holds with equality. This implies that constrained SEZ exporters solve the problem

$$\text{(A1)} \qquad \max_{p_F} \left[\left(\frac{\eta^n}{1-\eta^n}\right)\frac{1}{\underline{\eta}}\right](1+s)p_F^{1-\sigma} - \left[\left(\frac{\eta^n}{1-\eta^n}\right)\left(\frac{\left(1-\underline{\eta}\right)^{\sigma/(\sigma-1)}(\eta^n)^{1/(\sigma-1)} + \underline{\eta}^{\sigma/(\sigma-1)}(1-\eta^n)^{1/(\sigma-1)}}{\underline{\eta}^{\sigma/(\sigma-1)}(1-\eta^n)^{1/(\sigma-1)}}\right)\right] p_F^{-\sigma},$$

where we have, again, substituted $A_F(\omega) = \eta^n/(1-\eta^n)$ and the ESR constraint

$$p_H = \left(\frac{1-\underline{\eta}}{\underline{\eta}} \cdot \frac{\eta^n}{1-\eta^n}\right)^{1/(1-\sigma)} p_F$$

into the profit function (2).

Taking the first-order condition of (A1) with respect to p^F and substituting this in the ESR constraint yields optimal prices for constrained SEZ exporters:

$$\text{(A2)} \qquad p_H^{z,c} = \frac{1}{1+s} \cdot \frac{\sigma}{\sigma-1} \cdot \left[\frac{(1-\underline{\eta})^{\sigma/(\sigma-1)} (\eta^n)^{1/(\sigma-1)} + \underline{\eta}^{\sigma/(\sigma-1)} \cdot (1-\eta^n)^{1/(\sigma-1)}}{(1-\underline{\eta})^{1/(\sigma-1)} (\eta^n)^{1/(\sigma-1)}} \right],$$

$$\text{(A3)} \qquad p_F^{z,c} = \frac{1}{1+s} \cdot \frac{\sigma}{\sigma-1} \cdot \left[\frac{(1-\underline{\eta})^{\sigma/(\sigma-1)} (\eta^n)^{1/(\sigma-1)} + \underline{\eta}^{\sigma/(\sigma-1)} (1-\eta^n)^{1/(\sigma-1)}}{\underline{\eta}^{1/(\sigma-1)} (1-\eta^n)^{1/(\sigma-1)}} \right].$$

Plugging (A3) into (A1) and rearranging, yields

$$\text{(A4)} \qquad \pi^{z,c}(\eta^n, \underline{\eta}) = \left(\frac{\eta^n}{1-\eta^n} \right) \cdot \frac{1+s}{\underline{\eta}\sigma} \cdot (p_F^{z,c})^{1-\sigma} - f^z.$$

Further substitution of (A3) into (A4) results in

$$\pi^{z,c}(\eta^n, \underline{\eta}) = \kappa (1+s)^{\sigma} \underbrace{\left[\frac{\eta^n}{((1-\underline{\eta})^{\sigma/(\sigma-1)} (\eta^n)^{1/(\sigma-1)} + \underline{\eta}^{\sigma/(\sigma-1)} (1-\eta^n)^{1/(\sigma-1)})^{\sigma-1}} \right]}_{=\Theta(\eta^n, \underline{\eta})} - f^z$$

and therefore

$$\pi^z(\eta^n, \underline{\eta}) = \begin{cases} \kappa (1+s)^{\sigma} \Theta(\eta^n, \underline{\eta}) - f^z & \text{if } \eta^n(\omega) < \underline{\eta}, \\ (1+s)^{\sigma} \pi^n(\eta^n) - f^z & \text{otherwise.} \end{cases}$$

Proof of Proposition 1

Since we cannot explicitly solve for the level of natural export intensity $\hat{\eta}(s)$ that solves $\pi^n(\hat{\eta}(s)) = \pi^z(\hat{\eta}(s), \underline{\eta})$, we show that $\pi^n(\eta^n)$ and $\pi^z(\eta^n, \underline{\eta})$ intersect once in the interval $(0, \underline{\eta})$. To do so, we need to verify that four conditions hold:

(i) $\pi^n(0) > \pi^{z,c}(0, \underline{\eta})$;
(ii) $\pi^n(\underline{\eta}) < \pi^{z,c}(\underline{\eta}, \underline{\eta})$;
(iii) $\mathrm{d}\pi^n(\eta^n)/\mathrm{d}\eta^n > 0$ and $\mathrm{d}\pi^{z,c}(\eta^n, \underline{\eta})/\mathrm{d}\eta^n > 0$;
(iv) $\mathrm{d}\pi^n(\eta^n)/\mathrm{d}\eta^n < \mathrm{d}\pi^{z,c}(\eta^n, \underline{\eta})/\mathrm{d}\eta^n$ when $\eta^n < \underline{\eta}$.

Condition (i): This is straightforward: $\pi^n(0) = \kappa > \pi^{z,c}(0, \underline{\eta}) = -f^z$.

Condition (ii): If

$$s > \left[1 + \frac{f^z (1-\underline{\eta})}{\kappa} \right]^{1/\sigma} - 1,$$

then

$$\pi^n(\underline{\eta}) < \pi^{z,c}(\underline{\eta}, \underline{\eta}) = \pi^{z,u}(\underline{\eta}) = \frac{\kappa (1+s)^{\sigma}}{1-\underline{\eta}} - f^z.$$

Condition (iii): We have

$$\frac{\mathrm{d}\pi^n(\eta^n)}{\mathrm{d}\eta^n} = \frac{\kappa}{(1-\eta^n)^2} > 0.$$

Since

$$\frac{\mathrm{d}\pi^{z,c}(\eta^n, \underline{\eta})}{\mathrm{d}\eta^n} = \kappa(1+s)^{\sigma} \cdot \frac{\partial\Theta(\eta^n, \underline{\eta})}{\partial\eta^n},$$

we first need to calculate the latter derivative. Some algebra reveals that

$$\frac{\partial\Theta(\eta^n, \underline{\eta})}{\partial\eta^n} = \frac{\underline{\eta}^{\sigma/(\sigma-1)}(1-\eta^n)^{(2-\sigma)/(\sigma-1)}}{[(1-\underline{\eta})^{\sigma/(\sigma-1)}(\eta^n)^{1/(\sigma-1)} + \underline{\eta}^{\sigma/(\sigma-1)}(1-\eta^n)^{1/(\sigma-1)}]^{\sigma}} > 0.$$

Condition (iv): We now show that

$$\frac{\partial\Theta(\eta^n, \underline{\eta})}{\partial\eta^n} > \frac{1}{(1-\eta^n)^2},$$

which implies that

$$\frac{\mathrm{d}\pi^n(\eta^n)}{\mathrm{d}\eta^n} < \frac{\mathrm{d}\pi^{z,c}(\eta^n, \underline{\eta})}{\mathrm{d}\eta^n} \quad \text{when } \eta^n < \underline{\eta}.$$

We have

$$\frac{\underline{\eta}^{\sigma/(\sigma-1)}(1-\eta^n)^{(2-\sigma)/(\sigma-1)}}{[(1-\underline{\eta})^{\sigma/(\sigma-1)}(\eta^n)^{1/(\sigma-1)} + \underline{\eta}^{\sigma/(\sigma-1)}(1-\eta^n)^{1/(\sigma-1)}]^{\sigma}} > \frac{1}{(1-\eta^n)^2},$$

so the following successive inequalities hold:

$$\begin{aligned}
\underline{\eta}^{\sigma/(\sigma-1)}(1-\eta^n)^{\sigma/(\sigma-1)} &> [(1-\underline{\eta})^{\sigma/(\sigma-1)}(\eta^n)^{1/(\sigma-1)} + \underline{\eta}^{\sigma/(\sigma-1)}(1-\eta^n)^{1/(\sigma-1)}]^{\sigma} \\
\underline{\eta}^{1/(\sigma-1)}(1-\eta^n)^{1/(\sigma-1)} &> (1-\underline{\eta})^{\sigma/(\sigma-1)}(\eta^n)^{1/(\sigma-1)} + \underline{\eta}^{\sigma/(\sigma-1)}(1-\eta^n)^{1/(\sigma-1)} \\
\underline{\eta}^{\sigma/(\sigma-1)}(1-\eta^n)^{1/(\sigma-1)}\left(\frac{1-\underline{\eta}}{\underline{\eta}}\right) &> (1-\underline{\eta})^{\sigma/(\sigma-1)}(\eta^n)^{1/(\sigma-1)} \\
\underline{\eta}^{1/(\sigma-1)}(1-\eta^n)^{1/(\sigma-1)} &> (1-\underline{\eta})^{1/(\sigma-1)}(\eta^n)^{1/(\sigma-1)} \\
\frac{1-\eta^n}{\eta^n} &> \frac{1-\underline{\eta}}{\underline{\eta}} \\
\underline{\eta} &> \eta^n.
\end{aligned}$$

Conditions (i)–(iv) imply that firms with natural export intensity $\eta^n \in (0, \hat{\eta}(s))$ locate in the national customs territory, while firms with natural export intensity greater than $\hat{\eta}(s)$ locate in the SEZ. Among the latter, those with a natural export intensity below $\underline{\eta}$ are constrained SEZ exporters, and those with natural export intensity at least equal to the ESR threshold are unconstrained SEZ exporters.

Proof of Prediction 1

Recall that $\hat{\eta}$ is implicitly defined by $\pi^n(\hat{\eta}) = \pi^{z,c}(\hat{\eta}, \underline{\eta})$. We can express this indifference condition in more detail as

$$\text{(A5)} \qquad \mathcal{F}(\hat{\eta}, \underline{\eta}) \equiv \frac{\kappa}{1-\hat{\eta}} - \kappa(1+s)^{\sigma}\Theta(\hat{\eta}, \underline{\eta}) + f^z = 0.$$

We can then use the implicit function theorem in (A5) to determine the sign of $\mathrm{d}\hat{\eta}/\mathrm{d}\underline{\eta}$:

$$\text{(A6)} \qquad \frac{\mathrm{d}\hat{\eta}}{\mathrm{d}\underline{\eta}} = \frac{\kappa(1+s)^{\sigma}(\partial\Theta(\eta^n, \underline{\eta})/\partial\underline{\eta})|_{\eta^n=\hat{\eta}}}{(\mathrm{d}\pi^n(\eta^n)/\mathrm{d}\eta^n)|_{\eta^n=\hat{\eta}} - \kappa(1+s)^{\sigma}(\partial\Theta(\eta^n, \underline{\eta})/\partial\eta^n)|_{\eta^n=\hat{\eta}}}.$$

We have shown in Proposition 1 that the term in the denominator is negative when evaluated at $\eta^n = \hat{\eta}$ (recall that $\hat{\eta} \in (0, \underline{\eta})$). Therefore we now need only to sign the derivative $\partial\Theta(\eta^n, \underline{\eta})/\partial\underline{\eta}$ in the numerator to determine the sign of (A6):

$$\frac{\partial\Theta(\eta^n, \underline{\eta})}{\partial\underline{\eta}} = \frac{-\sigma\eta^n}{[(1-\underline{\eta})^{\sigma/(\sigma-1)}(\eta^n)^{1/(\sigma-1)} + \underline{\eta}^{\sigma/(\sigma-1)}(1-\eta^n)^{1/(\sigma-1)}]^{\sigma}} \times (-(\eta^n)^{1/(\sigma-1)}(1-\underline{\eta})^{1/(\sigma-1)} + (1-\eta^n)^{1/(\sigma-1)}\underline{\eta}^{1/(\sigma-1)}).$$

Since the term in large parentheses is strictly positive whenever $\eta^n < \underline{\eta}$, it follows that $\partial\Theta(\eta^n, \underline{\eta})/\partial\underline{\eta} < 0$, and therefore that $\mathrm{d}\hat{\eta}/\mathrm{d}\underline{\eta} > 0$. This means that when the ESR threshold falls, the export intensity cut-off to join the SEZ falls and more firms choose to locate there. In other words, if we let $\hat{\eta}_0$ denote the initial natural export intensity cut-off to enter the SEZ (i.e. when $\underline{\eta} > 0$), and let $\hat{\eta}_1$ denote the cut-off when locating in the SEZ is not subject to ESR, then we have shown that $\hat{\eta}_0 > \hat{\eta}_1$.

Notice that when $\underline{\eta} = 0$, $\pi^z(\eta^n, 0) = \pi^{z,u}(\eta^n)$ for all $\eta^n \in (0, 1)$. We can now find the natural export intensity cut-off, $\hat{\eta}_1$, that determines entry into the SEZ when there are no ESR explicitly:

$$\frac{\kappa(1+s)^{\sigma}}{1-\hat{\eta}_1} - f^z = \frac{\kappa}{1-\hat{\eta}_1},$$

which yields

$$\hat{\eta}_1 = 1 - \frac{\kappa}{f^z}((1+s)^{\sigma} - 1).$$

To ensure that not all firms locate in the SEZ once ESR are lifted, we require that the subsidy granted in the SEZ is not too large. More specifically, we need

$$s < \left(1 + \frac{f^z}{\kappa}\right)^{1/\sigma} - 1.$$

Effect on the mass of operating firms Having determined the conditions under which $\hat{\eta}_1 > 0$, we can identify four types of firms following the removal of ESR:

(i) Firms with $\eta^n \in (0, \hat{\eta}_1)$ operate in the national customs territory before and after the policy change. There is no change in their exports or in their profits.
(ii) Firms with $\eta^n \in [\hat{\eta}_1, \hat{\eta}_0)$ move from the national customs territory to the SEZ, where they operate as unconstrained SEZ exporters.
(iii) Firms with $\eta^n \in [\hat{\eta}_0, \underline{\eta}_0)$ were constrained SEZ exporters initially but become unconstrained after the reform.
(iv) Firms with $\eta^n \in [\underline{\eta}_0, 1)$ remain unconstrained SEZ exporters after ESR are eliminated, and therefore do not change their exports nor their profits.

We now show that the profits of firms in groups (ii) and (iii) increase after the removal of ESR. As noted above, the profits for firms of types (i) and (iv) are not affected by the policy change.

Profits for firms that move to the SEZ increase because they get to operate at the same natural export intensity as they did when they were located in the national customs territory but now receive the subsidy s.

Similarly, firms that remain in the SEZ but that stop being constrained by ESR also see their profits increase. This follows from the fact that the value of the revenue shifter $\Theta(\eta^n, \underline{\eta})$ is never greater than $1/(1-\eta^n)$, the revenue shifter of a firm operating at its natural export intensity η^n.

Since the profits of firms in the industry either increase or remain unchanged relative to the situation where $\underline{\eta}_0 > 0$, it follows that

$$\begin{aligned}
\mathbb{E}[\pi^0(\eta^n)] &\equiv \int_0^{\hat{\eta}_0} \pi^n(\eta^n)\,\mathrm{d}G(\eta^n) + \int_{\hat{\eta}_0}^{\underline{\eta}_0} \pi^{z,c}(\eta^n, \underline{\eta})\,\mathrm{d}G(\eta^n) + \int_{\underline{\eta}_0}^{1} \pi^{z,u}(\eta^n)\,\mathrm{d}G(\eta^n) \\
&< \int_0^{\hat{\eta}_1} \pi^n(\eta^n)\,\mathrm{d}G(\eta^n) + \int_{\hat{\eta}_1}^{1} \pi^{z,u}(\eta^n)\,\mathrm{d}G(\eta^n) \\
&\equiv \mathbb{E}[\pi^1(\eta^n)],
\end{aligned}$$

where $\mathbb{E}[\pi^k(\eta^n)]$ denotes the expected profit of operating in the industry when ESR $\underline{\eta}_k$ are in place, and $\mathrm{d}G(\eta^n)$ is the p.d.f. of natural export intensity, which can be obtained from the p.d.f. of firms' product appeal in the foreign market by means of the method of transformations for random variables.

Since the free-entry condition reads $\mathbb{E}[\pi(\eta^n)] = f^E(M)$, it follows that $\mathbb{E}[\pi^0(\eta^n)] < \mathbb{E}[\pi^1(\eta^n)]$ implies that $M^0 < M^1$, given that f^E is an increasing function of the mass of firms. This shows that the mass of operating firms in the industry increases when ESR are removed.

Proof of Prediction 2

Export sales (after subsidy) are given by

$$r_F^n = A_F(p_F^n)^{1-\sigma} = \sigma\kappa\left(\frac{\eta^n}{1-\eta^n}\right),$$
$$r_F^{z,u} = (1+s)A_F(p_F^{z,u})^{1-\sigma} = \sigma\kappa(1+s)^{\sigma}\left(\frac{\eta^n}{1-\eta^n}\right),$$
$$r_F^{z,c} = (1+s)A_F(p_F^{z,c})^{1-\sigma} = \sigma\kappa(1+s)^{\sigma}[\underline{\eta}\cdot\Theta(\eta^n,\underline{\eta})].$$

(i) Firms with $\eta^n \in (0, \hat{\eta}_1)$ operate in the national customs territory before and after the policy change. There is no change in their exports.

(ii) Firms with $\eta^n \in [\hat{\eta}_1, \hat{\eta}_0)$ move from the national customs territory to the SEZ, where they operate as unconstrained SEZ exporters:

$$\frac{r_F^{\text{before}}}{r_F^{\text{after}}} = \frac{r_F^n}{r_F^{z,u}} = \frac{1}{(1+s)^{\sigma}} < 1.$$

Therefore export revenue for these firms increases after ESR are eliminated.

(iii) Firms with $\eta^n \in [\hat{\eta}_0, \underline{\eta}_0)$ were constrained SEZ exporters initially but become unconstrained after the reform:

$$\text{(A7)} \qquad \frac{r_F^{\text{before}}}{r_F^{\text{after}}} = \frac{r_F^{z,c}}{r_F^{z,u}} = \frac{\underline{\eta}\cdot\Theta(\eta_n,\underline{\eta})}{\eta^n/(1-\eta^n)} > 1.$$

This means that firms that were located in the SEZ and that were constrained in their allocation of sales by ESR reduce their exports in response to the policy change.

We now verify that indeed (A7) is greater than 1 when $\eta^n < \underline{\eta}$. We have

$$\frac{\underline{\eta}\cdot\eta^n}{[(1-\underline{\eta})^{\sigma/(\sigma-1)}(\eta^n)^{1/(\sigma-1)} + \underline{\eta}^{\sigma/(\sigma-1)}(1-\eta^n)^{1/(\sigma-1)}]^{\sigma-1}} > \frac{\eta^n}{1-\eta^n},$$

so the following successive inequalities hold:

$$\underline{\eta}^{1/(\sigma-1)}(1-\eta^n)^{1/(\sigma-1)} > (1-\underline{\eta})^{\sigma/(\sigma-1)}(\eta^n)^{1/(\sigma-1)} + \underline{\eta}^{\sigma/(\sigma-1)}(1-\eta^n)^{1/(\sigma-1)}$$
$$\underline{\eta}^{1/(\sigma-1)}(1-\eta^n)^{1/(\sigma-1)}(1-\underline{\eta}) > (1-\underline{\eta})^{\sigma/(\sigma-1)}(\eta^n)^{1/(\sigma-1)}$$
$$\underline{\eta}^{1/(\sigma-1)}(1-\eta^n)^{1/(\sigma-1)} > (1-\underline{\eta})^{1/(\sigma-1)}(\eta^n)^{1/(\sigma-1)}$$
$$\frac{1-\eta^n}{\eta^n} > \frac{1-\underline{\eta}}{\underline{\eta}}$$
$$\underline{\eta} > \eta^n.$$

(iv) Firms with $\eta^n \in [\underline{\eta}_0, 1)$ remain unconstrained SEZ exporters after ESR are eliminated, and therefore do not change their exports.

TABLE A1
FIRM-LEVEL EXTENSIVE MARGINS OF EXPORTS' RESPONSE TO ESR REMOVAL—EXIT

	Exit at the firm–HS-6-digit level				Exit at the firm level			
	OLS (1)	OLS (2)	Probit (3)	Probit (4)	OLS (5)	OLS (6)	Probit (7)	Probit (8)
$Reform_{jt}$	−0.002		0.002		0.024**		0.021*	
	(0.009)		(0.009)		(0.010)		(0.011)	
$Reform_{jt} \times SEZ_\ell$		−0.020		−0.015		0.017		0.023
		(0.014)		(0.013)		(0.010)		(0.014)
$Reform_{jt} \times Non\text{-}SEZ_\ell$		0.021		0.006		0.019		0.019
		(0.013)		(0.014)		(0.022)		(0.020)
$Priority_j$	−0.067***		−0.063***		−0.072***		−0.071***	
	(0.017)		(0.016)		(0.016)		(0.017)	
$Priority_j \times SEZ_\ell$		−0.047**		−0.051***		−0.048***		−0.052***
		(0.018)		(0.018)		(0.017)		(0.019)
$Priority_j \times Non\text{-}SEZ_\ell$		0.058***		0.067***		−0.004		−0.001
		(0.018)		(0.018)		(0.018)		(0.018)
Year FE	✓		✓		✓		✓	
Year–location FE		✓		✓		✓		✓
HS 2-digit linear trends	✓	✓	✓	✓	✓	✓	✓	✓
Observations	170,380	170,380	170,991	170,991	170,979	170,991	170,991	170,991
R^2	0.049	0.065	0.0509	0.0522	0.032	0.057	0.0527	0.0529

Notes
Robust standard errors clustered at the HS 6-digit product level. The coefficients reported under Probit are marginal effects evaluated at the mean of other covariates. R^2 in the columns reporting probit estimates denotes McFadden's pseudo R-squared measure.
***, **, * indicate significance at the 1%, 5%, 10% level, respectively.

TABLE A2
IMPACT OF THE POLICY REFORM EXPORT VALUE AND NUMBER OF FIRMS AT THE HS 6-DIGIT PRODUCT LEVEL

Dependent variable	ln export value				ln number of exporters			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$Reform_{jt}$	0.091	0.096	0.119		0.163***	0.163***	0.158***	
	(0.101)	(0.101)	(0.100)		(0.033)	(0.033)	(0.032)	
$Reform_{jt} \times SEZ$				−0.168				0.122***
				(0.156)				(0.047)
$Reform_{jt} \times Non\text{-}SEZ$				0.102				−0.028
				(0.151)				(0.050)
$Priority_j$	1.287***	1.287***			0.392***	0.391***		
	(0.174)	(0.175)			(0.063)	(0.063)		
Linear trend $priority_{\tilde{j}t}$	−0.031***	−0.057***			−0.006*	−0.028***		
	(0.012)	(0.013)			(0.004)	(0.004)		
Linear trend $non\text{-}priority_{\tilde{j}t}$	0.031***	0.005			0.024***	0.002		
	(0.007)	(0.008)			(0.002)	(0.002)		
$Post08_t$	0.284***				−0.112***			
	(0.055)				(0.017)			
$Post12_t$	−0.820***				−0.251***			
	(0.109)				(0.034)			
Year FE			✓				✓	
HS 6-digit FE			✓				✓	
HS 2-digit trends			✓	✓			✓	✓
Year–location FE				✓				✓
HS-6-digit–location FE				✓				✓
Observations	46,258	46,258	46,258	46,258	46,264	46,264	46,264	46,264
R^2	0.014	0.016	0.506	0.694	0.009	0.010	0.528	0.761

Notes
Robust standard errors clustered at the HS 6-digit product level.
***, **, * indicate significance at the 1%, 5%, 10% level, respectively.

APPENDIX B: EXIT

In this appendix, we report a set of regressions regarding export exit. We define the extensive margin at both the firm–HS-6-digit-product level (columns (1)–(4) of Table A1) and the firm level (columns (5)–(8)). More precisely, exit is a dummy that takes the value 1 when either a firm or a firm–product combination is observed exporting for the *last time* in our data. Our estimating equations are

$$\text{Extensive}_{ij\ell t} = \beta_0\ \text{Reform}_{jt} + \beta_1\ \text{Priority}_j + f_t + \ \text{Trend}_{\tilde{j}t} + \varepsilon_{ij\ell t}$$

and

$$\begin{aligned}\text{Extensive}_{ij\ell t} = {} & \beta_1(\text{Reform}_{jt} \times \text{SEZ}_\ell) + \beta_2(\text{Reform}_{jt} \times \text{Non-SEZ}_\ell) \\ & + \beta_3(\text{Priority}_j \times \text{SEZ}_\ell) + \beta_4(\ \text{Priority}_j \times \text{Non-SEZ}_\ell) \\ & + f_{\ell t} + \text{Trend}_{\tilde{j}t} + \varepsilon_{ij\ell t}.\end{aligned}$$

We also estimate the effect of the reform on exit by means of a linear probability model and a probit estimator. The regressions include either a priority product dummy to control for time-invariant differences between products that experienced the elimination of ESR at different points in time (columns (1), (3), (5) and (7) of Table A1) or a product's priority status in each location (the SEZ and national customs territory; columns (2), (4), (6) and (8)).

APPENDIX C: ESTIMATES USING SEMESTER DATA

In this appendix we re-estimate the regressions presented in the main body of the paper using data aggregated at a biannual frequency. The reform dummy that turns on when

TABLE A3
SHARE OF SEZ IN EXPORT VALUE AND NUMBER OF FIRMS AT THE HS 6-DIGIT PRODUCT LEVEL

	Share of export value		Share of no. of exporters	
	(1)	(2)	(3)	(4)
Reform_{jt}	0.024		0.046***	
	(0.017)		(0.014)	
$\text{Priority}_j \times \text{Post08}_t$		0.013		0.051***
		(0.021)		(0.017)
$\text{Non-priority}_j \times \text{Post12}_t$		0.035		0.039
		(0.030)		(0.026)
Year FE	✓	✓	✓	✓
HS 6-digit FE	✓	✓	✓	✓
HS 2-digit linear trends	✓	✓	✓	✓
Observations	32,968	32,968	32,968	32,968
R^2	0.634	0.634	0.631	0.631

Notes
Robust standard errors clustered at the HS 6-digit product level.
***, **, * indicate significance at the 1%, 5%, 10% level, respectively.

TABLE A4
FIRM-LEVEL INTENSIVE AND EXTENSIVE MARGINS OF EXPORTS' RESPONSE TO ESR REMOVAL

	Intensive margin		Extensive margin							
			Entry at the firm–HS-6-digit level				Entry at the firm level			
	OLS (1)	OLS (2)	OLS (3)	OLS (4)	Probit (5)	Probit (6)	OLS (7)	OLS (8)	Probit (9)	Probit (10)
$Reform_{jt}$	−0.142*		0.001		0.058***		0.029***		0.035*	
	(0.075)		(0.009)		(0.022)		(0.007)		(0.019)	
$Reform_{jt} \times SEZ_\ell$		−0.216**		0.024*		0.086***		0.028**		0.092***
		(0.086)		(0.013)		(0.026)		(0.008)		(0.022)
$Reform_{jt} \times Non\text{-}SEZ_\ell$		0.088		−0.015		0.001		−0.011		0.002
		(0.137)		(0.012)		(0.026)		(0.017)		(0.021)
$Priority_j$			−0.154		12.848***		5.905***		12.506***	
			(2.444)		(4.593)		(2.011)		(3.371)	
$Priority_j \times SEZ_\ell$				8.363***		16.555***		7.847***		9.192***
				(2.294)		(4.823)		(1.647)		(3.126)
$Priority_j \times Non\text{-}SEZ_\ell$				8.812***		16.704***		7.925***		9.242***
				(2.294)		(4.825)		(1.651)		(3.128)
Firm–HS-6-digit FE	✓									
Year FE	✓		✓		✓		✓		✓	
Firm–HS-6-digit–location FE		✓								
Year–location FE		✓		✓		✓		✓		✓
HS 2-digit linear trends	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Observations	252,646	252,646	252,207	252,207	252,207	252,207	252,207	252,207	252,207	252,207
R^2	0.807	0.807	0.107	0.137	0.083	0.086	0.160	0.192	0.086	0.087

Notes
Robust standard errors clustered at the HS 6-digit product level. The coefficients reported under Probit are marginal effects evaluated at the mean of other covariates. R^2 in the columns reporting probit estimates denotes McFadden's pseudo R-squared measure.
***, **, * indicate significance at the 1%, 5%, 10% level, respectively.

exporters of HS 6-digit product j experience the removal of ESR in the SEZ is defined as

$$\text{Reform}_{jt} = \begin{cases} 1 & \text{if } [j \in \text{ Priority and } t \geq 2007\text{S2}] \text{ or } [j \notin \text{ Priority and } t \geq 2011\text{S2}], \\ 0 & \text{otherwise.} \end{cases}$$

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NOTES

1. General Council decision of 31 July 2007 WT/L/691. The other beneficiaries of this exemption were Antigua and Barbuda, Barbados, Belize, Costa Rica, Dominica, El Salvador, Fiji, Grenada, Guatemala, Jamaica, Jordan, Mauritius, Panama, Papua New Guinea, St Kitts and Nevis, St Lucia, Saint Vincent and the Grenadines, and Uruguay (the so-called 'Article 27.4 Countries' in reference to the article of the Agreement on Subsidies and Countervailing Measures that establishes this exemption). The notification also lists the subsidy programmes that needed to be reformed.
2. Countries designated by the United Nations as least-developed, and those with GNP per capita below US $1000 per annum, are exempted from the disciplines of the ASCM under the principle of special but differential treatment.
3. See Document G/SCM/40, 17 January 2002, Committee on Subsidies and Countervailing Measures. The conditions were that these countries could not account for more than 0.1% of the world's export trade, that they had a gross national income lower than US$20 billion in 2000, and that their subsidy programmes had to have come into existence before 2001.
4. Additionally, the sales made by SEZ firms in the Dominican customs territory were subject to the corresponding most-favoured nation import tariff.
5. See Article 3.4 and the Dominican Republic schedule in Annex I of the CAFTA-DR free trade agreement.
6. If firms differ only in terms of productivity, then they would all have the same export intensity.
7. In our simple model, the mass of firms does not affect the level of competition in the industry, while in models of monopolistic competition, the mass of firms affects expected profits through the price index. As we show below, the optimal prices for firms located in SEZ that are constrained by ESR are highly non-linear functions of the demand shifters. This prevents us from characterizing analytically how the elimination of ESR affects entry. Defever and Riaño (2017a) calibrate a model of subsidies subject to ESR in a monopolistically competitive environment that features heterogeneity in productivity and firms' demand across markets to investigate the general equilibrium implications of these subsidies.
8. Transaction quantities, which would allow us to construct unit values are, unfortunately, available from only 2012 onwards.
9. Median exports per firm across all locations in the Dominican Republic (averaged across our sample period) are 61,800 US dollars, while median exports per firm (averaged across all developing countries) in Fernandes *et al.* (2016) are 63,000 US dollars. The mean firm-level entry and exit rates for the group of developing countries reported by Fernandes *et al.* (2016) are 38% and 37%, respectively.
10. We chose to do this because conversations with officials from the Dominican Customs Agency suggest that SEZ firms took some time to adapt to the policy change, with only a handful of firms taking immediate

advantage of the possibility of selling more than 20% of their output domestically. Unfortunately, we cannot assess this claim directly because we lack information on firms' domestic sales.

11. Nevertheless, we also report an analogous set of regressions with exit as the dependent variable in Appendix B.
12. Our conclusions remain unchanged if we instead define entry as taking the value 1 when a firm or firm–product combination has a positive value of exports in year t but not in year $t-1$.
13. We also estimate linear probability models that incorporate HS 6-digit product fixed effects instead of the priority product dummy. Similarly, priority product dummies in each location are replaced by HS-6-digit-product–location fixed effects. These estimates are quite similar to those reported in Table 8 and are available on request.

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